

THE SINGARENI COLLIERIES COMPANY LTD

(A Government Company)



SINGARENI THERMAL POWER PROJECT STAGE-II (1x800 MW)

TECHNICAL SPECIFICATION

FOR

EPC PACKAGE

PART – B

(BOOK 1 OF 5 – MECHANICAL)

SECTION - VI

BIDDING DOCUMENT NO.:CW-CM-11159-C-O-M-001

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PART – B

MECHANICAL

**SINGARENI THERMAL POWER PROJECT
STAGE-II (1X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC NO.:CW-CM-11159-C-O-M-001**



PART –B	
SUB-SECTION	TITLE
PART-B COMMON CHAPTERS (BOOK 1 OF 5)	
G-01	OPERATING CAPABILITY OF THE PLANT
G-02	UNIT OPERATING PHILOSOPHY
G-03	LAYOUT REQUIREMENTS
G-04	STANDARD PG TEST PROCEDURE
G-05	STANDARD TYPE TEST PROCEDURE
G-06	PRE-COMMISSIONING & COMMISSIONING
G-07	MDL AND DATA REQUIREMENT
PART - B (MECHANICAL) (BOOK 1 OF 5)	
A -01	EQUIPMENT SIZING CRITERIA
A -02	STEAM GENERATOR AND AUXILIARIES INCLUDING ESP
A -03	Not Applicable
A -04	Not Applicable
A -05	FLUE GAS DESULPHURISATION SYSTEM
A -06	Not Applicable
A -07	STEAM TURBINE & AUXILIARIES SYSTEM
A -08	POWER CYCLE PIPING
A -09	LOW PRESSURE PIPING
A -10	Not Applicable
A -11	CONDENSATE POLISHING UNIT
A -12	SURFACE PREPARATION & PAINTING
A -13	THERMAL INSULATION
A -14	WATER TREATMENT PLANT
A -15	CW SYSTEM
A -16	COMPRESSED AIR SYSTEM
A -17	AIR CONDITIONING AND VENTILATION SYSTEM
A -18	FIRE PROTECTION AND DETECTION SYSTEM
A -19	FUEL OIL UNLOADING SYSTEM
A -20	COAL,BIOMASS HANDLING PLANT
A -21	ASH HANDLING PLANT (AHP)
A -22	MILL REJECT HANDLING SYSTEM
A -23	LP DOSING AND OXYGENATED TREATMENT SYSTEM
A -24	ELEVATORS, CRANES AND HOISTS
A-25	NOT APPLICABLE

**SINGARENI THERMAL POWER PROJECT
STAGE-II (1X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC NO.:CW-CM-11159-C-O-M-001**



SUB-SECTION – G-01

OPERATING CAPABILITY OF THE PLANT

**SINGARENI THERMAL POWER PROJECT
STAGE-II (1X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC NO.:CW-CM-11159-C-O-M-001**

CLAUSE NO.	एनटीपीसी NTPC			
	TECHNICAL REQUIREMENTS			
	OPERATING CAPABILITY OF PLANT			
1.00.00	OPERATING CAPABILITY OF PLANT			
1.01.00	The plant, it's unit (s) and its all auxiliaries equipment/systems shall be designed to operate with all the specified margins for continuous operation without any limitations under any of the conditions indicated in the Technical Specification. The major operating capabilities for the unit(s)/plant shall be as follows: (a) Operate continuously with turbine under VWO condition with rated steam parameters, design condenser pressure and 3% cycle make up. (b) Sliding Pressure Operation from rated pressure down to 40% of rated pressure with as well as without any throttle reserve. For modified sliding pressure condition, at any operating load, the throttle reserve shall be sufficient so as to achieve an instantaneous increase in turbine output by 5% of the corresponding load, by opening turbine control valves wide open. However, the output after instantaneous increase shall be limited to 105% of TMCR Load. The throttle reserve shall be 0% for pure sliding pressure mode of operation. (c) Operate continuously with HP heaters out of service with maximum specified cooling water temperature, 3% cycle make up and normal auxiliary steam requirement being tapped from cold reheat line, to generate maximum output without over stressing turbine components. The power output of the unit under this operating condition shall not be less than 800 MW or output corresponding to design BMCR heat duty, whichever is lower. (d) Automatic run back capability of the unit load on loss of critical auxiliary equipments (except PA fan), ensuring smooth and stable runback of the Steam Generator and Steam Turbine Generator equipments and systems. (e) Continuous TG output of 800 MW under rated steam conditions, specified worst condenser pressure, 3% cycle make-up and 47.5 Hz grid frequency. (f) The equipments and auxiliaries shall be suitable for continuous operation in the frequency range of 47.5 Hz to 51.5 Hz. (g) Unit shall be capable of increasing the load through condensate flow regulation in order to meet the load cycling requirement. Necessary measurements and logics shall be provided for implementation of the same. During condensate flow regulation hotwell level may be maintained through excess condensate dump line to condensate storage tank. (h) Turbine Generator set shall be capable of continuous operation with HP heaters out of service with maximum output not less than 800 MW. (i) Turbine shall be capable of operation on variable pressure mode during part load & start-up operation.			
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-G-01 OPERATING CAPABILITY OF PLANT	PAGE 1 OF 5

TECHNICAL REQUIREMENTS

- (j) TG set shall be capable of operating on house load during sudden total export load throw off using HP-LP bypass system. Unit shall not trip on overspeed in the event of total export load throw-off. TG output for house load operation may be considered 50 MW atleast for 1 hours.
- (k) In case of sudden reduction in demand (load throw off), the unit should get safely unloaded and stabilized for operation at house load with HP-LP bypass open to full capacity. All the components including valve body of HP and LP Bypass valves shall be designed for boiler highest safety valve set pressure due to sudden load throw off under transient conditions.
- (l) HP-LP Bypass should be capable of operation in parallel with turbine with all feed water heaters in service.
- (m) Bidder shall furnish Pure sliding pressure & Modified sliding pressure operation curves.
- (n) Plant shall be designed to give life of not less than 25 years. Further, expected numbers of Steam Turbine Generator start ups during design life are as follows:

	Type of starts	Number of starts
a	Hot Start	4000
b	Warm start	1000
c	Cold start	150

1.02.00 All the systems/equipments/auxiliaries under Bidder's scope shall be designed to cater to the above operating conditions envisaged for the unit(s)/plant by the Owner. Unless specified otherwise in the Technical Specification the design should cater to the above operating conditions with adequate margin as per standard practice prevailing in the fossil fired power plants.

1.03.00 The design and operating capability of the plant shall comply to the load flexibility requirements (ramp rates and technical minimum load) as per the CEA (Flexible Operation of Coal based Thermal Power Generating Units) Regulations, 2023 in addition to the requirements specified elsewhere.

The plant shall be suitable for load cycling which implies that it should be designed to operate continuously under two shift mode (daily start stop with one shift off) and load follow mode as specified. The design would cover adequate provision for quick startup and loading of the unit(s) to full load at a fast rate. Plant shall be capable of minimum N1 number of daily load cycles (N1 shall not be less than 2), load variation from 100% to 70 % (and vice versa) of MCR with a minimum ramp rate of 3% per minute and load variation from 70% to 55% (and vice versa) of MCR with a minimum ramp rate of 2% per minute, without affecting the design life of boiler and turbine-Generator systems. In addition to this, the plant shall also be capable of minimum N2 number of daily load cycles (N2 shall not be less than 1) from 55% to 40% of TMCR load (and vice versa) with a minimum ramp rate of 1% per minute. The main plant and its auxiliaries with their controls would be designed to permit operation of the units on house load without there being any necessity to shut down the unit(s) in the event of sudden loss of total load due to tripping of transmission lines or any other grid disturbances. The design of the plant equipments and control system would permit participation of the plant in automatic load frequency control. During above demonstration, parameters shall be

CLAUSE NO.	एनटीपीसी NTPC			
	TECHNICAL REQUIREMENTS			
1.04.01	maintained within prescribed limits as defined in closed loop control system requirements (Refer clause 1.03.26.02 of Sub section IV, Part A, Section VI). To make unit capable of continuous two shifting operation, the number of hot start ups shall be increased from 4000 numbers specified elsewhere to 6700 numbers without changing cold and warm start up as well as daily N1 (minimum 13400 cycles in total design life) and N2 (minimum 6700 cycles in total design life) requirements as defined above. Bidder shall design Turbine-Generator system meeting the load cycling conditions as indicated at clause no 1.03.00. In no case the design life of Turbine-Generator system shall be affected due to 1. 'Fatigue Damage', resulting from a. The number of Cold start up, Warm start up and Hot start up as defined elsewhere in the specification and b. Load cycling during defined plant life. 2. 'Creep damage' 3. The combined creep fatigue damage shall lie within acceptable limits.			
1.04.02	For the steam generator, in addition to the above requirement, specific design features incorporated and design/process improvements which are being offered for N1/N2 cycles shall be submitted along with the bid. Such design features and design/process improvements over and above conventional design shall be clearly brought out by the bidder in its bid. The Bidder shall provide references for earlier supplied steam generators which meet the specified cyclic duty requirements. The analysis and design/process improvements for cyclic operation suitability shall include all critical boiler components like headers (final Super heater outlet, economizer outlet, final reheater outlet etc.), membrane wall construction elements (tubing attachments, tension bars etc.), wind-box elements, boiler recirculation pump casing, superheater/reheater attachments, dissimilar weld joints etc. The Bidder shall provide information to the process adopted and analysis carried out for the design and operational improvements. Following shall be necessarily included: a) Header thickness reduction: the intervention may include improvement in properties of materials or materials, increase in number of headers etc. b) Use of full penetration welds for header/stub welds and header ligament de-sign improvements c) Design improvement in the mechanical design of water walls d) Design improvements to prevent economizer steaming e) Stress concentration improvements: identification of critical zones, fatigue analysis, operational feedback of regular de-signs; analysis/redesign of water-walls tube/fin system, SH/RH attachments, BRP (boiler recirculation pumps) casing design etc. f) Water chemistry improvements g) Vent/drain/spray system sizing improvements			
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-G-01 OPERATING CAPABILITY OF PLANT	PAGE 3 OF 5

CLAUSE NO.			
	TECHNICAL REQUIREMENTS h) Expansion joints design improvements and fatigue tests i) Refractory improvements Analysis of designs shall include CFD and FEM investigations. The bid proposal may be developed by the bidder based on earlier studies/investigations. CFD studies and FEM investigation shall be specifically carried out for the equipment/component selected/designed for the subject project/package. Necessary reports for the analysis (CFD and FEM) shall be furnished to the employer. The performance data re-quired for the analysis shall be developed using dynamic modelling for the steam generator. Visual/NDE protocols additionalities for critical components/equipment, analysis of fatigue damage and load cycling consideration as per the BS-EN 12952-3 or other equivalent code or other equivalent code etc. Results of design analysis which are required to be submitted as part of the EIFS (Engineering information flow system) shall be tied up with the Contractor. The Contractor shall be required to establish the design additionalities (changes in design, dimensions etc.) for making the steam generator suitable for load cycling as part of the bid proposal. The same shall be submitted as a separate document which shall be identified under EIFS. The document shall comprehensively cover each of the above-mentioned areas/components and others identified by the bidder. The process of analysis and results shall include in the document along with conceptual designs. The Contractor shall be required to help employer's engineer run through the complete analysis (as many areas shall not form part of the submitted document). Periodic inspection shall be carried out by the Contractor during the warranty period of all pre-identified areas with stress con-centration. The specifications include thermo-couples and other instruments to collect necessary data for the field test which shall be collected to enable further confirmation of the offered design and/or trouble-shooting. Bidder shall recommend additional instrumentation that may be required for the purpose. 1.05.00 a) Provision for life consumption/Equivalent Operating Hours (EOH) of critical components due to Creep & Fatigue shall be made available online (display in CCR) for Operating personnel. Also program/measures shall be made available online (display in CCR) to guide the operating personnel for maintenance planning. b) Resulting Damage Factor due to Creep-Fatigue interaction shall be made available online (display in CCR) for Operating personnel. 1.06.00 Boiler & Auxiliaries and Steam Turbine Generator & Auxiliaries and associated systems should be designed for 40% Technical Minimum Load (TML). Adequate changes in design to be considered for meeting this mandatory requirement ensuring the design life of Boiler and Turbine including its auxiliaries. Further, Contractor will share the detailed design documents for establishing the changes done in the design for ensuring continuous operation at 40 % TMCR Load. 1.07.00 As mentioned in clause 1.03.00 above, the design of the plant equipments and control system would permit participation of the plant in automatic load frequency control. Accordingly, implementation of primary and secondary reserve ancillary services such as FGMO, RGMO, Automatic Generation Control (AGC) or any other requirement stipulated as per the latest		
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-G-01 OPERATING CAPABILITY OF PLANT	PAGE 4 OF 5

TECHNICAL REQUIREMENTS

Indian Electricity Grid Code (IEGC) issued by Central Electricity Regulatory Commission (CERC) shall be in the scope of contractor. Further, in case CERC issues new guidelines with regards to primary and secondary reserve ancillary services, after detailed Engineering and before completion of warranty period of control system, the same shall also be implemented by the Contractor in consultation with Employer.



SUB-SECTION – G-02

UNIT OPERATING PHILOSOPHY

**SINGARENI THERMAL POWER PROJECT
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EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC NO.:CW-CM-11159-C-O-M-001**

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.0 <				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.0	Hotwell Level Normal level in Condenser is maintained by adding make-up water through normal makeup control valve (upto 3% makeup). If the make-up demand is not met through normal make-up and level falls below pre-determined level (adjustable), emergency makeup shall be supplied through Emergency makeup valve. In case the level rises above predetermined high level, the high level controller shall become operative at the high level and maintain the level by opening control valve on the excess condensate dump line . Alarm shall be provided in control room for hotwell level high and low. Motorised regulating valves are provided in bypass lines to control valves of Normal/Emergency make-up line which can be put into operation remote manually, in case of mal-operation of main control valve.			
5.0	CEP minimum recirculation Individual minimum condensate recirculation lines have been envisaged for 3x50% capacity condensate pumps at the upstream of the discharge check valves. Minimum recirculation flow control valves are provided in the recirculation lines from condensate pumps to hotwell to ensure minimum flow requirement of condensate pumps especially during start up and low load conditions. The control valve modulates when measured flow is varying between 0 T/hr to speed dependent set point of minimum recirculation flow and it closes fully when measured flow exceeds this speed dependent set point.			
6.0	Deaerator Operation Normally deaerator is supplied with steam from IP turbine extraction. Deaerator pressure varies as per extraction pressure at varying loads. De-aerator pegging pressure for cold, warm, hot start up and during HP-LP bypass operation, shall be as optimized by the bidder and shall be suitable to ensure required deaeration and water quality required for boiler. The optimized pressure should be same during warm, hot start up conditions and during HP-LP bypass operation. Steam is supplied from aux. steam header through pressure control valve. With the increase of parameters of CRH steam, Extraction to deaerator shall be shift to CRH. Steam source to deaerator will shift to IP extraction when sufficient pressure will be available.			
7.0	Deaerator Level Control During initial start-up & upto about 30% load, single element condensate control system using deaerator level signal is used for regulating condensate flow. During this operation low load control valve is in service. The deaerator level measured signal is compared with deaerator level set point. The error signal from the single element controller positions the low load control valve. When low load control valve is fully open (>85%), and the condensate discharge header pressure is more than 20 kg/cm2(g) (adjustable), the full load motorized regulating valve is opened automatically. After ensuring that the full load motorized regulating valve is fully opened, control shall be transferred from single element to three-element control. Low load control valve gets a closing command. The Pump speed shall be modulated based on the signal from three-element control. When the unit load is reducing and falls to about 30% and/or condensate discharge header pressure reduces below than 20 kg/cm2(g) (adjustable), then the full load valve will get a			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION- G-02 UNIT OPERATING PHILOSOPHY
PAGE 2 OF 5				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	closing command and the low load control valve shall open automatically. All controls shall be transferred to low load control valve. The Normal level in the deaerator is maintained with three element control circuit by regulating speed of the CEP through variable frequency drive (VFD). Three element of control system are: i) Feed water flow. ii) Condensate flow. iii) Deaerator level. The error signal produced between measured deaerator level and deaerator level set point is added to the feed water flow signal to form the condensate demand signal i.e. set point for condensate flow. This is compared with the condensate flow. Deviation if any will change the condensate controller output which provides the desired speed signal for VFD of individual condensate extraction pumps. Variation in pump speed will contribute to change the condensate flow required by the three element control system. CEP Discharge Header pressure shall be maintained above 20kg/cm²(g) (adjustable) under all operating condition. If the discharge pressure goes below 20kg/cm²(g) (adjustable), an alarm is given in the control room and control valve shall come into service and the motorised valve shall close and the control shall transfer from three element control to single element control. The Pump speed shall be modulated such that the Header pressure does not fall below 20 kg/cm²(g) (adjustable).			
8.0	Boiler Feed Pump			
8.1	Changeover Philosophy 1x 30% Motor Driven Boiler Feedwater Pump is used during initial clean-up & plant start-up. At low load feed water flow is controlled by 1x30% control valve. MDBFP speed will be varied to maintain DP (5 Kg/cm2) across FCV to maintain the water separator level. Above 30% load, 1x100%/2X50% MOV is opened and water flow is controlled by varying the BFP (boiler feed water pump) speed. 1st TDBFP will come in service at around 20% load when required steam parameters as required for TDBFP is available. After 1st TDBFP comes in service MDBFP scoop position will come down to minimum position & will come in hot standby mode and running TDBFP will maintain water separator level. Stop command to MDBFP will be issue by the operator based on running status of TDBFP. 2nd TDBFP will be come in service at approx. 50 % Load. In case one TDBFP is tripped, then one TDBFP and one MDBFP can operate to cater load of 95%. During the shutdown 1st TDBFP is shut down at 50% load and MDBFP comes in service at below 20% Load and simultaneously 2nd TDBFP is shut down below 20% load.			
8.2	Run Back Operation			
8.2.	In case when both the TDBFP's are running MDBFP shall be kept in Hot standby mode. In case when one TDBFP trips, runback shall be initiated to 75% Load. Simultaneously MDBFP ON command shall be issued. If MDBFP on feedback is not received within 5 sec(adjustable) then runback set point shall be changed to 60% Load. In this case one TDBFP will cater the			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION- G-02 UNIT OPERATING PHILOSOPHY
PAGE 3 OF 5				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
8.3	demand. If MDBFP will come in service then run back command will be stopped and one MDBFP & one TDBFP will cater the load demand of 95%. If One TDBFP is in operation and MDBFP is in recirculation mode and if suddenly running TDBFP trips then run back shall be initiated to 30% load, If MDBFP will not contribute in system in 15 sec then MFT shall be initiated. If One TDBFP is in operation and MDBFP is in standby mode (i.e. Motor off condition) then if suddenly running TDBFP trips then immediately MDBFP will be started. If MDBFP on feedback is not received within 5 sec, then MFT will be initiated on all BFP trip. However, if MDBFP on feedback is received within 5 sec (adjustable), then MFT will be defeated and within next 10 sec(adjustable), if MDBFP is not able to contribute the feed water in system then MFT will be initiated again. No BFP trip will be initiated on Separator level high-high, BFP shall be run in recirculation.			
	BFP Minimum Recirculation Control			
	Individual minimum feed water recirculation lines have been envisaged at the upstream of the discharge check valves. Control valves are provided in the recirculation lines from the boiler feed pumps to deaerator to ensure minimum flow requirement of BFP's especially during start-up & low load conditions. Flow transmitters provided for individual BFP flow measurement shall measure the flow and initiate pump recirculation by opening the minimum recirculation control valve as per speed dependent set point of recirculation flow. The minimum recirculation valve gets automatically closed, whenever the flow exceeds flow dependent set point with adjustable margin.			
9.0	LEVEL CONTROL OF HP/LP HEATERS			
9.1	HP Heaters			
	The basic need of level control in heater is to maintain NWL (Normal water level) for the safe and smooth working of turbine. The normal level in HP heaters are maintained by normal level controller by cascading the drain to next lower heater through control valve. In case level reaches low level set point, an alarm is initiated in the control room. If the level reaches high-level set point due to heater tube leakage or due to some malfunction, an alarm is initiated in the control room. The level is controlled by taking drain directly to condenser through emergency level control valve. When the high level control comes into operation to open emergency drain to condenser, the normal drain control valve will also remain open. If the level reaches high high-level set point, complete heater stream isolation starts and command shall be given simultaneously for the following actions. i) Close command to Extraction steam motorised isolating valves for all heaters in the corresponding stream. ii) Command will be given to open the feed water bypass line to bypass the complete stream of heaters. This will occur based on the arrangement as provided by the Bidders i.e. Box-A or Box-B arrangement as per Tender P&ID of Feed Water System. iii) Alternate drain Control valve of affected HPH to open fully. iv) An Alarm will be initiated in control room. v) Requirement of closure of higher HP heater drain to affected heater			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION- G-02 UNIT OPERATING PHILOSOPHY
				PAGE 4 OF 5

CLAUSE NO.	TECHNICAL REQUIREMENTS			
9.2	LP Heaters The basic need of level control in heater is to maintain NWL (Normal water level) for the safe and smooth working of turbine. The normal level in LP heater is maintained by normal level controller by cascading the drain to lower heaters through control valve. In case level reaches low level set point, an alarm is initiated in the control room. If the level reaches high-level set point due to minor heater tube leakage or due to some other malfunction, an alarm is initiated in the control room. The level is controlled by taking drain directly to condenser through emergency level control valve. When the high level control comes into operation to open emergency drain to condenser, the normal drain control valve will also remain open. If the level reaches high high-level set point, heater isolation starts and command is given simultaneously for the following interlock actions. i) Close command to Extraction steam motorised isolating valve for affected heater ii) Alternate drain Control valve of affected heater to open fully. iii) Forced closure of power assisted NRV in extraction line through ATRS. iv) An Alarm will be initiated in control room. v) To open motorised condensate bypass valve of affected heater and once the bypass valve starts opening (not closed status sensed by limit switch), closing signal shall be given to motorised condensate isolating valves at inlet and outlet of affected heater. vi) Close command to Normal drain control valve from higher LP heater.			
10.0	Overall Unit Operation: It is envisaged to start up the complete unit including offsite auxiliaries through single push-button operator action.			
11.0	In case when both the CEP's are running, the other CEP will be in Stand-by mode. In case when one CEP trips, runback shall be initiated to the operating load at that point or 75% Load (Adjustable) whichever is lower. Simultaneously command to stand by CEP shall be issued in Auto. If CEP ON feedback is not received within 10 sec (adjustable) then runback set point shall be changed to 60% Load. In this case one CEP will cater the demand. However, if Stand-by CEP comes in service then run back command will be stopped and two CEP will cater the load demand at that point.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-02 UNIT OPERATING PHILOSOPHY	PAGE 5 OF 5



SUB-SECTION – G-03

LAYOUT REQUIREMENTS

**SINGARENI THERMAL POWER PROJECT
STAGE-II (1X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
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CLAUSE NO.	TECHNICAL REQUIREMENTS																					
1.00.0	PLANT LAYOUT PHILOSOPHY																					
1.01.00	Broad Guidelines for General Layout Plan																					
1.01.01	General layout plan indicating the available spaces for proposed project is as shown in the tender drawing. It shall form the basis for further elaboration by the Bidder for the plant facilities, which are in his scope.																					
1.01.02	Bidder shall develop his own layout for the equipment offered considering sequential erection & ease of operation and the same are to be clearly brought out in the bid. The Equipment shall be laid out in a manner that ensures the highest Reliability, Availability, Maintainability and Safety of the powerplant. Further while preparing the detailed layout, planning the facilities in the Bidder's scope and deciding upon the transportation and construction/ erection strategy and functional requirements, the bidder shall ensure the following aspects: a) The entire construction activity shall take into account the commissioning of the unit phases matching with the final commissioning of the plant. b) The area for construction/erection facilities like lay-down, pre-assembly, offices and stores is to be managed by the Bidder within the overall area available within the plant boundary as shown in General Layout Plan. In case bidder requires additional area, he shall make his own arrangement at his cost outside the plant boundary. Development of the same including security etc. for the intended use will also be his responsibility. c) Face of the buildings and facilities shall be located in such a way so as to have an offset of minimum 15 m with respect to center line of double lane road and 12 meters with respect to center line of single lane road. The spacing between various buildings and facilities shall be suitably decided so as to avoid interference between the foundations. In case of rail track minimum 3m horizontal clearance between face of adjacent structure to center line of rail and 8.5m vertical clearance between bottom of structure to top of rail shall be maintained. Further as per the practice adopted in railways, any crossing below the rail track, minimum opening size of culvert shall be 2.0m wide X 1.8m deep. A walkway of min 600mm width shall also be made available in the culvert. d) The finished floor level at ground level of the TG building shall be designated at EL. 0.0M and shall be 500mm above the finished ground level (FGL) of that area. The finished floor level for various areas / facilities shall be as follows:- <table><tr><td>i)</td><td>FFL of Main Plant Building</td><td>EL. 0.00M</td></tr><tr><td>ii)</td><td>Top of paving for boiler / ESP area</td><td>EL. (-) 0.20M</td></tr><tr><td>iii)</td><td>Top of paving for Transformer Yard</td><td>EL. (-) 0.10M</td></tr><tr><td>iv)</td><td>FFL of Mill Bunker building and Chimney</td><td>EL. 0.00M</td></tr><tr><td>v)</td><td>FFL of other buildings in main plant area</td><td>EL. 0.00M</td></tr><tr><td>vi)</td><td>FFL of offsite buildings</td><td>500 mm above FGL of respective area</td></tr></table>				i)	FFL of Main Plant Building	EL. 0.00M	ii)	Top of paving for boiler / ESP area	EL. (-) 0.20M	iii)	Top of paving for Transformer Yard	EL. (-) 0.10M	iv)	FFL of Mill Bunker building and Chimney	EL. 0.00M	v)	FFL of other buildings in main plant area	EL. 0.00M	vi)	FFL of offsite buildings	500 mm above FGL of respective area
i)	FFL of Main Plant Building	EL. 0.00M																				
ii)	Top of paving for boiler / ESP area	EL. (-) 0.20M																				
iii)	Top of paving for Transformer Yard	EL. (-) 0.10M																				
iv)	FFL of Mill Bunker building and Chimney	EL. 0.00M																				
v)	FFL of other buildings in main plant area	EL. 0.00M																				
vi)	FFL of offsite buildings	500 mm above FGL of respective area																				
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-03 LAYOUT PHILOSOPHY	PAGE 1 OF 14																		

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.01.03	e) Fuel storage tanks, hydrogen cylinder room, hazardous chemical storage sheds etc., shall be designed in accordance with statutory agencies guideline. f) All the buildings and facilities shall be approachable by fire tenders. g) All statutory requirements including safe distances between various facilities as per applicable rules/acts/laws including local bye-laws are met. Control Room for Offsite facilities A) Control Equipment room (only for placing control and power system panels) for each of the following areas shall be provided near to their respective area/MCC/SWGR. However, HMIPIS for operation & monitoring of these control systems shall be placed at suitable locations complying requirements of clause no 2.04.03 of Sub-section-IIC of Part A. - Ash Handling system - FOPPH system - RAW water pump house - Water System B) Control room for placing panels as well as HMI shall be provided for following areas: - FGD System (This is in addition to LVS, Control desk and workstation at centralized offsite control room in control tower) - CHP System NOTE: FGD Control Building may be a part of ESP Control Building. Further Remote I/O (RIO) rooms shall be additionally provided on as required basis for offsite areas/FGD system. The exact RIO locations shall be finalized based on standard design practices, operational requirements, optimization of spaces etc. subject to owner's approval during detailed engineering stage. Also remote I/O room shall be provided for unitized ACW pumps (if required). Control Rooms / Control Equipment Rooms/ RIO rooms shall be air-conditioned. Batteries for power supply systems as required shall be placed in separate ventilated Battery rooms. If offsite control rooms are located at EL 0.0m then cable trench to be provided. However, for FGD building, cable vault shall be provided below switchgear & control room.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-03 LAYOUT PHILOSOPHY	PAGE 2 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.02.00	Main Plant Layout			
	Introduction The proposed location of main plant block is indicated in the general layout plan enclosed with the bid documents. However, bidder has an option to develop his own layout keeping the location/orientation of the main power block, power evacuation corridor, make-up water corridor same as shown in General Layout Plan. However, while developing the layout the bidder must give due consideration to the following requirements: a) Centralized control room (CCR) for the unit shall be located at the start/end of unit in the Control Tower in TG building towards boiler side at operating floor level. Besides this CCR, control equipment room (CER), programmer room, PC room, UPS/ charger room and battery room shall be provided . Symmetry to be ensured in finalizing CCR, CER, Programmer room, PC room, UPS/ Charger and battery room layouts. Bidder to ensure space to place standalone systems in first unit. One separate Offsite Control Room adjacent to main CCR at operating floor in control tower to be provided for operation and monitoring of Ash handling system, Water system and FGD system. So, the HMI of AHP, Water system and FGD system is to be located in this control room while control panels for these systems shall be located near process area. b) The control tower for the unit shall be multi-level, which can be extended from C-Row towards chimney side and shall essentially house but not be limited to the following facilities at operating floor :- i) Common control room at operating floor. Further, Control room to be free of any auxiliary/stub columns other than the C row central column with minimum depth as possible. ii) Offsite control room adjacent to main CCR at operating floor. iii) Control Equipment Room (CER) at operating floor. Unitized CER shall have sufficient space to accommodate all the panels except some miscellaneous panels like bottom ash DCS panels, Public address system panels, CCTV panels, CPU Service area panels etc. which can be placed at mezzanine floor. iv) Programmer room with programmer station & associated consoles. v) Conference room for 20 persons. vi) Shift supervisor room (min size 3M X4M) and C&I engineer room. vii) 24V charger, UPS & batteries on individual unit basis below at mezzanine floor level. viii) Cabling and all other facilities associated with the above system as brought out at para (f) below. ix) No vertical bracing is permitted at front face of Control room i.e. B-row of TG building.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-03 LAYOUT PHILOSOPHY	PAGE 3 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	x) Further no vertical bracing shall be envisaged in HT/LT switchgear room and associated cable vault area. xi) Viewing Gallery at the entrance. c) A SWAS room shall be provided and shall be located at 0.0M in TG building. An air-conditioned space of 10mX10m shall be provided adjacent to SWAS room for locating water analysis lab including office space. d) CCR, CER, Offsite control room, programmer room, 24V charger & UPS room, SWAS room, Conference room, C&I engineer room, Shift supervisor room shall be air conditioned areas. Battery Rooms for power supply systems as required shall be well ventilated areas. Pantry & separate Washroom/Toilet facilities for ladies & gents shall be provided contiguous to common control room. Further, no vertical bracings, pipes, cable shafts etc. shall be routed through control room or control equipment room. e) The following clearances to be maintained for C&I DDCMIS cabinets: i) Inter panel spacing - 1200mm ii) Clearance from back wall - 1200mm iii) Clearance from front wall - 1200mm iv) Clearance from side wall - 1000mm The above clearances are the minimum requirement and may increase with increase in door swing of the cabinets. e) The cable vault/ / cable spreader room space below the HT / LT switchgear room, Control Rooms, unit control equipment room, Programmer room, UPS, Charger room & Battery Rooms, Boiler MCC room shall have 800 mm wide and 2.1 m high movement passage all around the cable trays in the cable vault/ cable spreader room for easy laying/maintenance of cables. Proper unit wise segregation / separation of cables shall be provided in cable vault area. False floor to route cables is not permitted. The Bidder shall provide unit wise space for transformers (minimum 5mX5m) preferably in BMCC room along with motorized handling arrangement. No transformers shall be placed inside cable vault room and in open area. The transformers shall be placed inside the closed area. f) Bidder as a safety requirement shall provide Fire wall on A-row of TG building in front of power transformers as per the statutory and safety requirements. g) Operating floor in the main plant building and the floor of control Equipment rooms shall match with top level of TG deck. i) For other layout requirements of electrical, the Bidder to refer requirements mentioned elsewhere in the technical specifications.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-03 LAYOUT PHILOSOPHY	PAGE 4 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
1.03.00	Equipment layout While developing the layout, the Bidder shall ensure the following minimum requirements: 1. Area of unloading bays Minimum Two (2) nos. of maintenance bays (one number at start of unit) shall be provided in TG building. Width of maintenance bay shall be 10.5M (minimum). Further additional bays may be provided as per system/layout requirements. 2. Distance between TG hall (C-row) column and first row of boiler columns. 12 M (Clear passage width will be minimum 10 m) 3. Arrangement of TG set Longitudinal 4. Basement, Pits & Trenches a) Regular Basement floors are not acceptable in Main Plant Building. b) Regular Basement floors, trenches and pits in boiler/ mill bay area for routing pipes, cables etc are not acceptable 5. Clear walkways along A-row & B-row of Power House. a) 1.5m at all the levels of AB Bay b) 3.0m along B-row at operating floor level for interconnection with service building & in front of CCR. 6. Control Room Control room for Unit shall be provided at start/end of unit at operating floor level in B-C bay. 7. Control Equipment Room The Control Equipment Room shall be located at operating floor adjacent to control room. In case, based on the plant optimization few panels are required to be located at Mezzanine floor then the same must be located below control room. 8. Minimum clear working space around the equipment 1200mm		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-03 LAYOUT PHILOSOPHY	PAGE 5 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	9. Minimum clear working space around the Coal mills 10. Minimum width of all staircase 11. Clear approach width/height between Boiler & ESP 12. Clear approach width/height between ESP & ID fan 13. Clear passage between two ESP 14. Clear head room for material movement at ground level in Boiler Envelope 15. Clear head room for personal movement at ground level of Boiler below ducts. 16. Clear head room for personal movement over all Boiler Platforms 17. Clear Head room at different floors within Main Plant Building below pipes, ducts, Structures & cable trays etc. 18. Clear head room in bay between TG hall and first row of boiler column i.e. CD bay 19. Shape of Raw Coal Bunkers 20. No. of Fire Escape staircases in the main plant with fire doors at each landing. 21. Minimum straight length in flue Gas duct at ESP outlet for Opacity meters	1500mm 1200mm 12m minimum (Height=8m) 10m minimum (Height=8m) 10m wide (Minimum) 5.0m (Minimum) (Unless specified Otherwise) 2.5m(Minimum) 2.1m (Minimum) 2.5m (Minimum) 7m (Except in control tower area, Passage where the minimum head room shall be 5.0m) Circular Min-4 Nos. per unit .However the number shall meet the requirement of insurance companies. As required for accurate dust measurement within the battery limits.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-03 LAYOUT PHILOSOPHY	PAGE 6 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	22. Coal Mills can be located on the side/rear/front of the boiler. However, bunker emptying discharge chutes shall be placed outside the mill bunker building towards the side opposite of boiler envelope. 23. Adequate space and provision for handling/removal of pumps, motors, heaters, heat-exchanger, fans, Mills, Switchgear Panels, and Transformers during maintenance shall be provided. 24. Monorail beams with electrical hoists/ chain pulley block/ HOT crane as required shall be finalized during engineering stage and shall be supplied by the bidder. Opening provided in the floor for handling these equipment shall be closed with removable chequered plate. 25. Independent floor drains with separate down comers shall be provided wherever fire protection system is provided. 26. In TG bay at crane rail level, chequered plate walkway of minimum 500mm clear width from face of the column to the handrail (excluding handrail) on crane side to be provided for full length of the building along A-row & B-row columns. Further, in-between columns, walkway shall be provided in entire column sectional depth. 27. Two (2) nos. of interconnecting walkways (minimum 2.0m clear width) between TG building and boiler (on both side of boiler) at mezzanine, Operating, PRDS/Deaerator floor level shall be provided by Bidder for side mill/rear mill arrangement. In case of front mill arrangement, the mill bunker building shall be interconnected with 2.0m clear width platform with TG building at two levels (with one level necessarily connected with TG Hall operating floor and other interconnection level shall be decided during detailed engineering). The interconnection shall be on both sides of boiler center line for each elevation. Further cables between boiler and TG building shall be routed through interconnecting structure. Also interconnecting platform (min. 1.5m clear width) between Boiler and Coal Bunker Building at Feeder floor level and Tripper floor levels shall be provided by the bidder. Number of interconnecting platforms between boiler and coal bunker building for each level/floor specified above shall be two numbers on each side of boiler, i.e. four numbers per floor for side mill arrangement and two nos. for front and rear mill arrangement. 28. Layout of facilities and equipment shall allow removal of Generator Stator, Generator transformers, Station & Unit transformers without disturbing equipment, piping, cabling, ducts routed in the area. 29. While developing the layout, all roof extractor fans on AB bay roof shall be kept staggered and shall not be near the centerline of Turbo generator set. 30. The equipment / valves in the local pit / trenches are to be located in such a manner, that the same can be maintained / operated without any hindrance.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-03 LAYOUT PHILOSOPHY
		PAGE 7 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	31. Inside T.G building all piping shall be routed at a clear height of 2500mm (min.) from the nearest access level to clear man movement. Further, valves including actuators and instrument tapings shall be located in accessible positions and operating/maintenance platform for the same shall be provided. 32. Steam turbine, Generator and other equipment located in the turbine hall shall be accessible by the EOT cranes for their handling during erection and maintenance. Wherever special handling procedures are to be followed such as for the generator stator, rotor withdrawal of Generator etc., the same shall be described in written out document and attached with the bid. The offered layout of TG Hall shall be such that it shall be feasible to remove the Generator Stator and send it for repair without removal of any equipment located in TG Hall. Erection of STG Stator shall be carried out by tandem operation of EOT cranes. 33. In case auxiliaries such as BFP set are not in the reach of TG hall EOT crane, then separate EOT crane with proper maintenance area near BFP set shall be provided for complete erection and maintenance of BFP and its auxiliaries. The Bidder shall furnish the equipment laydown area for TDBFP and MDBFP parts/components with details such as blocks indicating orientation of dismantled items, travel path etc. necessarily by BFP EOT crane. Further, Bidder shall furnish handling arrangement drawing including special arrangements, pedestals, fixtures etc. for withdrawal / placement in laydown area. Bidder shall ensure obstruction free access path/walkway around TDBFP and MDBFP sets and approach to measuring instruments, valves, bearings etc. In case acoustic enclosures is envisaged, free access as elaborated above shall also be ensured with in the enclosure. Bidder to plan accordingly taking care of integral piping, lube oil piping, cabling, LIE/LIR etc. and 3D model shall incorporate all these facilities and 2D drawing extracted from 3D drawing shall be submitted. Pit shall be avoided for housing the lube oil system of TDBFP. In case bidder opts for pit, pit invert level shall be kept such that the clear headroom of min. 2.1 m shall be available from the grating platform. Access to top of the oil tank shall be ensured from EL 0.0M floor. Bidder shall ensure 600mm walkway all around the equipment/tank after all the oil/water/firefighting piping, cable trays etc. are considered. Free access to the pumps, valves and instruments shall be ensured. Entire access path shall be approachable from all the staircases. Further, Bidder to plan in advance and model all the equipment and piping including firefighting pipes inside oil pit area, in order to maintain clear walkway requirements. At least two separate accessways with stairs of minimum 1200mm width to oil pit area for each TDBFP shall be provided for safety. 34. The bidder has flexibility to route tie Bus ducts and DG Sandwich Bus ducts inside TG hall below operating floor level or mezzanine floor level or outside A-row on cantilever structure. The bus ducts shall be routed with minimum bends. In case Bus-ducts are routed outside A-row on cantilever structure, the bidder shall provide walkway of 600 mm wide and 2100 mm clear height for maintenance.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-03 LAYOUT PHILOSOPHY	PAGE 8 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Further, fire water pipes shall be routed underground (with proper encasement of pipes at roads/passage bay crossings) by the sides of main plant roads (inside the main plant area) from transformer yard to chimney area after clearing the road side drains. Fire water pipes shall not be routed on the same trestle over which the fuel oil pipes and steam pipes are running. In offsite areas, fire water pipes can be routed on trestles or on pedestals. In exceptional cases, fire pipes can be buried. V. Not used. VI. Head room below cable/ pipe rack in transformer yard area for movement of spare GT shall be such that the same can be moved with bushing installed. A clear gap of 500mm between top of bushing and BOS of the trestle shall be ensured. VII. A walkway of 600mm (minimum width) with handrails & toe guards shall be provided all along length of the gallery of pipe & cable trestle for maintenance of cables where the height of trestle is more than 3 m, ladders for approach to these platforms shall be provided near roads, passage ways and turning points. In the tier of trestle, wherever ash handling pipes are routed, grating platform all along the length and for full width of the gallery and trestle of that tier shall be provided. Further, one walkway of 600mm clear width shall also be ensured on the tier meant for routing the ash handling pipes. VIII. A clear head room of 2.1 m over the walkways of Pipe/cable trestle galleries for all tiers shall be ensured. Wherever, dry ash pipes are routed on the top most portion of the pipe/cable trestles, a clear head room of 2.1 m over the walkways of dry ash pipe rack shall be ensured. Also, clear gap between structures of each tier of trestle shall be maintained as 2.1 m (minimum). IX. Height of trestles at approach roads to various buildings/facilities shall be 8m. In case building are located in offsite area and are adjacent to each other, then as a good engineering practice, the height of trestle shall be maintained all over as 8.0m. X. The layout shall be developed so as to meet the requirements of the Cabling philosophy indicated in respective electrical chapters mentioned elsewhere. 40. Each equipment room shall be provided with alternate exits in case of fire/accidents as per requirements of factory act and TAC. Further minimum two number fireproof double door shall be provided in Cable vaults, HT/LT switch gear room and Boiler MCC rooms. 41. All cranes shall be provided with approach rung ladders at least at two places. Wherever cranes can't be maintained in situ on the carriage, facility to draw them to maintenance platforms as well as provision of suitable platforms shall be considered by the bidder. 42. Conventional type elevators shall be provided inside the TG building .Further, Conventional type elevators (One Passenger and one goods) shall be provided for each boiler. Landing shall be provided for each floor and up to the topmost floor of TG			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-03 LAYOUT PHILOSOPHY	PAGE 10 OF 14	

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	Building/ Boiler. Location of elevators shall be fixed during detail engineering stage, while finalizing the Layout. For further technical details refer respective portion of the Technical Specification. 43. For Ventilation requirement from A-row side of TG building, space for installation of multiple modular type Air washer units along with pumps shall be considered in AB bay at suitable elevations. No separate room outside A-row for locating Air Washer equipment and no trestle outside A-row for routing Ventilation duct shall be considered. Further, for Ventilation requirement in BC bay, adequate number of multiple modular type Air washer units along with pumps in BC bay shall be considered. All fresh air ventilation louvers shall be 2500mm from floor level and directed downward at an angle. 44. Battery room shall be properly ventilated to release the gases produced. No roof openings leading to electrical / C & I panels shall be allowed. Spaces for locating fans for Electrical / C & I battery rooms shall be identified in TG building layout drawings. An easily accessible wash basin with mirror shall be provided in the battery room. The enclosure of battery room shall be of brick wall. 45. Routing of pipes and cables is not permitted as cantilever to TG building outside A-Row. These shall be suitably routed within TG building. 46. ESP cum FGD Control room/ Electrical building shall be provided. If the ESP cum FGD Control room / Electrical building is more than two (2) storey, elevator of specified capacity shall be provided. 47. Minimum one (1) number of staircase shall be provided between two adjacent passes of ESP. These staircases shall be equally distributed on the inlet and outlet side of ESP. 48. Equipment operating/maintenance platforms at Mill Hoist Level, Mill Discharge Valve level, Bunker/Feeder Outlet Level, Cold and Hot air damper level, scanner approach level, oil gun approach level, approach to bottom of hopper for ash handling and for other equipment shall be provided. The platform shall be such that minimum 1.2m space is available all around the equipment for operation & maintenance. However, complete platform for mill maintenance shall be provided at one level in the mill bunker building. Further, 2.1m clear height shall also be available on all such platforms for the person to stand on the platform. 49. Equipment operating & maintenance platforms including supporting structures such as grating platform in the oil equipment room, control fluid equipment room, valve room, De-aerator, Gland Steam Condenser, Flash tank and for other equipment shall be supplied and erected by the Bidder. 50. Suitable motorized rolling shutters shall be considered in the equipment layout to be developed by the bidder on 'A'-row to facilitate the movement of Generator Transformers, Station & Unit transformers to the maintenance bay. The size of rolling shutter for TG hall shall be such that largest Power transformer can be brought inside TG hall for maintenance etc. The rail track shall be laid in maintenance bay for handling Power transformers.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-03 LAYOUT PHILOSOPHY
			PAGE 11 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Further rolling shutters at different location shall be provided in TG hall for the movement of material. 51. In offsite buildings MCC, minimum 2 (two) nos. fire door along with one rolling shutter of adequate size/ capacity shall be provided 52. Bidder to route non-cast basalt ash slurry pipelines on pedestal only and pipe culverts shall be provided at rail/road crossings. 53. A suitable rail track and associated facilities like Jacking pads, mooring posts etc., shall be provided to facilitate the movement of Generator transformers. Station and Unit transformers to the maintenance bay. These rail tracks shall be accessible from the equipment unloading area of TG bay by a rail track. 54. Approach platform shall be provided from ESP outlet to ID fan suction gate. 55. Flue Gas Desulphurization (FGD) shall be located within the main plant block beyond ESP. The common facilities of FGD can be located outside the main plant block. Bidder to bring out the details regarding FGD and its location basis clearly in bidding documents. FGD Switchgear/MCC room shall be sized for LT & HT Switchgear meeting the functional requirements. 56. In boiler area layout, the bidder shall consider space provisions for future installation of SCR System. As per the Employer's assessment the min. requirement of area on both sides of boiler centerline for such future purpose is 25mX25m each. Space provision may be planned either towards downstream of APH (i.e. between Air pre-heaters and first row of ESP column) or on both sides of the boiler. Bidder to clearly bring out the details regarding suitability of the provisioned area for future SCR system and its location basis with bid documents along with references of previously executed SCR System(s). 57. An area of 3000 sqm at a single location of min. 40 m width, to be kept near chimney for owner facility (required for carbon capture). 58. All facilities of mill reject handling system specified elsewhere in the specification such as pump, tank, conveyor, piping etc shall be above ground level in boiler area. 59. In case of front mill arrangement, all staircase wells in TG hall C-row side, shall be pressurized and also all doors/ shutters provided this side shall have a provision of air curtains to avoid ingress of coal/ash dust from boiler side. 60. In case Centralised oil storage and purification system is located outside T.G building, the complete Centralised oil storage and purification system including Tanks, Pumps, Motors, Purifier etc. should be kept under covered shed. Throughout clear headroom of min. 2500mm between bottom most point of the roof shed supporting structure (like			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-03 LAYOUT PHILOSOPHY	PAGE 12 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.04.00	61.	truss, purlin, etc.) and the topmost point of component of Centralised oil storage and purification system should be available.		
		ECW system equipment (Pumps, drives and PHEs etc.) for both TG and SG auxiliaries to be located within the T.G Building.		
		Laydown area for maintenance and overhauling.		
	1.	The layout of the steam turbine building shall permit sufficient lay down area for all the parts/components to enable carrying out maintenance and overhauling operations without any restrictions and without any hindrance to the operating personnel of other units.		
	2.	Steam turbo-generator unit shall be provided with its own lay down area on operating floor, thus enabling simultaneous maintenance and overhauling of all steam turbine generator units. In case any special arrangement for rotor maintenance is required, the same should be provided.		
	3.	All handling arrangement including any special arrangements like trolley, drive, pedestals etc. for carrying out maintenance and overhauling for steam turbine generator and its auxiliaries shall be provided by the bidder.		
	4.	The Bidder shall furnish general arrangement drawings indicating the equipment lay down area with details such as blocks indicating orientation of dismantled items, travel path etc.		
	5.	The Bidder shall also make arrangement for storing following mandatory spares (whichever is applicable as per scope of the package) inside TG hall with access from EOT crane:		
		a. Complete assembly of HPT module or its alternative, as applicable		
		b. Complete assembly of IPT module or its alternative, as applicable		
		c. LP Turbine bladed rotor assembly		
		d. HP/IP/LP casing		
		e. Drive Turbine bladed rotor for TDBFP		
		f. Generator Rotor		
		g. Boiler Feed Pump motor		
		The bidder shall provide the storage space for these spares at EL. 0.00 m of turbine hall. However, bidder can also store these spares on operating floor level at the end of unit. Further the option of keeping spares at operating floor shall be exercised after allocating the space for laydown of TG component during overhauling of unit. The storage of spares shall also not hinder any movement of man and material.		
		The number of maintenance bay specified elsewhere in the specification shall not be used for storing these unit assemblies.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION- G-03 LAYOUT PHILOSOPHY
				PAGE 13 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS		
1.05.00	Local Pits/trenches in Main Plant building are to be avoided. However, pits/sumps which are unavoidable such as condensate drain pit etc. shall be provided with required permanent dewatering arrangements by means of drainage pumps and piping. Drain network shall be provided to collect effluent generated from floor wash, equipment drain and process drain in TG hall/Boiler/Mill Bay/TP/ESP areas for further disposal upto final disposal point. Underground pipes for this purpose shall not be acceptable.		
1.06.00	Bidder's shall prepare the detailed layout of main power block area indicating the location of all major equipment. The layout shall be furnished along with the bids submitted by the bidder.		
1.07.00	In addition to above, layout requirements regarding Coal handling plant, Ash Handling Plant, Gypsum Handling Plant, Limestone Handling Plant, Water Treatment Plant and Fuel Oil Handling area buildings, specified elsewhere in the specification shall also be followed.		
1.08.00	Bottom flange level of Air-Preheaters (Both Primary and Secondary) hoppers and additional hoppers (if any) shall be fixed based on ash evacuation system as offered by the bidder taking care of clear height requirement between Boiler & ESP and considering unobstructed route for Fly Ash conveying pipes avoiding vertical bends.		
1.09.00	Bottom flange level of ESP outlet Hopper shall be at EL (+) 3.5m (Minimum). In case bidder opt for keeping the ESP Hopper O/L flange above EL (+) 3.5m, separate platform shall be provided for maintenance of ash handling equipment below ESP hopper level, with a clear headroom of 2.1m below ESP hopper flange/platform and clearance of 2.5 m (min.) shall be maintained from ESP area paving level. The Vacuum pump and other ash handling system equipment shall be located outside the ESP envelope and preferably below the inlet funnel of ESP.		
1.10.00	Adequate RCC paving to be provided around the equipment to facilitate handling with mobile cranes.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-03 LAYOUT PHILOSOPHY
			PAGE 14 OF 14



SUB-SECTION – G-04

STANDARD PG TEST PROCEDURE

**SINGARENI THERMAL POWER PROJECT
STAGE-II (1X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC NO.:CW-CM-11159-C-O-M-001**



TG & Auxiliaries Standard PG Test Procedure

Station Name Capacity----		
EPC Package		
1	OWNER	SCCL Limited (A Govt. of India Enterprise)
2	CONTRACTOR	Name
3	CONTRACT No.	
4	SUB-CONTRACTOR	
5	OWNER's Doc. No.	
6	CONTRACTOR's Doc. No. / Rev No.	/
7	SUB-CONTRACTOR's Doc No. / Rev. No.	/
8	DRG./DOC. Title	PERFORMANCE TEST PROCEDURE FOR TURBINE GENERATOR
9	PURPOSE	FOR APPROVAL

CLAUSE NO.	TECHNICAL REQUIREMENTS	

Revision status for owner's Document

Revision No.	Date	Name (On behalf of Owner)	Comment	Date	Name On behalf of Contractor)	Comment	Remarks

OWNER's APPROVAL			CONTRACTOR's APPROVAL		
Authorized Representative	signature	Name	Authorized Representative	Signature	Name
Approved by			Approved by		
Checked by			Checked by		
Prepared by			Prepared by		

CLAUSE NO.	TECHNICAL REQUIREMENTS	
<u>CONTENTS</u> Page no. 1. Test Objective 5 1.1 References and Standards 6 2. Test Parties 6 3. Contractual conditions of Performance Test 6 -9 4. Schedule of Testing 10 - 15 5. Calculations 15 -28 6. Auxiliary Power Consumption 28-32 7. Condenser Performance Test 32-42 8. Annexure & attachment		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE PAGE 3 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	<u>ATTACHMENTS TO BE PROVIDED BY VENDOR</u> 1. Heat Balance Diagrams 2. Correction Curves 3. Gland steam flow & Deaerator Vent flow 4. Measuring Instrument list along with diagrams. 5. Measuring spots for performance test 6. Isolation valve list 7. Deaerator Inlet condensate flow calculation 8. Check List 9. Sample calculation 10. Correction curves for Condenser Performance Test		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 4 OF 223



1. Test Objectives

This document provides the Performance Test Procedure for -----Station Name-----, capacity----- to confirm that the following item meet the guarantee value.

- i. **Unit** Heat Rate in Kcal/kWh under rated steam condition at -----mmHg condenser pressure value(abs) ----- in ---%--- percent make up at -----MW—Load, -----% -- TMCR.(Unit Heat Rate= Net Turbine cycle Heat rate (Kcal/kWh)/Boiler efficiency(%)), **(Note: Boiler efficiency & Turbine cycle Heat rate will be determined during SG PG test and TG PG Test respectively).**
- ii. **Unit** Heat Rate in Kcal/kWh under rated steam condition at -----mmHg condenser pressure value(abs) ----- in --%-- percent make up at -----MW—Load, ----(--% -- TMCR). (Unit Heat Rate= Net Turbine cycle Heat rate (Kcal/kWh)/Boiler efficiency(%)), **(Note: Boiler efficiency & Turbine cycle Heat rate will be determined during SG PG test and TG PG Test respectively).**
- iii. Continuous TG output of ----MW load----under rated steam condition.
- iv. Unit Auxiliary Power consumption at ----%-----TMCR (MW Load), under rated steam condition.
- v. Condenser Pressure at---%--- TMCR under rated steam condition at ----% make up
- vi. CW pumping power in kW for design CW flow and the pressure drop in CW side being measured in terminal points as per specification. (Pumping power shall be computed based on overall efficiency of ----- % of CW pump and drive.

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.1 References and Standards For guidance on test protocol, the following test code should be consulted. • ASME PTC-6 -2004 “Performance Test Codes for Steam Turbine” or latest revision and as specified elsewhere in specification. • ASME PTC-19.5- 2004 “ Performance Test Codes for flow measurement” or latest revision • ASME MFC 3M -2004 “ Measurement of fluid flow in pipes using Orifice, Nozzle, and Venturi” • IAPWS-IF97 “Thermodynamic calculations” 2. <u>Test Parties.</u> i. Witness :- SCCL Limited (Herein after called SCCL) ii. Contractor:- -----Name of organization---- iii. Sub- Contractor:- -----Name of organization---- 3. <u>Contractual conditions of Performance Test.</u> 3.1 <u>General</u> Performance test of the turbine generator unit upon satisfactory completion of preliminary check- up and test runs of the applicable equipment shall be carried out by -----Contractor’s name----- in line with applicable contractual agreement.				
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 6 OF 223



3.2 Reference Conditions and Guarantee values for the Performance Test.

Reference conditions of each test shall be tabulated in -----Table name----- . The Test condition should be adjusted to the each specified value as close as possible and the test result should be corrected to the reference conditions specified in the table by using correction curves in attachment ---No.--- .

Table No.---- Reference conditions and Guarantee value for performance Test

Test Item		Heat Rate Test I --% TMCR	Heat Rate Test II --% TMCR
	Unit		
Heat Balance Diagram		HBD No.----	HBD No.----
Generator Output in	kW		
Main Steam pressure at MSV	Kg/sq. cm(abs)		
Main Steam Temp at MSV	deg. C		
Hot Reheat Steam Temperature at IPT	deg. C		

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Reheater System Pressure Drop	%		
	Super heater spray water flow	Kg/h		
	Reheater water spray flow	Kg/h		
	Feed water pressure at terminal point	Kg/sq. cm(abs)		
	Condenser pressure	Kg/sq. cm(abs)		
	Generator Power factor			
	Frequency	Hz		
	Generator Hydrogen pressure	Kg/sq.cm(g)		
	Voltage	kV		
	Make up water flow	Kg/h		
	Boiler Feed water flow	Kg/h		
	Turbine Cycle Heat Rate	Kcal/kWh		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION- G-04 STANDARD PG TEST PROCEDURE
				PAGE 8 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	3.3 Test Method The turbine generator performance test is carried out according to ASME PTC6-2004 or latest revision and technical specification. Uncertainty on the test results is not applicable on account of measuring instruments inaccuracy & Fluctuation of parameters during the conductance of test. Ageing correction is not applicable for TG Cycle Heat Rate & Output test. Test will be conducted during trial operations. No shutdown will be allowed on account of PG Test preparations. The thermodynamic calculation is worked out and the measurement will be evaluated according to IAPWS-IF97. 3.4 <u>Provisions for Performance Test</u> Condensate flow nozzle (ASME PTC 6) will be installed by vendor Prior to initial operations. Condensate flow data will be available in DCS during performance test. All other online process instruments will be used for conducting TG Performance test. Average value of test data of the specified test period will be collected from DCS for evaluation purpose. Offline instrument will not be used during performance test. Vendor to ensure calibration validity of all instruments used for PG Test. Calibration certificates of test instruments shall be submitted to SCCL at least 15 days before the conductance of performance test. Instrument Calibration to be carried out in a NABL accredited Laboratory. 3.5 <u>Timing of Performance Test Execution</u> The acceptance test to be commenced during trial operations or during the period as defined in the contractual agreement.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 9 OF 223



4.0 Schedule of Testing

The following schedule for test events should be subjected to revision according to discussing progress between test parties.

4.1

Table 4.1 Test Program

	TEST LOAD	TEST NO.	TEST DURATION
Preliminary Test	---% TMCR	T-0	Two (02) hrs
Heat Rate/output Test-1	---% TMCR	T-1	Two (02) hrs
Heat Rate/output Test-2	---% TMCR	T-2	Two (02) hrs
Heat Rate Test/output -3	---% TMCR	T-3	Two (02) hrs
Heat Rate Test-4	----% TMCR	T-4	Two (02) hrs
Heat Rate Test-5	----%TMCR	T-5	Two (02) hrs
Heat Rate Test-6	----% TMCR	T-6	Two (02) hrs
Condenser Pressure Test	VWO	T-7	Two (02) hrs
TG Auxiliary Power Test	---% TMCR	T-8	Two (02) hrs
CW Pumping Power Test	---% TMCR	T-9	Two (02) hrs

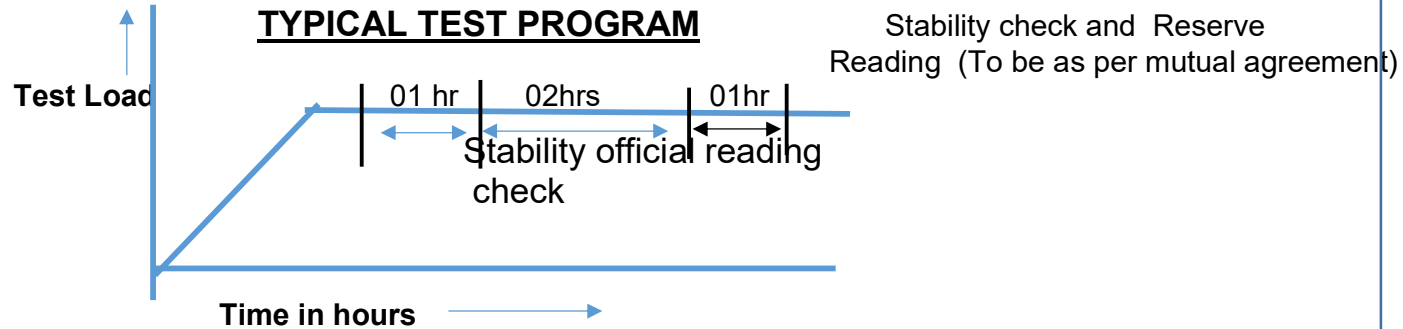
1 : Test data does not include one hour preliminary measuring for stability check and the reserve data reading after the official measurement.

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	2: T-3 and T-6 will be carried out in the case that the results of corrected heat rate in previous two tests (For T-3 : T-1 and T-2, For T-6 : T-4 and T-5) differ by more than 0.25%. 3: TG Auxiliary power consumption test will be carried out at the same time of Heat Rate Test at ---% load. 4: condenser performance Test will be carried out at ---- condition of Turbine with rated steam parameters. 4.2 Preliminary Test Preliminary test, T-0 should be carried out prior to all official test runs for the purpose of the cycle isolation check, instruments check and training personnel. No official test shall be carried out without justifiable preliminary test. If agreed by test parties and provided that all the requirements of a regular guarantee test have been met, the preliminary test may be declared as guarantee test. 4.3 Cycle Isolation The accuracy of test results depends on the isolation of the system. Extraneous flows should be isolated from the system. If there is any doubt about the ability to isolate extraneous flows during the test, preparations should be made prior to the test to measure these flows. The valves opening will be set according to Attachment--- before the test. The flows to be isolated are listed below. a) Blow off lines b) Drain lines on stop valves, control valves, and heaters etc. c) Turbine bypass lines (no leakage to be confirmed during the test) d) Interconnecting lines to the other system e) Heater drain bypass lines (Emergency Heater Drain Lines) f) Make up water line		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 11 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	g) Auxiliary Steam h) Other specified items to be listed separately 4.4 Number of Test Runs The number of tests is to be performed as follows. Preliminary test run for the ---% T-MCR output test and Heat Rate test : once (T-0) Official test runs for the ----% T-MCR output test and Heat Rate test : (T-1/T-2) Official test run for the ----% T-MCR output test and Heat Rate test : if required (T-3) Official test runs for the ---% T-MCR Heat Rate test : (T-4/5) Official test run for the 100% T-MCR Heat Rate test : if required (T-6) 1 : T-3 and T-6 will be carried out in the case that the results of corrected heat rate in previous two tests (For T-3 : T-1 and T-2, For T-6 : T-4 and T-5) differ by more than 0.25%. 2 : Auxiliary power consumption test will be carried out at the same time of Heat Rate Test at --% load.(refer Contract document) 4.5 Test Condition The Performance Test is to be conducted on the turbine while operating the unit in a normal mode. For the duration of the test, the unit must be holding steady conditions of flow, pressure and temperature. For this reason, it is necessary to establish the test conditions for at least one hour prior to the start of the tests. In order to avoid the application of large correction factors to the calculated test results, it is necessary that pressures and temperatures are close to the specified operating conditions.		
	SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE PAGE 12 OF 223



During the test, values of operating condition should be held within the limits listed in **Table 4.2** as possible.



4.2 PERMISSIBLE DEVIATION OF VARIABLES

Variable	Permissible deviation for the average of the test conditions from design or rated conditions(Note 1)	Permissible fluctuations during any test run (ASME PTC not applicable. Only C&I PG test reference value is applicable) (Note 2)
a) Initial(Main)-steam pressure	$\pm 3.0\%$ of absolute pressure	MS Pressure, MS temperature, HRH Temperature applicable as specified in C&I PG Test. Rest Parameter fluctuations not applicable.
b) Initial(Main) and reheat steam temperature	$\pm 16^{\circ}\text{C}$	
c) Exhaust pressure	$\pm 0.0035\text{kg/cm}^2$	
d) Reheater System pressure drop	$\pm 50\%$	
e) Primary Flow	Not specified	
f) Secondary Flow	$\pm 5.0\% \times (\text{Primary Flow} /$	

CLAUSE NO.	TECHNICAL REQUIREMENTS			

	Secondary Flow)	
g) Generator output	±5.0%	
h) Voltage	±5.0%	
i) Power factor	—	
j) Speed	±5.0%	

Notes:

1. Test will be conducted by vendor following Note 1 & Note 2 in the table 4.2.

2. When unreasonable or abnormal data are observed during the test, the test parties should discuss how to treat them. (For ex. Data deletion if required, the extension of the test duration etc.)

4.6 Two official test runs

Duplicate test runs shall be performed at -----MW and -----MW unit loads. The results of corrected Heat Rate shall agree within 0.25%. If they differ by more than 0.25%, third test shall be run at the same point. The corrected result of any one of the three test runs, which deviates from the corrected averaged result of all the runs by more than 0.25%, shall be eliminated; otherwise the results of all the three tests runs shall be acceptable.

4.7 Duration of Test Run

Duration of test run shall be **two hours**. One hour as minimum is necessary before the test run to confirm whether the plant is at satisfactory condition for the test.

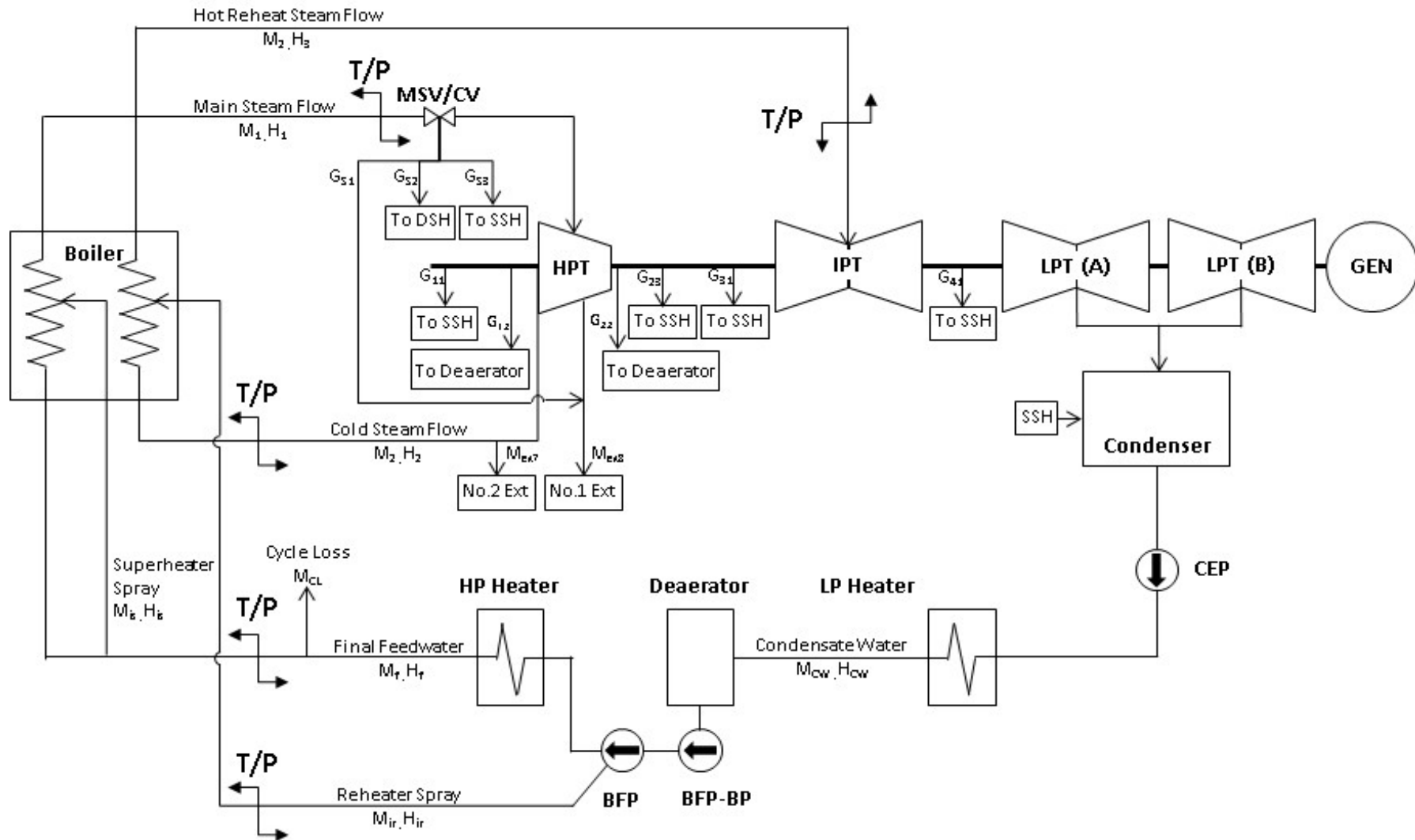
During two hours of the test run, unit has to run in **steady-state**.

SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 14 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	If unit is operated in steady-state conditions in shorter period, data taken during this shorter period may be used for official test calculations subject to owner agreement. 4.8 Frequency of Readings a) The most important measurement, that is the primary flow, shall be read at interval of as defined in DCS. b) Other important measurements, primary pressures, temperatures and secondary flows shall be read at interval as defined in DCS. c) Storage level changes, secondary pressures and temperatures, shall be read at interval as defined in DCS. d) The generator output shall be collected from online energy meter. Calculations 5.1 Arrangements of Data Checking It is necessary to correct pressures for water legs and barometric pressure, and apply appropriate corrections. After each test, log sheets will be collected and each log sheet will be checked for obvious erroneous readings. Mutual agreement to be made before adopting test data for evaluation. <u>5.2 Calculations of Heat Rate (Sample calculations to be provided)</u> Turbine cycle Heat Rate for Typical Cycle will be calculated using the following equation. (Nomenclature & Symbols are not mandatory for sample calculation)		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 15 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	<i>Symbols</i> <i>Flow</i> M1 = Main steam flow at main stop valve inlet kg/h M2 = Cold reheat steam flow at the reheater inlet kg/h Mf = Final feed water flow kg/h MCL = Cycle Loss kg/h **Gs1 = Control valve stem 1st leak-off flow kg/h **Gs2 = Control valve stem 2nd leak-off flow kg/h **Gs3 = Control valve stem 3rd leak-off flow kg/h **G11 = #1 gland 1st leak-off flow kg/h **G12 = #1 gland 2nd leak-off flow kg/h **G22 = #2 gland 2nd leak-off flow kg/h **G23 = #2 gland 3rd leak-off flow kg/h **G31 = #3 gland 1st leak-off flow kg/h **G41 = #4 gland 1st leak-off flow kg/h Mex8 = Extraction steam flow to HP #8 heater kg/h Mex7 = Extraction steam flow to HP #7 heater kg/h Mex6 = Extraction steam flow to HP #6 heater kg/h Mex5 = Extraction steam flow to deaerator kg/h	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE PAGE 16 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	*M_{cw} = Condensate water flow to deaerator kg/h **M_{dv} = Deaerator vent flow kg/h *M_{DEAE} = Variation of deaerator water storage (- : increase, + : decrease) kg *M_{COND} = Variation of condenser water storage (- : increase, + : decrease) kg *M_{is} = Superheater desuperhating spray flow kg/h *M_{i r} = Desuperheating water flowing into reheater system kg/h The following is the outline of a TYPICAL figure of boiler & turbine indicating the terminal points and parameters used in the calculation of Heat Rate. This is not mandatory.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE PAGE 17 OF 223



* Marked flows are actual measured values during the test.

CLAUSE NO.	TECHNICAL REQUIREMENTS



** Marked flows are calculated at **Attachment -----**.

The others are calculated as below.

Main steam flow at main stop valve inlet : $M1 = M_f - MCL$

Mass of Cycle Loss : $MCL = (MDEAE + MCOND) / 2$ (hours)

(If the value of MCL is less than 0, MCL is set to 0.)

MDEAE = (N.W.L area of deaerator) * (change level of deaerator) * density

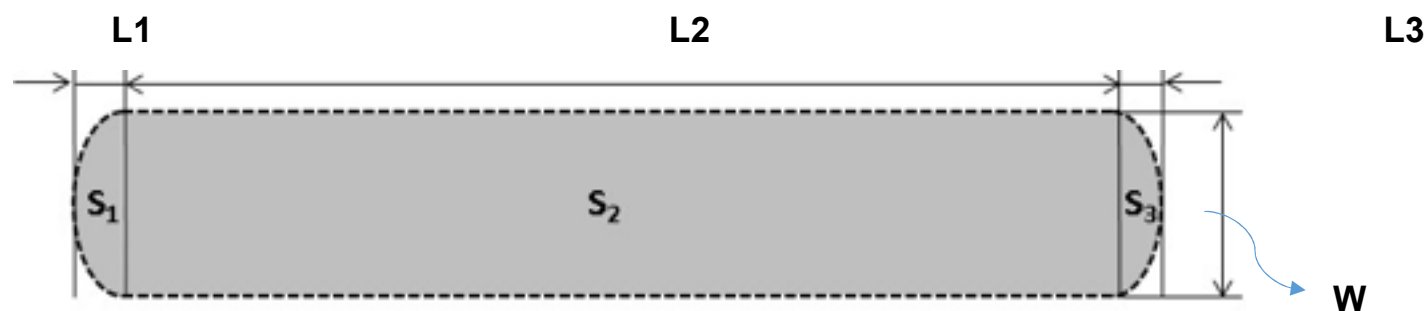
MCOND = (N.W.L. area of condenser) * (change level of condenser) * density

(The levels of condenser and deaerator are almost unchanged during the test.)

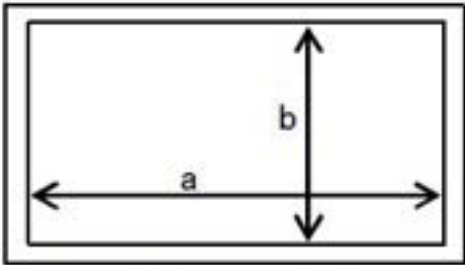
[N.W.L. area of deaerator is calculated as follows]

The following figure is the cross section of N.W.L. of deaerator.

Deaerator schematic diagram to be attached with all dimensions.



SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 19 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	W is two times that of ---- mm (this value is calculated by using the radius and distance from the center to N.W.L.) Side view of Deaerator to be attached. So the area is given by the sum of S1, S2 and S3. N.W.L. area of deaerator = S1 + S2 + S3 [N.W.L. area of condenser is calculated as follows] The following figure is the cross section of N.W.L. of condenser lower shell. a = b =  Size of Cond Lower Shell The area is given by the product of “a” and “b”. So N.W.L. area of condenser = a x b x 2 (Both HP/LP condenser) Cold reheat steam flow at the reheater inlet : M2 = M1 – Gs2 – Gs3 – G11 – G12 – G22 – G23 – Mex8 (ext from HPT if any)– Mex7(Ext from CRH) The unaccounted-for leakage during the tests is determined as MCL subtracted by measurable leakages. Mf , Mex5, Mex6, Mex7 and Mex8 are obtained by the following calculation (shown in Sec.5.3).		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 20 OF 223



The unaccounted-for leakage during the tests should not be more than **0.1%** of the design throttle flow. If the unaccounted-for leakage is more than 0.1% of design throttle flow, then Heat Rate will be increased by an amount of equal to half the difference between actual unaccounted-for leakage expressed as percentage of design throttle flow and 0.1% or in accordance with the customer's technical specification as the case may be. **(pl mention technical specification specific clause no. -----).**

<i>Symbols (Enthalpy)</i>	<i>Unit</i>
H1 = Main steam enthalpy	kcal/kg
H2 = Cold reheat steam enthalpy	kcal/kg
H3 = Hot reheat steam enthalpy	kcal/kg
Hf = Final feed water enthalpy	kcal/kg
Hex8 = Extraction steam enthalpy to HP #8 heater	kcal/kg
Hex7 = Extraction steam enthalpy to HP #7 heater	kcal/kg
Hex6 = Extraction steam enthalpy to HP #6 heater	kcal/kg
Hcw = Condensate water enthalpy to deaerator	kcal/kg
Hw8 = Feed water enthalpy to Desuper heater	kcal/kg
Hw7 = Feed water enthalpy to HP #8 heater	kcal/kg
Hw6 = Feed water enthalpy to HP #7 heater	kcal/kg

CLAUSE NO.	TECHNICAL REQUIREMENTS	

Hw5 = Feed water enthalpy to HP #6 heater	kcal/kg
Hd = Condensate water enthalpy to BFP	kcal/kg
Hd8 = Drain enthalpy from HP #8 heater	kcal/kg
Hd7 = Drain enthalpy from HP #7 heater	kcal/kg
Hd6 = Drain enthalpy from HP #6 heater	kcal/kg
Hdv = Deaerator tank saturated steam enthalpy	kcal/kg
His = Superheater spray water enthalpy	kcal/kg
Hir = Resuperheater spray water enthalpy	kcal/kg
Po = Unit output at Generator Terminal	kW
Pg = Unit output after deducting the power consumption	kW

----- All the enthalpies are obtained by measured pressures and temperatures using the IAPWS-IF97 or equivalent steam tables.

The considered power consumption above parameter is following to the SCCL's specification.

Table 5.1 Equipment whose auxiliary power is deducted from unit output (details to be mentioned as per Technical specification)

Equipment	Power consumption
Excitation system Power including transformer	Pa

SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 22 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS	

loss(※)	
Main Oil Pump	Pb
EHC Oil pump	Pc
Main Oil Tank Vapour Extractor	Pd
Equipment	Power consumption
BFPT Lub Oil Vapor Extractor	Pe
Main Seal Oil Pump	Pf
Seal Oil Vacuum Pump	Pg
Recirculating Seal Oil Pump	Ph
Stator Cooling Water Pump	Pi
Gland Steam Exhauster	Pj

So, 'Pg' calculated as follows= $P_o - P_a - P_b - P_c - P_d - P_e - P_f - P_g - P_h - P_i - P_j$

Heat Rate(HR)

(a)Input Heat

$$Q_{input} = M1 * H1 + M2 * H3 + Mir * H3$$

(b)Output Heat

$$Q_{output} = M1 * H_f + M2 * H_2 + Mir * H_{ir}$$

SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 23 OF 223



(c) Heat Rate

$$\text{HeatRate} = Q_{\text{input}} - Q_{\text{output}}/P_g$$

5.3 Feed Water Flow (Sample Calculation to be provided by Vendor)

The feed water flow is calculated from a mass and heat balance around the HP heaters and the deaerator as follows :

$$M_f = (1+K_6)*M_{cw} - (1-K_8) * M_{dv} + (M_{deae}/2) - M_{ir}/1-A + K_7*A$$

$$M_{ex8} = K_1*M_f$$

$$M_{ex7} = (K_2-K_1*K_3)*M_f$$

$$M_{ex6} = ((K_4-K_5*(K_1+ K_2 -K_1*K_3))*M_f$$

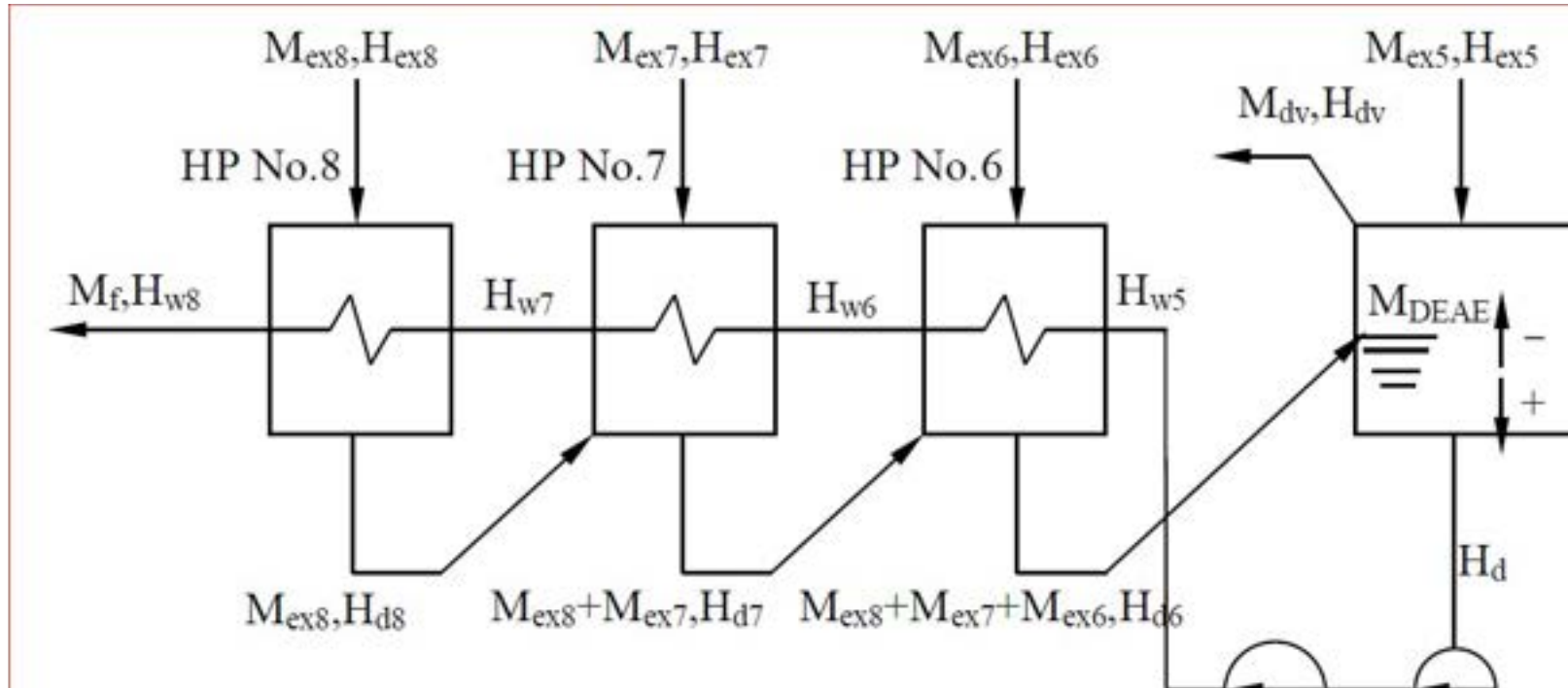
$$M_{ex5} = K_6*M_{cw} - K_7*(M_{ex8} + M_{ex7} + M_{ex6}) + K_8*M_{dv}$$

$$A = K_1+K_2-K_1*K_3 + K_4 - K_5*(K_1 + K_2 - K_1*K_3)$$

$$K_1 = (H_{w8}-H_{w7})/(H_{ex8}-H_{d8}), \quad K_2 = (H_{w7} - H_{w6})/(H_{ex7} - H_{d7}), \quad K_3 = (H_{d8} - H_{d7})/(H_{ex7} - H_{d7})$$

$$K4 = (H_{w6} - H_{w5}) / (H_{ex6} - H_{d5}), \quad K5 = (H_{d7} - H_{d6}) / (H_{ex6} - H_{d6}), \quad K6 = (H_d - H_{cw}) / (H_{ex5} - H_d)$$

$$K7 = (H_{d6} - H_d) / (H_{ex5} - H_d), \quad K8 = (H_{dv} - H_d) / (H_{ex5} - H_d)$$



5.4 Correction for Heat Rate

The following correction factors are to be applied to correct the test result for the effect of deviations of conditions from the specified.

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	The measured Heat Rate shall be divided by a total correction factor, in order to obtain the corrected Heat Rate. $HR_c = HR' / C$ Where, HR_c : Corrected Heat Rate on the specified condition HR' : Corrected Heat Rate only taking into account generator hydrogen pressure $(Q_{input} - Q_{output}) / (P_g)$ C : Total correction factor for Heat Rate correction $C = C1 * C2 * C3 * C4 * C5 * C6 * C7 * C8 * C9 * C10 * C11$ Where, C1 = Correction factor for main steam pressure C2 = Correction factor for main steam temperature C3 = Correction factor for reheater steam temperature C4 = Correction factor for reheater circuit pressure drop C5 = Correction factor for feed water pressure at terminal point C6 = Correction factor for average condenser pressure C7 = Correction factor for power factor C8 = Correction factor for frequency C9 = Correction factor for generator hydrogen pressure		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 26 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	C10 = Correction factor for voltage C11 = Correction factor for change in system water storage These correction curves (C1 ~ C11) are attached at -----. <u>5.5 Correction for Generator Output</u> The following correction factors are to be applied to correct the test result against deviations from the specified condition. The measured output shall be divided by a total correction factor, in order to obtain the corrected output. $P_c = (P_g) / C_x$ Where, P_c : Corrected generator output on the specified condition P_g : Unit output after deducting the power consumption (See Page.14) C_x : Total correction factor for output correction $C_x = C_{x1} * C_{x2} * C_{x3} * C_{x4} * C_{x5} * C_{x6} * C_{x7} * C_{x8} * C_{x9} * C_{x10} * C_{x11} * C_{x12}$ Where, C_{x1} = Correction factor for main steam pressure C_{x2} = Correction factor for main steam temperature		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 27 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	Cx3 = Correction factor for reheater steam temperature Cx4 = Correction factor for reheater circuit pressure drop Cx5 = Correction factor for RH spray flow Cx6 = Correction factor for feed water pressure at terminal point Cx7= Correction factor for average condenser pressure Cx8 = Correction factor for power factor Cx9 = Correction factor for frequency Cx10 = Correction factor for generator hydrogen pressure Cx11 = Correction factor for voltage Cx12 = Correction factor for change in system water storage These correction curves (Cx1 ~ Cx12) are attached at Attachment -----. <u>5.6. Comparison with guarantees</u> Comparison with guarantee should be made using corrected value of generator output and Heat Rate which are calculated in clause 5.5 and 5.6 as follows.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 28 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS
<u>Generator Output</u> Generator output guarantees are considered to be fulfilled when the following inequality is fulfilled. $P_c \geq P_{\text{guar}}$ Where, P_{guar} : Value of generator output according to the guarantee. P_c : Corrected generator output on the specified condition (calculated in clause 5.6) <u>Heat Rate</u> Heat Rate guarantees are considered to be fulfilled when the following inequality is fulfilled. $H_{Ra} \leq H_{R\text{guar}}$ Where, $H_{R\text{guar}}$: Value of Heat Rate according to the guarantee H_{Rc}: Corrected Heat Rate on the specified condition (calculated in clause 5.4) <u>6. Auxiliary power consumption</u> <u>6.1 General</u> This chapter describes the procedure for the measurement of the auxiliary power consumption. <u>6.2 Test Items</u> Measurement of auxiliary power consumption will be carried out at the following conditions.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001 SUB SECTION- G-04 STANDARD PG TEST PROCEDURE PAGE 29 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS	

-- Heat Rate Test at 100% T-MCR for confirming the measured value meets the guarantee value of the auxiliary power consumption

-- Heat Rate and Output Test at ----% T-MCR for calculating the generator output.

(Items to be measured their auxiliary power are listed in Table 5.1 for calculating Pg : Unit output after deducting the power consumption)

The guarantee value of the auxiliary power consumption is as follows.

Table 6.1 Guarantee value of auxiliary power consumption

Description	Auxiliary power consumption (kW)	Test Condition
At Heat Rate Test	-----	100% T-MCR

6.3 Detail of the test

Power consuming auxiliaries defined in the stage-II bid proposal are listed in below.

The power consumption of below listed equipment will be measured at switchgears.

Table 6.2 Equipment whose auxiliary power is guarantee or as specified in Functional guarantee

Power Consumption	Description	Total No.s	Working No.s
P1	Lube Oil Purification Equipment (including power for feed		

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	pump of purification system)			
P2	Control Oil Purification Equipment			
P3	Condenser vacuum pumps			
P4	CEP set			
P5	Drip pump			
P6	BFPT lube oil filtering pumps			
P7	BFPT main oil pump			
P8	Aux. lube oil pump for MDBFP			
P9	HP bypass hydraulic oil pump			
P10	DMCW pumps			
P11	ACW pumps			
P12	Condenser tube cleaning system ball recirculation pumps			
P13	-----% of –x---% of MDBFP power including MBP			
P14	-----% of one stream power of H2 gen plant			

* : The measurement of power consumption described above shall exclude loss of cable. Customer is to provide the calculation process and the calculated result of loss of cable.

The power consumption of the equipment which are connected to the switchgear (supplied by customer) furnished with CT/VT is measured by electricity meter supplied by -----.

SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 31 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS	

The measuring spots for auxiliary power consumption will be added in Attachment-----.

“Condenser tube cleaning system ball recirculation pumps (P12)”, “MDBFP (P13)” and “----% of one stream power of H2 gen plant (P14)” were listed in the stage-II bid proposal, but this equipment will not be used in Performance Test. So the power consumption of “Condenser tube cleaning system ball recirculation pumps” is based on the heat run test at site, that of “MDBFP” is -----% of the deemed power consumed by both the MDBFPs at 100% TMCR unit load which is based on the shop test result and that of “----% of one stream power of H2 gen plant” is based on the result of performance test at site in line with the customer’s specification (Section----, FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES-----).

The power consumption for the following auxiliaries are included in the Heat Rate Guarantee by deducting the consumed power from the Generator output and therefore these consumptions are not included under the Auxiliary Power consumption Guarantee and list of equipment described above.

Table 6.3 Number of equipment whose auxiliary power is deducted from unit output

No.	Description	Total No.	Working No.	Corresponding power described in 5.2
a	Excitation system Power including transformer loss(※)			Pa
b	Main Oil Pump			Pb
c	EHC Oil pump			Pc

SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 32 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS				

d	Main Oil Tank Vapour Extractor			Pd
e	BFPT Lub Oil Vapor Extractor			Pe
f	Main Seal Oil Pump			Pf
g	Seal Oil Vacuum Pump			Pg
H	Recirculating Seal Oil Pump			Ph
I	Stator Cooling Water Pump			Pi
j	Gland Steam Exhauster			Pj

※1 : Transformer Loss is calculated as follows. Sample calculation to be provided.

$$\text{Transformer Loss} = V_o + (GI/I_n)^2 * V_k * (273.16 + T)/(273.16 + T_n)$$

Where,

The following values are measured at shop test of transformer.

V_o = No load loss

V_k = Load loss

I_n = Base current

T_n = Base Temperature

The following values are measured during the performance test.

GI = Excitation Transformer current

T = Transformer winding temperature

SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 33 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	6.4 Measuring interval Each point shall be measured once in every 10 minutes. 6.5 Comparison with guarantees Guarantees of auxiliary power consumption are considered to be fulfilled when the following inequality is satisfied. $P_a \leq P_{\text{guar}}$ Where, P_{guar} : Value of auxiliary power consumption according to the guarantee (= ----- kW) P_a : Guaranteed Auxiliary Power Consumption = P_U + T_L P_U : Power consumed by the auxiliaries of the unit under test = Summation of P₁ ~ P₁₄ T_L : Losses of the transformers supplied by ----- based on works test reports. 8. Report of Test After the test completion, the final test report will be issued for the SCCL's review and include the followings: - Test conditions - Executive summary of test results - Calculation sheets (Soft form and Hard form) - Raw record of test measurements used for performance test calculation (Soft form) - Mutual agreement other than specified in this document - Calibration records of instruments		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 34 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS	

- Instruments readings (Soft form)
- Graphs
- Observations
- Final results obtained

CONDENSER PG TEST PROCEDURE

DESCRIPTION	Guarantee Value
Condenser pressure in mm Hg (abs) measured at 300 mm above the top row of condenser tubes under VWO condition, ---% make up, design CW temperature and CW flow.	---- mm Hg(abs)

1.0: SCOPE:

The purpose of this write-up is to provide detailed procedure for demonstrating the performance of steam surface condenser with regard to the guaranteed value mentioned in the above table:

2.0: COMPARISON:

The condenser is said to have fulfilled its design requirement when the measured back pressure when corrected for differences in measured and designed values of C.W. quantity, heat rejected in condenser, C.W. inlet temperature and cooling surface area is found to be equal or less than the designed back pressure of --- mmHg(abs).

SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 35 OF 223



3.0: DESCRIPTION AND DEFINITION OF BASIC TERMS (Typical Calculation)

Term	Symbol	Description	Unit
Condenser Load	H	Rate at which heat is rejected to circulating water in condenser	Kcal / hr.
Inlet Steam Temperature	Ts	Saturation temperature of steam corresponding to back pressure Ps (measured in mm HgC).	deg. C
Inlet Temperature	Tw1	Temperature of cooling water measured at condenser inlet	deg. C
Outlet Temperature	Tw2	Temperature of cooling water measured at condenser outlet	deg. C
Temperature rise	Tw	Increase of cooling water temperature from inlet to outlet.	deg. C
Cooling water flow	Qw	Quantity of cooling water circulating through condenser per unit time	Cub. M/hr.
Specific heat	Cp	Specific heat of cooling water	Kcal/kg-deg. C

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	4.0: COMPLIANCE TO STANDARD: The procedure is guided by recommendations of ASME-PTC 12 for steam surface condenser. 5.0: MEASUREMENT: The test scheme and mounting of instruments is as per approved PG Test instrumentation scheme and approved write-up on Performance Guarantee test for TG Package. 5.1 : Condenser Back Pressure: 8 Nos. (2 Nos. per wall) measurement points will be located 300 mm above top row of tubes. These are fitted with ASME basket to ensure static pressure measurement. These shall be uniformly located so as to cover total area above tubes. 5.2 : Circulating Water Temperature: 5.2.1 : Inlet Temperature: For PG Test measurement purpose of inlet temperature, four nos. (04) test points, two nos. on each condenser inlet nozzle will be provided. 5.2.2 : Outlet Temperature: For PG Test purpose, outlet temperature will be measured by providing six nos. symmetrically spaced measurement points on each outlet pipe at least five meters away from condenser nozzle. The points may be provided after bends and the length of insertion of each point will be different to obtain bulk mean temperatures.		
	SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE PAGE 37 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	5.2.3 : Correction: All temperatures will be measured with the help of RTDs in conjunction with digital multimeters. Test data-logger can also be used with prior agreement. The following corrections shall be applied to the measured values for arriving at the test values: - PRT/ RTD, Instrument calibrations. - Lead wire resistance, if applicable. 5.3 : Circulating Water Flow,(Sample calculations to be provided) No direct method shall be employed for measurement of C.W. quantity flowing through condenser. The same shall be computed from heat rejected to condenser obtained from test heat rate calculations. Hence condenser test shall be conducted in conjunction with turbine test. 5.4 : Cleanliness Factor: Prior to test, proper cleaning of the tubes and water boxes shall be done to obtain the desired tube cleanliness. 5.5 : Specific Heat: Specific heat of water which is used in condensers will be taken as unity.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 38 OF 223



6.0 : CONDITIONS FOR TEST:

6.2 : Machine Load:

Demonstration of Condenser Back Pressure will be carried out in conjunction with turbine test. The machine load shall be kept corresponding to VWO condition of Turbine with ----% make-up.

6.3 : Make-Up:

Condensate make-up of approx. -----% will be added to condenser during the test. Level of hot well and De-aerator shall be maintained by adding make-up.

6.4 : Allowable Deviations:

Testing shall be performed under conditions of inlet-water temperature, heat load, and cooling-water flow within the limits as specified in **Table 3.1 of ASME PTC 12.2**.

Testing Parameters	Deviations from specified conditions
Inlet Water Temperature	+/- 10 deg. F
Heat Load	+/- 5%
Cooling Water Flow	+/- 5%

7.0 : INSTRUMENTS AND THEIR ACCURACIES (PRESSURE / TEMPERATURE GAUGE):

The accuracy of various gauges shall conform to the recommendations of ASME PTC 12.2 for steam surface condensers.

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	8.0 : FREQUENCY AND DURATION OF MEASUREMENT: For condenser calculations, one hour data will be considered from minimum test duration of two hour period during steady state condition. Frequency of test data will be as specified in DCS. 9.0 : COMPUTATION OF RESULTS (Sample Calculation to be provided) 9.1 : Heat rejected to condenser will be calculated based on the uncorrected and actual heat rate of the Turbine Generator package at the time of test. Heat rejected to condenser will be the difference of Heat supplied to the Turbine less the Turbine output (Generator output corrected for mechanical / electrical losses and turbine losses). 9.2 : Computation of circulating water quantity / velocity will be done based on circulating water temperature measurements, heat load on condenser as per item 9.1 above and actual total tube sectional area per pass. Details of calculations will also be as per Annexure ---. 9.3 : The next step determines the actual (test) log mean temperature difference. Annexure --- gives the procedure for calculation of the same. The test LMTD corresponds to measured back pressure, C.W. velocity, actual surface area and C.W. inlet temperature. Hence, it shall be corrected for designed C.W. inlet temperature, velocity, surface area and heat rejected as identified in Annexure- --. The corrected condenser back pressure will be computed from corrected test LMTD as per Annexure-- --. Correction curves for the above varying parameters are enclosed as Annexure-----. 9.4 : The corrected back pressure will be compared with the design back pressure for the purpose of final evaluation.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 40 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS	

INSTRUMENT LIST FOR CONDENSER TEST

SL NO	MEASUREMENT PARAMETERS	NOMINAL VALUE	TYPE OF INSTRUMENT	RANGE OF INSTRUMENT	ACCURACY OF INSTRUMENT	REMARKS
01	Back Pressure	60-89 mmHgC	Absolute Manometer/ U-tube Manometer/ Pressure Transmitter	0-780 mmHgC	+0.10 mmHgC	
02	C.W. inlet temperature	15 -40 deg. C	RTD / Glass thermometers	0 -50 deg. C	+/-0.1 deg. C	
03	C.W. outlet temperature	25 -46 deg. C	RTD / Glass thermometers	0 -50 deg. C	+/-0.1 deg. C	
04	Atmospheric Pressure	700 –760 mmHgC	Fortins Barometer (Site Lab.)	0-760 mmHgC	+0.25 mmHgC	

Condenser Design Data

SI No.	Symbol	Description	Unit	Design Data
01	-	Design, Mfg.	-	HEI
02	Hlg	Heat Load	kcal/hr	
03	Qg	Cooling Water Flow	m3/hr	
04	Tw1d	Cooling Water Inlet Temperature	deg. C	
05	Psg	Back Pressure	mmHgC	

SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 41 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS				

06	L	Effective Tube Length	mm	
07	N	Number of Tubes	no.	
08	do x t	Tube outside dia. x thickness	mm x mm	
09	-	Dissolved Oxygen in hotwell condensate	cc/l	

MAIN CALCULATION TYPICAL TG Cycle (Sample Calculation to be Provided)

<u>Symbol</u>	<u>Description</u>	<u>Derivation</u>	<u>Units</u>	<u>Value</u>
Tw1m	Mean C W in temp	$(Tw11 + Tw12) / 2$	deg. C	
Tw2m	Mean C W out temp	$(Tw21 + Tw22) / 2$	deg. C	
Δtw	Mean C W temp rise	$(Tw2m - Tw1m)$	deg. C	
ρ	Density of water	-	Kg/cub.m	1000
Cp	Specific Heat of water	-	Kcal/kg	1.0
Ha	Heat added in the cycle	$HR \times Pg$	Kcal/hr	-
To	Output of Turbine	$(Pg / \eta_g + \text{---}) / 859.846$	Kcal/hr	
Hr	Heat rejected to condenser	$(Ha - To)$	Kcal/hr	
Qw	C W flow rate	$Hr / (\Delta tw \times \rho \times Cp)$	cub. M/hr	
Aw	C W flow area	$(\Pi \times di^2 \times N) / 4p$	Squ. M	
V	C W velocity	$Qw / Aw \times 3600$	m/sec.	
A	Condensing surface area	$\Pi \times do \times L \times N$	Squ. M	
θ	LMTD	$\Delta tw / \ln[(Ts - Tw1m) / (Ts - Tw2m)]$	deg. C	
Ts	Saturation Temperature		deg. C	

SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 42 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS			
LEGEND :				
Tw11 : C W Inlet temp – 1st half, Pg : Generator output, KW, Tw12 : C W Inlet temp – 2nd half, ηg : Generator efficiency, Tw21 : C W Outlet temp – 1st half, di : tube inside dia., mm Tw22 : C W Outlet temp – 2nd half, p : number of C W passes, HR : Cycle Heat Rate at VWO & --% MU				
CORRECTION OF LMTD AND BACK PRESSURE:				
Symbol	Description	Derivation	Units	
ft	C W inlet temp correction factor	Annexure (to be attached)		
fv	C W Velocity correction factor	-----do-----		
fh	Heat load correction factor	-----do-----		
Θc	Corrected LMTD	Θ x ft x fv x fh	deg.C	
X	Exponential	exp (Δtwd / Θc)		
Δtwd	Design C W Temp. rise	Hlg/ (Qg x g x Cp)	deg. C	
Tsc	Corrected steam temp.	tw1d + X * Δtwd /(X – 1)	deg. C	
Psc	Test condenser pressure(Ps) corrected to design point corresponding to Tsc		mmHgC	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION- G-04 STANDARD PG TEST PROCEDURE PAGE 43 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<i>Approved TEMPERATURE CORRECTION CURVE .(ft) (to be provided by vendor if required)</i>			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 44 OF 223	

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<i>Approved CW VELOCITY CORRECTION CURVE (fv) (to be provided by vendor if required)</i>			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 45 OF 223	

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<i>Approved HEAT LOAD CURRECTION CURVE (fh) (to be provided by vendor if required)</i>			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 46 OF 223	

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<i>Approved HEAT RATE CORRECTION CURVES(to be provided by vendor)</i>			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 47 OF 223	

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<i>Approved GENERATOR OUTPUT CORRECTION CURVES (to be provided by vendor)</i>			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 48 OF 223	

CLAUSE NO.	TECHNICAL REQUIREMENTS			
<i>ISOLATION VALVES CHECK LIST(to be provided by vendor)</i>				
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 49 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<i>HEAT BALANCE DIAGRAMS(to be provided by vendor)</i>			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 50 OF 223	

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<i>INTRUMENTATION SCHEME & INSTRUMENTS LIST(to be provided by vendor)</i>			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 51 OF 223	

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<i>SAMPLE CALCULATION OF TEST (to be provided by vendor)</i>			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 52 OF 223	



PERFORMANCE TEST PROCEDURE FOR AUXILIARY POWER CONSUMPTION

1 x -----MW -----THERMAL POWER PROJECT

Consultant:

SCCL LIMITED



EPC Contractor:

Title:

PERFORMANCE TEST PROCEDURE FOR
AUXILIARY POWER CONSUMPTION

SCCL No.:

Rev.:

Pages:

REVISION STATUS

Rev.	Detail / Description	Prepared		Reviewed				Approved	
		Name/ Sign	Date	Name			Sign	Name	Sign

	Details/ description	Date



Sl. No.	LIST OF CONTENTS
1.0	Objective
2.0	Method of Conductance of test
3.0	Frequency of Reading
4.0	Preparations
5.0	Measuring Instruments
6.0	Method of Calculation
7.	Sample Log Sheets & Protocols



1.0 OBJECTIVE

The Objective of the procedure is to detail out the methodology to carry out the testing and prove the Aux Power consumption as per guarantee (Guarantee declaration attached)

I. UNIT AUXILIARY POWER CONSUMPTION

The Unit auxiliary power consumption comprising of all Unit Auxiliaries required for continuous unit operation at ---- load (Technical Specification) MW (i.e. ---% rated load) under rated steam conditions and at condenser pressure of ----- mm Hg (abs) with -----% make-up.

The guaranteed Unit Auxiliary Power Consumption is ----- kW for one Unit.

II. STATION AUXILIARY POWER CONSUMPTION

Station auxiliary power consumption comprising of all station Auxiliaries required for continuous station operation at 1 x ----- MW (i.e. ---% rated load of all the units) under rated steam conditions and at condenser pressure of ===== mm Hg (abs) with ----% make-up.

The guaranteed Station Auxiliary Power Consumption is ----- kW.

2.0 METHOD OF CONDUCTANCE OF TEST:

The APC test for the unit will be conducted at ----- % TMCR with design coal at rated steam parameters and condenser pressure of ----- mm Hg with ----- % make up for each unit of ---- MW. This APC test shall have conducted while carrying out the -----% TMCR Unit Heat Rate test.

3.0 FREQUENCY OF READING:

The test duration will be 2 hours and the readings shall be from on line Energy meters. The average reading will be used to calculate the energy consumption.

4.0 PREPARATIONS:

Ensure that all concerned personnel are briefed about the test.

Reading record sheet for the parameters to be recorded is available. Sample sheet is attached as Annexure-C.

Following points shall be considered for Auxiliary Power Consumption test.

- o Power consumption of only continuously running equipment shall be included. In case of redundant auxiliary equipment, standby equipment will not be considered.



o Excitation power shall not be considered for APC.

o A checklist indicating the auxiliaries to be kept OFF while conducting the APC test shall be prepared and to be verified prior to test conductance. Refer Annexure-B

o Power consumption of the systems / equipment which are not required to be run continuously at -----% TMCR shall be excluded from the calculation of APC. All auxiliaries to be listed -----.

o The MCC's supplying power to the system / equipment which are to be excluded from the APC shall preferably be kept OFF. However, if it is not feasible to keep them OFF then its power consumption shall be measured and deducted from the Total APC. **An typical station indicative list of such MCC's is mentioned below**

- Soot Blower MCC
- Aux Boiler
- Admin Building
- Workshop Building
- Service Building
- Railway Siding
- Colony
- Auxiliaries and electrical loads of another Unit
- Electrical Supply for Welding receptacles, Elevator, EOT cranes & hoists, space heaters, heating units, Lighting, sump pumps, etc.

5.0 MEASURING INSTRUMENTS:

The auxiliary power consumption for the unit shall be measured using online energy meters ,SEL Relays or MFM meters or portable digital power meter or tong testers, as applicable.

NABL accredited calibrated Meters/Transducers will be used for measurements of kWh.

6.0 METHOD OF CALCULATION:

i. Unit Auxiliary Power Consumption

The unit auxiliary power consumption shall be calculated using the following relationship. $P_{au} = P_u + TL$ (Unit)

Where,

P_{au} = Guaranteed Unit Auxiliary Power Consumption.

P_u = Power consumed by the auxiliaries of the unit under test.

TL = Losses of the Generator Transformer and Unit Transformers based on works test reports

The power consumption (P_u) of entire unit auxiliaries fed from unit transformers shall be measured at the incomers of respective unit boards.



The auxiliaries to be considered:

TABLE-1: DRIVES CONSIDERED FOR UNIT AUXILIARY POWER CONSUMPTION OF A TYPICAL SUPER CRITICAL UNIT

Equipment	Quantity (no of working)
Cooling Tower Fans (IDCT)—	
Circulating water pumps (CW)	
Auxiliary Cooling water pumps (ACW)	
DM Cooling Water pumps (ECW)	
Condensate extraction pumps (CEPs)	
HP Vacuum Pump(In case of series Condenser)	
LP Vacuum Pump(In case of Series Condenser)	
LP Heater Drain Pump—if applicable	
HP Bypass	
LP Bypass	
Stator Coil Cooling Water Pump	
Air Side Seal Air Fan	
H2 Side Seal Air Fan	
Gland Seal Float Pump	
Generator Vapor Extractor Fan	
Main Turbine Lube Oil Pump	
Main Turbine VEF	
EH Oil Pump	
EH Oil Polishing Pump	
GSC Fan	
H2 Dryer	
Turbine Unit Oil Purifier	
MOT Heater	
COLCTCS Pumps	
Hydrazine dosing pumps	
Ammonia dosing pumps	
Mill Seal Air Fan	
Coal Mills (As per design)	
Mill Lube Oil Pumps(As per Design)	
Mill Hydraulic Oil Pumps(As Per Design)	
PA Fan	
PA Fan Lube Oil Pump	
PA Fan Control Oil Pump	
FD Fan	
FD Fan Lube Oil Pump	
FD Fan Control Oil Pump	
ID Fan	



ID Fan Lube Oil Pump	
ID Fan Control Oil Pump	
ID Fan Seal Air Fan	
RAPH	
RAPH Oil Unit Pump	
ECW SG	
Scanner Air Fan	
TDBFP Lube Oil Pump	
TDBFP VEF	
TDBFP Oil Purifier	
Auxiliary Oil Pump for MDBFP	
MDBFP	
Electrostatic Precipitator (ESP)	
Gas Recirculation Fan (if applicable)	
Air washer units for TG building	
FGD System i. Absorber Recirculation Pump(s) ii. Absorber Oxidation Blower(s)/Compressor(s) Air iii. Absorber Oxidation Tank Agitators iv. Gypsum Bleed Pumps v. Limestone Slurry Pump(s) vi. Process water pump(s) vii. Mist Eliminator Wash Water pump(s) viii. Booster Fans in case Booster Fan is provided by the Contractor.	

Note: For MDBFP only 15% of deemed power consumed at Design point as determined during shop test shall be considered
All auxiliary as per technical specification to be included

METHOD OF COMPUTATION OF AUXILIARY POWER CONSUMPTION FOR ESP: -

Electrostatic Precipitator with all TR sets, all hopper heaters including wrap around heaters of adapters, if applicable & all insulator heaters/pent house fans (if applicable) of all ESP passes working and rapping system in normal operation. During the test all hopper heaters including



wrap around heaters of adapters, if applicable & all insulator heaters/pent house fans (if applicable) of all ESP passes will be kept in continuously ON condition at 100% duty condition and set point temperature shall be kept 5 degrees Celsius above the Design flue gas temperature/ operating flue gas temp whichever is higher.

The measurement for guaranteed auxiliary power consumption shall be carried out during ESP collection efficiency test. The method for computing the power shall be as described below: -

a) Power consumption of ESP will be measured pass wise and for one pass (Say ESPA) at a time with the help of energy meter in ESP MCC.

b) Energy meter reading will be taken before starting the collection efficiency test and after completion of collection efficiency test.

c) Before starting collection efficiency test, switch off all the TR sets, all hopper heaters, all insulator heaters/pent house fans (if applicable) and rapping systems serving to one pass (ESP-A) temporally and note down energy meter readings for period t_1 i.e. E_1 . The power consumption shall be $W_1 = E_1/t_1$.

d) During the collection efficiency test the total energy fed in to ESP MCC of one pass (say ESP-A) will be measured during entire period of collection efficiency test i.e. E_2 . Total time (t_2) of test shall be noted. The power consumption shall be $W_2 = E_2/t_2$. During the test all hopper heaters of all ESP passes will be in ON condition and set point temperature shall be kept 5 degrees Celsius above the flue gas temperature.

e) Measured power consumption for one ESP pass (say ESP-A) $= (W_2 - W_1)$

f) Measured Electrostatic Precipitator power of one unit,

P_{ESP1} = Power of U#1 (Summation of all ESP pass).

P_{ESP2} = Power of U#2 (Summation of all ESP Pass).

Corrections shall be made if the test condition differs from the specified in the "GuaranteeDeclaration". Please refer Annexure-G

II. STATION AUXILIARY POWER CONSUMPTION

The station auxiliary power consumption shall be calculated using the following relationship. $P_{Stn} = P_{au-Stn} + TL_{(Stn)}$; $P_{au-Stn} = \sum (P_i \times D_i)$

Where,

P_{Stn} = Power consumed by the station auxiliaries

P_{au-Stn} = Total Power Consumption, while running at 100% design load for all the auxiliaries of the station.

P_i = Power consumed by each station auxiliary.

D_i = Duty factor to be considered for each station auxiliary.



$TL_{(Stn)}$ = Transformer Losses of the station transformers based on works test reports



TYPICAL STATION AUXILIARY POWER CONSUMPTION INCLUDES FOLLOWING SYSTEMS,

- Service Air Compressor
- Instrument Air Compressor
- Air Conditioning System
- Plant Water System
- Ash Handling Plant
- Coal & Biomass Handling Plant
- Mill Reject System
- Fuel Oil System----- Any other auxiliaries envisaged in technical specification

Duty factors will be applied for as per the clauses of Functional Guarantee's:

TABLE-2: LIST OF EQUIPMENT'S CONSIDERED FOR STATION AUXILIARY POWER CONSUMPTION

Sr.No	Equipment(or As envisaged in technical specification)	Duty Factor (as per technical specification)
a)	Air Conditioning System: Power consumption at motor input terminals of working units (i.e. excluding stand-by) at its rated duty point of Chilling machines, Chilled water Pumps, Condenser water Pumps, Air/water cooled condensing machines, precision airconditioners, Air handling units (AHU) fans, for the Air conditioning system of main plant TG Building, ESP Control Room Building, CHP Control Room Building, and Static ~ Excitation Control Room	
b)	Auxiliary Water System Pumps (Working Pumps)	
1	Makeup (Clarified water) water pump	
2	AC & Ventilation system make-up pumps.	
3	DM water make up pump	
4	Potable water pumps	
5	Filtered water feed pumps for DM plant	
6	Degassed water pump	
7	Service water pumps	
8	Make up water pumps at river end	
9	Raw water PT pumps & raw water ash pumps	
10	Station DMCW Pump	
11	Station auxiliary cooling water pumps	

CLAUSE NO.		TECHNICAL REQUIREMENTS		
12	Raw Water Pre-treatment Plant.			
13	Chlorination booster pump for raw water pretreatment & CW dosing			
d)	Ash handling Plant			
1	Bottom Ash Crushers – including air preheater ash			
2	Bottom Ash Crushers – (without air preheater ash) for jet pump system			
3	Bottom Ash Crushers –for submerged scrapper conveyor system/dry type bottom ash system.			
4	Bottom Ash H.P. Water Pumps – including air preheater ash			
5	Bottom Ash H.P. Water Pumps –without air preheater ash for jet pump system			
6	Bottom Ash H.P. Water Pumps –for submerged scrapper chain conveyor system/dry type bottom ash system			
7	Bottom Ash L.P. Ash Water Pumps			
8	Fly Ash Water Pumps			
9	Bottom Ash Slurry transportation pumps			
10	Bottom Ash Slurry disposal pumps – including air preheater ash			
11	Bottom Ash Slurry disposal pumps – without air preheater ash for jet pump system			
12	Bottom Ash Slurry disposal pumps – for submerged scrapper chain conveyor system/dry type bottom ash system			
13	Submerged scrapper chain conveyor/dry type bottom ash system			
14	(i) Fly ash conveying air compressors with air drying plant (ADP)			
15	(ii) Fly Ash Conveying Vacuum Pumps			
16	Transport air compressor with air drying plant (ADP)			
17	HCSD pumps			
18	Instrument Air Compressors with Air Drying Plant			
19	Ash Water Recirculation Pumps			
20	Eco water pump			
21	HCSD tank agitator			
22	Charge pump for HCSD			
e)	Mill Reject System: Compressor: Compressor: Duty Factor 1.0 (per unit power consumption shall be 50% of Power Consumption of the working compressor)			
f)	Coal Handling Plant			
	Total power consumption for all the equipment's including auxiliaries with single stream operation at its guaranteed flow path capacity except. - Lighting - Hoists - Coal sampling unit - Sump Pumps			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 62 OF 223



	- Elevators - DS, DE, Ventilation, SW System, Potable water system Duty factor for coal handling plant shall be 0.5	
g)	Fuel Oil system: Unloading pumps of fuel oil system	
h)	Cooling Tower for Auxiliary cooling water system	
i)	Plant Air Compressor (2Nos)	
j)	Instrument Air Compressor (2Nos)	



Transformer Losses (Sample Calculation to be provided by Vendor for approval)

TL = Losses of the Transformers based on works test reports.

TABLE-3: - TEST REPORTS LOSSES OF TRANSFORMER

Transformers	Sr No	No Load Loss (in kW)	Load Loss (in kW)	Cooler Loss (in kW)



ANNEXURE – A (METER MARKINGS)

Meter No.	Meter Description



ANNEXURE – B (CHECKLIST – AUXILIARY WHICH ARE TO BE EXCLUDED
IN CALCULATION OF APC)

SAMPLE LOG SHEETS & PROTOCOLS

Sr No.	Switchgear Name	Feeder Name & Number	Remarks
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			

CLAUSE NO.	T ECHNICAL REQUIREMENTS									

Annexure – C (Record Sheet for U#1

Time Interval	00:00	00:15	00:30	00:45	01:00	01:15	01:30	01:45	02:00	Average kW
Time										

		SCCL
Name		
Signature		

CLAUSE NO.

T ECHNICAL REQUIREMENTS



kWh Readings at Swyd

Time Interval	00:00	00:15	00:30	00:45	01:00	01:15	01:30	01:45	02:00	Average kW
Time										

***KVA READINGS AT SWYD**

Time Interval	00:00	00:15	00:30	00:45	01:00	01:15	01:30	01:45	02:00	Average kW
Time										

		SCCL
Name		
Signature		

CLAUSE NO.

T ECHNICAL REQUIREMENTS



***kWh Readings at U#1 3.5mtr switchgear room**

Time Interval	00:00	00:15	00:30	00:45	01:00	01:15	01:30	01:45	02:00	Average kW
Time										

		SCCL
Name		
Signature		

CLAUSE NO.	TECHNICAL REQUIREMENTS										

Time Interval	00:00	00:15	00:30	00:45	01:00	01:15	01:30	01:45	02:00	Average kW
Time										

		SCCL
Name		
Signature		

CLAUSE NO.	TECHNICAL REQUIREMENTS	

***kWh Readings of drives which should be OFF during test but are in ON condition (For U#1)**

Time Interval	00:00	00:15	00:30	00:45	01:00	01:15	01:30	01:45	02:00	Average kW
Time										

		SCCL
Name		
Signature		

CLAUSE NO.

TECHNICAL REQUIREMENTS



Annexure – D (Record Sheet for U#2)

*KWH READINGS

Time Interval	00:00	00:15	00:30	00:45	01:00	01:15	01:30	01:45	02:00	Average kW
Time										

		SCCL
Name		
Signature		

CLAUSE NO.

TECHNICAL REQUIREMENTS



*kVA Readings

Time Interval	00:00	00:15	00:30	00:45	01:00	01:15	01:30	01:45	02:00	Average kW
Time										

		SCCL
Name		
Signature		

CLAUSE NO.

TECHNICAL REQUIREMENTS



*KWH READINGS AT SWYD

Time Interval	00:00	00:15	00:30	00:45	01:00	01:15	01:30	01:45	02:00	Average kW
Time										

*kVA Readings at Swyd

Time Interval	00:00	00:15	00:30	00:45	01:00	01:15	01:30	01:45	02:00	Average kW
Time										

		SCCL
Name		
Signature		

CLAUSE NO.

T ECHNICAL REQUIREMENTS



KWH READINGS SWITCHGEAR ROOM

Time Interval	00:00	00:15	00:30	00:45	01:00	01:15	01:30	01:45	02:00	Average kW
Time										

		SCCL
Name		
Signature		

CLAUSE NO.

TECHNICAL REQUIREMENTS



*kWh Readings

Time Interval	00:00	00:15	00:30	00:45	01:00	01:15	01:30	01:45	02:00	Average kW
Time										

		SCCL
Name		
Signature		

CLAUSE NO.

TECHNICAL REQUIREMENTS



*KWH READINGS OF DRIVES WHICH SHOULD BE OFF DURING TEST BUT ARE IN ON CONDITION (FOR U#2)

Time Interval	00:00	00:15	00:30	00:45	01:00	01:15	01:30	01:45	02:00	Average kW
Time										

		SCCL
Name		
Signature		

CLAUSE NO.

TECHNICAL REQUIREMENTS



*kWh Readings at station Bus

Time Interval	00:00	00:15	00:30	00:45	01:00	01:15	01:30	01:45	02:00	Average kW
Time										

CLAUSE NO.

TECHNICAL REQUIREMENTS



Annexure – E (Record Sheet for Station)

*KVA READINGS AT STATION BUS

Time Interval	00:00	00:15	00:30	00:45	01:00	01:15	01:30	01:45	02:00	Average kW
Time										

		SCCL
Name		
Signature		

CLAUSE NO.

TECHNICAL REQUIREMENTS



kWh Readings Station incomer

Time Interval	00:00	00:15	00:30	00:45	01:00	01:15	01:30	01:45	02:00	Average kW
Time										
Incomer (M42)										

*KVA READINGS STATION INCOMER

Time Interval	00:00	00:15	00:30	00:45	01:00	01:15	01:30	01:45	02:00	Average kW
Time										
Incomer (M42)										

		SCCL
Name		
Signature		

CLAUSE NO.

TECHNICAL REQUIREMENTS



*kWh Readings at station incomer

Time Interval	00:00	00:15	00:30	00:45	01:00	01:15	01:30	01:45	02:00	Average kW
Time										
Incomer (M43)										

*KVA READINGS AT STATION INCOMER

Time Interval	00:00	00:15	00:30	00:45	01:00	01:15	01:30	01:45	02:00	Average kW
Time										
Incomer (M43)										

		SCCL
Name		
Signature		

CLAUSE NO.

TECHNICAL REQUIREMENTS



*kWh Readings at station incomer

Time Interval	00:00	00:15	00:30	00:45	01:00	01:15	01:30	01:45	02:00	Average kW
Time										
Incomer (M44)										

*KVA READINGS AT STATION INCOMER

Time Interval	00:00	00:15	00:30	00:45	01:00	01:15	01:30	01:45	02:00	Average kW
Time										
Incomer (M44)										

		SCCL
Name		
Signature		

CLAUSE NO.

TECHNICAL REQUIREMENTS



*kWh Readings at

Time Interval	00:00	00:15	00:30	00:45	01:00	01:15	01:30	01:45	02:00	Average kW
Time										

		SCCL
Name		
Signature		

CLAUSE NO.

TECHNICAL REQUIREMENTS



*kWh Readings

Time Interval	00:00	00:15	00:30	00:45	01:00	01:15	01:30	01:45	02:00	Average kW
Time										

		SCCL
Name		
Signature		

CLAUSE NO.

TECHNICAL REQUIREMENTS



*kWh Readings

Time Interval	00:00	00:15	00:30	00:45	01:00	01:15	01:30	01:45	02:00	Average kW
Time										

		SCCL
Name		
Signature		

CLAUSE NO.

TECHNICAL REQUIREMENTS



***kWh Readings at 3.3kV AHP Swgr**

Time Interval	00:00	00:15	00:30	00:45	01:00	01:15	01:30	01:45	02:00	Average kW
Time										

		SCCL
Name		
Signature		

CLAUSE NO.

TECHNICAL REQUIREMENTS



***kWh Readings at 3.3kV AHP Swgr**

Time Interval	00:00	00:15	00:30	00:45	01:00	01:15	01:30	01:45	02:00	Average kW
Time										

		SCCL
Name		
Signature		

***kWh Readings of drives which should be OFF during test but are in ON condition**

Time Interval	00:00	00:15	00:30	00:45	01:00	01:15	01:30	01:45	02:00	Average kW
Time										

		SCCL
Name		
Signature		

CLAUSE NO.

TECHNICAL REQUIREMENTS



***kWh Readings of drives which should be OFF during test but are in ON condition**

Time Interval	00:00	00:15	00:30	00:45	01:00	01:15	01:30	01:45	02:00	Average kW
Time										

		SCCL
Name		
Signature		

**Auxiliary Power Correction if any
(Sample calculation to be provided by vendor)**



PG Test Procedure for COLTCS

Station :

Drawing no :


CONTENTS FOR COLTCS PROCEDURE

SI No.	Description
1	General Description
2	Guarantee
3	Procedures
3 a	Life of sponge ball test
3 b	Number of Ball lost test
4	Logsheet
5	Technical Datasheet

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	1.0 General Description : This test procedure for condenser on load tube cleaning system shall cover following demonstration test at site: The test of COLTCS shall be carried out at site immediately after commissioning & 2 weeks of trial operation of the system. The test shall be conducted with intermittent operation of COLTCS for 24 hours operation per day. For test, the sponge rubber balls quality, make & size of approved technical datasheet drawing no -----mm shall be used. 2.0 Guarantee Condition : A) Life of sponge rubber balls : ----- weeks As per guarantee condition B) Number of balls lost during 1000 hours of plant operation : As per guarantee condition 3.0 Procedure: A) Life of sponge rubber balls: □ After commissioning in all aspects and stabilization. The COLTCS is ready for PG test for life of sponge rubber balls. - The life of sponge rubber balls is overall estimated in terms of count of unhealthy balls. - Quantity of balls of specified quantity, size and type to be used as per approved Technical datasheet. Charge the balls in ball collecting vessel. - Run the COLTCS on Auto Operation. - Collect the balls in ball collecting vessel twice a week. - Sort out the unhealthy balls with the help of ball sorter of opening size less than inner diameter of condenser tube. - Count the unhealthy balls and total recovered balls. - Maintain the record of Unhealthy balls, recovered balls and new balls charged in enclosed log sheet page no 5. - Calculate the life of sponge balls as: Formula for calculating the life of ball in as follows. $A = C/B \times 100$ - Where A is % of Nos. of Healthy balls observed after 3 weeks of operation. B is No of Initial balls charged. C is No of recovered healthy balls after 3 weeks of operation. The guarantee of life of sponge balls shall be deemed to be fulfilled in case of Number of healthy balls observed after expiry of no of weeks of operation (as per guarantee condition (A) is greater then 90%, (Say $A > 90\%$) B) Number of balls lost during 1000 hours of plant operation - Run the COLTCS on Auto operation. - Collect the balls in ball collecting vessel once a week. - Count the recovered balls. - Maintain the record of recovered balls & balls charged in the enclosed log sheet after 2 weeks.. - Calculate the Nos. of balls lost during 1000 hours operation. - After ----- weeks when balls have worn out, the basic charge of old balls shall be replaced with the new balls, such worn out balls shall be treated as recovered balls. - Formula for calculating the no. of balls lost in PG Test as follows. $A = C/B \times 100$	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE PAGE 92 OF 223



Where,

A= % of Nos. of balls recovered till 1000 hours (6 weeks) operation

B= Initial balls charged during 1000 hours (6 weeks) operation.

C= Recovered balls at end of 1000 hours (6 weeks) of operation.

The guarantee of Nos. of balls lost during 1000 hours of plant operation shall be deemed to be fulfilled in case of number of balls lost observed in total 6 weeks (42 days ,24 *7,i.e.1000 hours) operation is within guarantee condition (B).

4.0

LOG SHEET

PG Test For Condenser On Load Tube Cleaning System

Customer	:						W.O. No.	:			
End User	:						P.O. No.	:			
Project	:						Item	:			
Procedure Ref. No.	:						Tag No.	:			
Week End	Date	Observation						Remarks			
		Nos. of Ball Recovere d	Balls Worn out (W)	Nos. of Balls Charg ed	WITNESSED BY						
					SCCL	Main contractor	Vendor				
0											
0.5											
1											
1.5											
2											
2.5											
3											
3.5											
4											
5											
6											



TEST RESULTS

After expiry no of weeks of Guarantee 6 Weeks (1000 Hrs. of Operation) Test Results :
condition (2.0 (A),Page 3)

Initial Balls Charged Qty. ' B ' =.....

Total wornout Balls Qty. ' W ' =.....

Recovered Healthy Balls Qty. ' C ' = (B – W) =.....

$$\% \text{ of Healthy Balls } \frac{C \times 100}{B} = \frac{\quad \times 100}{\quad} = \dots\dots\dots$$

Healthy Balls observed against specified
≥ 90%

Initial Balls Charged Qty. ' B ' =.....

Recovered Balls Qty. after 6 weeks opn. ' C6 ' =.....

Ball Lost Qty. after 6 weeks opn. ' C ' = (B – C6) =.....

$$\% \text{ of Ball lost after 6 weeks opn. } = \frac{C \times 100}{B} = \frac{\quad \times 100}{\quad}$$

Balls Lost observed against specified within

Vendor Name

Main contractor name

SCCL Ltd

5.0 Technical datasheet Drwg no -----

Approved Technical datasheet from SCCL (Engg to)be attached along with transmittal



Performance guarantee test procedure of TG Noise Level

Table of Contents:

- 1. SCOPE**
 - 1.1. NOISE REQUIREMENTS
 - 1.2. TURBINE HALL RECOMMENDATIONS
 - 1.3. NOISE TEST SCHEDULE
- 2. REFERENCE DOCUMENTS**
- 3. NEAR FIELD NOISE MEASUREMENTS**
 - 3.1. RELEVANT ACOUSTIC PARAMETER
 - 3.2. TEST POINTS
 - 3.3. TIME OF MEASUREMENT
 - 3.4. OPERATING CONDITIONS
 - 3.5. NEAR FIELD NOISE DATA CORRECTION AND ACCEPTANCE CRITERIA
- 4. INSTRUMENTATION AND MEASUREMENT METHOD**
 - 4.1. INSTRUMENTATION
 - 4.2. MEASUREMENT METHOD
- 5. TEST REPORT**



1. SCOPE

The following document is the procedure, which defines the way to carry out near field noise measurements of the equipment.

1.1. Noise Requirements

Near Field Noise Guarantee

The 'A' weighted surface sound pressure level determined over the measurement surface at a height of 1.5 m above floor level in elevation and at a distance of one (1) meter horizontally from equipment / machine, expressed in decibels to a reference of 0.0002 microbar, shall not exceed 85 dB (A), except for:

- (a) Safety valve and associated vent pipes for which it shall not exceed 105dB(A)
- (b) Regulating drain valves in which case it shall be limited to 90 dB(A)
- (c) TG in which case it shall not exceed 90dB(A)
- (d) HP-LP bypass valves and other intermittently operating control valves: 90 dB(A) at 1meter
- (e) BFP motor: 90 dB(A) at 1meter

Correction for background noise and reverberation shall be done according to ISO 3746:2010.

Near Field Noise exclusions

Excluded from the below noise guarantees (near field) are the following operating conditions and parts of the Plant:

- Any noise not emanating from equipment under test.
- Start-up and shut down or trip of the plant or parts of plant.
- Equipment failure and unit trip.
- Steam turbine bypass operation.
- Areas within acoustical enclosures.

1.2. Turbine Hall Recommendations

The noise inside the turbine hall does not only depend on the equipment characteristics, but also on the building absorption factors (not in vendor scope). In order to limit the indoor noise level build-up due to the sound reflections, the inner side of the wall cladding should be sound absorbing, typically with 80 mm minimum of rock wool material behind a perforated steel sheet (perforation >20%). It is recommended to treat at least 40% of the walls.

1.3. Noise Test Schedule

The noise level measurements will be carried out during the continuous base load operation of the Plant when all the equipment is running in their nominal conditions.

2. REFERENCE DOCUMENTS

- Contract
- ISO 3746-2010 Acoustics – Determination of sound power levels of noise sources. Survey method.

3. NEAR FIELD NOISE MEASUREMENTS

3.1. Relevant acoustic parameter

The instantaneous A-weighted sound pressure pA(t) will be recorded near the running equipment of the Plant, and then, the surface sound pressure level will be derived from these measured values after applying corrections for the background noise and the influence of reflecting sound.

As a guideline for the near field noise survey, the recommendations of standard ISO 3746-2010, which specifies a procedure to determine the A-weighted surface sound pressure level emitted by noise sources, will be followed.



3.2. Test points

The noise level L_{pA} will be measured in several test points regularly distributed on an enveloping measurement surface at a distance of 1 m from the equipment outlines in the areas normally accessible to personnel for maintenance/operation activities. The microphone will be placed at a height of 1.5 m above the ground level or walkways. The selection of the measurement points will be done on site, and agreed by all parties. The locations of the test points will be indicated on the record sheets attached to the test report. In case of an area containing several single noise sources for which it is not possible to circulate between them, the measurements will be done on the walkways around the whole area.

3.3. Time of measurement

The near field noise measurements can be carried out any time along the whole day. A relevant measurement period T shall be used to take into account the possible fluctuation of the sound pressure $p_A(t)$ at one time and then obtain the more significant average noise level L_{pA} . As the Plant components emit steady noise levels during base load operation, a short measurement period ($T = 10$ s) is chosen for time averaging. In case a variable noise level appears clearly near equipment during the measurement, the measurement period will be extended to cover the noise fluctuation period.

3.4. Operating conditions

Near field noise measurements will be done at each specified test point during the continuous base load operation, when the different Plant components function under the nominal conditions.

3.5. Near field noise data correction and acceptance criteria

To calculate the surface sound pressure level emitted by each equipment, procedure according to ISO 3746-2010 should be followed.

The A-weighted surface sound pressure level $\langle L_{pA} \rangle$ shall be calculated from the measured average A-weighted sound pressure level $\langle L'_{pA} \rangle$ after applying corrections K_{1A} for background noise and K_{2A} for influence of reflected sound as defined in ISO 3746-2010, Sections 8.1 – 8.3

$$\langle L_{pA} \rangle = \langle L'_{pA} \rangle - K_{1A} - K_{2A}$$

The background noise correction K_{1A} shall be calculated from the average A-weighted sound pressure level $\langle L'_{pA} \rangle$ recorded at the microphone positions, and the average A-weighted sound pressure level $\langle L''_{pA} \rangle$ of the background noise, as described in section 8.3.3 of the above mentioned standard:

$$K_{1A} = -10 \cdot \log_{10} \left(1 - 10^{-0.1 \Delta LA} \right) \text{ dB(A)}$$

where $\Delta LA = \langle L'_{pA} \rangle - \langle L''_{pA} \rangle$

The environmental correction for buildings K_{2A} is determined by the procedure given in Annex A of the mentioned standard. The magnitude of this correction K_{2A} that depends on the size of the equipment, and on the equivalent sound absorption area of the test room will be calculated as follows :

$$K_{2A} = 10 \cdot \log_{10} \left[1 + 4 \cdot \frac{S}{A} \right] \text{ dB(A)}$$

Where:

A is the equivalent sound absorption area of the room (in m^2)

S is the area of the measurement surface around the equipment (in m^2)

The contractual requirements and acceptance criteria apply to the resulting A-weighted surface sound pressure level $\langle L_{pA} \rangle$ calculated for each equipment area.



4. INSTRUMENTATION AND MEASUREMENT METHOD

4.1. Instrumentation

All the measurements will be carried out with a sound level meter (SLM) class 1 with integrating facility in accordance with standards IEC61672-1:2002 and IEC61260:1995.

A copy of the technical data sheet and of the calibration certificate will be given for each apparatus.

The sound level meter will be calibrated before and after each series of measurement with a sound level calibrator class 1 in accordance with standard IEC60942: 2003, type Bruel & Kjaer 4231 or equivalent. A copy of the technical data sheet and of the calibration certificate of the standard noise source will be given.

4.2. Measurement method

The near field noise measurements will be performed according to the standard ISO 3746 - 2010 in several test points, chosen regularly distributed on an enveloping measurement surface at a horizontal distance of 1m from the equipment outline and at a height of 1.5m above the ground or walkways.

Test implementation

- During the measurement period, all the doors and access panels of the different buildings and equipment must be closed. All the equipment, especially noise attenuation devices, shall be correctly mounted.
- To avoid parasitical sound reflections, the test performer shall stand at 0.5 m minimum distance from the microphone.
- The microphone will be protected with a windscreen.
- The “slow” response time of the sound level meter will be used for all measurements assuming that the noise emitted by the Facility equipment does not present important and quick variations.

5. TEST REPORT

The aim of the test report is to summarize the test objectives, the results and to make conclusions about the compliance of the Facility with the contractual noise requirements. The test report will also collect all the measured noise level values with indication of the test points location near the equipments.

The report will also contain the following information:

- (1) Model and serial number of the measurement apparatus used.
- (2) The calibration standard used.
- (3) Test performer and observer names and date of the measurements.
- (4) Comment about the possible variations of the noise level during the measurement. (ex: noise level emitted by an equipment which is not constant in time, abnormal noise level due to bad operation conditions, ...)



**PG Test Procedure for TG & SG Plate Heat
Exchanger (PHE)**

Station : -----

Drawing no : -----



CONTENTS FOR PHE PROCEDURE

SI No.	Description
1	OBJECTIVE AND SCOPE:
2	GUARANTEES
3	TEST CONDITION
4	PREPARATION OF TEST
5	CONSTANCY OF TEST CONDITIONS
6	DURATION OF TEST AND FREQUENCY OF READINGS
7	INSTRUMENTS AND METHODS OF MEASUREMENTS
8	CALIBRATION OF INSTRUMENTS
9	EVALUATION OF TEST RESULTS:
10	TEST LOG SHEET
11	CORRECTION CURVES
12	TECHNICAL DATASHEET



1.0 Objective & Scope

The function of Plate Heat Exchanger is to maintain the desired temperature of equipment cooling water system in closed cycle. The purpose of this procedure is to provide the methodology for determining the performance of PHE's as per **Guarantees condition as defined in 2.0 below** & with regard to the proper functioning of the PHE by comparing the actual heat transfer coefficient with the expected overall heat transfer coefficient.

2.0 GUARANTEES:

Technical datasheet specification : Approved technical datasheet drawing no -----.

Mention technical datasheet parameters (temperature & flow) in fouled condition for guarantee condition with pr drop value .

DM water leaving PHE's is a function of heat transfer coefficient of the PHE's, the actual overall heat transfer coefficient shall be calculated and compared with expected overall heat transfer coefficient. In case of the actual Heat Transfer coefficient is equal or more than expected overall heat transfer coefficient (in fouled conditions), the guarantee shall be deemed to be met.

3. TEST CONDITION

- Vendor to ensure that the PHE's are sufficiently cleaned to remove clogging / debris before the conductance of PG test.
- Every effort should be made to conduct the test runs under specified conditions & within accuracy of instruments.
- Test to be conducted under steady state condition of operation specially load, temperature & flow rate conditions.
- Before carrying out the test, it should be ensured that all the equipment's are inworking condition.
- All instrument used for the test should have valid calibration certificate. All instruments shall be calibrated in an approved / NABL accredited test lab.

4.0 PREPARATION OF TEST:

Prior to the test, the vendor shall be given an opportunity to examine and familiarize themselves with all the apparatus with the PHE's and the piping involved. All parties to the test shall certify that the PHE's are in satisfactory condition for the test. All the ACW pumps, ECW pumps, Self-Cleaning strainers and Plate heat exchangers shall be in working condition.

5.0 CONSTANCY OF TEST CONDITIONS:

Any condition like flow rates , inlet & outlet temps of ECW & ACW side, whose variation may affect the test result shall be made as constant as far as possible before the test run begins and shall be maintained constant throughout the run. It is desirable to observe and record all reading for a brief period after the unit has attained steady conditions but before the formal readings of the run have begun.

6.0 DURATION OF TEST AND FREQUENCY OF READINGS:

The test runs shall continue for a period sufficiently long to ensure accurate and consistent results. 15 Minutes is usually sufficient for a single test run.



Time interval between readings:

- a) Temperature : Every 2 Minutes
- b) Differential Pressure : Every 2 Minutes
- c) Flow Rate : Every 2 minutes

All observations shall begin simultaneously at the beginning of a test run and during this time reading shall be taken simultaneously for both the PHE's under the test.

7.0 INSTRUMENTS AND METHODS OF MEASUREMENTS:

7.1 Temperature Measurement:

The temperature of DMCW and ACW at inlet and outlet of PHE's shall be measured with Thermocouple / RTD / Temperature Gauge at accuracy not higher than + 0.1 degC. Temp gauge on the inlet side as well as on the outlet side shall be mounted on the pipeline, by the vendor.

7.2 Measurement of Pressure Drop:

The pressure drops are to be measured with the help of Pressure Gauges (to be installed for the purpose of the test only) across inlet and outlet of PHE. The accuracy of Pressure Gauge should not be higher than 0.1 MWC.

7.3 Measurement of Flow Rate:

TG PHE :

Measurement of the flow rate on the primary side & secondary side of the PHE's for TG Auxiliaries to be done by ultrasonic flow meter of **accuracy $\pm 2\%$ of FSD**. The total flow rate shall be equally divided into number of PHE in operation. To achieve the above mentioned accuracy with the flow meter, upstream and downstream pipe length of 10D/5D straight length without any obstacle (bends, tee, valve, reducer, expander etc) is required. If in actual site condition, above straight lengths are not available, appropriate correction factor in flow rate will be applied to correct the measured flow rate as per below Table 1. **Vendor to provide the correction factors**

Table 1

Sr no	TG PHE	SIDE MEASURED	AVAILABLE STRAIGHT LENGTH	CORRECTION FACTOR	OBSTACLES
		Primary			
		Secondary			

Vendor to provide the correction factors

SG PHE :

Measurement of the flow rate on the primary side & secondary side of the PHE's for SG Auxiliaries to be done by ultrasonic flow meter of accuracy $\pm 2\%$ of FSD. The total flow rate shall be equally divided into number of PHE in operation. To achieve the above mentioned accuracy with the flow meter, upstream and downstream pipe length of 10D/5D straight length without any obstacle (bends, tee, valve, reducer, expander etc) is required. If in actual site condition, above straight lengths are not available, appropriate correction factor in flow rate will be applied to correct the measured flow rate as per below Table 2. **Vendor to provide the correction factors.**



Table 2

Sr no	SG PHE	SIDE MEASURED	AVAILABLE STRAIGHT LENGTH	CORRECTION FACTOR	OBSTACLES
		Primary			
		Secondary			
Vendor to provide the correction factors					

8.0 CALIBRATION OF INSTRUMENTS:

All instruments shall be calibrated in an approved / NABL accredited test lab. The Calibration Certificate in original shall be carried by PG test team. Copy of calibration Certificates shall be submitted to SCCL before start of PG test.

9.0 EVALUATION OF TEST RESULTS:

9.1 **Pressure Drop:** Complete evaluation method with formulae used to be provided by vendor .

9.2 **Heat Transfer Coefficient** (Evaluation of Thermal Performance) Complete evaluation method with formulae used to be provided by vendor

9.3 : **Sample calculation** for 9.1 & 9.2 to be provided by vendor.

10.0 LOG sheet for Demonstration test of Inlet & Outlet temperatures of DM water on Primary & secondary side of Plate heat exchangers

Project: -----

Duration: -----Minutes

a) Readings for primary (DMCW) side for TG auxilliary

Table 3

Time	Sr no	Pressure at inlet of PHE Kg/cm ² (g)	Pressure at outlet of PHE Kg/cm ² (g)	Pr drop	Q1 Noted flow from the Ultrasonic flow meter m ³ /hr	T1 Temp at Inlet to PHE (°C)	T2 Temp at Outlet to PHE (°C)	Heat Load Kcal/hr (H1)	LMTD (°C)	Actual OHTC Kcal/ Hr.m ² °C (Km)	Expected OHTC Kcal/ Hr.m ² °C (Ke))

Note: Readings to be taken at taken intervals of 2 minutes for each PHE



b. Readings for secondary (ACW) Side of PHE's for TG Auxiliary
c. Readings for primary (DMCW) Side of PHE's for SG Auxiliary
d. Readings for secondary (AW) Side of PHE's for SG Auxiliary
Above same format to be repeated & attached as table 3 to for b,c,d.

11.0 Performance curves Drawing no -----

Approved Correction curve from SCCL (Engg to)be attached along with transmittal

12.0 Technical datasheet Drwg no -----

Approved Technical datashhet from SCCL (Engg to)be attached along with transmittal



PG Test Procedure for Condensate Polishing Unit System

1.0 Scope of PG test:

PG Test shall be conducted after successful trial run to establish all the guaranteed parameters/ values for each service vessel:

- 1.1 Three run under normal condition at rated design flow.
- 1.2 One run under condenser leak condition at rated design flow.
- 1.3 Chemical consumption for regeneration as per technical specifications.
- 1.4 Pressure drop across the polisher service vessel in clean and dirty condition of resin at rated design flow.
- 1.5 100% Transfer of resins from CPU service vessel to regeneration vessel and vice-versa.
- 1.6 Performance of all the interlocks provided.
- 1.7 Noise, vibration levels, protection & interlock and other functional guarantees of different rotating machines and equipment

2.0 GUARANTEES:

The Condensate polishing system shall be designed to maintain the guaranteed effluent quality & length of service runs at normal condition, start-up, and condenser leakage conditions. The guarantees shall be as below:

2.1 INFLUENT AND EFFLUENT WATER QUALITIES FOR CONDENSATE POLISHING PLANT UNDER NORMAL RUN CONDITION:

Sl. No.	IONIC CONCENTRATION (as such)	INFLUENT	EFFLUENT (maximum)
1.	Ammonia, ppb	150	--
2.	Total dissolved solids, ppb	100	20
3.	Silica, ppb	30	5* (refer note below)
4.	Iron, ppb	50	5
5.	Sodium, ppb	10	2
6.	Chlorides, ppb	10	2
7.	pH	8.5-9.0	--
8.	Effluent conductivity after removal of ammonia & amines, $\mu\text{S/cm}$ at 25°C	---	< 0.10 or less
9.	Suspended matter (Crud), ppb	Not more than 25	<5

Note:

- i) Silica value shall be 7 ppb as per resin supplier recommendations in case the temperature of the condensate is 50°C & above.
- ii) Under the above operating and design flow through the polisher units, the un-ammoniated resins shall not reach "ammonia break-point" in less than 30 days (720 hrs) of continuous operation while maintaining the above effluent quality. Whenever specific conductivity starts increasing from 0.1 micro mhos/cm in the effluent, it is deemed that "ammonia break point" is reached.

2.2 TEST UNDER STARTUP CONDITIONS (50 hrs at rated flow):

During startup conditions, the quality of influent shall be as follows:

S.No.	PARAMETER	INFLUENT (Maximum)	EFFLUENT (Maximum)
1.	TDS, ppb	2000	--



2.	Silica, ppb	150	--
3.	Crud, ppb	1000	150

Note:

- For design purposes, average crud loading shall be considered as 500 ppb
- Useful service run between two successive regenerations at design flow rate with above conditions should not be less than 50 hours.

2.3

TEST UNDER CONDENSER LEAK CONDITION:

Under condenser tube leakage condition, the quality of influent shall be as follows:

S.No.	PARAMETER	INFLUENT	EFFLUENT (Maximum)
1.	TDS, ppb	2000	--
2.	Sodium, ppb	--	20
3.	Silica, ppb	--	20

Note:

- The influent TDS will be in addition to the normal influent load. The anion and cation load in influent design TDS shall be based on circulating water analysis.
- Useful service run between two successive regenerations at design flow rate with above conditions should not be less than 50 hours.

2.4

TEST UNDER CONDENSER LEAK CONDITION:

The quantities of hydrochloric acid (as per IS:265, technical grade) required for regeneration of one vessel resin (cation) charge and the quantity of sodium hydroxide (as per IS:252, rayon grade) lye or as flakes required for regeneration of one vessel resin (anion) charge shall be as follows:

S.No.	REGENERANT	QUANTITY (Kgs)
1.	Hydrochloric acid (100%)	125 kg x design cation resin volume (M3)
2.	Sodium hydroxide (100%)	160 kg x design anion resin volume (M3)

2.5 PRESSURE DROP:

At the design flow rate, the maximum pressure drop across the polisher service vessels shall be as follows:

S.No.	PARAMETER	PRESURE DROP AT DESIGN FLOW RATE (Kg/cm ²)
1.	Under clean conditions	2.1
2.	Under dirty conditions	3.5

Note:

- The pressure drop under clean conditions shall include losses due to entrance & exit nozzles, distributors, under drains, resins and the effluent resin traps.
- The pressure drop under dirty conditions shall include the pressure drop across effluent resin traps.

2.6 Transfer of resin from service vessel to regeneration vessel shall be complete (100%).

2.7 During PG test period, all service vessels shall also be checked for their rated design flow.

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	2.8 Parallel operation of all CPU vessels at total design flow should be checked once in all units during PG test. 3.0 GENERAL REQUIREMENTS: The clauses as given in GTR (General technical requirements), Technical specifications and Notification of award shall be final and binding. 3.1 PG Test will be conducted within a period of two months after successful completion of trial operation. 3.2 The PG test shall be undertaken only after the resins have been subjected to at least three normal regeneration and service cycles after commissioning. 3.3 During PG Test all the alarms and inter-locks to be checked 3.4 All relevant analysis results and test certificates shall be submitted by the vendor for the exchanger bed media prior to the commencement of PG Test. 3.5 All the instruments required for conducting PG test shall be calibrated by the vendor in presence of SCCL representatives prior to the start of the PG Test by the standard methods acceptable to SCCL. Wherever this is not possible, valid calibration certificates by an approved agency shall be submitted by the vendor. 3.6 Standard analytical procedures shall be followed for the determination of various chemical parameters. Laboratory facilities as available at SCCL site may be made available, if required. If laboratory facility does not exist for any test, the supplier will arrange the same from SCCL/Govt. approved laboratories. 3.7 The influent and effluent parameters shall be analyzed every 4-hour. However, online analyzers provided shall be taken for recording every 2-hour wherever applicable. 3.8 Necessary tools and instruments required for PG Test shall be arranged by the vendor. Laboratory facilities as available at site may be made available, if required. If laboratory facility does not exist for any test, the supplier will arrange the same from SCCL/Govt. approved laboratories. 3.9 In case, during PG test if the equipment/ system has failed to meet the guarantees, the vendor shall carry out all necessary modifications and/or replacements to make the equipment/system comply with the guaranteed requirements at no extra cost to the Employer and re-conduct the PG Test with employer's consent. 3.10 Vendor will submit authenticated documents with signature and stamp on each page. 3.11 If start-up and condenser leak conditions do not exist during the entire PG test period, a joint protocol will be submitted for the same. 3.12 All the log-sheets and protocols of PG test shall be jointly signed by the supplier and SCCL representatives. Unsigned or not jointly signed log-sheets & protocols will not be accepted for evaluation. 3.13 PG test report of total CPU package, complete in all respects, shall only be considered for evaluation. 3.14 Pre requisites for performance test: i) Availability of SCCL & Supplier personnel / operational staff during the test. ii) Uninterrupted power supply within specified parameters for the duration of the Test. Power supply is required for all Analysers. iii) Adequate and uninterrupted Condensate Water and chemical supply. iv) Sufficient illumination to be ensured in CPU Service area and Regeneration area.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE PAGE 107 OF 223



4.0 PERFORMANCE GUARANTEE TEST PROCEDURE FOR CONDENSATE POLISHING UNIT:

S.NO.	EQUIPMENT	OBJECTIVE	PROCEDURE	REMARKS
1.	Condensate polishing plant for turbo generator units- 1 & 2.	To establish the followings during three consecutive Normal Service runs. i). For CPU PG test, two number identified resin lots shall be tested for three service run by ensuring that at least two (if CPU is 3x50%)/ three (if CPU is 4x33%) number service vessels of each unit should be covered during PG test under normal service run. ii). During PG test period, all service vessels shall be checked for their rated design flow. iii). Parallel operation of three CPU vessels at total design flow should be checked once in all three units during PG test.	--- Using normal regeneration level, externally regenerate the resins filled in each service vessel one by one and re-fill the service vessels with regenerated resins. Start auto service run of first vessel by controlling inlet and bypass valves. After establishing design flow through the first vessel, start auto service run of second vessel and then third vessel by adjusting the above valves and ensuring the design flow passing through all the three vessels.	---- i). The test will be carried out with two (if CPU is 3x50%)/ three (if CPU is 4x33%) service vessels. ii). In case total design flow is not available, two vessels at their design flow (---- m³/h) or one vessel at its design flow (- --- m³/h) will be tested for normal service PG test run. iii). Bypass valves should be full closed during PG test. iv). The flow rates through each service vessels and total flow will be measured with the help of online flow meters after half an hour from the time the vessels are put into service. v). Flow rate will be recorded every 2-hours.
		iv). Service length of 30 days (720 hours) at design flow between	The service run will continue till the effluent parameters remains within limits as given	Total flow through each vessel will be measured using

CLAUSE NO.	TECHNICAL REQUIREMENTS				
S.NO.	EQUIPMENT	OBJECTIVE	PROCEDURE	REMARKS	
		two regenerations using single regenerant quantity. the un-ammoniated resins shall not reach "ammonia break-point" in less than 30 days (720 hrs) of continuous operation while maintaining the effluent quality as specified in Section-2.1. Whenever specific conductivity starts increasing from 0.1 micro mhos/cm in the effluent, it is deemed that "ammonia break point" is reached.	in Section-2.1; the Specific conductivity of the effluent remains less than or equal to 0.100 $\mu\text{S/cm}$ at 25°C or throughput per vessel has reached ----- m^3 whichever occurs earlier. If the inlet quality is higher than the design value as per Section-2.1, service cycle will be reduced based on the load and the same shall be established. The revised calculations for higher inlet load than design will be accepted after approval of SCCL. There will be three normal PG test runs with an identified resin lot for a unit preceded by single regeneration Average result from three consecutive PG test runs will be considered for evaluation.	online flow integrators. Flow rate, total flow and online parameters will be recorded every 2-hours. Other chemical parameters will be tested 4-hourly in the laboratory. In case a service run is interrupted & stopped for some time and again restarted after extra rinsing, such extra rinse water volume will be added to service run output.	
		vi) Pressure drop across the polisher service vessel of 2.1 kg/cm^2 in clean and 3.5 kg/cm^2 under dirty conditions of resin at design flow.	The pressure drop under clean conditions will be measured after half an hour of the vessel containing freshly regenerated resins are put into service. The pressure drop under dirty conditions will be measured at the end of service run.	The pressure drop across the resin bed will be measured using online differential pressure indicator. The pressure drop under clean conditions shall include losses due to entrance & exit nozzles, distributors, under drains, resins and the effluent resin trap and under dirty conditions shall include the pressure drop across effluent resin traps. Pressure drop will be recorded every 2-hours.	
2.	Condensate polishing plant for turbogenerator units- 1, & 2.	To establish the followings during start up condition run: i) Useful service run of not less than 50 hours. ii) Total crud	-- Freshly single regenerated resins are transferred to service vessel and the vessel is put into service.	-- The influent crud level during startup will be up to 1000 ppb.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 109 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS				
S.NO.	EQUIPMENT	OBJECTIVE	PROCEDURE	REMARKS	
		content of the effluent not more than 150 ppb.	The influent & effluent crud levels are measured every 4-hour.	The crud levels are measured gravimetrically using 0.45 micron filter paper.	
3.	Condensate polishing plant for turbogenerator units- 1, & 2.	To establish the followings during condenser leak condition run:			
		i) Useful service run of not less than 50 hours. ii) Both sodium and silica contents of the effluent to be less or equal to 20 ppb. iii) All other effluent parameters as per Annexure -I.	Freshly single regenerated resins are transferred to service vessel and the vessel is put into service.	The influent TDS will be 2000 ppb in addition to the normal influent contaminants as stated in Section-2.4. Flow rate, total flow and online parameters will be recorded every 2-hours. Other chemical parameters will be tested 4-hourly in the laboratory.	
4.	Condensate polishing plant for turbogenerator units- 1, & 2.	To establish all other guarantees/ parameters as specified in Section 2.0 of this procedure and Scope.	--	--	
5.0 Agency should submit the detailed PG test procedure based on the above details for approval of SCCL.					
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 110 OF 223



PG Test Procedure for DM Plant (Ion Exchange Resin-based)

Scope: PG Test shall be conducted after successful trial run to establish:

2. Quality and quantity of water produced from different filter/exchanger beds of DM streams as per technical specification
3. Time requirement for regeneration as per technical specification
4. Chemical requirement for regeneration as per technical specification
5. Functioning of the plants in manual, semi-auto and auto modes (as specified).
6. To establish the performance under actual installed conditions with the pumps as a part of the system & when operating against the system resistance. The purpose of the test will be to confirm whether the equipment meets specifications in respect of following parameters as per the technical specification with respect to Capacity, Total dynamic head (TDH) and Power.
7. Noise, vibration levels, protection & interlock and other functional guarantees of different rotating machines and equipment

The purpose of the test will be to confirm whether the equipment meets specifications w.r.t. the guaranteed parameters. The acceptance criteria will be as per the defined technical specifications.

Test Methodology:

S.N.	Unit	Test Objective	Test Procedure	Remarks
	Activated Carbon Filters	To Check: a. The capacity of each filter. b. The effluent quality from each filter. c. Backwash & rinse time requirement of each filter d. The guarantee parameters.	a. Backwash & run each filter at the design flow rate with the corresponding D.M. stream by the mode at which the stream is running. b. Check the effluent quality of the outlet of each filter for the guaranteed parameters. c. The end of run of filter will be considered when the rated throughput is achieved or the differential pressure becomes 80% of the maximum tolerable pressure difference, whichever is earlier.	a. In case pressure difference exceeds 80% of max tolerable then the test will be repeated. Reason for high pressure difference & action taken shall be recorded in PG test report. b. The activated carbon shall work for a period of not less than 3 years without any regeneration / activation. <i>Along with P.G. Test evaluation report, a certificate in this respect shall be issued by the vendor.</i>
	DM STREAM	To Check: a. The quantity & quality of water produced from each cation, anion & MB unit. b. The time requirement for regeneration.	a. Run the units to exhaustion or to the calculated output. Single regenerate the units & consider the subsequent run at design flow as the test run for the cation, anion & MB units. b. Total backwash of counter current strong exchanger shall be done only when the DP across the strong exchanger units is more than 80% of the maximum tolerable pressure difference.	a. If there is an interruption of more than 2 hours during service run due to any reason, extra rinse water quantity is to be added in the output of respective units. Record the total time of regeneration and backwash required for ACF, Cation, Anion and MB along with chemical consumption. b. Inlet water analysis shall be determined by making arithmetic average of all two hourly readings of filtered water

CLAUSE NO.		T ECHNICAL REQUIREMENTS			
			c.The chemical requirement for regeneration. d. The guarantee parameters.	c. Double regeneration is necessitated to the anion if it is subjected to alkaline brine wash or total backwash; double regeneration of cation is necessitated if it is subjected to total backwash. There after run the unit with single qty of chemicals and run the unit up to calculated throughput for P.G. Test. d. The end of cation exchanger will be considered when the calculated output has been reached or the effluent quality as per guarantee is not met from the cation or when the strong base anion exchanger of the relevant stream has reached its end point, whichever occurs earlier. e. Demonstrate total time of regeneration of cation & anion units within the guaranteed time and also demonstrate regeneration time for cation, anion and MB units within the guaranteed time. f. The end of run of anion exchanger will be considered when the calculated output has reached or the effluent quality as per guarantee is not met from the strong base anion or when the cation exchanger of the relevant stream has reached its end points, whichever occurs earlier. g. The end of run of MB exchanger will be considered when the guaranteed parameters are not met with for the effluent or when the desired output is achieved, whichever is earlier. h. All exchanger and degasser shall be checked for the guaranteed parameters. i. Before & after the test, check the resin volume in all the exchanger beds.	taken during the test. Based on this inlet water analysis, regeneration level employed, resin volume provided the guaranteed capacity of the stream in terms of total volume (gross output) of treated water (cu.m) between two regenerations shall be calculated before test. c. Quantity of treated water as determined by this test shall be checked against calculated quantity of treated water as in b) and must be equal to or more than the calculated amount.
	D.M Stream parallel run of all the	To Check: The functional requirement.	a. Regenerate the exhausted units. b. Run all the streams in parallel for at least 8 hours. c. Check the functional requirement	Ideally start all streams service run together to try to get 8 hours’ parallel run together. Samples of water will be	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE			TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 112 OF 223

CLAUSE NO.		T ECHNICAL REQUIREMENTS									
	streams		including DCS.				analyzed every two hours from outlet of activated carbon filter, cation exchanger, degasser pump, anion exchanger and mixed beds exchanger.				
Table A: CHEMICAL PARAMETERS (OUTPUT QUALITY)											
Sample_ID	Organic Matter in ppm (as KMnO4 consumption)	Turbidity (NTU)	Sodium (as ppm CaCO3)	pH	Spec Conductivity (us/cm) at 25 deg C	Free CO2 as CO2 (ppm)	Reactive Silica as SiO2 (ppm)	Iron as Fe (ppm)	Free residual ClO2 (ppm)	Total Hardnes as pp CaCO3	
ACF Outlet	*BDL	<0.5	---	---	---	---	---	---	#ND	---	
Cation Outlet	---	---	Sodium leakage through cation shall not exceed 2ppm throughout the period between two regenerations.	---	---	---	---	---	---	---	
Degassed Outlet	---	---	---	---	---	< /= 5.0	---	---	---	---	
Anion Outlet	---	---	---	---	Not more than 10.0	---	Not to exceed 0.2	---	---	---	
MB Outlet	---	---	---	6.8-7.3	Not more than 0.1	---	Not to exceed 0.01	#ND	---	#ND	
Among all the parameters pH & Conductivity shall be measured by online analysers while others will be measured by mutually agreed standard test procedures.											
*BDL: Below Detectable Limit, #ND: Not Detected											
<u>CYCLE OF STREAM OPERATION:</u>											
Three regeneration and service cycle (One in manual and two in auto mode) shall be carried out for each stream. And one regeneration & service cycle shall be carried out for MB exchanger. The average value for each DM stream shall be taken for evaluation.											
<u>OTHER GUARANTEES & NORMS:</u>											
i. All the instruments and interlocks provided with requisite controls and alarms shall be checked during period of test record. ii. List of instruments shall be provided by the vendor. All the instruments required for the P.G test should be calibrated by the contractor in presence of SCCL representative prior to the start of the Test. Whenever this is not possible, valid calibration certificate by an independent NABL-accredited calibration agency shall be submitted by the contractor. iii. Before starting PG test, output calculation based on present feed water analysis will be submitted by vendor. iv. Before the start of PG test, resin and ACF quantity is to be recorded for each vessel. v. Agency should submit complete resin literature details alongwith output calculation for verification by SCCL. vi. If any of the guaranteed parameters cannot be tested at site SCCL laboratory, the agency shall arrange for the testing of the same at SCCL approved laboratory or NABL – accredited laboratory. After the completion of the above, the result copy to be duly signed and submitted. Note: Agency should submit the detailed PG test procedure based on the above details for approval of SCCL.											
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE			TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001			SUB SECTION- G-04 STANDARD PG TEST PROCEDURE			PAGE 113 OF 223		



PG TEST PROCEDURE FOR DM PLANT (UF-RO-BASED)

1.0 SCOPE: PG Test shall be conducted after successful completion of trial run to establish the various guarantee parameters:

8. Effluent quality and capacity of water each of ultrafiltration, reverse osmosis skid, degasser and mixed bed exchangers.
9. Noise and vibration level of all rotary equipments.
10. Current, voltage, motor input power, frequency, speed, bearing/motor winding temperature, vibration and noise-level of pumps, blowers and their drives and parallel operation of pumps & blowers.
11. Total power consumption of the pumps and power consumption of individual pumps as defined in technical specifications shall be taken for evaluation.

2.0 GENERAL REQUIREMENTS:

- a. Responsibility of test conductance: Agency
- b. Water analysis standard procedures to be adopted during PG Test are as follows:
 - i. ASTM D4195: Standard Guide for Water Analysis for Reverse Osmosis Applications” or equivalent methods of the AWWA/APHA Standard Methods of USEPA.
 - ii. Standard procedures related to SWRO (Surface water RO) system include D 3739, D4189, D4194, D4195, D 4516, D4582, D 4692, D 4993.
- c. All necessary tools & tackles, equipment, any additional equipments viz. piping, valves strainers etc required for PGT shall be arranged by vendor. Laboratory facilities at site shall be made available for analysis purpose. In absence of proper lab facility, same shall be arranged by the vendor/sample to be got tested at external NABL –accredited labs.
- d. Calibration of instruments required for conducting the PGT shall be done from external Govt approved/ NABL-accredited laboratories. Calibration certificate validity should be till the end of PG Test.
- e. Quality of resin in each MB vessel along with top-up quantity, if any, is to be recorded before the start of PGT.

3.0 TEST METHODOLOGY:

- a) PGT shall be conducted for a minimum period of 72 hours for each UF and RO Train/Skid/Stream. The test shall be carried out for each train/skid in sequence.
- b) For each MB, three cycle (regeneration and service) shall be carried out. The average value for each stream shall be taken for evaluation.
- c) Inlet water analysis shall be determined by making arithmetic average of all readings of filtered water taken during the test.
- d) Based on the inlet water analysis (at MB inlet), regeneration level employed, resin volume provided, & characteristic curves employed, the guaranteed capacity of the stream in terms of total volume of treated water (cum) between regenerations shall be calculated and submitted by the agency. Resin volume for taking output should include buffer layer provided. The calculation shall be submitted to SCCL for approval.
- e) For Mixed Bed, the guaranteed output shall be as specified.
- f) DM stream shall be operated in all the modes supplied like auto/manual etc
- g) Parallel run of all the streams shall be carried out for a period of at least eight hours to check the functional requirement.
- h) Samples of water shall be withdrawn every two hours from the outlet of UF/RO/DG/MB and analysed at site laboratory/ Govt-approved laboratories/ NABL-accredited laboratories.
- i) Power consumption calculated for specified drives shall be summed up to arrive at total power consumption.
- j) Total power consumption of pumps as well as individual power consumption should not exceed as defined in technical specifications.

Note:

- i. UF-CIP/ RO-CIP procedures and recipe are to be vetted by OEM of UF/RO and to be provided before conductance of PGT.
- ii. Agency has to supply the O&M manual of UF-RO-MB plant before PGT conductance.


4.0 PG TEST PROCEDURE:

S.N.	Unit	Test Objective	Test Procedure	Remarks
1a	Ultrafiltration	Capacity with backwash and air-scouring (if applicable)	System to be run for 72 hours.	Test duration: 72 hours for each Train/Skid/Stream.
1b		Effluent Quality	UF to be taken into service after every backwashing/cleaning. Effluent to be sampled and analysed.	Inlet & outlet flow, pH, turbidity, SDI, KMnO4 number and residual Chlorine/ ClO2 to be measured at every 2 hours.
1c		Backwash Water Requirement	Backwashing to be carried out.	Water consumption to be recorded in each successive backwash/cleaning.
2a	Feed Water inlet at RO skid	Influent flow	Adjust the flow of each RO skid as per defined technical specifications.	Test duration: 72 hours for each Train/Skid/Stream.
2b		Influent quality	RO effluent to be sampled and analysed.	Feed flow, pressure, Conductivity, pH, TDS, Res chlorine/ ClO2, SDI, ORP, Boron (if applicable) to be measured every 2 hours.
3a	RO Permeate	Effluent Capacity	Adjust the permeate and reject flow in such a way that the RO recovery meets the required technical specifications.	Test duration: 72 hours for each Train/Skid/Stream.
3b		Effluent Quality	System to be run for 72 hours.	Permeate Flow, Pressure, Conductivity, pH, TDS to be measured every 2 hours.
4	At Degasser inlet and outlet	Effluent Quality	System to be run for 72 hours.	Flow, pH, CO2 & conductivity to be measured every 2 hours.
5	At MB inlet & outlet	To check: a) The quality & quantity of water produced from each MB unit. b) The requirement for regeneration. c) The chemical requirement for regeneration.	a) Regenerate the MB units with guaranteed quantity of chemicals. b) Run the units upto calculated output. c) The end of MB exchange shall be considered when the guaranteed parameters are not achieved for the effluent or when the desired output is achieved, whichever is earlier. d) Time required for regeneration. e) Double regeneration, if necessitated to the MB after seven (or as	a) Three Service cycles for each MB shall be conducted. b) Total time of MB regeneration along with chemical consumption to be recorded. c) Guaranteed net output from each MB unit between two successive regenerations (using guaranteed chemical quantities) shall be as defined in technical specifications. Quality of MB outlet shall be as per guaranteed parameters.



			specified elsewhere) regenerations. Use double qty of chemicals for double generation.	
6	Mixed Bed Ion Exchange Units	Parallel run of DM Streams to check the functional requirement	a) Regeneration of exhausted MB units. b) Run MB streams in parallel for eight hours. c) Check all programs of service and regeneration of MB.	Quality of MB outlet shall be as per guaranteed parameters. Ideally start all the stream service run together to try to get 8 hours parallel run together.

5.0 GUARANTEED PARAMETERS (AS SPECIFIED IN TECHNICAL SPECIFICATIONS)

S.N.	Unit	Test Objective	Parameters	Remarks
1	UF	Effluent Capacity	Net permeate flow from each UF skid/Train	
		Effluent Quality	SDI, Turbidity, BOD, Organic Matter	
		Life of UF membrane	5 years (minimum) or as specified in technical specifications	
2	RO feed	Effluent Quality	SDI, turbidity, pH, Res ClO ₂	
3	RO permeate	Effluent Capacity	Net permeate flow from each RO skid	
		Effluent Quality	TDS	
		Life of RO membrane	3 years (minimum) or as specified in technical specifications	
4	Degasser Tower	Effluent Capacity	As per technical specifications	
		Effluent Quality	CO ₂ at degasser outlet	
5	MB unit	Effluent Capacity	As per technical specifications	
		Effluent Quality	Reactive silica < 0.01 ppm as SiO ₂ Iron as Fe- Not Detectable as per ASTM D 1068. Total Hardness- BDL pH- 6.8-7.3 Conductivity- Max 0.1 us/cm	
		Regeneration time	As per technical specifications	

Note:

- Agency has to submit the detailed PGT procedure as per the above details for approval of SCCL.
- List of instruments has to be provided by agency during PGT procedure submission for approval purpose.



Standard PG Test Procedure:

Pre-Treatment Plant

Scope: PG Test shall be conducted after successful trial run to establish the various guarantee parameters as defined in the technical specifications.

- (a) Guaranteed effluent quality and capacity for each of Clarifier, Gravity Filter, Tube Settler and Coal Slurry Settling Pond.
- (b) Sample collection and analysis:

Table1:

S.N.	Sample_ID	Chemical parameters	Frequency of sampling
1	Raw Water	All parameters given in feed analysis	Once/day
2	Clarifier Outlet	Flow, Organic matter, Iron content, Turbidity	Two-hourly
3	Gravity Filter Outlet	Flow, Turbidity	Two-hourly
4	Tube Settler Inlet & Outlet	Flow, Turbidity, Oil & Grease	Two-hourly
5	CSSP outlet	TSS, Particle size	Two-hourly

Note: Joint sampling to be done during PGT.

- (c) Noise and vibration levels of all rotary equipments.
- (d) Current, voltage, motor input power, frequency, speed, bearing/motor winding temperature, vibration and noise level of pumps, blowers and their drives and parallel operation of pumps and blowers, if applicable are to be demonstrated.
- (e) Capacity, head and power consumption of specified pumps.

General Requirements:

- (a) Responsibility of conducting the test: Agency
- (b) Standard analytical procedures to be followed for chemical parameter determination.
- (c) All necessary tools & tackles, equipment, any additional equipments viz. piping, valves strainers etc required for PGT shall be arranged by vendor. Laboratory facilities at site shall be made available for analysis purpose. In absence of proper lab facility, same shall be arranged by the vendor/sample to be got tested at external NABL labs.

Test Methodology:

- (a) After raw water supply is established in clarifier, flow to be adjusted as desired, amount of treatment chemicals is to be assessed by jar test at site.
- (b) PGT shall be carried out separately for clarifier, gravity filter, tube settler, coal slurry settling pond of rated flow for a time period as defined in technical specifications.
- (c) The guaranteed parameters of respective systems shall be demonstrated during performance guarantee test as per approved test procedure, test procedure is to be submitted by agency.

**PT-CW Clarifier , PT-DM Clarifier & Tube Settlers**

Test Objective	Test Procedure	Remarks
Effluent Capacity	Flow is to be adjusted so that the effluent quantity from clarifiers/Tube Settler is as defined in technical specifications.	i.Duration of each test shall be 8 hours and one run in one day shall be conducted. ii.Three tests shall be run for each clarifier/Tube settler and average value of three test runs shall be considered for approval.
Effluent Quality	Chemicals shall be dosed based on laboratory Jar Test results for the water available at the time of PGT. 20% overloading test of each clarifier is to be done exactly in line with 100% flow test procedure for 8 hours.	

PT-Potable Gravity Filter & PT-DM Gravity Filter

Test Objective	Test Procedure	Remarks
Effluent Capacity	Flow is to be adjusted so that the effluent quantity from clarifier is as defined in technical specifications.	i.Duration of each test of filter shall be 24 hours. ii.Three tests shall be run for each gravity filter and average value of three test runs shall be considered for approval.
Effluent Quality	Effluent from filter is to be sampled and analysed. Backwash water requirement not to exceed 2% of water treated between two successive backwashes.	

Coal Slurry Settling Pond (CSSP)

Test Objective	Test Procedure	Remarks
Effluent Quality	Flow is to be adjusted so that the effluent quantity from CSSP is as defined in technical specifications.	i.Duration of each test shall be 8 hours for each pond. ii.Three tests shall be run for each pond and one test in one day shall be conducted. iii. Average value of three test runs shall be considered for approval. iv. Rated flow shall be provided by SCCL during PGT. If rated inlet flow is not available, PGT shall be conducted as per prevailing conditions and recording of reason for non-availability be done jointly.

**Test Summary (Table 2):**

S.N.	Unit	Test Objective	Parameters	Remarks
1	PT-CW clarifier, PT-DM Clarifier	Effluent Capacity	Flow	By Flow Transmitter
		Effluent Quality	Turbidity & Iron	By Offline testing
			Organic matter	KMnO4 Method
2	PT-Potable Gravity Filter, PT-DM Gravity Filter	Effluent Capacity	Flow	By Flow Transmitter
		Effluent Quality	Turbidity	By Offline testing
3	Tube Settler	Effluent Capacity	Flow	By Flow Transmitter
		Effluent Quality	Turbidity, Oil & Grease	By Offline testing
4	CSSP	Effluent Quality	Effluent TSS at the outlet of each CSSP during storm water flow condition as defined in technical specifications.	By Flow transmitter and offline testing of TSS

Note:

- i. List of instruments is to be provided by vendor.
- ii. Chemical consumption: As per design calculations submitted by agency.
- iii. Agency should submit the detailed PG test procedure based on the above details for approval of SCCL.



Performance guarantee test procedure of CW Pump (Vertical Pumps)



Project :	
Stage	
Package :	CW System Equipment
Customer	SCCL Limited, New Delhi
Doc. Title	Performance guarantee test procedure of CW Pump
SCCL Doc. No	
No of pages	
Date	



1.0 SCOPE OF THE PERFORMANCE TEST

This procedure covers the performance guarantee testing of C.W. Pumps carried out at site after installation and successful completion of trial operation of pumps. Performance test of CW pumps will be carried out at site to demonstrate trouble free mechanical running of individual pumps and parallel operation of the pumps. Objective of the test is to verify following parameters -

1.1 Guaranteed Values to be demonstrated

1.	Maximum Vibration Level (MICRON)		_____ at Motor DE
2.	Noise Level	:	Less than 85 dBA at a distance of 1 mtr from floor level (all around pump and motor) with single pump running in free field condition and with correction for local background noise. (Minimum 6 point shall be covered)
3.	Parallel Operation	:	Load Sharing within 10% (Input power differential at Motor Terminal during differential operation of two pumps should be within 10 %)
4.	Bearing Temperature	:	_____
5.	Operation of discharge butterfly valve (opening and closing time)		
6	Capacity of accumulator		It should have enough capacity for one cycle (open & close) of operation without external AC Power

1.2 Verification of all Interlock & Protections

During Performance Testing Verification of all Interlock & Protections relating to the Pump & Motor, as per approved Control Write up is to be checked, mainly covering from points 7 to 9

7	Motor Brg	:	_____ Deg C (for alarm) _____ Deg C (for trip)
8	Pump Thrust cum Guide Bearing	:	_____ Deg C (for alarm) _____ Deg C (for trip)
9	Motor Winding Temperature	:	_____ Deg C (for alarm) _____ Deg C (for trip)

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	<u>1.3 Other Parameters to be measured</u> 1.3.1 Current (Amps) 1.3.2 Voltage (Volts) 1.3.3 Input in KW to Motor Terminal 1.3.4 Frequency in cycles / sec 1.3.5 Speed of the pump in rpm 1.3.6 Sump Level in sump & forebay 1.3.7 Discharge Pressure 2 GENERAL CONDITIONS: 2.1 The pump shall be in good operating condition at the time of test. 2.2 Water level should be maintained as per requirement of the Pump during the Test. 2.3 Approved data sheet of the Pumps shall be presented to SCCL site before conductance of PG Test. 2.4 Before commencing the test, pump alignment, free running condition of rotor shall be checked. 3 TESTING METHOD: 3.1 The pump shall be tested at the actual achieved speed of the electric motor. 3.2 There should be equal load sharing between two pumps running in parallel with no abnormal vibrations, sound or hunting of head and flow. Load sharing between any two pumps running in parallel should be within 10%. 3.3 Interlocks and protection relating to CW Pumps, motors and discharge butterfly valves shall be tested prior to PG test. 3.4 The opening and closing timings of the CW Discharge Butterfly Valve shall be checked for opening & closing position and shall be in line with approved data sheet. The capacity of accumulator shall be checked by opening and closing of valve after switching off electric supply to oil pump. Accumulator capacity will be checked by Switching off the AC Power Supply. Accumulator should have enough capacity for one cycle (open & close operation) of operation in such a condition. 3.5 The procedure shall include the following documents: Annexure A - Format for recording test readings. Annexure B – Pump Datasheet, Performance curve, Valve Datasheet. Annexure C – Pump house MGA showing the flow measuring location.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE PAGE 123 OF 223



4 MEASUREMENT OF CHARACTERISTICS:

Measurement of the different parameters will be carried out as per below method. Typical layout /sketch for measurement and instrument location will be given as Annexure.

4.1 MEASUREMENT OF INTAKE- FREE WATER LEVEL:

The value of water level shall be measured by using measurement tape /scale or level transmitter.

4.2 MEASUREMENT OF INTAKE WATER TEMPERATURE:

The measurement shall be carried out by thermometer.

4.3 MEASUREMENT OF DISCHARGE PRESSURE:

The discharge pressure (Pd) is measured by means of a Bourdon Type Pressure Gauge / Pressure transmitter. Gauge shall be provided at pump discharge flange.

4.4 MEASURING OF THE POWER:

Motor input Power is measured by using the power analyzer at motor terminals

4.5 MEASUREMENT OF THE PUMP SPEED:

The pump speed will be measured with the help of calibrated non-contact type digital Tachometer.

4.6 MEASUREMENT OF THE VIBRATIONS:

Vibration measurements shall be taken at all flow conditions but guaranteed at duty point. Checks will be done as per HIS. Vibrations will be checked at motor top, motor bottom and pump (at thrust bearing) in the Horizontal, Radial and Vertical directions using IRD 308 or equivalent instruments.

4.7 MEASURING OF NOISE & BEARING TEMPERATURE:

Noise measurement shall be carried out all around the pump and motor set at a distance of 1 meter from the floor level with a sound level meter. The noise shall be corrected for the local background noise and correction on account of test environment as per HIS. Minimum six reading shall be taken for noise measurement.

The motor bearing and winding temperatures shall be recorded from DCS system. If data in DCS system is not available, then Motor bearing and winding temperature shall be recorded from analog thermometer / hand held digital Thermometer. Temperature will be recorded at 15 minutes interval, during two hours duration of test & the maximum temperature recorded should not be more than _____ Degree Centigrade.



The readings shall be recorded in stabilized condition simultaneously and only after verifying that the readings taken is logical. Vibration and noise will be recorded at each observation point except shut-off. Vibration and noise are guaranteed at duty point only.

5.0 CHECK OF RESULTS AND CERTIFICATES

The test results shall be compared and be conformity with the Guaranteed Values against Point No. 1.0 of this procedure.

6.0 LIST OF INSTRUMENTS FOR SITE TEST

Calibration of instruments shall be carried out prior to conductance of the test at any Govt. Institute / NABL Approved Lab (to be got approved from SCCL prior to test) / SCCL approved laboratory duly accredited by competent Govt. agency. The Calibration Certificate shall be furnished to SCCL before conductance of the test. Calibration certificates of the instruments will be shall be valid during the test period.

Sr. No.	Parameters to be measured	Instrument	Accuracy	Remarks
1	Power (Motor input power)	Wattmeter/Power Analyzer	±0.5 %	----
2	current	Ammeter	±0.5 %	----
3	Voltage	Voltmeter	±0.5 %	----
4	Frequency	Frequency meter	±0.5%	
5	Speed	Non Contact type	±1rpm	
6	Temperature	Digital Thermometer	±0.1 Deg C	
7	Vibration	IRD-308 or Eqv.	±3 %	
8	Noise level	Sound level meter	±2 dB	
9	Pressure Measurement	Pressure Gauge (Bourdon Type)	±0.5 %	
10	Level gauge	Existing plant instruments		
11	Time	Stop Watch	±0.5%	
12	Flow	Flow measuring device (Preferably Ultrasonic Flow Meter)	±1.5%	

CLAUSE NO.	T ECHNICAL REQUIREMENTS			
The above-mentioned instruments and any other instruments required shall be provided by Vendor. The above list is not exhaustive. Any other instrument required for the test will be arranged by the contractor along-with valid calibration certificate. 7.0 CONCLUSION Data shall be recorded as per the table annexed herewith ANNEXURE-A Compiled report shall be submitted for acceptance.				
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 126 OF 223



REFERENCE DOCUMENTS: : HYDRAULIC INSTITUTE STANDARD (HIS), USA


ANNEXURE-A (READINGS OF PG TESTS)

Pump No: _____

Sr. No.	Time Parameter	Reading 01	Reading 02	Reading 03	Reading 04
1	Pump sump water level with reference to pressure gauge				
2	Pump discharge pressure (kg/cm ²)				
3	Speed (RPM)				
4	Motor Input power (KW)				
5	Flow meter reading				
6	Motor bearing temperature (oC)				
7	Pump bearing temperature (oC)				
8	Motor winding temperature (oC)				
9	Noise level (in dBA) Six points -Horizontal -Vertical				
10	Water temperature °C				
11	Ambient temperature °C				
12	Valve Opening time (Sec.)				
13	Valve Closing time (Sec.)				
14	Frequency of electrical supply (Hz)				
15	Frequency of electrical supply (Hz)				
16	Sump Level / Forebay level				
17	Capacity of Accumulator				

Pumps running in Parallel (Parallel operation test)

	Discharge Pr.		Discharge pr.		
Sr.No.	Pump No.1	Power in kW	Pump No.2	Power in kW	Remarks
	Kg/cm ²		Kg/cm ²		
1					
2					


Vibration Readings

CW Pump #	DISPLACEMENT (MICRONS)		
	Hz. (X)	Hz. (X)	Vertical
Bearing – Motor DE Side			

NOISE LEVEL:

Noise Level of CW Pump –Motor Set (in dBA) CW

Pump #

HORIZONTAL PLANE						VERTICAL PLANE					
E-1	E-2	E-3	E-4	E-5	E-6	V-1	V-2	V-3	V-4	V-5	V-6

BUTTERFLY VALVE FOR C. W. PUMP #

Sr. No	DESCRIPTION OF OPERATION	TIME TAKEN IN SECS
1	Opening from 100% Closed position to 100% Open	
2	Normal closing from 'Full open' to 'Full close'	



Annexure B – Pump Datasheet, Performance curve, Valve Datasheet.



Annexure C – Pump house MGA showing the flow measuring location.



Performance guarantee test procedure of CW Pump

Concrete / Metallic Volute Pumps

Project :	
Stage	
Package :	CW System Equipment
Customer	SCCL Limited, New Delhi
Doc. Title	Performance guarantee test procedure of CW Pump
SCCL Doc. No	
No of pages	
Date	



1.1 OBJECT & SCOPE OF SITE PERFORMANCE TEST

Performance test of CW pumps will be carried out at site and guaranteed performance at rated point will be verified. The test will be aimed at establishing pump performance characteristics i.e. capacity vs. head, power and efficiency.

Site performance test will be conducted in two stages:

PG Test – Stage I:

Establishing pump performance characteristics for Head, Power and efficiency vs. pump flow – for one CW pump.

Tests on one of the CW pump will establish the Hydraulic Performance for comparison with contractual guarantees. The pump will also be tested in order to establish a pump performance curve with head, power and efficiency plotted against flow. Vibration, noise and bearing temperatures will also be recorded during the test.

PG Test – Stage-II :

Performance guarantee test for all the pumps.

After installation of all pumps, the pumps will be tested for guaranteed motor input power, load sharing, vibration, noise, bearing temperature, motor winding temperature, opening/closing time of Butterfly valve and capacity of accumulator. Please note that during stage II tests, the pump flow will not be measured and therefore Hydraulic performance will not be established. The Hydraulic Performance of all pumps will be based on stage- I test on one pump only.

SCOPE

- Verification of all Interlocks & Protection relating to the Pump & Motor and EHO Discharge BFV.
- Proper running of Pumps on load without abnormal Vibration, sound or hunting of head and flow will be verified and Temperature of Bearings will be checked.
- Verification of Pump & Motor Bearing Vibration and measurement of Noise Level.
- Verification of satisfactory parallel operation of Pump.
- Verification of satisfactory operation of Discharge Butter Fly Valve. Opening and closing time of BFV and capacity of the Accumulator will also be checked.

2.0 DETAILS OF CW PUMP

PARAMETER	VALUE	UNITS
Pump Type		
Service Circulating Water		M3/Hr
Duty Point Parameters (As per approved Data Sheet)		



Discharge		M3/Hr
Pump Head (Total Dynamic Head)		MWC
Pump Efficiency		%
Pump Input		KW
Power consumption at duty point at motor terminals		KW
Speed (rated)		rpm
Motor Make		
Motor Rating		KW
Motor speed		rpm

3.0 Guaranteed Parameters

Sr. No	Parameter	Value	Remarks
1	Guaranteed Capacity	_____	M3/Hr
2	Pump Head (Total Dynamic Head)	_____MWC	(No –ve tolerance)
3	Power consumption at duty point at motor terminals	_____KW	(No –ve tolerance)
4	Pump Efficiency	_____%	
5	Maximum Vibration Level (MICRON)	_____at Motor DE	As per approved data sheet
6	Noise Level	Less than 85 dBA (Minimum 6 point shall be covered)	At a distance of 1 mtr from floor level (all around pump and motor) with single pump running in free field condition and with correction for local background noise.
7	Parallel Operation	Load Sharing within 10% (Input power differential at Motor Terminal during differential operation of two pumps should be with in 10 %)	
8	Bearing Temperature	_____	
9	Operation of discharge butterfly valve (opening and closing time)		
10	Capacity of accumulator	It should have enough capacity for one cycle (open & close) of operation without external AC Power	

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	4.0 GENERAL CONDITIONS 4.1 The pump shall be in good operating condition at the time of test. 4.2 Water level should be maintained as per requirement of the Pump during the Test. 4.3 Approved data sheet of the Pumps shall be presented to SCCL site before conductance of PG Test. 4.4 Before commencing the test, pump alignment, free running condition of rotor shall be checked. 5.0 TESTING METHOD PROCEDURE – STAGE-I : 5.1 One of the CW pump will be chosen by SCCL for this test. 5.2 The pump shall be tested at the actual achieved speed of the electric motor. 5.3 The performance test will be conducted for deciding the characteristics of Head, Power and Efficiency variation vs. flow of the pump to outline the range of operation from shut-off to maximum flow permissible under site condition and verifying the guaranteed parameters. No negative tolerance will be permitted on head, capacity and efficiency. 5.4 There should be equal load sharing between two pumps running in parallel with no abnormal vibrations, sound or hunting of head and flow. Load sharing between any two pumps running in parallel should be within 10%. 5.5 Interlocks and protection relating to CW Pumps, motors and discharge butterfly valves shall be tested prior to PG test. 5.6 The opening and closing timings of the CW Discharge Butterfly Valve shall be checked for opening & closing position and shall be in line with approved data sheet. The capacity of accumulator shall be checked by opening and closing of valve after switching off electric supply to oil pump. Accumulator capacity will be checked by Switching off the AC Power Supply. Accumulator should have enough capacity for one cycle (open & close operation) of operation in such a condition. The procedure shall include the following documents: Annexure A - Format for recording test readings. Annexure B – Pump Datasheet, Performance curve, Valve Datasheet. Annexure C – Pump house MGA showing the flow measuring location.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE PAGE 135 OF 223



6.0 MEASUREMENT OF CHARACTERISTICS:

Measurement of the different parameters will be carried out as per below method. Typical layout /sketch for measurement and instrument location will be given asAnnexure.

6.1 MEASUREMENT OF CAPACITY:

Flow measurement at site shall be carried out using recirculation line / CW supply line. For the flow measurement, ultrasonic flow measuring instrument shall be installed in the line.

6.2 MEASUREMENT OF INTAKE- FREE WATER LEVEL:

The value of water level shall be measured by using measurement tape /scale or level transmitter.

6.3 MEASUREMENT OF INTAKE WATER TEMPERATURE:

The measurement shall be carried out by thermometer.

6.4 MEASUREMENT OF DISCHARGE PRESSURE:

The discharge pressure (Pd) is measured by means of a Bourdon Type Pressure Gauge / Pressure transmitter. Gauge shall be provided at pump discharge flange.

6.5 DETERMINATION OF THE DYNAMIC HEADS (DIN):

The dynamic part of the delivery head is calculated by considering the flow velocity in the discharge pressure measuring point (Vd) therefore follows formula:

$$DIN = Vd^2 / 2g (m)$$

6.6 MEASURING OF THE POWER:

Motor input Power is measured by using the power analyzer at motor terminals. The power input will be determined from measurement of the electrical power input to the motor coupled to the pump. The motor input power may also be measured by Two-Wattmeter method.

Motor output will be computed by using graph of motor efficiency given by the motor manufacturer for the type tested job motor.

6.7 MEASUREMENT OF THE PUMP SPEED:

The pump speed is measured by means of Tachometer. Test results will be evaluated at actual speed achieved and speed correction shall be made if there is frequency variation with respect to 50 Hz.

6.8 MEASUREMENT OF THE VIBRATIONS:

Vibration measurements shall be taken at all flow conditions but guaranteed at duty point. Checks will be done as per HIS. Vibrations will be checked at motor top, motor bottom and pump (at thrust bearing) in the Horizontal, Radial and Vertical directions using IRD 308 or equivalent instruments.



6.9 MEASURING OF NOISE & BEARING TEMPERATURE:

Noise measurement shall be carried out all around the pump and motor set at a distance of 1 meter from the floor level with a sound level meter. The noise shall be corrected for the local background noise and correction on account of test environment as per HIS. Minimum six reading shall be taken for noise measurement.

The motor bearing and winding temperatures shall be recorded from DCS system. If data in DCS system is not available, then Motor bearing and winding temperature shall be recorded from analog thermometer / hand held digital Thermometer. Temperature will be recorded at 15 minutes interval, during two hours duration of test & the maximum temperature recorded should not be more than Degree Centigrade.

The readings shall be recorded in stabilized condition simultaneously and only after verifying that the readings taken is logical. Vibration and noise will be recorded at each observation point except shut-off. Vibration and noise are guaranteed at duty point only.

7.0 EVALUATION OF TESTING RESULTS:

7.1 CAPACITY:

Capacity shall be measured by calibrated flow meter installed in the Recirculation / CWline.

7.2 TOTAL HEAD:

$$H_t = H_d - L + D_{IN}$$

$$H_t (m) = \text{Total pump head}$$

$$H_d (m) = \text{Pump delivery head (Pressure gauge / Pressure Transmitter reading in (MWC)}$$

$$L (m) = \text{Difference in elevation between intake free water level (Zw) and discharge gauge center line (Zg). (I.e } Z_w - Z_g)$$

$$D_{IN} (m) = \text{Dynamic head referred to measuring point of discharge pressure (Pd)}$$

7.3 INPUT POWER AT MOTOR TERMINAL:

Input Power at motor terminal shall be measured using the Power Analyzer.

7.1 HYDRAULIC POWER OF PUMP:

$$P_{idr} = Q \times H_t \times \rho / 367.2$$



P_{idr} (KW) = Hydraulic power Q

(m³/h) = Pump capacity. H_t (m) =

Total pump head.

r in gm / cc = Value of specific gravity = 1.0 gm/cc

7.2 PUMP EFFICIENCY:

$\eta\% = (P_{idr} / P) \times 100$

η (%) = Pump Efficiency

P_{idr} (kW) = Hydraulic Power

P (kW) = Shaft absorbed (Input power to pump)

7.3 MOTOR OUTPUT POWER:

Motor output power ($P_{m out}$) = Input power to motor x Motor efficiency
Motor efficiency will be as per approved motor data sheet.

7.4 RESULTS CONVERSION FROM TESTING TO RATED SPEED:

Test results will be evaluated at actual speed achieved and speed correction shall be made if there is frequency variation with respect to 50 Hz.

CAPACITY:

$Q_N = (n_N/n) \times Q$

HEAD:

$H_N = (n_N/n)^2 \times H$

ABSORBED POWER:

$P_N = (n_N/n)^3 \times P$

Where -

Q_N (m³/h) = Capacity at rated speed. Q (m³/h) = Capacity at test speed.

H_N (m) = Head at rated speed. H (m) = Head at test speed. n_N = Rated speed.

n = Test speed.

P_N (KW) = Absorbed power at rated speed. P (kW) = Absorbed power at test speed.



8.0 CHECK OF RESULTS AND CERTIFICATES

The test results shall be compared and be conformity with the Guaranteed Values mentioned in section 3.0 of this document.

9.0 LIST OF INSTRUMENTS FOR SITE TEST

Calibration of instruments shall be carried out prior to conductance of the test at any Govt. Institute / NABL Approved Lab (to be got approved from SCCL prior to test) / SCCL approved laboratory duly accredited by competent Govt. agency. The Calibration Certificate shall be furnished to SCCL before conductance of the test. Calibration certificates of the instruments will be shall be valid during the test period.

Sr. No.	Parameters to be measured	Instrument	Accuracy	Remarks
1	Power (Motor input power)	Wattmeter/Power Analyzer	±0.5 %	----
2	current	Ammeter	±0.5 %	----
3	Voltage	Voltmeter	±0.5 %	----
4	Frequency	Frequency meter	±0.5%	
5	Speed	Non-Contact type	±1rpm	
6	Temperature	Digital Thermometer	±1 0 C	
7	Vibration	IRD-308 or Eqv.	±3 %	Suitable
8	Noise level	Sound level meter	±2 dB	
9	Pressure Measurement	Pressure Gauge (Bourdon Type)	±0.5 %	Suitable
10	Level gauge	Existing plant instruments		
11	Time	Stop Watch	±0.5%	
12	Flow	Flow measuring device (Preferably Ultrasonic Flow Meter)	±1.5%	Suitable

The above-mentioned instruments and any other instruments required shall be provided by Vendor. The above list is not exhaustive. Any other instrument required for the test will be arranged by the contractor along-with valid calibration certificate.

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	10.0 CONCLUSION Data shall be recorded as per the table annexed herewith ANNEXURE-A Compiled report shall be submitted for acceptance. <i>REFERENCE DOCUMENTS: HYDRAULIC INSTITUTE STANDARD (HIS), USA</i>		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 140 OF 223



ANNEXURE-A (READINGS OF PG TESTS)

Pump No.:

Sr. No.	Time Parameter	Reading 01	Reading 02	Reading 03	Reading 04
1	Pump sump water level with reference to pressure gauge				
2	Pump discharge pressure (kg/cm ²)				
3	Speed (RPM)				
4	Motor Input power (KW)				
5	Flow meter reading				
6	Motor bearing temperature (oC)				
7	Pump bearing temperature (oC)				
8	Motor winding temperature (oC)				
9	Noise level (in dBA) Six points -Horizontal -Vertical				
10	Water temperature °C				
11	Ambient temperature °C				
12	Valve Opening time (Sec.)				
13	Valve Closing time (Sec.)				
14	Frequency of electrical supply (Hz)				
15	Frequency of electrical supply (Hz)				
16	Sump Level / Forebay level				
17	Capacity of Accumulator				

Pumps running in Parallel (Parallel operation test)

	Discharge Pr.		Discharge pr.		
Sr.No.	Pump No.1	Power in kW	Pump No.2	Power in kW	Remarks
	Kg/cm ²		Kg/cm ²		
1					



2

Vibration Readings

CW Pump #	DISPLACEMENT (MICRONS)		
	Hz. (X)	Hz. (X)	Vertical
Bearing – Motor DE Side			

NOISE LEVEL:

Noise Level of CW Pump –Motor Set (in dBA) CW Pump #

HORIZONTAL PLANE						VERTICAL PLANE					
E-1	E-2	E-3	E-4	E-5	E-6	V-1	V-2	V-3	V-4	V-5	V-6

BUTTERFLY VALVE FOR C. W. PUMP #

Sr. No	DESCRIPTION OF OPERATION	TIME TAKEN IN SECS
1	Opening from 100% Closed position to 100% Open	
2	Normal closing from 'Full open' to 'Full close'	

**Annexure B** – Pump Datasheet, Performance curve, Valve Datasheet.

**Annexure C** – Pump house MGA showing the flow measuring location.



NATURAL DRAFT COOLING TOWER THERMAL PERFORMANCE TEST PROCEDURE

TABLE OF CONTENTS

Section Description

1.0 INTRODUCTION

- 1.1 SCOPE
- 1.2 TEST GOAL
- 1.3 TOWER DESCRIPTION
- 1.4 COMMERCIAL ITEMS
- 1.5 PARTIES TO THE TEST

2.0 REFERENCES AND DEFINITIONS

- 2.1 TEST CODES AND STANDARDS
- 2.2 CONSTANTS AND UNIT CONVERSIONS
- 2.3 PROPERTY DATA
- 2.4 DEFINED TERMS AND ABBREVIATIONS

3.0 TEST OVERVIEW

- 3.1 TEST DESCRIPTION
- 3.2 RESPONSIBILITIES
- 3.3 CONDITION OF EQUIPMENT
- 3.4 PRE-TEST PREPARATION
- 3.5 DESIGN OPERATING CONDITIONS AND GUARANTEE
- 3.6 TEST METHODOLOGY
- 3.7 PROPOSED TEST SCHEDULE

4.0 TEST MEASUREMENTS

- 4.1 MEASUREMENT METHODOLOGY

5.0 CALCULATION METHODOLOGY

- 5.1 CALCULATION OVERVIEW

6.0 REPORTING REQUIREMENTS

- 6.1 DATA DELIVERY
- 6.2 TEST REPORT DELIVERY
- 6.3 FINAL TEST REPORT REQUIREMENTS



TABLE OF APPENDICES

Appendix Title

A MANUFACTURER PERFORMANCE CURVE B
MANUAL DATA SHEETS
C PRIMARY AND SECONDARY MEASUREMENTS



1.1 Introduction

1.2 Scope

This document, hereinafter referred to as the “Test Procedure”, describes the procedures for conducting the Cooling Tower Thermal Performance Test at SCCL Plant, hereinafter referred to as the “Plant”. This Test Procedure contains guidelines for conducting the test, the test set-up, list of test instrumentation, data to be acquired, and equations to be used for the calculation of results.

1.3 Test Goal

The goal of the test is to accurately determine the thermal performance of the cooling tower for contractual acceptance.

1.4 Tower Description

The cooling tower, located at the Plant, is a hyperbolic natural draft cooling tower with (type of fill) and without fan assist.

1.5 Commercial Items

Testing shall be in accordance with CTI ATC-105 (2000), and in accordance with the Contract. Any inconsistencies between any of the provisions in this Test Procedure, and/or any of the Appendices herein, shall be resolved by giving precedence in the following order:

- I. The Contract
- II. . This Test Procedure and any Authorized Modifications
- II. Governing Performance Test Code(s) and Standards

1.6 Parties to the Test

The parties to the performance test are as follows: Owner / Purchaser:

Contractor / Manufacturer: Testing
Subcontractor:

The Testing Subcontractor shall appoint a Test Director to be in charge of all testing activities. Representatives for each party identified above shall be designated to observe the test, confirm that it was conducted in accordance with this Test Procedure, and if necessary, shall have the authority to approve any agreed upon test exceptions in writing. A joint protocol should be signed by all the parties before the test declaring that cooling tower is fit for the test in all respect.

2.1 References and Definitions

2.2 Test Codes and Standards

The following list of Codes and Standards shall be used in part in the testing of the Cooling Tower as deemed applicable by the Contractor:

- *CTI ATC-105 (2000) Acceptance Test Code for Water Cooling Towers*

2.3 Constants and Unit Conversions

Code-specific conversion factors required for use in the determination of test results shall be in accordance with CTI Bulletin STD-145(95).

2.4 Property Data

The psychometric calculations are based on ASHRAE formulations, if required.

2.5 Defined Terms and Abbreviations

Any capitalized terms that are not separately defined in this Test Procedure shall have the meaning for that term as defined by the Contract.

ASHRAE American Society of Heating, Refrigerating and Air-Conditioning Engineers

ASME American Society of Mechanical Engineers

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	<i>Guarantee Performance parameter guaranteed by the Contract DAS</i> <i>Data Acquisition System</i> <i>RTD Resistive Temperature Device</i> <i>Test Director Responsible for the coordination and direction of the performance tests in accordance with this Test Procedure</i> <i>Test Procedure This document</i> <i>Test Run Period of time in which testing parameters are collected.</i> 3.1 Test Overview 3.2 Test Description The goal of the Test is to accurately determine the thermal performance of the cooling tower. The Test will be performed under the general guidelines of the CTI ATC-105 (2000). The Test will consist of measurements of circulating water flow rate, air and water temperatures, relative humidity, wind speed and direction, and barometric pressure. These measured Test parameters will be evaluated with the manufacturer supplied thermal performance curves to determine the thermal performance of the tower by comparing predicted cold water temperature with test cold water temperature. 3.3 Responsibilities The responsibilities for each of the involved parties to the test are as follows: Owner Responsibilities • Operate the tower such that the manufacturer specified limits are not exceeded. • Provide a stable heat load to the tower sufficient for testing. • Provide a stable electrical power source for all temporary test instrumentation and equipment required to perform the Test. The Test equipment will require a standard 110 volt single phase AC power source for the data acquisition system and the psychrometers. • Allow full access for the Testing Subcontractor to setup temporary instrumentation, and to record measurements manually if applicable. Contractor / Manufacturer Responsibilities • Overall Test coordination of all on-site logistical activities in support of the Performance Test. • Designate the necessary personnel to witness the execution of the Performance Test, including a witness who shall have the authority to agree to any revisions/deviations to the Test Procedure. • Correct any defects that may occur that prevent the safe and reliable operation of the Tower. • Coordinate with control room operations prior to and during the test. • Provide access via ladders, man lifts, or scaffolding as needed including access to pitot taps. Testing Subcontractor Responsibilities • Provide temporary test instrument data acquisition system and NIST-traceable, calibrated, temporary test instrumentation. • Calibrate temporary test instrumentation prior to the Test. • Install temporary test instrumentation with Contractor assistance as needed.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 148 OF 223



- Prepare this Test Procedure and make changes, as needed.
- Analyze the test results and prepare a Test Report following the completion of the Test.
- Provide a Test Director who shall direct, coordinate and oversee the Test activities, and ensure that the Test is executed per this Test Procedure.

Test Director Responsibilities

- The Test Director, or acting designee, shall be present during the entire testing period.
- Keep a test log to note any Plant Upsets which may cause the test data to violate the stability criteria listed in this Test Procedure.
- Ensure that the Test is conducted in accordance with this Test Procedure, or record any deviations with agreement by the parties to the Tests, where necessary/applicable.
- Coordinate and direct the Test.
- Train and organize test data collectors, as needed.
- Effect proper safety compliance for onsite Testing Subcontractor personnel.
- Communicate with the Contractor and Owner
- Distribute copies of all raw Test data to all parties following the Test

3.4 Condition of Equipment

At the time of testing, the tower shall be clean and in good operating condition. Specific items that shall be checked prior to the start of testing are listed in Table 3-1.

Table 3-1: Required Conditions of the Tower

Condition

1. The water distribution system shall be essentially free of foreign materials that may impede the normal flow of water.
2. All mechanical equipment shall be in good operating condition.
3. The fill and drift eliminators shall be essentially free of algae and other foreign materials that may impede normal air flow.
4. The water in the cold water basin shall be at normal operating elevation.

3.5 Pre-Test Preparation

The following pre-test preparations shall be executed under the direction of the Test Director:

Manufacturer

- Verify the condition of the equipment meets the requirements of Section 3.3.
- Verify the tower is well balanced prior to flow measurements.

Testing Subcontractor

- Verify the primary measurements against the secondary measurements and station indications if applicable.
- Verify all data acquisition systems are running and recording data per Section 4.0.
- Manual data sheets, shown in Appendix B and data collector requirements shall be



determined and made available prior to testing.

- Any deviations to this Test Procedure identified prior to testing shall be identified and agreed upon in writing by the parties to the test.
- Test equipment will be checked to insure proper operation prior to testing including temperature comparisons.

3.6 Design Operating Conditions

The Design Operating Conditions of the cooling tower are given in Table 3-2 below.

Table 3-2: Design Operating Conditions

Parameter		Units	Value
Circulating Water Flow Rate	m ³ /hr		
Hot Water Temperature		°C	
Cold Water Temperature		°C	
Ambient Wet-Bulb Temperature		°C	
Dry-Bulb Temperature		°C	
Relative Humidity		%	
Barometric Pressure	in Hg		
Pumping Head (above basin)	m		

Every effort shall be made to conduct the Test as close to the design operating conditions as possible. The maximum permissible variations from the design operating conditions are given in Table 3-3 below.

Table 3-3: Maximum Permissible Variation from Design Operating Conditions

Parameter	Limit
Circulating Water Flow Rate	± 10 %
Range	± 20 %
Wet-Bulb Temperature	± 8.5 °C
Dry-Bulb Temperature	± 14 °C
Barometric Pressure	1 in Hg
Wind Speed (at one-half the air inlet height)	< 4.5 m/s for the 60 Minute Average, < 7.0 m/s for the 1 Minute Moving
Wind Speed (at the discharge of the	Average Throughout the 60 Minutes Visual inspection per ATC-105 (00) tower) Section 2.3.2.2.
Relative Humidity	Shall not fall below 40%

The Test conditions shall meet the constancy requirements of ATC-105 given in Table 3-4 below.

Table 3-4: Required Constancy of Test Conditions During the Test

Parameter	Constancy of Test Conditions
Circulating Water Flow Rate	± 2 %

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	Heat Load & Range $\pm 5 \%$ Wet-Bulb Temperature* $\pm 1^{\circ}\text{C} / \text{hour}$ Dry Bulb Temperature* $\pm 3^{\circ}\text{C} / \text{hour}$ Air Wet-Bulb Temperature maximum $\pm 1.5^{\circ}\text{C}$ deviation of a reading from the test run average Air Dry-Bulb Temperature maximum deviation $\pm 4.5^{\circ}\text{C}$ of a reading from the test run average * Limit on the liner least squares trend	
	3.7 Test Methodology 3.6.1 The Test shall be conducted in general accordance with CTI ATC-105. 3.6.2 The test duration shall include a minimum of six (6) one (1) hour periods of test data where the operating conditions are within the limitations specified in Section 3.5, and the test data shall be collected over a minimum of 2 days. 3.6.3 There shall not be rain during or at least two (2) hours before the test. 3.6.4 The vertical dry bulb gradient shall be at least $0.65^{\circ}\text{C} / 100 \text{ m}$ decrease of height unless specified otherwise in the contract. For an acceptable test, the average dry bulb temperature at or near the top of the air inlet shall be at least 0.15°C less than the average dry bulb temperature at 1.5 m above grade level. 3.6.5 The heat load on the tower should be steady for a minimum of thirty (30) minutes prior to the start of testing. 3.6.6 Test parameters should be measured for as long as Test conditions permit. The Test director will review the data and select one (1) Test Run that is one (1) hour in duration shall be based on stability criteria. The most stable hour of data will be utilized to calculate the tower thermal performance. Data stability will be determined by the Test Agency engineer and DAS software. The averaged data from the most stable Test run shall be evaluated with the manufacturer's performance curves given in Appendix A to determine tower thermal performance. 3.6.7 Test parameters will be measured from a combination of temporary test instruments supplied by the Performance Testing Agency and permanent plant instrumentation, see Appendix C. The calibrated accuracy of all instruments shall meet the requirements of ATC-105. Instrument readings will be recorded by the plant control systems, temporary data acquisition system, and manually by test personnel. 3.6.8 Prior to testing, all thermal probe outputs will be compared in a water bath to verify that the probes were not damaged in shipment. Only probes which read less than $\pm 0.1^{\circ}\text{F}$ from the water bath average will be used. 3.6.9 Manufacturer's recommended operating guidelines shall be followed throughout all testing. No equipment shall be operated outside of its design limits. To the extent practical, systems will be in automatic control during the tests. Any deviation from standard operation should be noted and approved by all parties to the Test.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE PAGE 151 OF 223



3.6.10 Should any adjustment to the tower circulating water flow rate be necessary, throttling should be attempted at the pump discharge and condenser valves in order to maintain clean full flow profiles in the risers for the water flow measurements. After testing, any flow control will be at the discretion of plant operations.

3.6.11 All flows to and from the tower shall remain steady during each Test Run. If possible, the blow down shall be isolated and the makeup flow shall remain steady during each Test Run.

3.6.12 A test log should be kept by the Test Director to note any Plant Upsets which may cause the test data to violate the stability criteria or operational limits listed in the Test Procedure and cause test interruption.

3.6.13 Data recorded during a Plant Upset (Plant Upsets may include circulating pump trip, or unexpected weather changes) shall be omitted from the test average and not included in the calculation of the test results. Unless otherwise specified, the Performance Test shall resume at a minimum of thirty (30) minutes following the recovery of stability. The Test Runs shall be extended for a period of time equal to the duration of the test interruption.

3.7 Proposed Test Schedule

The proposed test schedule is provided in Table 3-5 below. The schedule is subject to change.

Table 3-5: Proposed Schedule for Testing Agency

Activities	Estimated Hours
Install Equipment	12
Measure water flow, Collect Thermal Test data	8
Collect Additional Thermal Test Data	8
Pack equipment, Calculate Preliminary Results	8

4.1 Test Measurements

4.2 Measurement Methodology

4.2.1 Test measurements shall be recorded with a combination of temporary installed and permanent plant instrumentation. A complete list of measurements can be found in Appendix C.

4.2.2 Primary measurements are defined as those used to calculate test results.

4.2.3 Secondary measurements are defined as those that do not enter into the calculation of the results. These measurements shall be used as a quality indicator of the test.

4.2.4 All instrumentation for the recording of primary measurements shall be calibrated prior to the performance test in accordance with ATC-105 (2000). Calibration records for all test instrumentation will be provided when equipment arrives on site prior to testing.

4.2.5 A temporary installed data acquisition system (DAS) shall be utilized to acquire the majority of the test data. Data recorded digitally shall be collected every thirty (30) seconds.

4.2.6 Manually recorded data shall be recorded once per test run unless specified otherwise.

5.1 Calculation Methodology

5.2 Calculation Overview

This section outlines the steps for determining the Cooling Tower Thermal Performance.

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	The following test parameters are evaluated as part of the Test: 1. Water Flow Rate 2. Hot Water Temperature 3. Cold Water Temperature 4. Wet-Bulb Temperature 5. Dry-Bulb Temperature 6. Vertical Dry Bulb Gradient 7. Barometric Pressure 8. Wind Speed 9. Relative Humidity The data for each parameter is displayed and averaged for a sliding one hour window throughout the entire data set. Limits from the ATC-105 code are applied to the parameter averages. The average data from the six (6) most stable one (1) hour test runs are inserted into a model, where the manufacturer's performance curves for this tower are digitally interpolated to derive the predicted cold water temperature at the test day ambient air wet bulb temperature, ambient air dry bulb temperature, cooling range, water flow and relative humidity. Calculation of tower performance Determination of predicted Cold water temperature for CT:- The cold water temperature shall be read from the performance curves for 90%, 100% and 110% of rated flows at test wet bulb temperature, range, relative humidity. The three points thus obtained from the performance curves are plotted to obtain a cross plot, which is a relation between water flow and cold water temperature. From the cross plot obtained above the predicted cold water temperature shall be read at test water flow. The predicated cold water temperature measurements are corrected for wind speed as per the curve given by manufacturer in Appendix A. Acceptance Criteria If the test cold water temperature is less than or equal to predicted cold water temperature as detailed above, the tower is deemed to have met the guarantee. 6.1 Reporting Requirements 6.2 Data Delivery A copy of all data sheets and logged data will be furnished to all parties at the completion of the test prior to demobilization. 6.3 Test Report Delivery The Performance Test Report shall be completed within thirty (30) days of the completion of the Test.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE PAGE 153 OF 223



6.4 Final Test Report Requirements

The Performance Test Report shall include:

- A copy of all data sheets and raw data required by this procedure.
- A copy of the manufacturer's data including the performance curves.
- A description of the cooling tower with its orientation.
- A sketch of the installation showing the measurement location of circulating water flows, temperatures, wind speed, barometric pressure, etc.
- Date and time of test runs start and finish.
- Description of conditions under which the test runs were conducted.
- Summary and discussion of the Test results.
- Notes on any unusual observations, data, or conclusions.
- Signed pre-test agreements.
- Any mutually-agreed upon deviations to the Test Procedure (if applicable).
- Instrument calibration data including instrument calibration forms will be supplied for any temporary test instrumentation used to obtain data for the test.

APPENDICES

Appendix Title

A Manufacturer Information B

Manual Data Sheets

C Primary and Secondary Measurements



APPENDIX A

Manufacturer Information



APPENDIX B

Manual Data Sheets



APPENDIX C

Primary and Secondary Measurements

PRIMARY TEST MEASUREMENTS

Primary measurements are defined as those used to calculate test results. They will be recorded if an electronic interface to the data can be established. A temporary test Data Acquisition System (DAS) shall be used to monitor the majority of the precision test pressures and temperatures. The test DAS will include at least one (1) data logger connected to a laptop computer. Automatically monitored parameters will be scanned a minimum of once every 30 seconds using the test DAS. If the data acquisition system is not available for testing, primary measurements will be manually recorded every five (5) minutes. Location of instruments shall be as per specifications requirement.

Primary measurements will be based on the following:

- Flow measurement will be carried out in the pitot tube locations provided at site. An air-over-water manometer will be used to measure the differential pressure between the impact and the static ports of the pitot.
The circulating water flow rate is anticipated to remain steady throughout the mobilization. The water flow to the tower will be measured once, and then checked before each test run by monitoring the manometer differential pressure at the midpoint of the header. The discharge pressure of the circulating pumps, the power consumption of the pumps, and other plant data shall be monitored if available to insure the circulating water flow rate to the tower is steady throughout the test.
- Hot water temperature shall be measured with two (2) RTD's installed in the tower riser or at the discharge of inlet risers into the distribution system. Hot water temperature may be measured in multiple taps if necessary.
- Cold water temperature shall be measured with a least nine (9) RTD's installed in a grid at the discharge of the cold water basin.
- Wet-bulb temperature will be measured at a distance as defined (preferably at a location approximately 1.5 m above basin curb elevation not less than 15m or more than 100m to windward of the cooling tower or at a suitable location after mutual agreement) for ambient WBT using RTD's installed in twelve (12) CTI-compliant mechanically aspirated psychrometers located at four (4) equal area points suspended from ropes at three (3) elevations around the tower circumference
- Dry-bulb temperature will be measured at a distance as defined (preferably at a location approximately 1.5 m above basin curb elevation not less than 15m or more than 100m to windward of the cooling tower or at a suitable location after mutual agreement) for ambient using RTD's installed in twelve (12) CTI-compliant mechanically aspirated psychrometers located at four (4) equal area points suspended from ropes at three (3) elevations around the tower circumference
- Barometric pressure will be measured with a calibrated barometer near the temporary DAS.
- Make up water flow and temperature shall be measured with permanent plant instrumentation if necessary. If permanent plant instrumentation is not available, makeup water flow shall be approximated from the tower evaporation rate, and makeup water

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	temperature shall be measured with a temporary installed RTD. The ambient wind speed will be measured with a calibrated RM Young meteorological station placed upwind of the tower in an open and unobstructed location beyond the influence of the inlet air. If wind speed is contractually agreed to be utilized as a correction to the tower performance, it will be considered a primary measurement. SECONDARY MEASUREMENTS Secondary variables are measured variables that do not enter into the calculation of the results. Secondary measurements are recorded as a quality indicator of the test. Information Only variables may be recorded for the Test Director's information.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE PAGE 158 OF 223



PG TEST PROCEDURE FOR TG & SG PLATE HEAT EXCHANGER (PHE)

Station : -----

Drawing no : -----



CONTENTS FOR PHE PROCEDURE

Sl No.	Description	Page No.
1	OBJECTIVE AND SCOPE:	3
2	GUARANTEES	3
3	TEST CONDITION	3-4
4	PREPARATION OF TEST	4
5	CONSTANCY OF TEST CONDITIONS	4
6	DURATION OF TEST AND FREQUENCY OF READINGS	5
7	INSTRUMENTS AND METHODS OF MEASUREMENTS	5-7
8	CALIBRATION OF INSTRUMENTS	8
9	EVALUATION OF TEST RESULTS:	8
10	TEST LOG SHEET	9-10
11	CORRECTION CURVES	11
12	TECHNICAL DATASHEET	12



1.0 Objective & Scope

The function of Plate Heat Exchanger is to maintain the desired temperature of equipment cooling water system in closed cycle. The purpose of this procedure is to provide the methodology for determining the performance of PHE's as per **Guarantees condition as defined in 2.0 below** & with regard to the proper functioning of the PHE by comparing the actual heat transfer coefficient with the expected overall heat transfer coefficient.

2.0 GUARANTEES:

Technical datasheet specification : Approved technical datasheet drawing no -----.

Mention technical datasheet parameters (temperature & flow) in fouled condition for guarantee condition with pr drop value .

DM water leaving PHE's is a function of heat transfer coefficient of the PHE's, the actual overall heat transfer coefficient shall be calculated and compared with expected overall heat transfer coefficient. In case of the actual Heat Transfer coefficient is equal or more than expected overall heat transfer coefficient (in fouled conditions), the guarantee shall be deemed to be met.

3. TEST CONDITION

Vendor to ensure that the PHE's are sufficiently cleaned to remove clogging / debris before the conductance of PG test.

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	• Every effort should be made to conduct the test runs under specified conditions & within accuracy of instruments. • Test to be conducted under steady state condition of operation specially load, temperature & flow rate conditions. • Before carrying out the test, it should be ensured that all the equipment's are inworking condition. • All instrument used for the test should have valid calibration certificate. All instruments shall be calibrated in an approved / NABL accredited test lab. 4.0 PREPARATION OF TEST: Prior to the test, the vendor shall be given an opportunity to examine and familiarize themselves with all the apparatus with the PHE's and the piping involved. All parties to the test shall certify that the PHE's are in satisfactory condition for the test. All the ACW pumps, ECW pumps, Self-Cleaning strainers and Plate heat exchangers shall be in working condition. 5.0 CONSTANCY OF TEST CONDITIONS: Any condition like flow rates , inlet & outlet temps of ECW & ACW side, whose variation may affect the test result shall be made as constant as far as possible before the test run begins and shall be maintained constant throughout the run. It is desirable to observe and record all reading for a brief period after the unit has attained steady conditions but before the formal readings of the run have begun.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE PAGE 162 OF 223



6.0 DURATION OF TEST AND FREQUENCY OF READINGS:

The test runs shall continue for a period sufficiently long to ensure accurate and consistent results. 15 Minutes is usually sufficient for a single test run.

Time interval between readings:

- a) Temperature : Every 2 Minutes
- b) Differential Pressure : Every 2 Minutes
- c) Flow Rate : Every 2 minutes

All observations shall begin simultaneously at the beginning of a test run and during this time reading shall be taken simultaneously for both the PHE's under the test.

7.0 INSTRUMENTS AND METHODS OF MEASUREMENTS:

7.1 Temperature Measurement:

The temperature of DMCW and ACW at inlet and outlet of PHE's shall be measured with Thermocouple / RTD / Temperature Gauge at accuracy not higher than + 0.1 degC. Temp gauge on the inlet side as well as on the outlet side shall be mounted on the pipeline, by the vendor.

7.2 Measurement of Pressure Drop:

The pressure drops are to be measured with the help of Pressure Gauges (to be installed for the purpose of the test only) across inlet and outlet of PHE. The accuracy of Pressure Gauge should not be higher than 0.1 MWC.



7.3 Measurement of Flow Rate:

TG PHE :

Measurement of the flow rate on the primary side & secondary side of the PHE's for TG Auxiliaries to be done by ultrasonic flow meter of **accuracy $\pm 2\%$ of FSD**. The total flow rate shall be equally divided into number of PHE in operation. To achieve the above mentioned accuracy with the flow meter, upstream and downstream pipe length of 10D/5D straight length without any obstacle (bends, tee, valve, reducer, expander etc) is required. If in actual site condition, above straight lengths are not available, appropriate correction factor in flow rate will be applied to correct the measured flow rate as per below Table 1.

Vendor to provide the correction factors

Table 1

Sr no	TG PHE	SIDE MEASURE D	AVAILABLE STRAIGHT LENGTH	CORRECTION FACTOR	OBSTACLES
		Primary			
		Secondary			
Vendor to provide the correction factors					

**SG PHE :**

Measurement of the flow rate on the primary side & secondary side of the PHE's for SG Auxiliaries to be done by ultrasonic flow meter of accuracy $\pm 2\%$ of FSD . The total flow rate shall be equally divided into number of PHE in operation. To achieve the above mentioned accuracy with the flow meter, upstream and downstream pipe length of 10D/5D straight length without any obstacle (bends, tee, valve, reducer, expander etc) is required. If in actual site condition, above straight lengths are not available, appropriate correction factor in flow rate will be applied to correct the measured flow rate as per below Table 2 .

Vendor to provide the correction factors.

Table 2

	SG PHE	SIDE MEASURED	AVAILABLE STRAIGHT LENGTH	CORRECTION FACTOR	OBSTACLES
		Primary			
		Secondary			
<i>Vendor to provide the correction factors</i>					



8.0 CALIBRATION OF INSTRUMENTS:

All instruments shall be calibrated in an approved / NABL accredited test lab. The Calibration Certificate in original shall be carried by PG test team. Copy of calibration Certificates shall be submitted to SCCL before start of PG test.

9.0 EVALUATION OF TEST RESULTS:

9.1 Pressure Drop: *Complete evaluation method with formulae used to be provided by vendor .*

9.2 Heat Transfer Coefficient (Evaluation of Thermal Performance)
Complete evaluation method with formulae used to be provided by vendor

9.3 : Sample calculation *for 9.1 & 9.2 to be provided by vendor.*



10.0 LOG sheet for Demonstration test of Inlet & Outlet temperatures of DM water on Primary & secondary side of Plate heat exchangers

Project: -----

Duration: -----Minutes

a) Readings for primary (DMCW) side for TG auxilliary

Table 3

Time	Sr no	Pressure at inlet of PHE Kg/cm ² (g)	Pressure at outlet of PHE Kg/cm ² (g)	Pr drop	Q1 Noted flow from the Ultrasonic flow meter m ³ /hr	T1 Temp at Inlet to PHE (°C)	T2 Temp at Outlet to PHE (°C)	Heat Load Kcal/hr (H1)	LMTD (°C)	Actual OHTC Kcal/ Hr.m ² °C (Km)	Expected OHTC Kcal/ Hr.m ² °C (Ke))

Note: Readings to be taken at taken intervals of 2 minutes for each PHE

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<i>b. Readings for secondary (ACW)Side of PHE's for TG Auxiliary</i> <i>c. Readings for primary (DMCW) Side of PHE's for SG Auxiliary</i> <i>d. Readings for secondary(AW) Side of PHE's for SG Auxiliary</i> <i>Above same format to be repeated & attached as table 3 to for b,c,d.</i>		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 168 OF 223

**11.0 Performance curves Drawing no -----**

Approved Correction curve from SCCL (Engg to)be attached along with transmittal

**12.1 Technical datasheet Drwg no -----**

Approved Technical datashhet from SCCL (Engg to)be attached along with transmittal



STANDARD TEST PROCEDURE PERFORMANCE GUARANTEE FOR MISCELLANEOUS PUMPS

Station:


CONTENTS

SI No.	Description	Page No.
1	OBJECTIVE OF TEST	
2	SCOPE OF PG TEST	
3	GENERAL CONDITIONS	
4	CALIBRATION OF INSTRUMENTS	
5	GUARANTEED PARAMETERS	
6	METHOD OF PERFORMANCE TESTING	
7	FUNCTIONAL GUARANTEES	
8	DURATION OF TEST	
9	TEST INSTRUMENT	
10	PROFORMA FOR READINGS OF PG TEST	
11	METHOD OF PERFORMANCE TESTING OF BUTTERFLY VALVE	



PG TEST PROCEDURE FOR MISCELLANEOUS PUMPS

____ EQUIPMENT PACKAGE FOR ____ STATION, STAGE- _ _

SCCL Drg. No.: _____ Vendor Drg. No.: _____ Date: –

1. OBJECT OF P.G. TEST:

Site test of Miscellaneous (SACW/RW (PT & ASH)/ ECW/DMCW/ ACW) Pumping equipment will be conducted to establish the performance under actual installed conditions with the Pumps as part of the system and when operating against the system resistance.

2. SCOPE:

P.G. Test applicable to Miscellaneous (SACW/RW (PT & ASH)/ ECW/DMCW/ ACW) Pumping equipment is as follows:

- 2.1. Verification of all Interlocks & Protection relating to the Pump & Motor.
- 2.2. Proper running of Pumps on load will be verified and Temperature of Bearings will be checked.
- 2.3. Verification of Pump & Motor Bearing Vibration and measurement of Noise Level.
- 2.4. Verification of satisfactory parallel operation of Pump.
- 2.5 Verification of satisfactory operation of Discharge Butter Fly Valve.

3. GENERAL CONDITIONS:

- 3.1. The Pump shall be in good operating condition at the time of test.
- 3.2. Water level shall be maintained as per requirement of the Pump during the test.
- 3.1. Approved Data Sheet of the Pumps, Shop test results witnessed by SCCL & Performance Curve based on Shop Test result shall be presented to SCCL – _ Site before conductance of PG Test.

4. CALIBRATION OF INSTRUMENTS:

All Instruments required for the Test, except Current Transformers, will be arranged by vendor. Calibration of Instruments, to be supplied by vendor for the Tests shall be the responsibility of vendor. Any one of the following independent agencies shall carry out calibration of these Instruments:

- 4.1. Electronic Research & Testing Laboratory – Kolkata.
- 4.2. Any other Government Institute / SCCL approved Laboratory.
- 4.3 Copies of the valid Calibration Certificates of all instruments shall be sent to SCCL – _ Station . Site at least 15 days before conductance of PG Test for approval.

5. GUARANTEED VALUES TO BE PROVED / DEMONSTRATED (Values to be filled up as per attachment 10):

- 5.1. Guaranteed Design Capacity: (M3/Hr.): Shop Test only
- 5.2. Guaranteed Total Head: (MWC) : Shop Test only
- 5.3. Total Bowl Head at guaranteed Design capacity: Shop Test only
- 5.4. Rated Speed (RPM) : Shop Test & Demo at site
- 5.5. Guaranteed Power consumption at Motor Terminals at Duty point (KW): Shop Test only

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	5.6. Maxm. Power Consumption at Motor Terminals in the Pump operating range (KW): Shop Test only 5.7. Vibration Level (Velocity in mm / sec) : Site Test 5.8. Noise Level (d BA) : Site Test 5.9. Parallel Operation (Site Test) : For equal load sharing Input Power to Motors should be within _ _ %. 5.10. Bearing Temperature (°C) (Site Test) : _ _ Deg. C (maximum) NOTE: Total Head = Pressure at Centre line of Pump Discharge Flange + Velocity Head at Discharge Flange + Level difference between minimum water level to Centre line of the Pressure Gauge at Pump Discharge Flange. <u>OTHER PARAMETERS TO BE MEASURED (MAY NOT BE GUARANTEED)</u> a) Current in Amps. b) Voltage in Volts c) Frequency in Cycles / Sec. d) Sump Level 6. <u>METHOD OF PERFORMANCE TESTING OF (_____ / ~~MW~~ (PT & ASH) / ECW/DMCW/ ACW) PUMPS: _____</u> 6.1. Speed will be measured with the help of a calibrated non-contact type Digital Tachometer. 6.2. Power input (P) will be measured with the help of two calibrated Wattmeters and suitable Current Transformers & Voltage Input at MCC of the client will be used for this purpose. 6.3. <u>Correction Factor</u> Rated Speed of the Pump $\text{Speed Ratio} = \frac{\text{Test Speed of the Pump}}{\text{Rated Speed of the Pump}} = C$ $\text{Corrected discharge head at rated speed} = C \times H$ $\text{Corrected Power Input at rated speed} = C \times P$ Discharge of the Pump (Q) will be found out from the H/Q Curve obtained during Performance Testing of the Pump at Test Laboratory of VENDOR Works. 6.4. Acceptance Criteria: Vibration & Noise level should be within specified limits. 7. FUNCTIONAL GUARANTEE TEST: 7.1. Noise Level Check: Noise measurement will be done all around Pump & Motor Set at a distance of 1.0 Metre from the nearest surface of the Pump – Motor Set at a height of 1.0 Metre from the floor level, as per HIS by a Noise Level Meter. The maximum level of Noise should be _____ dBA. 7.2. Vibration check: Vibration will be checked at all Bearing locations (NDE & DE Sides of Motor & NDE & DE Sides Pump Bearing) as per HIS / IS with the help of Vibrometer in Horizontal, Vertical and Axial directions. The acceptable limit is _ _ mm / sec (velocity) or _ _ microns (displacement).	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE PAGE 174 OF 223



7.3. Parallel Operation Check: Parallel operation check will be carried out by operating two Pumps in parallel. At equal heads / discharge pressure, equal load sharing of the pumps connected in parallel shall be measured by checking power input at Motor Terminals. The Power Values should be within _ %. There should not be any abnormal noise / vibration during parallel operation.

7.4. Bearing Temperature: All Pump and Motor Bearing Temperature will be recorded at 15 minutes interval, during two hours duration of test & the maximum temperature recorded should not be more than Degree Centigrade. A hand held Thermometer should be used for this purpose.

8. DURATION OF TEST:

Test should be conducted for duration of 2 hours.

9. LIST OF INSTRUMENTS FOR SITE TEST:

SL. NO.	INSTRUMENT	TYPE	ACCURACY	REMARKS
1	Wattmeter	Industrial / Laboratory	+ 0.5%	
2.	Pressure Gauge	Bourdon type	+ 0.5%	
3.	Vibrometer	IRD 308 or equivalent	+ 3%	
4	Noise Level meter	Sound level	+ 2 d BA	
5	Digital Tachometer	Electrical non-contact type	+ 1 RPM	
6.	Digital Thermometer		+ 0.1 Deg C	
7.	Stop Watch		+ 0.5 %	

10. *PROFORMA FOR READINGS OF PG TEST:*

10.1. Pumps running in parallel (Frequency of reading – 15 minutes)

SL. NO.	PUMP NO.			PUMP NO.		
	Disch. Pr.	Wattmeter	Reading	Disch. Pr.	Wattmeter	Reading
	(Kg / Cm ²)	W-1	W -2	(Kg / Cm ²)	W -3	W -4
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						


10.2. Vibration Readings:

___PUMP #	VELOCITY IN MM / SEC		
	Horizontal	Vertical	Radial
Motor NDE Side			
Motor DE Side			
Pump NDE Side			
Pump DE Side			

10.3. Readings of Individual Pump during test (frequency of readings – 15 minutes)

(MuW/RW (PT & ASH)/ ECW/DMCW/ ACW) PUMP #

SL. NO.	Difference of height between Water level & Pr. Gauge (Meters)	Discharge Pressure (Kg / Cm2)	Speed (RPM)	Wattmeter Reading (W-1)	Wattmeter Reading (W-2)
.					
.					
.					
.					
.					
.					
.					
.					

CT Ratio -----, Wattmeter (W-1) Constant ----, Wattmeter (W-2) Constant -----

10.4. Noise Level of ___Pump – Motor Set (in d BA):

PUMP #

HORIZONTAL PLANT						VERTICAL PLANTE					
E-1	E-2	E-3	E-4	E-5	E-6	V-1	V-2	V-3	V-4	V-5	V-6



10.5. Bearing Temperature, in Deg. C (Frequency 15 Minutes):

PUMP #

SL. NO.	Motor DE in Deg C	Motor NDE in Deg C	Pump DE in Deg C	Pump NDE in Deg C
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				

11. METHOD OF PERFORMANCE TESTING OF BUTTERFLY VALVE:

Test of Butterfly valve should be carried out in the following manner:

11.1. Valve will be given an “OPEN” Command. It should open from fully closed position to fully open position without any problem. The Valve should stop automatically after it reaches Full Open (100 % open) position.

11.2. The Valve will then be issued a “CLOSE” Command. It should reach fully closed condition from fully open condition without any problem. It should stop automatically once it reaches fully closed position (100% closed).

11.3. The time taken for Opening & Closing of Butter Fly Valves should be as per approved Data Sheet.

PROFORMA FOR RECORDING OF PG TEST FOR Butter Fly Valve (BFV)

BFV FOR _____ PUMP #	TIME IN SECONDS
From 100% closed to 100% open position	
From 100% open to 100% closed position	

Note:

1. Vendor to sign /digitally sign and stamp on all pages of PG procedure.
2. Attachment 10 giving guaranteed parameters to be enclosed.
3. Relevant pages of Functional Guarantee & LD to be enclosed.
4. Relevant pages of Tech Specs to be enclosed.



STANDARD PERFORMANCE GUARANTEE AND ACCEPTANCE TEST

PROCEDURE FOR AIRCONDITIONING SYSTEM FOR VARIOUS AREAS OF

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.0.0 INTRODUCTION				
In accordance with the condition of contract /letter of award on successful completion of system trial operation at site and liquidation of all defects, the system/ individual equipments shall be subjected to performance and Guarantee Tests at site.				
2.0.0 SCOPE				
The test procedure shall cover the Performance and Guarantee Tests to be conducted at site for the entire system / subsystems and individual equipments covered in the A.C. Package. The test procedure shall cover the testing method for parameters covered as — Guaranteed Parameters in LOA and checking of ratings and performance requirements stipulated for various equipments covered in the specifications.				
3.0.0 OBJECTIVE OF THE TEST				
3.1.0 To check healthy working of all the equipments forming the total air conditioning system.				
3.2.0 To check the power consumption of the motors for which power consumption limits are guaranteed at specified capacity of equipments.				
3.3.0 To verify the total capacity of the plant including stand-by equipments. The tonnage rating obtained from all AHUS/Chillers is to be cross checked from the heat rejection across the condensers. However, capacity of plant shall be verified during summer (May-August) but room temperature verification for 24 hours shall be done in both summer and monsoon.				
3.4.0 Capacity rating and guaranteed power consumption to be established during summer only during May to August when the ambient temperature (DBT) is generally high (Additional heating load if required shall be provided by SCCL / Vendor).				
3.5.0 To check the temperature and relative humidity conditions during summer and monsoon in the air-conditioned space with those incorporated in the contract.				
However Relative Humidity shall not be guaranteed for areas catered by High wall/Cassette/Ductable split air conditioners				
3.6.0 Operating parameters of the system to be logged for complete cycle with calibrated instruments at the time of capacity test during summer.				
3.7.0 Operating parameters of the system to be logged with online instruments except calibrated psychrometer for Room condition test during Monsoon test.				
3.8.0 To check satisfactory operation of all safety switches and electrical interlocks for each individual equipment and for the complete system.				
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION- G-04 STANDARD PG TEST PROCEDURE
				PAGE 179 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	3.9.0 Vibration and noise level to be measured for all rotating equipments. 4.0.0 CONDITONS OF TEST 4.1.0 Conductance of test Performance and Guarantee Test at site shall be conducted by accredited representatives of the CONTRACTOR/ Vendor and SCCL Limited. The contractor shall be given permission to inspect the entire system in advance and make it ready for test. Contractor representatives shall witness and associate with all phases of test and record the data jointly with SCCL representatives. 4.1.1 The responsibility for conducting the test rests with the contractor. 4.2.0 TEST INSTRUMENTS 4.2.1 All instruments required for the PG test will be provided by the contractor at their cost. 4.2.2 Calibration of test instruments shall be responsibility of the contractor. 4.2.3 Calibration of instruments (to be used in the test) shall be carried out at a Govt. /SCCL approved test laboratory. 4.2.4 Calibration of the instruments should be carried out prior to, but not more than six months before the commencement of the test. The calibration certificate of the instruments should be valid for the period of the test. 4.2.5 Calibration certificates (in original) of all instruments from Govt. /SCCL approved Test Laboratory shall be submitted by the contractor for SCCL approval prior to start of the test. Original Calibration certificate will be returned to Contractor after review & acceptance of the certificate. 4.2.6 All the calibrated instruments preferably shall be sealed after calibration at Test Lab & intactness of the seal shall be checked by SCCL before start of the test. If sealed, SCCL shall issue a certificate confirming the breakage of the seal after verification of instruments. 4.2.7 All on line instruments, which will be used during the test, shall be calibrated at Govt. /SCCL Test Laboratory. 4.2.8 On line pressure gauges shall be used for recording the parameters of compressor cycle. 4.2.9 Calibrated gauges of $\pm 0.5\%$ accuracy shall be used on water circuit for pressure and temperature measurement.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 180 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	4.2.10 Airflow of AHU shall be measured by using calibrated anemometer / velometer. 4.2.11 Bearing temperature is to be measured with thermometer of ± 1 degree C accuracy with Least count LC of 0.5 degree C. 4.2.12 Dry and wet bulb temperatures shall be measured using sling psychrometers. The thermometers of sling psychrometer shall be of $\pm 0.5\%$ accuracy with LC of 0.5 degree C. 4.2.13 All power consumption measurements shall be done by 2-wattmeter method OR Clamp-ON power analyser/tong tester method of accuracy class $\pm 1\%$ duly calibrated shall be used. 4.2.14 Tachometer for RPM measurement shall be of $\pm 1.0\%$ accuracy. 4.2.15 Calibrated instruments shall be used for vibration and noise level measurement. 4.3.0 PRE-REQUISITES TO THE PG TESTS. 4.3.1 The contractor should furnish a written statement to the effect that work covered in the contract has been completed for the system for which PG test will be carried out. 4.3.2 All the erection /commissioning protocols in respect of hydro test of pipe lines headers, alarm /annunciation /control system, vibration and noise level data of AHU, condenser and chiller pump etc. During commissioning shall be made available during PG test by the Contractor. 4.3.3 All SCCL approved data sheets for the plant /system for which PG test is to be carried out to be made available during PG test. 4.3.4 Uninterrupted power supply within specified parameters for the duration of the Test to be ensured by other agencies 4.3.5 Proper lubrication and oil level of all equipments to be ensured. 4.3.6 Cleanliness of plant /system 4.3.7 Protection relays of switchgears and all motor feeders shall be checked by other agencies. 4.3.8 Readiness of all protections, interlocks and safety switches to be ensured. Joint protocol in this respect shall be signed 4.3.9 Availability of suitable fire protection systems /fire fighting equipments to be ensured by other agencies during PG test.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 181 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	4.3.10 Deputation of team to site to associate with the P&G test to be ensured by the contractor. 4.3.11 Arrangement of all calibrated test instruments as per cl 4.2.0 to be ensured by the contractor. 4.3.12 The plant /system shall be jointly inspected by SCCL and the contractor and a joint protocol shall be signed that the plant is fit for P&G Test. 4.3.13 All the power measurement shall be done by 2 watt meter method. The watt meters of accuracy +/- 1% duly calibrated shall be used. 4.4.0 GUARANTEED PARAMETERS DECLARATION 4.4.1 The contractor should furnish a declaration in the manner as per Appendix -I for the guaranteed parameters which attract levy of liquidated damages for Shortfall in performance. Also declaration shall be given by contractor for other parameter covered as guaranteed parameter (Without liquidity damages). 4.4.2 TEST METHODOLOGY The test can be classified into four following groups: 1) Equipment performance 2) Capacity Assessment - Verify the plant capacity (tonnage rating) during summer (May to August) when ambient temperature (DBT) is generally high. 3) Power consumption -At specified capacity of the equipment 4) Room condition test- During summer and monsoon. 5.0.0 Equipment performance The plant should run continuously for 2 to 3 hours for stabilization of the system before measurements. After stabilization of the system, various parameters of the major equipment will be recorded in hourly log sheet. Four sets of such readings are to be recorded under stable conditions. Following are the parameters to be recorded during equipment performance check 5.1.1 Current rating and voltage of all motors with on line panel meter or calibrated tong tester to be logged. 5.1.2 Bearing temperature of all motors with calibrated thermometer.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 182 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	5.1.3 Pressure of water at condenser water pump inlet and outlet with calibrated gauges (To be done preferably with differential pressure gauge in order to avoid inaccuracy). 5.1.4 Pressure of water at chilled water pump inlet and outlet with calibrated gauges (To be done preferably with differential pressure gauge in order to avoid inaccuracy). 5.1.5 Temperature of water at condenser inlet and outlet with calibrated gauges. 5.1.6 Temperature of water at chiller inlet and outlet with calibrated gauges. 5.1.7 Dry and wet bulb temperature of entering air to AHU and of leaving air from cooling coil with calibrated psychrometer. DBT and WBT measurement of leaving air from Cooling coil of AHU shall be done at plenum or canvas connection of AHU. 5.1.8 Velocity of air shall be measured on the filters at the suction area the AHUs with calibrated anemometer /velometer. 5.1.9 After completion of capacity tests, working of heaters and humidifiers shall be demonstrated by adjusting the set points. The instruments controlling these equipments are to be kept in their set points during PG test and shall operate automatically only, if the inside conditions demand for. 5.1.10 Following shall be checked for cooling tower - Correct direction of fan with proper orientation of leading and trailing edges shall be checked. - Free & clear flow of all nozzles shall be checked. - Inlet & outlet temperature of cooling tower shall be recorded. 5.1.11 Speed of rotating equipment, wherever possible, shall be checked with calibrated Tachometer. 5.1.12 Proper working of modulating type mixing valves to be demonstrated by adjusting set points. 5.1.13 Noise and vibration level measurement Vibration and noise level of compressor, condenser water pump, chilled water pump, AHU fan, cooling tower motor shall be measured during PG test. Permissible limit of vibration for pumps shall be ____ microns peak to peak and for AHU, shall be in line with VDI-2056 class IV machines (good zone). Vibration level of compressor shall not exceed ____ mm/sec RMS velocity. Vibration level of Cooling Tower and other equipments shall be as per manufacturer recommendation shall be made available during testing. However acceptance vibration limit of all the equipments shall be made available at the time of testing. The maximum noise level shall be ____ dbA at 1.5 meter elevation and at a horizontal distance of 1.0 meter from the equipment.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 183 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	5.1.14 Parallel operation of chilled water pumps and condenser water pumps to be demonstrated at site. 5.2.0 CAPACITYASSESSMENT: i) CHILLED WATER SYSTEM: The capacity of the plant shall be assessed by chiller method as detailed in 5.2.2. The same will however, be cross checked also by condenser and AHU method as detailed at 5.2.3. and 5.2.1 respectively. In centralised chiller plant cumulative tonnage capacity (by chiller method) of all running equipment shall match with all running AHU's chiller system ii) PAC /AIR-COOL CONDENSING UNIT PAC/Air Cooled condensing units is -Direct Expansion type of AC Plant and hence the capacity of these units shall be assessed based on AHU method as detailed below in 5.2.1 (iii) AIR COOLED CHILLING SYSTEM: The capacity of the plant shall be assessed by chiller method as detailed in 5.2.2. The same will however, be cross checked also by AHU method as detailed at 5.2.1. In centralised chiller plant cumulative tonnage capacity (by chiller method) of all running equipment shall match with all running AHU's chiller system 5.2.1 Plant capacity from AHU method For verifying the plant capacity by AHU method the total air quantity handled by individual AHU shall be measured as mentioned below: Air quantity measurement will be taken on filters in front of AHU suction area. The air velocity shall be measured with calibrated anemometer / velometer. While taking this measurement, the following conditions are to be maintained: - All the AHUs except the standby unit should be in running condition. - Doors leading to AHU room should be kept closed and all other openings in AHU room as well as in the air-conditioned space and the areas in the return air path are to be sealed. - Air quantity of fresh air should be measured and damper is to be adjusted to allow the required quantity of fresh air only.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 184 OF 223



- d. Air velocity should be measured using calibrated Anemometer /velometer. Velocity shall be taken at 9 traverse in the direction perpendicular to AHU suction area on the each filter. Measurements shall be carried out to compute average air flow.

AHU being the ultimate equipment for heat transfer, capacity of the system shall be arrived at by calculations based on various recorded data of AHU.

It is to be ensured that while recording different parameters of AHU, the compressor shall run at full load.

METHOD OF CALCULATIONS:

$$\text{AHU capacity (TR)} = Q_a \times (E_1 - E_2) \times D / 3024$$

Where, Q_a = Quantity of air in M³/hr
 D = Density of air at AHU inlet in kg/m³
 E_1 = Enthalpy of entering air at AHU in Kcal/kg
 E_2 = Enthalpy of leaving air from AHU in Kcal/kg

Q is to be calculated by multiplying mean velocity of air by inlet suction area of AHU.

i.e. Q (in M³/hr) = Effective Filter size x No of Filters x Average Velocity x 3600

E_1 & E_2 are to be found out by plotting dry and wet bulb temperatures of entering and leaving air on psychometric chart.

5.2.2 PLANT CAPACITY FROM CHILLER:

Capacity of plant shall be assessed by chiller method. Same however will be cross checked by AHU method as detailed in 5.2.1

$$\text{TR} = \frac{Q_w \times (T_1 - T_2) \times 1000}{3024}$$

Where

TR = Capacity in TR

Q_w = Water flow rate through chiller (M³/Hr) = Quantity of water circulated by chilled water pump in M³/Hr

T_1 = Water temperature at chiller inlet (°C)

T_2 = Water temperature at chiller outlet (°C)

1000 = Multiplying factor



Q_w is to be obtained from the characteristic curve of the chiller water pump and pressure differential across the pump. Necessary correction for actual speed with respect to design speed shall be made. Original Characteristic curves of the chiller water pump shall be submitted by vender along with test results.

5.2.3 PLANT CAPACITY FROM CONDENSER/ HEAT REJECTION FROM CONDENSER

Heat rejection across the condenser should be equal to the sum of the heat absorbed by the evaporator (cooling coil) and the equivalent heat of the compressor shaft K.W.

Heat absorbed by the evaporator maybe calculated from the corresponding data of the AHU recorded simultaneously by the formula in 5.2.1 above

Heat rejection across the condenser (Kcal/hr)

$$= Q_w \times (T_1 - T_2) \times 1000 \text{ k-Cal/Hr} \dots\dots\dots A$$

Where,

Q_w = Water flow rate thru condenser (M³/Hr) = Qty of water circulated by cond. water pump in M³/hr

T₁ = Water temp. at condenser outlet (degC)

T₂ = Water temp. at condenser inlet (degC).

1000 = Multiplying factor

Q_w is to be obtained from the original characteristic curve of the pump and pressure differential across the pump. Necessary correction for actual speed with respect to design speed shall be made.

Characteristic curves of the condenser water pump shall be submitted by the vendor along with test result.

Heat equivalent of compressor shaft KW (Kcal/hr) = Input KW of compressor motor x motor efficiency x 860..... B

1KW = 860 Kcal

Tonnage Capacity= (A-B)/3024

Since 1Ton = 3024Kcal/hr.

5.3.0 POWER CONSUMPTION TEST:

Measurement of power for all motors shall be done by Power Analyzer or Two wattmeter method only. Power measurements shall be done at rated capacity during capacity test of equipments.

5.4.0 ROOM CONDITION TEST:

Room condition test shall consist of taking the readings of dry and wet bulb temperatures at different location points to be mutually decided at site in the areas which are air-conditioned by the respective system /plant. Room Condition test shall be done after stabilization of system.



The dry and wet bulb temperature shall be measured by sling psychrometer which will have accuracy of $\pm 0.5\%$ with a least count of 0.5°C .

This will be carried out for 24 hours continuously and readings will be taken every two hours. Standby equipment should be changed over during this 24 hours. This test shall be carried out during summer when the maximum ambient temperature is at least 40°C and during monsoon when relative humidity prevalent is not less than (-10%) of design value.

6.0.0 AIR COOLED CONDENSOR SYSTEM

6.1.1 PLANT CAPACITY FROM AHU METHOD

For verifying the plant capacity by AHU method total air quantity handled by individual AHU shall be measured as mentioned below.

Air quantity measurement will be taken in AHU suction in a direction perpendicular to AHU suction area. The air velocity shall be measured with calibrated anemometer/Velometer. While taking this measurement, following conditions are to be maintained:

- I. All the AHUs except the standby should be in running condition.
- II. Doors leading to AHU room should be kept closed and all other openings in AHU room as well in the air conditioned space and areas in return path are to be sealed.
- III. Air quantity of fresh air should be measured and damper to be adjusted to allow the required quantity of fresh air only.
- IV. Air velocity shall be measured using calibrated Anemometer / velometer. Velocity shall be taken at 9 traverse points in a direction perpendicular to AHU suction area. Measurements shall be carried out to compute average air flow.

AHU being the ultimate equipment for heat transfer, capacity of the system shall be arrived at by calculations based on various recorded data of AHU.

It is to be ensured that while recording different parameters of AHU the compressor shall be at full load.

METHOD OF CALCULATION

$$T = Q \times d \times (E1 - E2)$$

Where

T = Capacity in TR

Q = Quantity of air in m^3/hr

d = density of air at AHU inlet in Kg/m^3 (At AHU inlet temperature and pressure to be measured and density to be calculated)

E1 = Enthalpy of entering air at AHU in Kcal/kg



E2 = Enthalpy of leaving air from AHU in Kcal/kg

Q is to be calculated by multiplying mean velocity of air by inlet suction area of AHU.

i.e. Q (in M³/hr) = Effective Filter size x No of Filters x Average Velocity x 3600

E1 & E2 are to be found out by plotting dry and wet bulb temperatures of entering and leaving air on psychometric chart.

6.1.2 PLANT CAPACITY FROM CONDENSOR

Heat rejection across the condenser should be equal to sum of the heat absorbed by the evaporator (cooling coil) and the equivalent heat of compressor shaft KCal/Hr.

Heat absorbed by the evaporator may be calculated from corresponding data of AHU recorded simultaneously by the formula of 6.1.1 above.

Heat rejection across the condenser (K Cal/Hr)

$$Q_a = \dot{m}_a \times C_p \times \Delta T (T_1 - T_2) \dots \dots \dots A$$

Where Q_a = Heat rejection capacity of compressor (KW)

$\dot{m}_a$ = mass flow rate of air ($V_a \times \rho_a$) Kg/sec

V_a = Volume flow rate per fan M³/sec

ρ_a = Density of Ambient Air 1.0933 Kg/sec

C_p = Specific heat of air 1.006 KJ/KgK

T_1 = Outlet air temp in ° C at condenser

T_2 = Inlet temperature in ° C at condenser

Q_a is to be obtained from condenser approved data sheet/selection sheet

Original Characteristics curves of the condenser fan shall be submitted by the vendor along with test results

Heat equivalent of compressor shaft (Kcal/hr)

$$= \text{Input KW of compressor motor} \times \text{motor efficiency} \times 860 \dots \dots \dots B$$

(As 1KWh =860 KCal)

$$\text{Tonnage Capacity} = (A-B)/3024$$

Since 1TR= 3024 KCal / Hr



ANNEXURE – I

TECHNICAL PARAMETERS OF AC SYSTEM

Design Ambient Temperature (summer)	i) DB –°C
	ii) WB –°C
Design Ambient Temperature (monsoon)	i) DB –°C
	ii) WB –°C
Design Ambient Temperature (winter)	i) DB –°C
	ii) WB –°C

Design Indoor Conditions

i) All Building	DB 24°C±1°C	RH 50%±5%

Selected AC plant capacity as per SCCL Technical specification/Heat load calculation.

Sl. No.	Item	Capacity (each)	Quantity
1.0	Centralized AC system for Main plant Control Rooms		
1.1	Water cooled Chiller	 TR	(.....Working + ...Standby)
1.2	Chilled water pumps & motor	 m ³ /hr at MWC	(.....Working + ...Standby)
1.3	Condenser cooling water pump & motor.	(.....Working + ...Standby)	(.....Working + ...Standby)
1.4	Cooling tower with fan & drive.	 m ³ /hr	(.....Working + ...Standby)
1.5	Air Handling Units	 m ³ /hr	(.....Working + ...Standby)
2.0	A/C system for ESP Control Room of Unit #1 & #2		
2.1	Air cooled condensing units.	 TR	(.....Working + ...Standby)
2.2	Air Handling Units	 m ³ /hr	(.....Working + ...Standby)
3.0	A/C system for Water System Control Building.		
3.1	Air cooled condensing units.	 TR	(.....Working + ...Standby)
3.2	Air Handling Units	 m ³ /hr	(.....Working + ...Standby)

Note : Bidder to indicate equipment rating for Service Building, Administrative Building, Auditorium building, Canteen building, IT building, ASH handling plant VFD/control room, FGD control room, VFD control of Air cooled condenser(if applicable), Simulator Building (if applicable) and other buildings as per scope of work.



Appendix – I

GUARANTEED PARAMETERS WITH LIQUIDATED DAMAGES

Main Power House (TG Building)				
SL NO	EQUIPMENT DESCRIPTION	DUTY	Absorbed power (Guaranteed) at motor input terminal.	Value Tested During PG test
1	Water cooled Chiller - 1	(Continuous/St andby)	....	.....
2	Water cooled Chiller - 2		....	.....
3	Water cooled Chiller - 3		....	.....
4	Chilled water pumps – 1		....	.....
5	Chilled water pumps – 2		....	.....
6	Chilled water pumps – 3		....	.....
7	Condenser water pumps – 1		....	.....
8	Condenser water pumps – 2		....	.....
9	Condenser water pumps – 3		....	.....
10	AHU - 1		....	.....
11	AHU - 2		....	.....
12	AHU - 3		....	.....

ESP/VFD Control Building				
SL NO	EQUIPMENT DESCRIPTION	DUTY	Absorbed power (Guaranteed) at motor input terminal.	Value Tested During PG test
1	Air Cooled Condensing Unit - 1	(Continuous/Standby)	....	.....
2	Air Cooled Condensing Unit - 2		....	.....
3	AHU - 1		....	.....
4	AHU - 2		....	.....

Water System Control Building				
SL NO	EQUIPMENT DESCRIPTION	DUTY	Absorbed power (Guaranteed) at motor input terminal.	Value Tested During PG test
1	Air Cooled Condensing Unit - 1	(Continuous/Standby)	....	.....
2	Air Cooled Condensing Unit - 2		....	.....
3	AHU - 1		....	.....
4	AHU - 2		....	.....



Service Building				
SL NO	EQUIPMENT DESCRIPTION	DUTY	Absorbed power (Guaranteed) at motor input terminal.	Value Tested During PG test
1	Water cooled Chiller - 1	(Continuous/St andby)	....	.....
2	Water cooled Chiller - 2		....	.....
4	Primary Chilled water pumps – 1		....	.....
5	Primary Chilled water pumps – 2		....	.....
6	Secondary Chilled water pumps – 1		....	.....
7	Secondary Chilled water pumps – 2		....	.....
8	Condenser water pumps – 1		....	.....
9	Condenser water pumps – 2		....	.....
10	AHU - 1		....	.....
11	AHU - 2		....	.....
12	AHU - 3		....	.....

Administrative Building				
SL NO	EQUIPMENT DESCRIPTION	DUTY	Absorbed power (Guaranteed) at motor input terminal.	Value Tested During PG test
1	Water cooled Chiller - 1	(Continuous/St andby)	....	.....
2	Water cooled Chiller - 2		....	.....
4	Primary Chilled water pumps – 1		....	.....
5	Primary Chilled water pumps – 2		....	.....
6	Secondary Chilled water pumps – 1		....	.....
7	Secondary Chilled water pumps – 2		....	.....
8	Condenser water pumps – 1		....	.....
9	Condenser water pumps – 2		....	.....
10	AHU - 1		....	.....
11	AHU - 2		....	.....
12	AHU - 3		....	.....

Total cumulative power consumption of AC system package is KW as per bidding documents. (Bidder to attach relevant page of bidding document)



Note: The above list is indicative only. Bidder to furnish the guaranteed power consumption of all equipment which attract Liquidated damages as per specification/contract.

Project :....., STAGE-.... (...x..... MW)

Package: Air condition System COA No. :.....

Contractor: Owner :SCCL Limited

**STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE
AIR CONDITIONING SYSTEM**

Equipment	Description of Parameter	Guaranteed Value as per LOA	Quantity (Working quantity as per Tech. Spec.)	Value Noted during PG Test
AC Plant for Main Plant Area: TG BUILDING				
1	Chilling Unit Plant .	Auxiliary Power consumption in KW at motor terminal at rated duty point for each drive	 KW	Nos
2	Chilled Water Pump for main AC Plant M ³ /hr at M total Head	Auxiliary Power consumption in KW at motor terminal at rated duty point for each drive	KW	Nos
AC Plant for ESP Building & WSCB				
3	CONDENSING UNITS: TR	Auxiliary Power consumption in KW at motor terminal at rated duty point for each drive	KW	Nos.
4	CONDENSING UNITS: TR .	Auxiliary Power consumption in KW at motor terminal at rated duty point for each drive	 KW	 Nos.
5	Condenser Water Pump for main AC Plant M ³ /hr at M total Head	Auxiliary Power consumption in KW at motor input terminal at rated duty point for each drive	KW	Nos.
AHU Fans for Various Areas				
6	i) AHU - 1 to 6 - M ³ /hr at mmWC	Auxiliary Power consumption in KW at motor terminal at rated duty point for each drive	KW	Nos
	ii) AHU - 7 to 8 - M ³ /hr at mmWC	Auxiliary Power consumption in KW at motor terminal at rated duty point for each drive	KW	Nos
	iii) AHU - 9 to ...No.s - M ³ /hr at mmWC	Auxiliary Power consumption in KW at motor terminal at rated duty point for each drive	KW	Nos



STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE FOR AIR CONDITIONING SYSTEM

Project :....., STAGE-.... (...x.... MW)

Package: Air condition System COA No. :.....

Contractor: Owner :SCCL Limited

STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE AIR CONDITIONING SYSTEM

GUARANTEED PARAMETERS (Parameter covered under liquidity damages)

[illegible]

Contractor :



Appendix I

FORMAT FOR RECORDING AIR QUANTITY ACROSS AHU

Project :, STAGE-.... (...x.... MW)

Package: Air condition System COA No. :

Contractor: Owner : SCCL Limited

STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE
FOR AC SYSTEM

Date :

Reading Set : Unit of Operation No. of Filters : Effecting Filter Size (L x W) m² :

Filter No	No of Reading in each Filter / Point (m/s)				
	1	2	3	4	5

Average Velocity (m/s) :

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Appendix - II

Project :....., STAGE-.... (...x..... MW)

Package: Air condition System COA No. :.....

Contractor: Owner :SCCL Limited

STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE
FOR AC SYSTEM

Date :

FORMAT OF CHECKING POWER CONSUMPTION OF MOTORS - AIR CONDITIONING PACKAGE

SL No	Time in hr	Current in amps	Voltage in volts	Wattmeter reading	Actual power	Power factor	Remarks
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			

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Appendix -III

Project :....., STAGE-.... (...x..... MW)

Package: Air condition System COA No. :.....

Contractor: Owner :SCCL Limited

STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE FOR AC SYSTEM

Date :

STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE FOR AC SYSTEM

FORMAT OF CHECKING POWER CONSUMPTION OF MOTORS - AIR CONDITIONING PACKAGE

SL No	Time in hr	Current in amps	Voltage in volts	Wattmeter reading	Actual power	Power factor	Remarks
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		RR - Y - B	RY RY - YB - RB	RR - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			

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Appendix – V

Project :, STAGE-.... (...x.... MW)

Package: Air condition System COA No. :

Contractor: Owner :SCCL Limited

STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE FOR AC SYSTEM

Motor make :

Location & application :

Guaranteed power cons. (as per LOA/Contract)

Dated of calibration of instrument and name of test :

Reading Set No :

Date :

FORMAT OF CHECKING POWER CONSUMPTION OF MOTORS - AIR CONDITIONING PACKAGE

SL No	Time in hr	Current in amps	Voltage in volts	Wattmeter reading	Actual power	Power factor	Remarks
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		RR - Y - B	RY RY - YB - RB	RR - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			

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Appendix -III

Project :, STAGE-.... (...x..... MW)

Package: Air condition System COA No. :

Contractor: Owner :SCCL Limited

STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE FOR AC SYSTEM

Motor make :

Location & application :

Guaranteed power cons. (as per LOA/Contract)

Dated of calibration of instrument and name of test :

Reading Set No :

Date :

FORMAT OF CHECKING POWER CONSUMPTION OF MOTORS - AIR CONDITIONING PACKAGE

SL No	Time in hr	Current in amps	Voltage in volts	Wattmeter reading	Actual power	Power factor	Remarks
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - YY - B	RY - YB YB - RB	R - YY - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			
		R - Y - B	RY - YB - RB	R - Y - B			

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CONTRACTOR


FORMAT FOR RECORDING OF EQUIPMENT PARAMETERS
Appendix-IV
Project :, STAGE-.... (...X..... MW)
Package: Air condition System COA No. :
Contractor: Owner :SCCL Limited
STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE FOR AC SYSTEM
Date :
Area : MAIN POWER HOUSE
Instrument Used & SL No : .
Reading set no :

SL No	EQUIPMENT	Parameters	Reading 1	Reading 2	Reading 3	Reading 4
			Time :	Time :	Time :	Time :
1	CHILLER No :	Water temp. at inlet (°C)				
		Water temp. at outlet (°C)				
2	CHILLER No :	Water temp. at inlet (°C)				
		Water temp. at outlet (°C)				
3	CONDENSER No :	Water temp. at inlet (°C)				
		Water temp. at outlet (°C)				
4	CONDENSER No :	Water temp. at inlet (°C)				
		Water temp. at outlet (°C)				
5	CHILLED WATER PUMP No :	Pressure at suction (kg/cm ²)				
		Pressure at discharge (kg/cm ²)				
		Bearing temp. of motor (°C)				
		Rotating speed (RPM)				
		Full Load Current				
6	CHILLED WATER PUMP No :	Pressure at suction (kg/cm ²)				
		Pressure at discharge (kg/cm ²)				
		Bearing temp. of motor (°C)				
		Rotating speed (RPM)				
		Full Load Current				
		Pressure at discharge (kg/cm ²)				
		Bearing temp. of motor (°C)				
		Rotating speed (RPM)				
		Full Load Current				
7	COOLING TOWER & FAN MOTOR No :	Inlet Temperature (°C)				
		Outlet Temperature (°C)				
		Flow through nozzle				
		Inlet Temperature (°C)				
		Outlet Temperature (°C)				
		Flow through nozzle				

SCCL
CONTRACTOR


FORMAT FOR RECORDING VIBRATION LEVEL & NOISE LEVEL OF EQUIPMENT

Appendix - V

Project :, STAGE-.... (...x.... MW)

Package: Air condition System COA No. :

Contractor: Owner :SCCL Limited

Date :

STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE FOR AC SYSTEM

Instrument Used & SL No :

Reading set no : Area : MAIN POWER HOUSE

SL N o	EQUIPMENT	READING No	TIME	DISPLACEMENT IN MICRON (Acceptable value ----- microns)			NOISE LEVEL IN dBA (acceptable value ---- dBA)	RPM	REMARKS
				V	A	H			
1	AHU No :	1							
		2							
		3							
		4							
2	AHU No :	1							
		2							
		3							
		4							
3	AHU No :	1							
		2							
		3							
		4							
4	AHU No :	1							
		2							
		3							
		4							
5	AHU No :	1							
		2							
		3							
		4							
6	AHU No :	1							
		2							
		3							
		4							
7	AHU No :	1							
		2							
		3							
		4							
		2							
		3							
		4							
		4							
SCCL				CONTRACTOR					


FORMAT FOR RECORDING VIBRATION LEVEL & NOISE LEVEL OF EQUIPMENT
Appendix - V

Project :, STAGE-.... (...x..... MW)

Package: Air condition System COA No. :.....

Contractor: Owner :SCCL Limited

Date :

STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE FOR AC SYSTEM

Instrument Used & SL No :

Reading set no : Area : ESP CONTROL ROOM

SL No	EQUIPMENT	READING No	TIME	DISPLACEMENT IN MICRON (Acceptable value ----- microns)			NOISE LEVEL IN dBA (acceptable value ---- dBA)	RPM	REMARKS
				V	A	H			
1	AHU No :	1							
		2							
		3							
		4							
2	AHU No :	1							
		2							
		3							
		4							
3	AHU No :	1							
		2							
		3							
		4							
4	AHU No :	1							
		2							
		3							
		4							
5	AHU No :	1							
		2							
		3							
		4							
6	AHU No :	1							
		2							
		3							
		4							
7	AHU No :	1							
		2							
		3							
		4							
SCCL								CONTRACTOR	



Appendix - VI

Project :, STAGE-.... (...x.... MW)

Package: Air condition System COA No. :.....

Contractor: Owner :SCCL Limited

Date :

STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE FOR AC SYSTEM

Instrument Used & SL No :

Reading set no : Area : ESP CONTROL ROOM

SL No	EQUIPMENT	READING No	TIME	Entering Air Parameters			Leaving air parameters		
				DB (C)	WB(C)	Enthalpy Kcal/Kg	DB (C)	WB(C)	Enthalpy Kcal/Kg
1	AHU No :	1							
		2							
		3							
		4							
2	AHU No :	1							
		2							
		3							
		4							
3	AHU No :	1							
		2							
		3							
		4							
4	AHU No :	1							
		2							
		3							
		4							
5	AHU No :	1							
		2							
		3							
		4							
6	AHU No :	1							
		2							
		3							
		4							
7	AHU No :	1							
		2							
		3							
		4							
SCCL				CONTRACTOR					


FORMAT FOR RECORDING VIBRATION LEVEL & NOISE LEVEL OF EQUIPMENT
Appendix -VII
Project :, STAGE-.... (...x.... MW)
Package: Air condition System COA No. :
Contractor: Owner :SCCL Limited
STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE FOR AC SYSTEM
Instrument Used & SL No :
Date :
Reading set no : Area : MAIN POWER HOUSE

SL No	EQUIPMENT	READING No	TIME	DISPLACEMENT IN MICRON (Acceptable value - ---- microns)			NOISE LEVEL IN dBA (acceptable value ---- dBA)	REMARKS
				V				
1	CHILLING UNIT No :	1						
		2						
		3						
		4						
2	CHILLING UNIT No :	1						
		2						
		3						
		4						
3	CHW PUMP No :	1						
		2						
		3						
		4						
4	CHW PUMP No :	1						
		2						
		3						
		4						
5	CHW PUMP No :	1						
		2						
		3						
		4						
6	CCW PUMP No :	1						
		2						
		3						
		4						
SCCL				CONTRACTOR				



Area : FORMAT FOR RECORDING VIBRATION LEVEL & NOISE LEVEL OF EQUIPMENT								
Appendix-VIII Project :, STAGE-.... (...x..... MW) Package: Air condition System COA No. : Contractor: Owner : SCCL Limited								
STANDARD GUARANTEE AND ACCEPTANCE TEST PROCEDURE FOR AC SYSTEM								
Instrument Used & SL No : _____ Date : _____								
Reading set no : Area ESP & WSC BUILDING								
SL No	EQUIPMENT	READING No	TIME	DISPLACEMENT IN MICRON (Acceptable value ----- microns)		NOISE LEVEL IN dBA (acceptable value ----- dBA)		REMARKS
				V				
1	COND. UNITS	1						
		2						
		3						
		4						
2	COND. UNITS	1						
		2						
		3						
		4						
SCCL				CONTRACTOR				

Note:

1. Vendor to sign /digitally sign and stamp on all pages of PG procedure.
2. Attachment 10 giving guaranteed parameters to be enclosed.
3. Relevant pages of Functional Guarantee & LD to be enclosed.
4. Relevant pages of Tech Specs to be enclosed.



**PG TEST PROCEDURE FOR VENTILATION SYSTEM PACKAGE
PROJECT : ----- SUPER THERMAL POWER PROJECT (-- X -- MW)**

OBJECTIVES OF THE TESTS:

I.	To Verify the guarantee parameters.
II.	To check healthy working of all the equipment forming the total Ventilation system.
	Following parameters shall be measured during Guarantee Test.
III..	D.B., W.B. temp. and saturation efficiency of Evaporative Cooling
IV..	System and D.B and W.B temperature of UAF System during summer
V.	Capacity of Centrifugal Fans
VI.	Power Consumption of fans & pumps at rated capacity using watt meters. Current and voltage rating of motors shall also be recorded.
VII.	Vibration & Noise Level of pumps and fans
VIII.	Bearing Temp. of Motors, fans & pumps.
IX.	Fan speed.
X.	Pressure drop across air washer and UAF units.
XI.	To check satisfactory operation of all electrical interlocks for each individual equipment and for the complete system.
XII.	Performance test for Centrifugal & Axial flow (i.e. R. Exhauster, Propeller type Tube Axial fan etc.) Fans

1. EQUIPMENT PERFORMANCE

The plant should continuously run for two hours for stabilization of the system before commencement of taking measurement of different parameters.

Following are the parameters to be recorded during equipment performance test:

- I. Current and Voltage or Power drawn by motors.
- II. Bearing temperature of motors, fans and pumps to be measured
- III. Pressure developed by pumps shall be measured
- IV. The Air flow quantity shall be calculated by measuring velocity with help of anemometer /velometer in front of suction filters in a direction perpendicular to filter planes and at 1" distance from the filter. Air Washer Room shall be closed while taking reading on Anemometer/Velometer. Velocity shall be measured at 5-7 transverse points across the filters to compute average velocity for flow calculations.

$$\text{Test Capacity (M}^3\text{/sec)} = \text{Inlet Suction Area(M}^2\text{)} \times \text{Average Velocity (M/sec)}$$

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	V. Dry bulb temperature, Wet bulb temperature of entering air before the air washer and leaving air just after the eliminators. VI. Vibration and noise level of centrifugal fans and associated motors to be measured. The limit will be as per QAP/Relevant standard. VII. Fan speed by Tachometer .		
	2. CONDUCTANCE OF TEST i) Responsibility for conducting the test rests lies with Contractor. ii) Guarantee Test shall be conducted at site by representatives of Vendor and SCCL as per the procedure hereunder. Contractor shall be given permission to inspect the system in advance and make it ready for the test.		
	3. TEST INSTRUMENTS All instruments required for the test shall be arranged by Vendor free of cost. Calibration of test instruments shall be responsibility of Vendor. I. Calibration of instruments (to be used in the test) shall be carried out at an Govt./NABL approved test laboratory and calibration certificate of the instruments should be valid during the period of the test. II. Calibration certificate (in original) of all instruments shall be submitted to SCCL Site for approval. III. All the calibrated instruments shall be sealed after calibration at test lab and intactness of the seal shall be checked by SCCL before start of the test. IV. Bearing Temperature is to be measured using thermometers of ± 1 deg. C accuracy having least count of 0.5 deg. C. V. Online pressure gauges shall be used for recording the parameters of pumps. VI. Calibrated gauges of accuracy $\pm 0.5\%$ shall be used on water circuit for temperature & pressure measurements. VII. Air flow shall be measured using calibrated velometer / Anemometer. VIII. Dry bulb & Wet bulb temp shall be measured using sling psychrometer. The thermometers of psychrometer, shall be ± 0.5 deg. C accuracy with least count of 0.5 deg. C. IX. Wattmeter of $\pm 1.0\%$ accuracy class shall be used for power consumption measurement. X. Vibration & Noise level of motors, fans & pumps shall be measured by calibrated instruments. XI. Tachometer for R.P.M. measurement shall be of $\pm 1.0\%$ accuracy. XII. Manometer for pressure drop across filters. XIII. Voltage and current shall be measured using tong tester/Clamp meter of $\pm 1\%$ accuracy class. 4. PRE-REQUISITES TO THE GUARANTEE TEST I. All the installation / commissioning protocols in respect of alarm/ annunciation/ control system,		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 207 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	pipeline flushing, vibration & noise level measurement data of motors, fans & pumps during commissioning shall be made available during Guarantee Test by the contractor. II. All SCCL approved data sheets for the plant/system for which Guarantee Test is to be carried out shall be made available during the test. III. Uninterrupted power supply within specified parameters for the duration of the test shall be ensured by SCCL. IV. Proper lubrication and oil level of all equipment to be ensured. V. Cleanliness of Plant/System shall be ensured by SCCL. VI. Protection relays of switchgears and all motor feeders shall be checked. VII. Readiness of all protections, interlocks and safety switches to be ensured. Joint protocol in this respect shall be signed. VIII. Availability of suitable fire protection system/ fire fighting equipment to be ensured by SCCL during Guarantee Test. IX. Deputation of team to site to associate with the test to be ensured by the Contractor. X. Arrangement of all calibrated test instrument as per Cl. No. 2.02.00 to be ensured by the Contractor. XI. The plant/ system shall be jointly inspected by SCCL and the contractor and a joint protocol shall be signed that the plant is fit for conducting guarantee Test. 1 Successful completion of trial operation. 5.TEST METHODOLOGY I. SATURATION EFFICIENCY OF AIR WASHER UNIT Before commencement of Guarantee Test of Air Washer System, the plant shall run for at least 2-3 hours for stabilization of system and all required adjustments shall be done by vendor till all guaranteed parameters are achieved. Also before start of test working of various mechanical/electrical parts to be checked visually and satisfactory operation of all electrical interlocks and controls to be checked. SATURATION EFFICIENCY shall be computed using following formula:- $\text{Saturation Efficiency} = \frac{T_e - T_1}{T_e - t_e} > \text{-----} \text{ (As per Technical Specification)}$ Where, Te = Dry Bulb temperature Entering Air Washer Unit. T1 = Dry Bulb Temperature leaving Air Washer Unit. te =Wet Bulb Temperature entering Air Washer Unit Dry Bulb & Wet Bulb Temperature at Inlet & Outlet of Air Washer shall be measured by Sling Phychrometer. Sling Phychrometer reading will be taken through moving air and continued till thermometer reading becomes steady. The thermometer forming part of Sling Phychrometer shall be of + 0.5% accuracy with least count of 0.5 deg. C. II. In case of UAF units, Dry Bulb & Wet Bulb temperature at inlet and outlet of UAF unit shall be measured by sling phychrometer. III. VIBRATION & NOISE LEVEL Vibration of Centrifugal Fans and Pumps and Associated Motors shall be measured.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 208 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	Acceptance criterion for Vibrations and noise level shall be as per technical specification. IV. BEARING TEMPERATURE Motor, Fan & Pump Bearing Temperature, wherever possible, shall be measured by Surface Contact. V. General Functional Test (Run Test) of all equipment shall be done at site.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 209 OF 223



PROJECT: ---- THERMAL POWER STATION (---x ---MW) PACKAGE :

VENTILATION SYSTEM

P.G TEST LOG SHEET FOR AIR WASHER/UAF SYSTEM

Location/System :						
		A	B	C	D	E
1	Velocity across Filter (M/Sec.)					
		Average velocity (M/Sec.) =				
2	Area of Filter (M2)					
3	Pump (RPM)	Fan:			Pump :	
4	Current (Amp)	Fan Motor			Pump Motor	
		R			R	
		Y			Y	
		B			B	
5	Voltage (V)	Fan:			Pump :	
6	Bearing temp. Deg. C	Fan:			Pump :	
7	Dry bulb temp (Te)					
8	Wet bulb temp (te)					
9	Dry bulb temp (TI)					
10	Pump Discharge Pressure (Kg/cm2)					
11	Pressure drop across the Air washer (mm W.C)					
12	Noise (dBA)					
13	Vibration	V	H	A		



Standard TG PG Test Procedure of Compressed air System

Station Name--- Capacity		
1	OWNER	SCCL Limited (A Govt. of India Enterprise)
2	CONTRACTOR	Name-----
3	CONTRACT No.	
4	SUB-CONTRACTOR	
5	OWNER's Doc. No./Rev No	
6	CONTRACTOR's Doc. No. / Rev No.	/
7	SUB-CONTRACTOR's Doc No. / Rev. No.	/
8	DRG./DOC. Title	PG TEST PROCEDURE FOR Compressed air System
9	PURPOSE	FOR APPROVAL



REVISION STATUS FOR OWNER'S DOCUMENT

[illegible]

OWNER's APPROVAL			CONTRACTOR's APPROVAL		
Authorized Representative	signature	Name	Authorized Representative	Signature	Name
Approved by			Approved by		
Checked by			Checked by		
Prepared by			Prepared by		

CLAUSE NO.	TECHNICAL REQUIREMENTS			
CONTENTS 1. Scope 2. Objective of the test 3. Test Conditions & Pre requisites of Test 4. Test Instrumentation 5. Test Methodology 6. Formats (As applicable) 7. Attachments 5 5 6-7 7-8 8-10 11-12 13				
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 213 OF 223	

**Test Parties: -**

- a. **Witness :- SCCL Limited (Herein after called SCCL)**
- b. **Contractor: -** -----Name of organization
- c. **Sub- Contractor: -** -----Name of organization

*This document provides the Performance Guarantee Test Procedure for **Compressed Air System** Station Name-----, capacity----- to confirm that the following item meet the guarantee value as per **SCCL technical specification Functional Guarantee & Liquidated Damage (FGLD) & Attachment 10** (whichever is applicable).*

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	Scope: - PG test shall be Conducted as per Contract. The test procedure shall cover the performance test to be conducted at site for the Compressed air system and accordingly listed in this procedure. The test procedure shall cover the testing method for technical parameters, checking of ratings and performance requirements stipulated for various equipment covered in this procedure. 2. OBJECTIVE OF THE TEST: - The objective of test is to be checking following parameters of air compressed system: 1. To check healthy condition of all equipment forming total compressed air system. 2. Operating parameters of the system to be logged for the complete cycle with online (calibrated) instruments at the time of test. 3. To check satisfactory operation of all safety switches and electrical interlocks for each individual equipment and for the complete system. 4. To check healthy condition of all electrical as well as instruments installed on air compressed system. 5. Operability test of balance system which cannot be operated/checked at the vendor's work/plant 6. Check parallel operation of working compressors 7. To check pressure, drop across ADP, capacity & outlet dew point of each ADP (Air Dryer Plant). 8. Noise level measurement, vibration/shock pulse measurement shall be conducted. 9. The capacity measurement & power consumption of the compressors shall be conducted either at the shop floor or test bed of vendor workshop. Signed Copies of the test reports by VENDOR & SCCL shall be furnished during the site PG test & it will be acceptable to both parties VENDOR TO QUOTE/INCLUDE THE SUITABLE VALUE OF GUARANTEED PARAMETERS VALUE FOR SL NO, 6,7,8, 9 AS PER SCCL TECH SPECS (FGLD SHEET) ATTACHMENT 10 & APPROVED TECH DATA SHEET (WHICHEVER IS APPLICABLE) 3. Test conditions responsibility & prerequisites before the test SCCL i. Conductance of PG test by representatives of Vendor and SCCL as per the approved PG test Procedure.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 215 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	ii. Contractor shall be given permission to inspect the system in advance and make it ready for the test. iii. To ensure Continuous run of plant for at least two hours for stabilization of the system before commencement of PG test. iv. Availability of approved data sheets for the plant/system during the test. v. To ensure Cleanliness of Plant/System, filters etc & uninterrupted power supply within specified parameters during the test. vi. Availability of suitable fire protection system/firefighting equipment's to be ensured. vii. Successful completion of trial operation of Compressors. CONTRACTOR I. Deputation of team to site to associate with the test to be ensured by the Contractor II. Readiness of Formats as well instrument availability for Recordings of Parameters for PG test requirements. III. Responsibility for conducting the test rests with Contractor. IV. Calibration of all instruments used during the test in an approved NABL labs/ labs certified by SCCL & Hand over of all calibration certificates (in original) to SCCL at least 15 days before start of the PG test. V. All the installation / commissioning protocols in respect of alarm/ annunciation/ control system, pipeline flushing, vibration & noise level measurement data of motors, fans & pumps during commissioning shall be made available during Guarantee Test. VI. Readiness of all protections, interlocks and safety switches to be ensured. Joint protocol in this respect shall be signed before the Test. VII. Sufficient skilled/ required Manpower availability & removal of Instruments as required/Instructed by SCCL.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 216 OF 223

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<i>The plant/ system shall be jointly inspected by SCCL and the contractor and a joint protocol shall be signed that the plant is fit for conducting guarantee Test</i> TEST INSTRUMENTS All instruments required for the site performance test shall be provided/arranged by the Contractor. The instruments furnished below shall be used for the purpose of the PG. If additional instruments are required for the test, the same shall be arranged by supplier at the time of testing. Calibration of all instruments used during the test in an approved NABL labs/ labs certified by SCCL & Hand over of all calibration certificates (in original) to SCCL at least 15 days before start of the PG test. ▪ <i>Bearing Temperature</i> is to be measured using RTD by 0.5 % accuracy or better. ▪ <i>Pressure gauges</i> shall be used for recording the parameters of pumps. Accuracy 0.5 % or better. ▪ <i>Wattmeter</i> of + 0.5 % accuracy class or better shall be used for power consumption measurement. ▪ Vibration & Noise level of motors, fans & pumps shall be measured by calibrated instruments. ▪ Manometer to be used for measurement of pressure drop across filters. ○ Voltage and current shall be measured using <i>tong tester/Clamp meter</i> of +/- 0.5 % accuracy class or better. TEST METHODOLOGY ● AIR DRYER DEW POINT The demonstration of the Dew point temperature at atmospheric pressure at the rated full load to be carried out at site. The atmospheric Dew point temperature at the air dryer outlet shall be ----- deg C as per approved Dryer datasheet drawing no -----specification. The graph showing the relation between Atmospheric dew point (ADP)		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 217 OF 223



& Pressure dew point(PDP) shall be provided by Contractor.

- PRESSURE DROP ACROSS AIR DRYER

The pressure drops across the air dryer, while the dedicated Instrument air compressor and dryer combination is working together at the rated load shall be recorded.

- AIR COMPRESSOR

PROTECTION AND ALARM CHECK

Operation of protection interlocks, alarms shall be checked and recorded. However, the joint inspection reports / protocols, made before / during commissioning of the units duly signed by the site officials shall be verified and considered as official documents for this purpose.

- DISCHARGE AIR PRESSURE: -

The compressor air discharge pressure and current shall be recorded in the format for the site performance test. Performance of receiver drain traps shall be checked and recorded in the format for the site performance test.

NOISE LEVEL MEASUREMENT

The specified noise level is ----- dB (A) as per standard reference code preferably ISO 2151 code.

Noise level shall be measured by a calibrated portable instrument. It shall be measured at 1 metre distance from the equipment and at 1.5 metre above the floor level. The readings shall be taken at all four sides of the compressor unit.

For eventual noise, from the discharge line, accessories and /or ancillary equipment which are not included, a correction factor of Maximum 4 dB (A) shall be allowed for background & ambient noise.

This correction factor is based on the background noise in the air compressor room having multiple compressor units along with the canopy with sound absorbing foam.

The noise levels shall be recorded in the format for the site test.



- VIBRATION MEASUREMENT

The vibration measurements shall be as per international standard (VOi 3836, Group 2) or ISO 10816-3.

Based on the above reference, the limits of vibration in terms of velocity shall be :-

Acceptable velocity value = 10 mm / sec [RMS] or less

The readings shall be taken with the calibrated portable instrument and recorded in the format for the site test.

CAPACITY & POWER MESUREMENT OF COMPRESSOR

Capacity & power consumption test copy witnessed at shop floor /Test bed of Contractor shall be acceptable for this test.



**Formats (Complete system) PROJECT: Station Name -----, Capacity (-----
 ----) PACKAGE : Compressed Air System Date :-----**

Compressor Model		Customer	
Compressor Make		O/A Number	
Compressor Sr. No		Consultant	
Main motor Sr. No		Main Motor Make	

• **PERFORMANCE TEST DATA OF COMPRESSOR & AIR DRYER**

SL.NO	PARAMETER	UNIT	Reading 1	Reading 2
1.	Time	HR: MIN		
2.	Ambient Temperature	Deg C		
3.	Ambient Pressure	Bar A		
4.	Relative humidity	%		
5.	Compressor Discharge	Bar G		
6.	Cooling water inlet	Bar G		
7.	Cooling water outlet	Bar G		
8.	Cooling water inlet	Deg C		
9.	Cooling water outlet	Deg C		
10.	Main Drive motor Current	Amp		
11.	Auxiliary air compressor power	kW		
12.	Noise level	dBA		
13.	Vibration velocity	mm/sec		
Air dryer				
14.	Atmospheric dew point	Deg C		
15.	Air Pressure drop	Bar G		
16.	Cooling water inlet	Bar G		
17.	Cooling water outlet	Bar G		
18.	Cooling water inlet	Deg C		
19.	Cooling water outlet	Deg C		
20.	Air outlet pressure	Bar G		
21.	Air outlet temperature	Deg C		
22.	Air dryer power	kW		



• **PERFORMANCE GUARANTEES**

SL.NO	PARAMETER	Unit	Test value /Observation	Remarks
1.	Parallel operation of air compressors	-		Yes / No
2.	Air dryer plant power consumption	kW		OK / Not OK
3.	Atmospheric Dew point at outlet of Air Dryer Plant	Deg C		OK / Not OK
4.	Pressure drops across air dryer plant	Bar G		OK / Not OK
5.	Compressor Noise level	dBA		OK / Not OK
6.	Vibration velocity (RMS)	mm/se c		OK / Not OK

• **GENERAL PARAMETERS**

SL.NO	PARAMETER	Value/Observatio	Remarks
1.	General observation on equipment installation		OK / Not OK
2.	General observation on Compressor system layout and Piping		As per approved drawing
3.	Approved engineering doc + Shop test reports		Yes / No
4.	Availability of instruments for performance test as per		Yes / No
5.	Availability of safety equipment's at site		Yes / No
6.	Start equipment as per start up procedure in instruction manual		Yes / No
7.	Leakages in Pipe Joints (Soap solution method)		OK / Not OK

CLAUSE NO.	TECHNICAL REQUIREMENTS		
8.	Smooth operation of valves (Hand operation)		OK / Not OK
9.	Field instruments working		OK / Not OK
10.	Protection and Alarms		OK / Not OK
Attachment (to be provided by Contractor)			
1) SCCL Tech specifications sheet (FGLD) of Compressed Air system .			
2) Attachment 10 or relevant document.			
3) Approved data sheet if any.			
4) Any transmittal received for this System.			
5) ADP vs PDP graph to be provided by Contractor			
6) Shop test reports of individual compressors showing FAD, DAP and specific power consumption			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE
PAGE 222 OF 223			

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	Following may be noted related to PG Test 5) PG test should be done at design coal GCV however for conductance of PG test coal GCV variance can be allowed from -10% to + 5% of design coal. 6) Formula for applying correction shall be as per BSEN 12952-15 (2003). 7) PG test to be done irrespective of any shortfall from rated parameters if it is attributed to design issues. 8) During ramping and PG test, maximum metal temperature in the penthouse (as per MTM) shall not exceed the design metal temperature of the material for the boiler pressure parts as in Steam Generator technical specification of Part-B 9) Penthouse maximum & minimum MTM temperature difference should be within 40 deg.C. Necessary combustion tuning shall be done to ensure the same. 10) PG test will be conducted under normal operating conditions with cleaning of APH and Boiler by online cleaning device. CO should not exceed 100 PPM during PG test before air preheater.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	PAGE 223 OF 223



SUB-SECTION – G-05

STANDARD TYPE TEST PROCEDURE

**SINGARENI THERMAL POWER PROJECT
STAGE-II (1X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC NO.:CW-CM-11159-C-O-M-001**

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.00.00 1.01.00 <				

CLAUSE NO.	TECHNICAL REQUIREMENTS				
1.04.00	The inter-stage tapping is blanked off/isolated for NPSH testing, i.e. no inter-stage flow. The test will be conducted to determine the NPSH requirement of the pump at 25%, 50%, 80%, 100% & 125% of rated flow corresponding to "Design point" speed with softened quality of water. For a particular % flow rate, suction head available at the pump inlet will be varied in steps. This is achieved by throttling the suction valve of the pump. At every inlet pressure, the flow rate handled by the pump is kept constant (within $\pm 2\%$ of variation) and the values of suction pressure, discharge pressure, inter stage pressure, pump speed and suction temperature are recorded. For each flow rate, suction pressure is varied in steps until a head drop of more than 3% (1st stage pressure) has been experienced. Minimum 3 readings will be taken to establish the average first stage head and then Minimum five readings, bracketing the region of head drop will be recorded during the testing. Out of these at least 2 points shall be around greater or equal to 3% head drop. Plots will be made for NPSH vs head developed by 1st stage for all flows. From the plots NPSH values corresponding to 1% & 3% head drop will be determined for all the above % flows. Finally, Flow vs NPSH characteristic (1% & 3% head drop) will be drawn & value of NPSH at rated flow corresponding to " Design point" will be the requirement of the pump. The test will be repeated for the other % flow rates. Acceptance Criteria : 1. NPSH(R) (3% head drop) at Design point shall not be more than 1/2.5 of NPSH available. 2. NPSH(R) (3% head drop) at Design point shall not be less than the NPSH(R) determined by the suction specific of 10000 US unit and 9500 US unit for main pump and booster pump respectively calculated with the flow of Design point with Inter-stage closed.				
	Pressure Pulsation Test The pump will be tested with softened quality of cold water (about 10°C - 40°C) at approved test speed using test plant motor. The test schematic arrangement to be furnished in the type test report. Pressure pulsation will be measured using piezoelectric pressure sensors. The system is designed to measure dynamic pressure in the frequency range upto 10Khz scanning frequency 2.5Khz. The pressure sensor shall be mounted in straight section of pipe at least 2D from any joint, bend. The dynamic pressure would be measured by applying the signal to an FFT or similar analyser configured to display the root-mean-square (rms) value in the chosen frequency range. Pressure pulsation of suction and discharge of pump will be measured at all the measuring points of percentage range of design flows (25%, 50%, 65%, 80%, 100% & 125%) with enough suction pressure more than the specified NPSH available. Acceptance Criteria: Root mean square value of pressure pulsation Δp_{rms} at all flow $\leq 3\%$ of pump developed head.				
1.05.00	Axial Thrust Measurement Test The pump will be tested with softened quality of water at design point temp($\pm 5^{\circ}\text{C}$) approved speed using test plant drive motor. The test schematic arrangement along with load cell arrangement to be furnished in the type test report.				
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION- G-05 STANDARD TYPE TEST PROCEDURE	PAGE 2 OF 41

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.06.00	Axial thrust measurement will be carried out by minimum of 3 number of measuring points on each active and non-active side of thrust bearing. The expected load with worn out clearance at trip speed for TDBFP and maximum speed for MDBFP shall be submitted for approval prior to the test along with the calculation basis of expected load curve. Total axial thrust measurement on each side will be calculated by taking average load on each pad and multiplying it with total number of pads. The net thrust is then deduced by difference of thrust on each side. Axial thrust measurement value will be recorded at 125%, 100%, 80%, 65%, 50%, 25% and 20% of design flow. Thrust measured at test speed to be converted to thrust at maximum speed for MDBFP and trip speed for TDBFP shall be calculated as per affinity laws. Alternatively if the arrangement for measurement of resultant thrust is available, same may also be accepted. Acceptance Criteria: Two times of the worst thrust from minimum speed to trip speed of TDBFP and minimum speed to maximum speed of MDBFP at all flow values from 0% to 125% and internal clearances being 100% or 200% of new clearance under which condition thrust is higher. Visual Cavitation Test Visual cavitation test for one first stage production impeller of each type of BFP will be carried out. This test will be conducted with softened quality of cold water (about 10 to 40°C) at approved test speed using test plant motor. The test schematic arrangement to be furnished in the type test report. The suction pressure is first increased to totally cavitation free situation at pump inlet, Pump suction pressure will be gradually decreased to dynamically scaled NPSH available keeping the flow constant. Visual inspection at this point is done to see if any bubble formation is occurring. The suction pressure will be further reduced slowly till the first appearance of steady bubbles on surface of all the vanes for determination of incipient cavitation suction pressure at pump inlet. The cavity length will then be measured. For visual observation of the impeller inlet the suction casing of the test pump is equipped with a Plexiglas window. By using stroboscopical lighting it is possible to get a “non-moving” picture and to detect visible incipient cavitation (bubbles) at the vane entry for decreasing system pressure. The above test procedure will be repeated with 25%, 50%, 65%, 80%, 100% & 125% of Design Point. Acceptance Criteria: 1. Cavitation-free (bubble free) at NPSH (A) for 100 % Design flow. 2. NPSHi should be lower than NPSH (A) at design flow. 3. At NPSHi, maximum bubble length shall be less than 1% of impeller OD.			
	1.07.00	Complete Strip Down Test Complete strip down of the Boiler feed pump which undergoes performance test, NPSH test, etc. shall be done in order to check problems like internal rubbing damage, excessive wear etc. Acceptance Criteria:		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-05 STANDARD TYPE TEST PROCEDURE	PAGE 3 OF 41


Log Sheet for Pressure Pulsation Test (Annex-II)

Parameter	Unit	25%	50%	65%	80%	100%	125%
Speed							
Discharge Pressure							
Suction pressure							
Pressure pulsation at suction							
Pressure pulsation at discharge							
Pressure pulsation of suction at corrected speed							
Pressure pulsation of discharge at corrected speed							

Log sheet for Axial Thrust Measurement (Annexure-III)

Parameter	Unit	100%	80%	65%	50%	25%	20%	125%
Speed								
Flow								
Temperature of test water								
In board Load Cell 1								
In board Load Cell 2								
In board Load Cell 3								
Out board Load Cell 1								
Out board Load Cell 2								
Out board Load Cell 3								

Log sheet for Visual Cavitation (Annexure-IV)

Parameter	Unit	100%	80%	65%	50%	25%	125%

CLAUSE NO.	TECHNICAL REQUIREMENTS 																	
	Speed																	
	Flow																	
	Temperature of test water																	
	Suction pressure gauge height																	
	Discharge pressure gauge height																	
	Inner diameter of suction pipe																	
	Inner diameter of discharge pipe																	
	Atmospheric pressure																	
	Cavity length																	
Log sheet for complete strip down test (Annexure-V)																		
<table border="1"> <thead> <tr> <th>INSPECTION ITEMS</th> <th>RESULTS</th> </tr> </thead> <tbody> <tr> <td> Water passages, such as casing : No injurious bruises and defects(excessive wear, rubbing damage, scratches, scoring, dent, crack etc.) on the internal and external surfaces. </td> <td></td> </tr> <tr> <td> Water passages for impellers : No injurious bruises and defects(excessive wear, rubbing damage, scratches, scoring, dent, crack etc.) on the surfaces of water passages. </td> <td></td> </tr> <tr> <td> Sliding surfaces of wearing rings : No injurious excessive wear, rubbing damage, scratches, scoring, dent, crack etc. on the sliding surfaces. </td> <td></td> </tr> <tr> <td> Contacting surfaces of bearings : No injurious excessive wear, rubbing damage, scratches, scoring, dent, crack etc. on the sliding surfaces. </td> <td></td> </tr> </tbody> </table>									INSPECTION ITEMS	RESULTS	Water passages, such as casing : No injurious bruises and defects(excessive wear, rubbing damage, scratches, scoring, dent, crack etc.) on the internal and external surfaces.		Water passages for impellers : No injurious bruises and defects(excessive wear, rubbing damage, scratches, scoring, dent, crack etc.) on the surfaces of water passages.		Sliding surfaces of wearing rings : No injurious excessive wear, rubbing damage, scratches, scoring, dent, crack etc. on the sliding surfaces.		Contacting surfaces of bearings : No injurious excessive wear, rubbing damage, scratches, scoring, dent, crack etc. on the sliding surfaces.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	Coupling : No injurious excessive wear, rubbing damage, scratches, scoring, dent, crack etc. on the sliding surfaces.		
	Sliding surfaces(i.e. seal face) of mechanical seal. : No injurious excessive wear, rubbing damage, scratches, scoring, dent, crack etc. on the sliding surfaces. Mechanical seals shall be dismantled and seal faces shown.		
	Shaft : No injurious defects (excessive wear, rubbing damage, scratches, scoring, dent, crack etc.) on any machined surfaces.		
	Others : No injurious defects (excessive wear, rubbing damage, scratches, scoring, dent, crack etc.) on any machined surfaces.		
	*Any other parameter which is required for calculation shall also be measured and added in respective log sheets.		
2.00.00	Vacuum Pump		
2.01.00	Vacuum Pump Cavitation Test		
2.01.01	Scope This procedure shall be applicable to the cavitation test of each type/model of liquid ring vacuum pump. The cavitation test shall be conducted on one of the contracted vacuum pumps. The pump shall be installed on a package for test with same accessories as contracted.		
	Brief Description of Cavitation Test The purpose of cavitation test is to examine and prove the vacuum pump has no cavitation damage when running for 150 hours continuously, with suction blanked off condition. Two groups of photographs will be taken on impeller blades before and after test running. These photographs will be concentrated on the leading and trailing edge area, and the photographed position will be at the center between tip and bottom on both edges.		
	Preparation of Pumps for cavitation test a. The pump impellers are to be cleaned and painted (as per standard practice of pump supplier) on the impeller blades and hub.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-05 STANDARD TYPE TEST PROCEDURE PAGE 7 OF 41

CLAUSE NO.		TECHNICAL REQUIREMENTS																																																																																																																																																																																															
2.01.06		Acceptance Norm																																																																																																																																																																																															
		a. A complete record sheet for operating parameters recorded during test running shall be submitted and set of photographs taken before and after cavitation test shall be submitted with test report. All recorded parameters shall be in the range of acceptance.																																																																																																																																																																																															
		b. A comparison will be made between the two groups of photographs taken before and after test running. The result of comparison shall show that all marked impeller blades have no visible cavitation damage and no exposure of base material due to paint removal after testing.																																																																																																																																																																																															
		<table><tr><th rowspan="2">Duration hours</th><th colspan="2">Inlet pressure</th><th colspan="2">Seal water temperature</th><th rowspan="2">Pump outlet temp</th><th rowspan="2">Seal water flow rate</th><th rowspan="2">Cooling water flow rate</th><th colspan="2">Pump Bearing temperature</th><th colspan="2">Ambient condition</th><th rowspan="2">Motor current</th><th rowspan="2">Motor Output Power</th><th colspan="2">Record Time</th><th rowspan="2">Signature</th></tr><tr><th>Inlet</th><th>Outlet</th><th>Inlet</th><th>Outlet</th><th>Temperature</th><th>Air pressure</th><th>Time</th><th>Date</th></tr><tr><td>Start</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>6</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>8</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>10</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>20</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>30</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>														Duration hours	Inlet pressure		Seal water temperature		Pump outlet temp	Seal water flow rate	Cooling water flow rate	Pump Bearing temperature		Ambient condition		Motor current	Motor Output Power	Record Time		Signature	Inlet	Outlet	Inlet	Outlet	Temperature	Air pressure	Time	Date	Start																	2																	4																																		6																	8																	10																	20																	30																
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		This procedure shall be applied to the saturated/humid air performance test of liquid ring vacuum pump (contracted) of each type for the condenser(s). The test shall be conducted on the typical package as per test bed set up of pump supplier/OEM.																																																																																																																																																																																															
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE					TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001					SUB SECTION- G-05 STANDARD TYPE TEST PROCEDURE					PAGE 9 OF 41																																																																																																																																																																																		

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.02.02	Applicable Codes and Standard ASME HEI ASTM ISO 10816-3(VIBRATION) ANSI			
	Main test equipment and device a. One set of vacuum pump package consist of vacuum pump, motor, heat exchanger, separator, and other necessary accessories. b. A mixing device system consist of mixing chamber, spray device, electric heater, control panel, centrifugal pump unit, etc. as per standard practice of the manufacturer. c. Performance test station with data recorder and calculation program. - Testing is to be carried out with calibrated critical flow orifices, of which make and selection shall comply with HEI 2866-2007 "Standards for Steam Jet Vacuum System" section 5.4. - Water vapour measurement will be with calibrated relative humidity meter. Calibration Certificates of critical flow nozzles shall be presented during testing and also submitted with final report. d. Testing shall be carried out using clean water as service liquid. e. During testing, anti-cavitation shall be closed (if applicable in bidder design), which is mounted on the pipeline introduced from outlet of separator to port plate of vacuum pump. Note: In HEI, flow nozzles are referred to instead of orifice and hence read "Nozzle" in place of "Orifice" throughout this procedure.			
2.02.03	Test Procedure a. Before start of test examine and ensure the mixing device system operating properly. b. Connect the vacuum pump package to the mixing chamber with inlet valve open (if envisaged in test bed set-up). c. Supply water to the whole system till the right level as required. Supply cooling water to heat exchanger continuously. d. Start motor for vacuum pump and centrifugal pump for pre-running for 30 minutes at least. e. During testing, appropriate calibrated orifices shall be applied to be mounted at the inlet of mixing system to achieve the specified air flow. f. 100% saturation level of the mixing vessel outlet is monitored by the RH meter. g. The test shall be carried out at the specified inlet pressure (i) At operating suction pressure of 1 inch as per HEI (ii) At guaranteed design suction pressure LP (Low pressure) condenser (iii) At guaranteed design suction pressure of HP (High pressure) condenser or any other suitable selected operating suction pressure apart from ii & iii, in which design operation pressure of condenser at specified ITD (Initial Temperature Difference) shall be included as specified elsewhere in the specification.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-05 STANDARD TYPE TEST PROCEDURE	PAGE 10 OF 41

CLAUSE NO.		TECHNICAL REQUIREMENTS																																																																																	
2.02.04		h. ITD shall be maintained constant as specified through varying cooling water temperature, to meet each tested inlet pressure. Cooling water temperature shall be adjusted by a chiller/heater (as per requirement) at inlet of heat exchanger. Vacuum pump I.T.D = Saturation temperature corresponding to optimized condenser pressure for the respective condenser shell (which is considered for guaranteed condenser pressure) – specified cooling water inlet temperature to vacuum pump seal water cooler. i. Downstream pressure of the orifices shall be maintained to keep the air flow through the orifice is critical. j. Saturated air temperature at the mixing vessel outlet shall be maintained at 4.17°C below the saturation temperature corresponding to the specified inlet pressure. Note: Critical orifices: Vacuum pump supplier to select combinations of HEI flow nozzles/orifices taking into account variation in ambient conditions. Suitable margin may also be taken in total flow aggregate from all nozzles, if required, to meet duty requirement as no correction on test results shall be allowed. In report critical orifices specification like mass flow rate, diameter combination of orifices used for each test points shall be attached. Test result: All related test data shall be recorded and filled as per attached table below. A graph of the test results shall be generated to show performance of capacity (air and water vapour mass load at pump inlet) at corresponding absolute inlet pressure, to compare with submitted performance curves.																																																																																	
	2.02.05	Saturated Air test record of Vacuum pump for each model to be tested <table><tr><th>Test Point</th><th>Inlet Pressure</th><th>Pump inlet temp. sub-cooled to 4.17 °C</th><th>Seal Water Flow Rate</th><th>Seal Water Inlet temperature</th><th>Seal Water Outlet temperature</th><th>Cooling Water Inlet Temp.</th><th>Pump suction humidity/ Atmospheric humidity</th><th>ITD</th><th>Pressure at orifice</th><th>Atmospheric pressure</th><th>Orifice</th><th>Motor Output Power</th><th>Test Speed</th></tr><tr><td>1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>													Test Point	Inlet Pressure	Pump inlet temp. sub-cooled to 4.17 °C	Seal Water Flow Rate	Seal Water Inlet temperature	Seal Water Outlet temperature	Cooling Water Inlet Temp.	Pump suction humidity/ Atmospheric humidity	ITD	Pressure at orifice	Atmospheric pressure	Orifice	Motor Output Power	Test Speed	1														2														3														4												
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CLAUSE NO.	TECHNICAL REQUIREMENTS																																			
2.02.06	Noise and Vibration Report: Pump Noise and vibration test report shall be prepared and submitted as per requirement of NTPC QA and/or elsewhere specified in specification.																																			
3.00.00	Condensate Extraction Pump																																			
3.01.00	Scope NPSH (R) Test on one CEP shall be conducted as per latest code of HIS and Technical specification requirements.																																			
3.02.00	Measurements Table 1 shows maximum permissible measurement device uncertainty for the different acceptance grades. It is important to note that these maximum uncertainty values pertain to the measurements at the guarantee point.																																			
	<table><tr><th>Measurement Quantity</th><th colspan="2">Accuracy of the instruments</th></tr><tr><td></td><th>Accuracy</th><th>Permissible amplitude of fluctuation</th></tr><tr><td>Rate of flow</td><td>± 0.25%</td><td>± 0.50%</td></tr><tr><td>Differential head</td><td>± 0.10%</td><td>± 0.50%</td></tr><tr><td>Discharge Head</td><td>± 0.10%</td><td>± 0.50%</td></tr><tr><td>Suction Head</td><td>± 0.10%</td><td>± 0.50%</td></tr><tr><td>Suction Head for NPSH testing</td><td>± 0.10%</td><td>± 0.50%</td></tr><tr><td>Driver power input</td><td>± 0.35%</td><td>± 0.75%</td></tr><tr><td>Speed of rotation</td><td>± 1 rpm, 0.01%</td><td>± 0.3%</td></tr><tr><td>Torque</td><td>± 0.9%</td><td>± 2.0%</td></tr><tr><td>RTD</td><td>± 0.5%</td><td>-</td></tr></table>			Measurement Quantity	Accuracy of the instruments			Accuracy	Permissible amplitude of fluctuation	Rate of flow	± 0.25%	± 0.50%	Differential head	± 0.10%	± 0.50%	Discharge Head	± 0.10%	± 0.50%	Suction Head	± 0.10%	± 0.50%	Suction Head for NPSH testing	± 0.10%	± 0.50%	Driver power input	± 0.35%	± 0.75%	Speed of rotation	± 1 rpm, 0.01%	± 0.3%	Torque	± 0.9%	± 2.0%	RTD	± 0.5%	-
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3.03.00	All the instruments used for testing will be calibrated in line with latest code of HIS. NPSH(R) Test The test is performed in an open loop with clean water having a temperature of approx. 20-40°C and at a constant speed. Pump test speed shall be as per latest HIS code using test plant motor. The test schematic arrangement to be furnished in the type test report. Pump to be tested in full assembled condition. However, number of stages may be reduced for test as per test bed requirement. The test will be conducted to determine the NPSH requirement of the pump at 25%, 50%, 80%, 100% & 125% of rated flow corresponding to "Design point" speed. For a particular % flow rate, suction head available at the pump inlet will be varied in steps.																																			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-05 STANDARD TYPE TEST PROCEDURE	PAGE 12 OF 41																																

CLAUSE NO.	TECHNICAL REQUIREMENTS																			
	At each flow, as valve is throttled, the suction pressure at the pump suction drops, i.e. available NPSH (NPSHA) gets lower and lower. At some point, cavitation begins, and with it, pumps Head begins to drop. As NPSHA is reduced, a point is reached where the curves break away from a straight-line trend. When it drops by 3%, the value of NPSHA there is what is called NPSH required, i.e. NPSHR. Variation of suction conditions is achieved by suction valve throttling in open loop test system. At every inlet pressure, the flow rate handled by the pump is kept constant (within ±2% of variation) and the values of suction pressure, discharge pressure, pump speed and suction temperature are recorded. For each flow rate, suction pressure is varied in steps until a head drop of more than 3% (1st stage pressure) has been experienced. Minimum 3 readings will be taken to establish the average first stage head and then Minimum five readings, bracketing the region of head drop will be recorded during the testing. Out of these at least 2 points shall be around greater or equal to 3% head drop. Plots will be made for NPSH vs head developed by 1st stage for all flows. From the plots NPSH values corresponding to 1% & 3% head drop will be determined for all the above % flows. Finally, Flow vs NPSH characteristic (1% & 3% head drop) will be drawn & value of NPSH at rated flow corresponding to "Design point" will be the requirement of the pump. The test will be repeated for the other % flow rates. Acceptance Criteria: The tested result of NPSHR is acceptable if it meets NPSH margin requirement of specification and suction specific speed requirement as under: 1. Positive tolerances on committed NPSH are not allowed. NPSH(R) (3% head drop) at Design point shall not be more than 1/2 of NPSH available. 2. NPSH(R) (3% head drop) at Design point shall not be less than the NPSH(R) determined by the suction specific of 11000 US unit calculated with the flow of Design point. NPSHR test Report: A detailed report with all test data and curves will be prepared after the test. Tests will determine the following curves in accordance with the data obtained: • NPSHA vs Total Differential Head • Flow vs NPSHR Log sheet for NPSH Test <table><tr><td>Project</td><td></td><td>Pump Model</td><td></td></tr><tr><td>Pump stages</td><td></td><td>Pump Sr no</td><td></td></tr><tr><td>Impeller sl no</td><td></td><td>Discharge pipe ID</td><td></td></tr><tr><td>Test Motor SI no</td><td></td><td>Suction Pipe ID</td><td></td></tr></table>				Project		Pump Model		Pump stages		Pump Sr no		Impeller sl no		Discharge pipe ID		Test Motor SI no		Suction Pipe ID	
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-05 STANDARD TYPE TEST PROCEDURE	PAGE 13 OF 41																

CLAUSE NO.	TECHNICAL REQUIREMENTS						
	Rated Flow		Rated Speed				
	Impeller Dia						
	Level difference between measurement device and reference planes on suction side		Level difference between measurement device and reference planes on discharge side				
	Level difference between reference planes of suction & discharge side						
	Description	Unit	1	2	3	4	5
	Test Speed						
	Water temperature						
	Density of water						
	Flow						
Suction Pressure							
1 st stage Pressure							
Barometric pressure							
Vapour pressure at inlet of suction impeller							
Test Date							
Witnessed by							
Remarks							
4.00.00	TG area Expansion Bellows						
4.01.00	Fatigue Life Cycle Test						
4.01.01	The objective of this test is to verify and determine the sustainability of the bellows fatigue working for minimum 10000 Cycles. The Bellows will be tested with internal pressure and the result is expressed in No. of cycles.						
4.01.02	Test Requirements The No. of Convolutions of the Bellows will be as per data sheet.						
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION- G-05 STANDARD TYPE TEST PROCEDURE		PAGE 14 OF 41	

CLAUSE NO.	TECHNICAL REQUIREMENTS								
4.01.03	2. Test Temperature will be Ambient. 3. The test medium will be water. 4. The Pressure Gauge and other instruments being used will be calibrated. 5. Test Pressure for Fatigue Life Cycle test will be the design pressure as per approved drawing. 6. The Cyclic Movement of the Bellows shall be equal to the equivalent axial movement as indicated in approved document. 7. The test displacement is in Axial Direction only. 8. One cycle means starting from free length position to make one Compression or Expansion and return to its free length position. 9. Tested Bellows shall not be supplied or used anywhere as it has consumed the working life.								
	Sl. No.	Sizes	No. of Convolution	Equivalent Axial Movement	Test Pressure (Design Pressure) for Cycle Life Test	No. of Cycles/Minute (Max)	Movement Per Cycle		
	Test Method								
	1. Two Bellows are to be used for fatigue life cycle testing. The Bellows shall be duly inspected and cleared for all stages as per approved document prior to testing. 2. The Bellows will be welded with end pipes and closed with blind ends. Arrangement to be done as per diagram. 3. The convolution length of both Bellows is initially measured. 4. In neutral condition, the top Bellows is kept in pre-compression equal to stroke length and the bottom Bellows is kept in free length position (length over convolution). When upward stroke is applied, the top Bellows comes to free length position & the bottom Bellows comes to the compressed position; when the reverse stroke is applied, the top Bellows is compressed and the bottom Bellows comes back to the free length position. 5. The test shall be carried out at a travel speed not exceeding 60 inches / minute (1524 mm per minute), as per EJMA CL F-3.4 . The number of cycles per minute shall not exceed the limit as given in the Table. 6. The test pressure is indicated by a calibrated Pressure Gauge installed in the line, the pressure shall be gradually increased from zero to the specified design pressure and will be maintained till the completion of test. 7. The No. of cycles undergone in the test is indicated in electromechanical/Digital counter. 8. The Bellows has to be tested for 10000 cycles.								
	SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE						TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-05 STANDARD TYPE TEST PROCEDURE	PAGE 15 OF 41

CLAUSE NO.	TECHNICAL REQUIREMENTS 																																																																
	9. Observation sheet shall be as per log sheet. 10. After completion of specified No of cycles, the compensators will be examined for the leakages at the specified pressure. Acceptance Norm After completing 10000 cycles, the Bellows will be visually examined at the specified pressure and shall not have any leakage or failure. The Bellows element shall not have any leakage or failure until completion of the specified cycles. RECORD FOR FATIGUE LIFE CYCLE TEST <table border="1"> <thead> <tr> <th colspan="4">Fatigue Test Report</th> </tr> </thead> <tbody> <tr> <td colspan="2">Appd.Doc.No. :</td> <td colspan="2">Customer :</td> </tr> <tr> <td colspan="2">Approved Drawing No. :</td> <td colspan="2">Order No. & Date :</td> </tr> <tr> <td colspan="4">QAP No. & Date :</td> </tr> <tr> <td colspan="4">Nominal Size</td> </tr> <tr> <td>Design Pressure</td> <td></td> <td>Bellows material :</td> <td></td> </tr> <tr> <td>Test Temperature</td> <td></td> <td>No.of convolution :</td> <td></td> </tr> <tr> <td>Test Pressure</td> <td></td> <td>No.of ply x Thickness</td> <td></td> </tr> <tr> <td>Test Medium</td> <td></td> <td>Convolution Pitch</td> <td></td> </tr> <tr> <td>Bellows OD</td> <td></td> <td>Convolution Depth</td> <td></td> </tr> <tr> <td>Bellows ID</td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td>Date</td> <td>Time</td> <td>Counter Reading (No. Of cycles)</td> </tr> <tr> <td>Test Started</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Test Finished</td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="4">TEST RESULT:</td> </tr> <tr> <td colspan="4" style="height: 100px;"></td> </tr> </tbody> </table> For NTPC Vendor Date:	Fatigue Test Report				Appd.Doc.No. :		Customer :		Approved Drawing No. :		Order No. & Date :		QAP No. & Date :				Nominal Size				Design Pressure		Bellows material :		Test Temperature		No.of convolution :		Test Pressure		No.of ply x Thickness		Test Medium		Convolution Pitch		Bellows OD		Convolution Depth		Bellows ID					Date	Time	Counter Reading (No. Of cycles)	Test Started				Test Finished				TEST RESULT:							
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RECORD FOR FATIGUE LIFE CYCLE TEST

Fatigue Life Cycle Test – Dimension Observation												
Date of testing :					Customer :							
Drawing no. :					QAP No. & date :							
Size :					Material code :							
Pr. Kg/cm ² (g)	Cycles	Pitch			Depth			L	Time	Date	Remark	Sign
		Q1	Q2	Qn	W1	W2	Wn					
	0	INITIAL PITCH			INITIAL DEPTH							

For NTPC
Date:

Vendor

RECORD FOR FATIGUE LIFE CYCLE TEST

Fatigue Life Cycle Test - Log								
Date of testing :				Customer :				
Drawing no. :				QAP No. & date :				
Material Code :				Size :				
Date	Starting		Ending		Day's total reading	Grand total	Remarks	Sign
	Time	Counter reading	Time	Counter reading				
		0						
		1000						
		2000						
		3000						
		4000						
		5000						
		6000						
		7000						
		8000						
		9000						
		10000						

For NTPC
Date:

Vendor

CLAUSE NO.	TECHNICAL REQUIREMENTS	
4.02.00	Squirm Test	
4.02.01	Test Objective - The objective of this test is to determine the Pressure at which deformation of the profile of a single Bellows, beyond allowable percentage, takes place under pressure and compare it with the design value. - The measurement will be taken with internal pressure.	
4.02.02	Test Requirements - The Bellows under test shall have the convolutions as per the approved drawing. - The Bellows shall be duly inspected and cleared for all stages as per approved QP prior to testing. - The Temperature will be Ambient. - The test medium will be water. - The Pressure Gauge being used will be calibrated.	
4.02.03	Test Method - The Bellows will be welded with end pipes and closed with blind flanges. The inlet and vent connections will be provided as per sketch. - The pressurization will be done either with manual pump or with power operated pump. - The Bellows will be internally pressurized in steps starting from design pressure (rounded off to nearest value) with an increment of 10% of anticipated Squirm Pressure rounded off to the nearest value, but not less than 0.5 Kg/Cm²(g) and not exceeding 1 Kg/Cm²(g). - At every step the pressure will be maintained and the measurement of convolution pitch will be taken at locations and noted in the table as per Format. - The Pressure at which the pitch measured under internal Pressure, exceeds 1.15 times of Initial pitch, prior to pressurization is recorded as Squirm Pressure. - The test shall be stopped if the squirm has not occurred at the anticipated pressure. - The pitch will be measured and noted in table. The measurement will be done by holding the internal pressure. ACCEPTANCE NORM Squirm should not occur at a pressure equal to or less than the pressure specified in the Table.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001
SUB SECTION- G-05 STANDARD TYPE TEST PROCEDURE		PAGE 18 OF 41

CLAUSE NO.	TECHNICAL REQUIREMENTS 																															
	SI.NO.	Size	Drawing number	No. of Convolution	Testing Temp.	Anticipated Squirm Pressure																										
	RECORD FOR SQUIRM TEST <table border="1"> <thead> <tr> <th colspan="2">Squirm Test Report</th> </tr> </thead> <tbody> <tr> <td>Appd.Doc.No. :</td> <td>Customer :</td> </tr> <tr> <td>Approved Drawing No. :</td> <td>Order No. & Date :</td> </tr> <tr> <td>QAP No. & Date :</td> <td>Size :</td> </tr> <tr> <th colspan="2">BELLOWS DATA</th> </tr> <tr> <td>Nominal Size :</td> <td>-</td> </tr> <tr> <td>Bellows OD :</td> <td>Bellows Material :</td> </tr> <tr> <td>Bellows ID :</td> <td>Design Pressure :</td> </tr> <tr> <td>No. Of Convolution :</td> <td>Test Temperature :</td> </tr> <tr> <td>No. Of Ply x Thickness :</td> <td>Anticipated Squirm Pressure :</td> </tr> <tr> <td>Convolution Pitch :</td> <td>Test Medium :</td> </tr> <tr> <td>Convolution Height :</td> <td></td> </tr> <tr> <td colspan="2"> TEST RESULT: </td> </tr> </tbody> </table> For NTPC Vendor Date:						Squirm Test Report		Appd.Doc.No. :	Customer :	Approved Drawing No. :	Order No. & Date :	QAP No. & Date :	Size :	BELLOWS DATA		Nominal Size :	-	Bellows OD :	Bellows Material :	Bellows ID :	Design Pressure :	No. Of Convolution :	Test Temperature :	No. Of Ply x Thickness :	Anticipated Squirm Pressure :	Convolution Pitch :	Test Medium :	Convolution Height :		TEST RESULT:	
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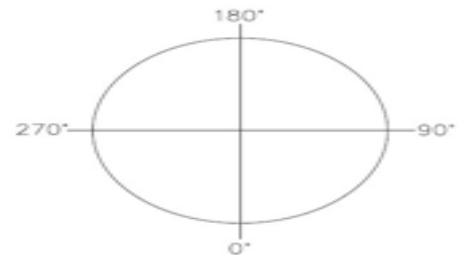
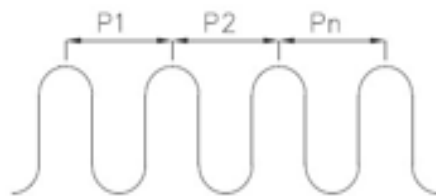


RECORD FOR SQUIRM TEST

Dimensional Inspection Details of the Bellows subjected to Squirm						
Appd. Doc. No. :			Customer :			
Approved Drawing No. :			Order No. & Date :			
QAP No. & Date :			Size :			
Pressure Kg/cm ² (g)	Location	PITCH				
		1	2	3	4	n
	0°					
	90°					
	180°					
	270°					
	0°					
	90°					
	180°					
	270°					
	0°					
	90°					
	180°					
	270°					

For NTPC
Date:

Vendor



Note:

- 1) A Line on the convolution outer surface shall be marked as a reference measuring point.
- 2) All readings of the pitch will be taken at the same measuring point.

4.03.00

Meridional Yield and rupture test

4.03.01

Test Objective

The objective of this test is to determine the Pressure at which the Yield (permanent deformation) of the convolution beyond allowable yield pressure and rupture (test is limited to four times the anticipated yield pressure for safety reasons) in a single Bellows takes place.

CLAUSE NO.	TECHNICAL REQUIREMENTS											
4.03.02	NOTE: The anticipated Yield pressure shall not be less than or Equal to Squirm Pressure is given below: Table: <table><tr><th>Sl.No.</th><th>Sizes</th><th>No. Of Convolution</th><th>Anticipated Yield Pressure</th></tr><tr><td></td><td></td><td></td><td></td></tr></table>				Sl.No.	Sizes	No. Of Convolution	Anticipated Yield Pressure				
	Sl.No.	Sizes	No. Of Convolution	Anticipated Yield Pressure								
4.03.03	Test Requirements 1) The same Bellows assembly which was subjected to squirm test to be used for this test. 2) The temperature will be ambient. 3) The test medium will be water. 4) The pressure gauge being used will be calibrated. 5) The final anticipated yield pressure shall be as per table. 6) The dimension of the convolution to be measured at every stage at minimum 4 locations after relieving the internal Pressure. Test Method 1) Pressurize the specimen in steps by starting from squirm pressure and returning to zero pressure after each step. 2) The increment in pressure to be the nearest rounded off value of 10% of anticipated yield pressure, but not less than 0.5 Kg/Cm²(g) and not exceeding 1 Kg/Cm²(g). 3) The pressure to be held for a period of 5 minutes before returning to Zero pressure every time. 4) After each step, with zero pressure the convolution pitch to be measured as per the enclosed Sketch and recorded in sample table Format. 5) Yield is said to have occurred if any permanent bulging of flat sides of convolution or increase in root diameter or increase in pitch dimension in excess of 1.15 times as compared to dimensions measured initially at the same location. 6) After finding the yield pressure, the specimen shall be pressurized continuously. 7) The pressure at which gross distortion, root collapse and ultimate failure of the Bellows occurs to be noted and recorded as rupture pressure. 8) The test is limited to four times the anticipated yield pressure for safety reasons.											
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION- G-05 STANDARD TYPE TEST PROCEDURE								
PAGE 21 OF 41												



ACCEPTANCE NORM

- 1) Yield and rupture should not occur at a pressure equal or less than yield pressure specified in the Table.
- 2) Test will be stopped once the pressure reaches four times the squirm pressure even if the bellows not attaining yield and rupture for safety reasons.

CAUTION: Adequate safety measure will be incorporated to ensure safe testing and evaluation.

RECORD FOR MERIDIONAL YIELD AND RUPTURE TEST

Purchaser's Name :
 P.O. No. & Date :
 Project Name :
 QAP Ref. :
 QAP Stage :
 Nominal Bore :
 Tag No. :
 Drg No. :
 Date :

	AT 0°					AT 90°					AT 180°					AT 270°				
Position	1	2	3	4	n	1	2	3	4	n	1	2	3	4	n	1	2	3	4	n
Pitch at Initial																				
1.15 times																				
Desired pressure																				
Desired pressure																				
Desired pressure																				
Rupture pressure																				

CLAUSE NO.	TECHNICAL REQUIREMENTS																												
	RECORD FOR MERIDIONAL YIELD AND RUPTURE TEST <table><tr><td colspan="2">Yield & Rupture Test Report</td></tr><tr><td>Appd. Doc. No. :</td><td>Customer :</td></tr><tr><td>Approved Drawing No. :</td><td>Order No. & Date :</td></tr><tr><td>QAP No. & Date :</td><td>Size :</td></tr><tr><td colspan="2">BELLOWS DATA</td></tr><tr><td>Nominal Size :</td><td>-</td></tr><tr><td>Bellows OD :</td><td>Bellows Material :</td></tr><tr><td>Bellows ID :</td><td>Design Pressure :</td></tr><tr><td>No. Of Convolution :</td><td>Test Temperature :</td></tr><tr><td>No. Of Ply x Thickness :</td><td>Anticipated Yield & Rupture Pressure :</td></tr><tr><td>Convolution Pitch :</td><td>Test Medium :</td></tr><tr><td>Convolution Height :</td><td></td></tr><tr><td colspan="2">TEST RESULT:</td></tr><tr><td colspan="2"></td></tr></table>	Yield & Rupture Test Report		Appd. Doc. No. :	Customer :	Approved Drawing No. :	Order No. & Date :	QAP No. & Date :	Size :	BELLOWS DATA		Nominal Size :	-	Bellows OD :	Bellows Material :	Bellows ID :	Design Pressure :	No. Of Convolution :	Test Temperature :	No. Of Ply x Thickness :	Anticipated Yield & Rupture Pressure :	Convolution Pitch :	Test Medium :	Convolution Height :		TEST RESULT:			
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TEST RESULT:																													
5.00.00	PIPING AREA Expansion Bellows																												
5.01.00	PROCEDURE FOR FATIGUE LIFE CYCLE TEST																												
5.01.01	TEST OBJECTIVE The objective of this test is to verify and determine the sustainability of the compensator's fatigue working with the values arrived in design calculation, in number of cycles. 1. One cycle means starting from free length position to make one Compression and return to its free length position. 2. Test Temperature will be Ambient. 3. The test medium will be potable water. 4. The Pressure Gauge and other instruments being used will be calibrated. 5. Test Pressure for Fatigue Life Cycle test will be the design pressure as per approved drawing. 6. The Cyclic Movement of the compensator shall be to the equivalent axial movement. 7. The test displacement is in Axial Direction only. 8. The compensator subjected to fatigue life cycle test shall be distinctly identified. 9. Tested compensators shall not be supplied or used anywhere as it has consumed the working life.																												
5.01.02	TEST METHOD 1) Two Compensators are to be used for fatigue life cycle testing. 2) The Compensators shall be duly inspected and cleared for all stages as per approved QP prior to testing.																												
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-05 STANDARD TYPE TEST PROCEDURE	PAGE 23 OF 41																										

CLAUSE NO.	TECHNICAL REQUIREMENTS																		
	3) The compensators will be welded with end pipes and closed with blind ends. The inlet and vent connections shall be provided. 4) The convolution length of both compensators is initially measured. 5) The top compensator is kept in pre-compression equal to stroke length. The bottom compensator is kept in free length position. When upward stroke is applied, the top compensator comes to free length position & the bottom compensator comes to the compressed position; when the reverse stroke is applied, the top compensator is compressed and the bottom compensator comes back to the free length position. 6) The Fatigue Life Cycle Testing machine is power operated with Hydraulic Rams and the movement is controlled with Micro limit Switches. 7) The test shall be carried out at a travel speed not exceeding 60 inches / minute (1524 mm per minute). 8) The test pressure is indicated by a calibrated Pressure Gauge installed in the line. 9) The No. of cycles undergone in the test is indicated in electromechanical counter. 10) For the life cycle test, the number of test cycles shall be minimum 10,000 cycles. ACCEPTANCE NORM After completing the prescribed number of cycles, the compensators will be visually examined at the specified pressure and shall not have any leakage or failure. <tr><td>5.02.00</td><td>PROCEDURE FOR SQUIRM TEST</td><td></td></tr> <tr><td>5.02.01</td><td> TEST OBJECTIVE The objective of this test is to determine the Pressure at which deformation of the profile of the Compensator, beyond allowable percentage, takes place under pressure and compare it with the design value. NOTE The anticipated Squirm pressure based on column instability shall be calculated. </td><td></td></tr> <tr><td>5.02.02</td><td> TEST REQUIREMENTS 1. The Compensator under test shall have the convolutions as per the approved drawing. 2. The compensator shall be duly inspected and cleared for all stages as per approved QP prior to testing. 3. The Temperature will be Ambient. 4. The test medium will be potable water. 5. The Pressure Gauge being used will be calibrated. </td><td></td></tr> <tr><td>5.02.03</td><td> TEST METHOD 1. The compensator will be welded with end pipes and closed with blind flanges. The inlet and vent connections shall be provided. 2. The pressurization will be done either with manual pump or with power operated pump. 3. The compensator will be internally pressurized in steps starting from design pressure (rounded off to nearest value) with an increment of 10% of anticipated Squirm Pressure rounded off to the nearest value. 4. At every step the pressure will be maintained and the measurement of convolution pitch shall be done and recorded. </td><td></td></tr> <tr><td colspan="2">SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE</td><td>TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001</td></tr> <tr><td colspan="2">SUB SECTION- G-05 STANDARD TYPE TEST PROCEDURE</td><td>PAGE 24 OF 41</td></tr>	5.02.00	PROCEDURE FOR SQUIRM TEST		5.02.01	TEST OBJECTIVE The objective of this test is to determine the Pressure at which deformation of the profile of the Compensator, beyond allowable percentage, takes place under pressure and compare it with the design value. NOTE The anticipated Squirm pressure based on column instability shall be calculated.		5.02.02	TEST REQUIREMENTS 1. The Compensator under test shall have the convolutions as per the approved drawing. 2. The compensator shall be duly inspected and cleared for all stages as per approved QP prior to testing. 3. The Temperature will be Ambient. 4. The test medium will be potable water. 5. The Pressure Gauge being used will be calibrated.		5.02.03	TEST METHOD 1. The compensator will be welded with end pipes and closed with blind flanges. The inlet and vent connections shall be provided. 2. The pressurization will be done either with manual pump or with power operated pump. 3. The compensator will be internally pressurized in steps starting from design pressure (rounded off to nearest value) with an increment of 10% of anticipated Squirm Pressure rounded off to the nearest value. 4. At every step the pressure will be maintained and the measurement of convolution pitch shall be done and recorded.		SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-05 STANDARD TYPE TEST PROCEDURE		PAGE 24 OF 41
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SUB SECTION- G-05 STANDARD TYPE TEST PROCEDURE		PAGE 24 OF 41																	

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	ACCEPTANCE NORM The deformation in the compensator profile occurring due to internal pressure shall be construed as unacceptable squirm, when the convolution pitch under internal pressure to the convolution pitch before application of pressure exceeds 1.15 for unreinforced and 1.20 for reinforced bellows. This deformation in profile should not occur before the anticipated squirm pressure.	
5.03.00	MERIDIONAL YIELD AND RUPTURE TEST	
5.03.01	TEST OBJECTIVE The objective of this test is to determine the Pressure at which the Yield (permanent deformation) of the profile and rupture in the Compensator takes place. NOTE The anticipated Yield pressure, shall not be less than or Equal to Squirm Pressure.	
5.03.02	TEST REQUIREMENTS 1. The same Compensator assembly which was subjected to squirm test to be used for this test. 2. The temperature will be ambient. 3. The test medium will be potable water. 4. The pressure gauge being used will be calibrated.	
5.03.03	TEST METHOD 1. Pressurize the specimen in steps by starting from squirm pressure and returning to zero pressure after each step. 2. The increment in pressure to be 10% of the anticipated yield pressure. 3. Pressurize the specimen in step starting from squirm pressure and returning to zero Pressure after each step. The increment in pressure to be the nearest rounded off value of 10% of anticipated yield pressure. 4. After each step, with zero pressure the convolution pitch to be measured and recorded. 5. Yield is said to have occurred if any permanent bulging of flat sides of convolution or increase in root diameter or increase in pitch dimension in excess of 1.15 times is observed. 6. After finding the yield pressure, the specimen shall be pressurized continuously. 7. The pressure at which gross distortion, root collapse and ultimate failure of the compensator occurs to be noted and recorded as rupture pressure. 8. The test is limited to four times the anticipated yield pressure for safety reasons. ACCEPTANCE NORM Yield should not occur at a pressure equal or less than (Squirm Pressure). NOTES: 1.) Other requirements specified in EJMA, Latest edition shall also be met in addition to the requirements specified in above type test procedures. 2.) In case of any discrepancy between above procedures and EJMA, latest edition, requirements of EJMA, Latest edition shall govern and same shall be complied. SAFETY CAUTION: Adequate safety measure should be incorporated to ensure safe testing and evaluation.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-05 STANDARD TYPE TEST PROCEDURE PAGE 25 OF 41

CLAUSE NO.	TECHNICAL REQUIREMENTS																																		
6.00.00	Strainer for MDBFP/MDBP/TDBFP/TDBP/CEP																																		
6.01.00	Summary:																																		
The performance of the filters assesses using weighing method. During these test, each filter to be installed, one at a time, in calibration line of gravimetric facility at lab with installation of suitable upstream and downstream reducers/diffusers.																																			
Pressure drop across the filters to be measured for different flow rates with 100% clean filter elements. Test to be repeated in each case with 50% clogging of filter elements. The report describes the details of test circuit at Lab. methodology of pressure drop tests & test results. Test to be carried out at 25%, 50%, 75%, 100% & 125% of design flow rate.																																			
<table><tr><th>Sr. No.</th><th>Description</th><th>Case-1</th><th>Case-2</th><th>Case-3</th><th>Case-4</th><th>Case-5</th></tr><tr><td>1.</td><td>Item name</td><td>Suction Strainer MDBFP</td><td>Suction Strainer MDBP</td><td>Suction Strainer TDBFP</td><td>Suction Strainer TDBP</td><td>Suction Strainer CEP</td></tr><tr><td>2.</td><td>Max pressure drop at 100% clean condition at design flow rate</td><td>0.15 Kg/Cm2</td><td>0.15 Kg/Cm2</td><td>0.15 Kg/Cm2</td><td>0.15 Kg/Cm2</td><td>0.1 Kg/Cm2</td></tr><tr><td>3.</td><td>Max pressure drop at 50% clogged condition at design flow rate</td><td>0.2 Kg/Cm2</td><td>0.2 Kg/Cm2</td><td>0.2 Kg/Cm2</td><td>0.2 Kg/Cm2</td><td>0.15 Kg/Cm2</td></tr></table>								Sr. No.	Description	Case-1	Case-2	Case-3	Case-4	Case-5	1.	Item name	Suction Strainer MDBFP	Suction Strainer MDBP	Suction Strainer TDBFP	Suction Strainer TDBP	Suction Strainer CEP	2.	Max pressure drop at 100% clean condition at design flow rate	0.15 Kg/Cm2	0.15 Kg/Cm2	0.15 Kg/Cm2	0.15 Kg/Cm2	0.1 Kg/Cm2	3.	Max pressure drop at 50% clogged condition at design flow rate	0.2 Kg/Cm2	0.2 Kg/Cm2	0.2 Kg/Cm2	0.2 Kg/Cm2	0.15 Kg/Cm2
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Note: Type test shall be conducted on one of the Contract filter for each TDBP, MDBP, TDBFP, MDBFP and CEP.																																			
The Simplex Basket Filter to be tested for pressure drop shall be install in test lines of the high precision gravimetric calibration system installed at LAB, by providing sufficient straight length upstream of the filter in the test arrangement. During flow measurements the flow with constant velocity, after passing through the filter under test, divert for known interval of time into weigh tank installed on a pre-calibrated weighing system.																																			
Pressure drop across the test filter at different flows is computed from the differential pressure measured across the filter using mercury manometer/differential transmitter. The flow rate to be measured gravimetrically. The experiments to be conducted initially for 100% clean condition of filter element. There by experiments to be repeated for filter at 50% clogged condition by manually blocking the filter elements flow surface to approximately 50% of surface area by wrapping a polythene adhesive tape. Pressure drop curve to be																																			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001			SUB SECTION- G-05 STANDARD TYPE TEST PROCEDURE		PAGE 26 OF 41																												

CLAUSE NO.	TECHNICAL REQUIREMENTS			
6.02.00	established for filter for its 100% clean condition and with 50% blockage condition. The actual flow rate through the filters was measured by installing it in a high precision flow measuring circuit with gravimetric standard designed in accordance with ISO 4185 fig. 1C.			
	HIGH PRECISION FLOW MEASURING CIRCUIT AND TEST PROCEDURE: Large sized calibration circuit is based on primary gravimetric standards as per ISO 4185 and the medium sized flow calibration circuit is based on primary volumetric standards as per ISO 8316 where flow meters and other flow meters like filters, valves venture meter etc are calibrated/tested for its related performance. The ratio of mass to time is the primary measurement of flow rate. Clean clear normal water at room temperature without any floating material is used in the test circuit. Temperature of the water shall be measured in the starting and shall be maintained during the test and it is open loop. Sump of the Calibration Laboratory provides source of water to the variable speed – DC motor driven pumps which feed water at constant flow rate either into the Constant Head Tank (CHT) or directly into the flow meter line. Throttling valves are provided, which give a fine control for adjusting the flow rate. Additional controls to adjust flow rate are, variable speed of pumps and a throttle controlled bypass line connecting delivery pipe with suction. The flow after passing through filter under test enters in two diverters operating in parallel. Each diverter has a fish tail wherein the cross-section of flow changes from circular to a narrow-rectangular section and here it emerges out as a two dimensional high-speed jet underneath the jet is an oscillating diverter, which diverts the flow to the sump in one position and into the weigh tank in another. It also triggers a precision time counter in the process to the “ON” position in its travel from sump to tank and to the “OFF” position during travel from tank to sump. Two weigh tanks, each of 50 tone capacity have been installed on load cells (with resolution 10 kg). The capacity of 100 tones has been adopted considering the largest flow rate of 2cum/sec for a collection of 50 seconds. Thus, the time taken for an electronic timer of 1ms resolution is used for measurement of diversion. Thus, the time taken for the collected water in weigh tank is measured to a resolution of one millisecond. Difference of the two mass readings viz. initial mass of weight tank before diversion of flow and mass of tank after diversion of flow is the net mass of water collected. The ratio of net mass to the collection time is the primary measure of flow rate. Test Data shall be recorded as per the test log sheet attached here with Schematic (Line Diagram with all test instruments) of the test set-up & test log sheet. To effect 50% clogging of the filter element, the following steps to be adopted:			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-05 STANDARD TYPE TEST PROCEDURE	PAGE 27 OF 41

CLAUSE NO.	TECHNICAL REQUIREMENTS				
6.03.00	(A) A curved area of two concentric cylinders of the filter element through which the flow passes during filtration of each filter to be measured. (B) The 50% area to be blocked to be estimated. (C) The estimated blockage of flow area of filter element to be achieved by partially blocking the outside cylinder and inside cylinder of the filter element across direction of flow through the filter. Polythene adhesive tape are externally used for purposes of blockage of filter element by 50%.				
	TRACEABILITY OF MEASUREMENTS: Flow rate measurements in this procedure are based on static calibration of the weighing system using Cast Iron dead weights in different denominations. The actual mass values of these dead weights has been verified and certified by National Physical Laboratory, New Delhi to an uncertainty of 1 in 10,000. Timer for measurements of diversion time is basically crystal-controlled oscillator having stability of 1 in 10⁶ in the temperature range of 20°C to 45°C. The timer actuates and stops exactly when diverter's partition plate, during its travel crosses the hydraulic centre of the jet falling through fish tail of diverter, thus the transition time of flow diverter from sump to tank and vice versa do not affect the accuracy of time measurements. The Flow rate measurements comply with ISO 4185. Fig. 1C Accuracies of the instruments as follows: Weigh bridge: Mass 10 kg in 50,000 kg i.e. 0.02% Time counter*: Time 0.001 in 100 seconds i.e. 0.001% Mercury Manometer: 1mm of Hg Note: These above instruments shall be calibrated having validity of 12 months.				
6.04.00	PROCEDURE OF TESTING: The Simplex Basket Filters to be installed in the standard test line (As per schematic) of large flow meter calibration facility with 35D upstream straight length and 25D downstream straight length. A five and half digit/time counter to be used to measure the time of diversion onto the measuring tank. Suitable pressure drops provided on the inlet and outlets of the filters is utilized for measurement of the differential pressures across the filter. A “U” tube manometer / differential transmitter is used for measurement of differential head and in turn the pressure drop across filters. Reading shall be recorded at the time of 5 to 10min. (approx.) The test line and filter shall be filled with water and entrapped air shall be cleared using air bleeds provided on the line. Flow rate shall be adjusted to a desired value in the test range by either speed variation of pumps or by manual equalizing valves installed on the test line				
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION- G-05 STANDARD TYPE TEST PROCEDURE	PAGE 28 OF 41

CLAUSE NO.	TECHNICAL REQUIREMENTS			
6.05.00	downstream of the filter. When flow conditions is stabilized, actual flow rate is determined by diverting water into the weigh tanks for measured time period. The mass of water diverted is measured using 100T electronic weigh system. The differential pressures across the filter, time of diversion of water into tank, initial and final mass of weigh tank were recorded. The flow rate (by gravimetric method) is computed as per sample calculation as elaborated below. Subsequently, the flow rate is to be varied and the test procedure to be repeated. The pressure across the filter to be measured near about the rated flow rates, as well as at about 2 to 3 additional low flow rate values (i.e. 25%, 50 % and 75% of design flow rate) and about 125% high flow rates with respect to the rated flow rate. Pressure loss curves to be plotted for each of the three filters for both conditions viz. 100% clean and 50% clogged. NOTATIONS:- W1 = Initial mass of weigh tank (kg) W2 = Final mass of weigh tank (kg) T = Time of collection of water in weigh tank (sec) B.C = Buoyancy correction factor = 1.00106 (Tank calibration by cast iron dead weights) ρ = Relative density of water at measured temperature (kg/cum) Qm = Actual mass flow rate (kg/sec) Qa = Actual volume flow rate of flow measuring in weighing tank L1 = Height of mercury column in manometer limb connected to upstream of filter in mm of Hg L2 = Height of mercury column in manometer limb connected to downstream of filter in mm of Hg P = Head loss across filter in mWC p = Differential head across the filter in mm of Hg Δp = Pressure drop across filter in kg/cm2 Sample Calculation: Estimation of flow rate by gravimetric method measurement was undertaken using following formulae (sample calculation): Initial mass of weigh tank W1 = 800 Kg Final mass of weigh tank W2 = 10500 Kg Time of collection of water in weigh tank T = 41 sec Buoyancy correction factor B.C = 1.00106 (Tank calibration by cast iron weights) Water density ρ = 1000.23 Kg/m3 Relative mercury density ρm = 13.6 Relative Water density (Generally) ρw = 1 Actual mass flow rate Qm = (W2-W1)/T kg/sec.			
	SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE			
	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001			
	SUB SECTION- G-05 STANDARD TYPE TEST PROCEDURE			
	PAGE 29 OF 41			

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	$= (10500-800)/41$$=236.58 \text{ kg/sec}$ Actual volume flow rate= $\{(W2-W1) \times B.C. / T \times \rho\} \times 3600$ $= \{(10500-800) \times 1.00106 /41 \times 1000.23\} \times 3600$ $= 852.41 \text{ m}^3/\text{hr}$ Height of mercury column in upstream side, L1 = 550 mm of Hg Height of mercury in downstream side, L2 = 510 mm of Hg Pressure drop across filter, $\Delta p = (L1 - L2) = (550 - 510) = 40 \text{ mm of Hg}$ Pressure drop across filter in mWC = $(L1 - L2) \times (\rho_m - \rho_w)/1000$ $= (550 - 510) \times 12.6/1000$ $=.504 \text{ mWC}$ Pressure drop across filter in Kg/cm2 = $0.504/10$ $= .0504 \text{ kg/cm}^2$			
7.00.00	Oil Purifier			
7.01.00	Objective To measure effectiveness of oil purifier / separator w.r.t. reduction of solid contaminants from mineral oil. Oil Grade: Type test for particle size shall be conducted with ISO VG 46/ISO VG 32 oil. Desired cleanliness level for particle size: With this test, the Purifier shall be demonstrated for the condition that the purified oil shall not contain more than 500 ppm of moisture and ma. Particle size confirming to code 15.12 as per ISO 4406.The above particle size and moisture content shall be demonstrated with Inlet oil quality confirming to 21/18 as per ISO 4406 and 15000 PPM moisture content respectively in one pass. Type: Centrifuge or any other type oil purification system as per manufacturer’s standard practice.			
7.02.00	Procedure and Set-Up in case of Centrifuge type purifier: a) Assemble the centrifuge bowl in purifier mode and set up the module as per the schematic flow diagram. b) Start the feed and set the purifier for desired capacity and temperature to maintain during test i.e. desired flow (As per data sheet) and 65 Deg C. Check the calibration certificate of all the equipments used in test.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-05 STANDARD TYPE TEST PROCEDURE	PAGE 30 OF 41

CLAUSE NO.	TECHNICAL REQUIREMENTS			
7.03.00	c) Start the module and wait till it reaches full speed. The module is started initially in recirculation mode (fresh oil is circulated back to dirty oil tank). d) Add particulate matter (contamination) in dirty oil tank to achieve contamination level of 21/18 as per ISO 4406 by ensuring proper mixing of the particulate matter (contamination). e) Now the module is ready for the Type test. Run the centrifuge. f) The oil flow (capacity) is checked using measuring flask/flow meter. In case of measuring flask desired capacity is measured by collecting the oil in a jar of 5 ltrs. And time taken to fill this jar. At least three readings are taken to adjust the capacity. The capacity is adjusted by flow adjusting inlet valve. g) Collect samples from centrifuge inlet sampling point after one minute of mixing dirt and collect sample at outlet after two minute of mixing dirt. h) In case of purifier where polishing filter is also applicable in such cases first sample will be collected by bypassing the filter and then by passing through polishing filter sample will be collected at the outlet of the polishing filter. i) The samples should be checked for its contamination using CMTI instruments which are made available at the type test venue. All the sample readings are recorded as per the Log Sheet. j) Multiple samples will be collected. Stop the centrifuge after collection of Sample. Procedure and Set-Up in case of Coalescer type purifier: a) Ensure all connections as per diagram of the test scheme. Ensure all drains and vents are closed. Install the particle counter to check the oil quality just before at the inlet of filter. b) Fill the oil drum 1 with oil and other oil drum (Oil Drum 2) with oil and solids/particle which shall be injected in oil to make inlet oil impurity level 21/18 as per ISO 4406. c) Before start the test start the pump and heater until the oil reaches the test temperature (40-50 Deg C). Check the calibration certificate of all the equipments used in the test. d) Open the dirt injection valve to allow the concentrated dirty oil to enter the flow stream of the system just before the inlet. The pump motor mixes the injection of dirty oil with the clean oil coming from the clean oil tank. e) Take an inlet sample after the pump at the inlet sample port. This will be particulate inlet sample. When sample result meet code 21/18 requirement progress to another step otherwise adjust the dirt injection valve. f) Start to inject the water into the inlet of the system using a flow meter in order to reach 15000 PPM of moisture content in the inlet sample. g) Allow 5 minutes of wait time to allow water and dirt to travel through the system. h) Take sample at inlet and outlet of filter in cleaned sample bottle.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-05 STANDARD TYPE TEST PROCEDURE	PAGE 31 OF 41

CLAUSE NO.	TECHNICAL REQUIREMENTS						
7.04.00	i) Put the safety cap, pack the sample carefully and properly in front of all party and sent it for analysis to lab for checking the purity level.						
	ACCEPTANCE CRITERIA						
	- Removal of 15,000ppm water down to 500 ppm water or less in one pass. - Removal of particulate at Code 21/18 on the inlet to Code 15/12 as per ISO 4406 or less on the outlet in one pass						
	Log Sheet						
	Sl. NO.	Oil Temp.(Deg C)	Flow (L/Min)	Solids (ISO 4406)	Water (L/Min)	No. of Sample	Time elapsed since FAT Starts

CLAUSE NO.

TECHNICAL REQUIREMENTS



G & D :

Leak Tightness Type Test Procedure for Guillotine Gates

Employer Drg No. : / Rev.00

PROJECT: Stage – (..... MW)

01

Rev.

Date

Description

Sign

Date

Prepared

Reviewed

Approved

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	1. Scope This procedure deals with the Test set up, methodology and calculations involved in type testing of Gate / Damper for establishing the leak tightness of Gate / Damper used in pressurized systems. 2. Reference documents 2.1 Corresponding Drawings 2.2 Approved Quality Plan 3. General 3.1 The Gate & Flap damper shall be tested in vertical position and the damper shall be tested in horizontal position Approved Quality Plan. 3.2 The Gate / Damper shall be operated for a minimum of five (5) times, before testing. 3.3 One operation is defined as from fully closed position to fully open position and back to fully closed position. 3.4 Upon completion of testing, the Gate / Damper shall be visually inspected for any physical damage to its components. 4. Test Procedure 4.1 Equipment requirement for type test is detailed out and the arrangement of the test equipment shall be as shown in the Annexure – II & III when they are to be tested without using seal air and as per Annexure – IV & V when they are to be tested with seal air. 4.2 The Gate / Damper (Item No. 01) shall be kept closed. 4.3 Energize the pressurizing fan (Item No. 02) and by adjusting the by-pass valve (Item No. 06) set the plenum duct (Item No. 04) pressure to the Gate / Damper pressure at MCR condition by using pressure tap (Item No. 07) and U Tube Manometer / Digital manometer. 4.4 Measure and record the velocity head at Pitot tubes (Item No. 08). Minimum three readings will be taken in each measurement and average will be recorded. Readings will be tabulated as per Annexure –I. 4.5 Using the formulae given in clause 5.0, calculate the leakage flow rate and estimate the degree of leak tightness of Gate / Damper. 4.6 If Seal Air is applicable, the same shall be connected and leakage will measured and calculated with Seal Air as per the step 4.3 to 4.5. Refer test set up drawings, Annexure – IV & V) 5 Calculations Variables D - ID of connecting pipe mm T - Temperature deg C Pst - Plenum Chamber Pressure (static) mm WC Vp - Velocity head mm WC d - Density of air kg/m³ A - Connecting duct area of Cross section m² V - Velocity m/sec Q - Flow rate (leak rate) m³/ sec V = 4.4222 x K x √Vp √d			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-05 STANDARD TYPE TEST PROCEDURE	PAGE 34 OF 41

CLAUSE NO.	TECHNICAL REQUIREMENTS																						
	Where V - Velocity of air in m /sec Vp - Velocity head in mm of WC measured in pitot tube K - Constant for single point reading (0.91 for single point reading) d - Air density (kg/m³) at test temperature and pressure. d = $\frac{1.225 \times (288.5)}{(273 + T^{\circ}\text{C})} \times \frac{(10335 + P_{st})}{10335}$ Q = A x V % Leakage = $\frac{\text{Leakage flow (Q)}}{\text{Flow rate of medium at MCR}} \times 100$ Correction for Temperature & Pressure: Q1 = Q x (d/ d1) Where, Q1 - Leak rate of medium at specified temperature & pressure d1 - Density of medium at specified temperature & pressure Equipment List																						
	<table><tr><th>Item No.</th><th>Description</th></tr><tr><td>01</td><td>Typical Gate / Damper: Gate / Damper to be tested</td></tr><tr><td>02</td><td>Pressurizing Fan sized to provide air supply at rated pressure to the plenum duct (Item No. 04) for testing.</td></tr><tr><td>03</td><td>Connecting pipe to connect pressurizing fan and plenum duct.</td></tr><tr><td>04</td><td>Plenum Duct to apply pressure to the Gate / Damper</td></tr><tr><td>05</td><td>Thermometer to measure the Temperature.</td></tr><tr><td>06</td><td>Bypass Valve mounted on the connecting duct to regulate the pressure in the plenum duct.</td></tr><tr><td>07</td><td>Pressure Tap provided to measure the air pressure in the plenum duct.</td></tr><tr><td>08</td><td>Pitot tube to measure velocity head.</td></tr><tr><td>09</td><td>Seal Air Blower (In case of testing using seal air supply. Refer Annexure- IV & V)</td></tr></table>	Item No.	Description	01	Typical Gate / Damper: Gate / Damper to be tested	02	Pressurizing Fan sized to provide air supply at rated pressure to the plenum duct (Item No. 04) for testing.	03	Connecting pipe to connect pressurizing fan and plenum duct.	04	Plenum Duct to apply pressure to the Gate / Damper	05	Thermometer to measure the Temperature.	06	Bypass Valve mounted on the connecting duct to regulate the pressure in the plenum duct.	07	Pressure Tap provided to measure the air pressure in the plenum duct.	08	Pitot tube to measure velocity head.	09	Seal Air Blower (In case of testing using seal air supply. Refer Annexure- IV & V)		
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-05 STANDARD TYPE TEST PROCEDURE																				
			PAGE 35 OF 41																				



G & D :

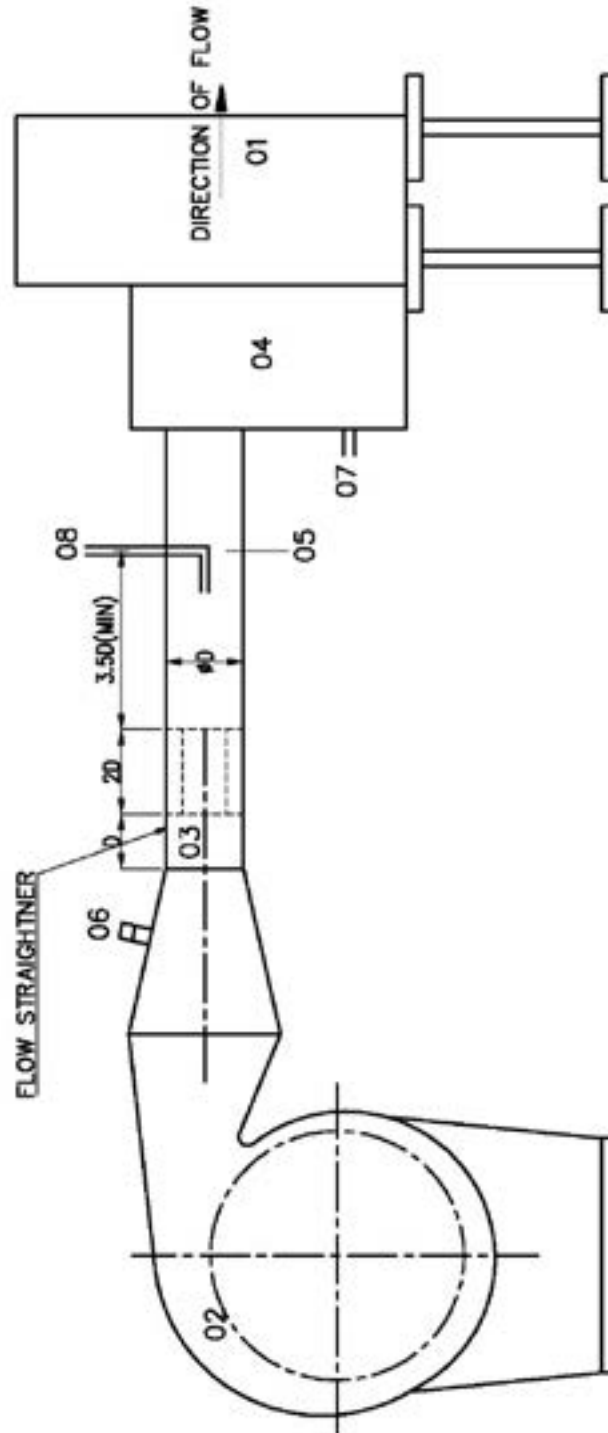
Annexure – I

LEAKAGE TEST OF GATE / BIPLANE DAMPER / FLAP DAMPER						
Project :			Size :			
WO No :			Test Date :			
			Time :			
Measured Values	Unit	Test 1	Test 2	Test 3	Test 4	Test 5
Pressure (Atm), PB	mbar					
Wet bulb temp, tw	°C					
Dry bulb temp, td	°C					
Track temp, T	°C					
Plenum chamber st. pr, Pst	mmWC					
Track static pr, Pst-track	mmWC					
Track dynamic pr, Vp	mmWC					
Area of track, A	m ²					
Seal air Pr	mmWC					
Calculated Values						
Volume flow thro' gate (MCR) Qs	m ³ /s					
Density (site), d1	kg/ m ³					
Air density (test), d	kg/ m ³					
Air velocity, V	m/s					
Volume leak (test), Q	m ³ /s					
% of leak tightness (test)	%					
Volume leak (site), Q1	m ³ /s					
% of leak tightness (site)	%					
Tested by :			Witnessed by :			

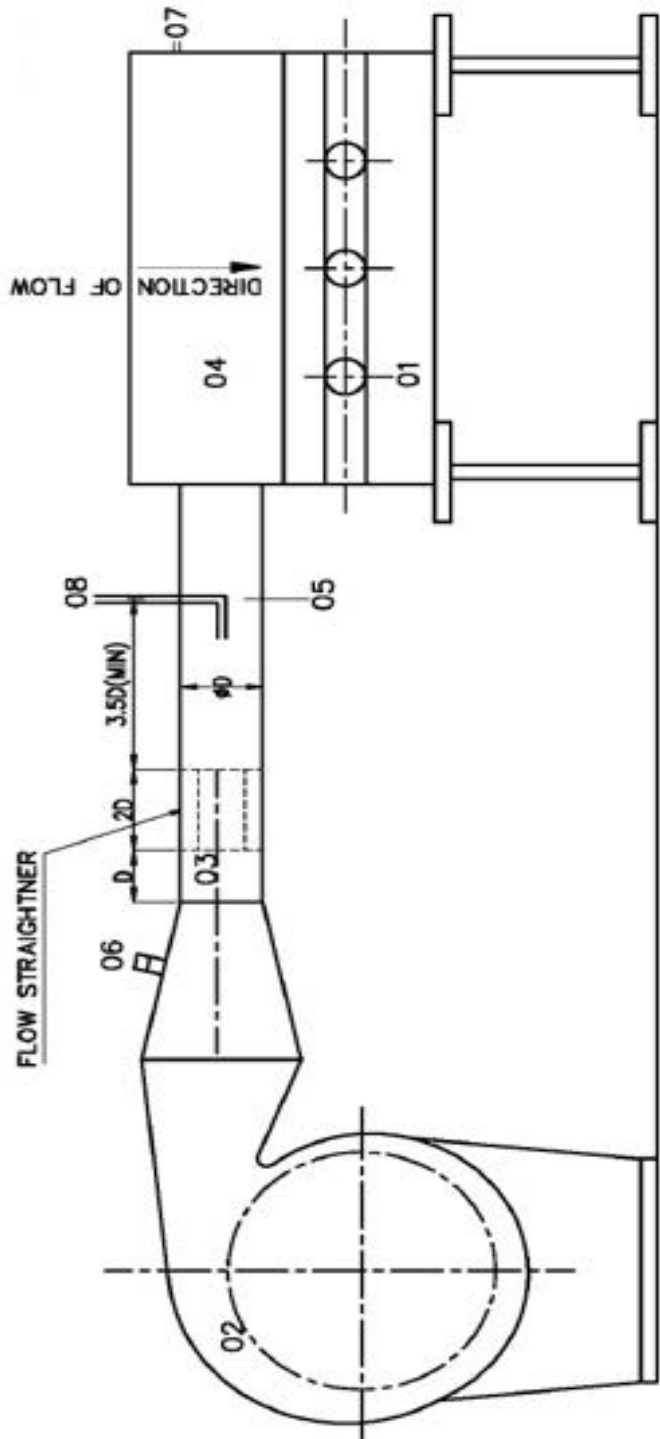
CLAUSE NO.		TECHNICAL REQUIREMENTS 													
		GATES / DAMPERS PARAMETERS for Leak Tightness Type Testing PROJECT: SINGARENI THERMAL POWER PROJECT STAGE-III (1 X 800 MW)													
SL.No.	Cust No. in which type test planned	Gate / Damper Location & Size (Height, mm x Width, mm)	PGMA	Quantity in each unit	Quantity to be type tested in project	Type of Gate / Damper	Operating parameter				Seal Air Parameter		Leak Tightness		Sub supplier Vendor code details & – /
							Vol. m ³ /sec	Pressure mm WC	Temp. ° C	Density Kg/m ³	Volume CFM	Pressure mm WC	Without Seal	Air %		With Seal	Air %
		Legend : Type of GATE / Damper (GT = Guillotine Gate, BL = Biplane Damper) The above details are in line with Employer approved GA drawings of ESP Gates for this project (Employer drg no. :)													
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE			TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001				SUB SECTION- G-05 STANDARD TYPE TEST PROCEDURE				PAGE 37 OF 41				



ANNEXURE-II (GATE)

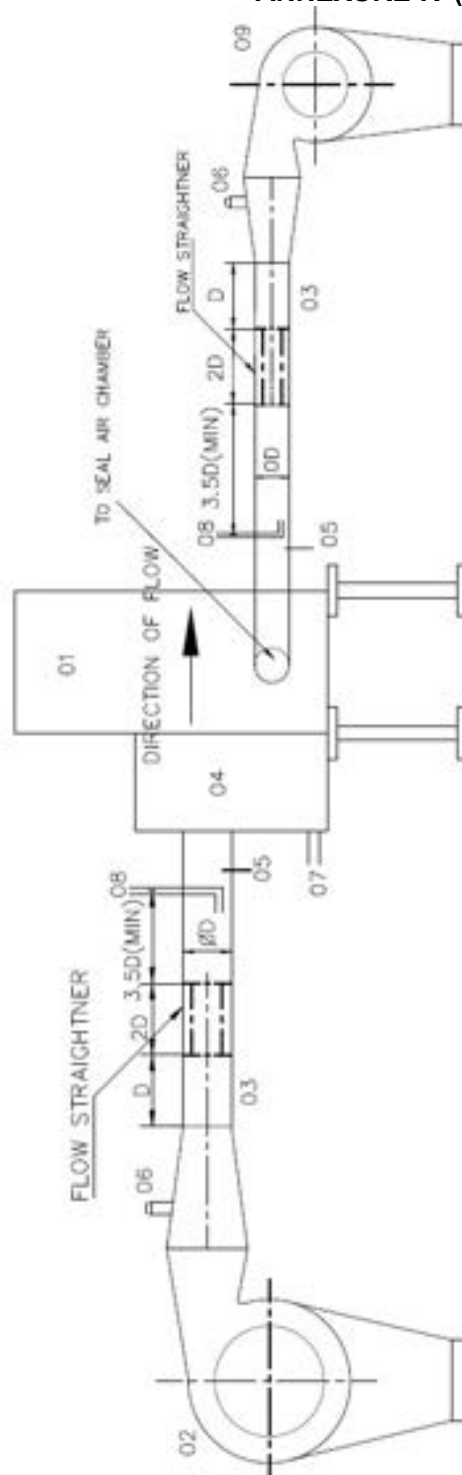


ITEM NO	ITEM NAME
01	GATE
02	PRESSURISING FAN
03	CONNECTING TRACK
04	PLENUM CHAMBER
05	TRICHOMETER
06	BY PASS VALVE
07	PRESSURE TAP
08	PITOT TUBE

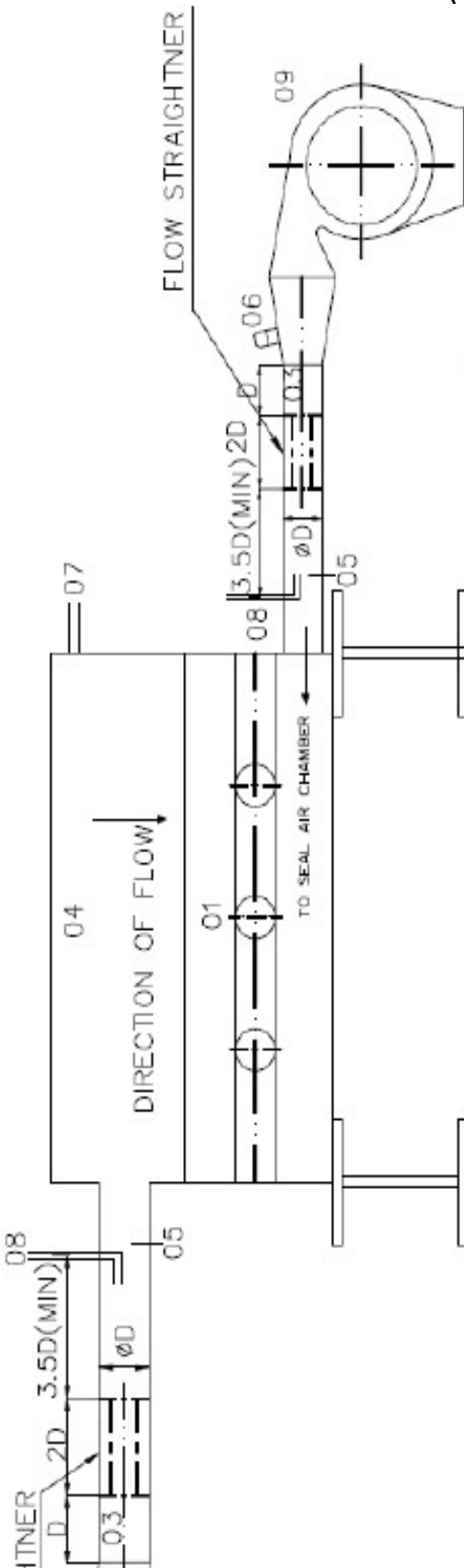
CLAUSE NO.	TECHNICAL REQUIREMENTS																					
	ANNEXURE-III (DAMPER)																					
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-05 STANDARD TYPE TEST PROCEDURE	PAGE 39 OF 41																			



ANNEXURE-IV (GATE WITH SEAL AIR BLOWER)



ITEM NO	ITEM NAME
01	GATE
02	PRESSURISING FAN
03	CONNECTING TRACK
04	PLENUM CHAMBER
05	THERMOMETER
06	BY PASS VALVE
07	PRESSURE TAP
08	PITOT TUBE
09	SEAL AIR BLOWER

CLAUSE NO.	TECHNICAL REQUIREMENTS																											
	ANNEXURE-V (DAMPER WITH SEAL AIR BLOWER)																											
																												
			<table><tr><td>1</td><td></td><td></td><td></td><td></td></tr><tr><td>2</td><td>FAN</td><td></td><td></td><td></td></tr><tr><td>3</td><td>TRACK</td><td></td><td></td><td></td></tr><tr><td>4</td><td>MBER</td><td></td><td></td><td></td></tr><tr><td>5</td><td>R</td><td></td><td></td><td></td></tr></table>	1					2	FAN				3	TRACK				4	MBER				5	R			
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2	FAN																											
3	TRACK																											
4	MBER																											
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION- G-05 STANDARD TYPE TEST PROCEDURE	PAGE 41 OF 41																									



SUB-SECTION – G-06

PRE-COMMISSIONING & COMMISSIONING

**SINGARENI THERMAL POWER PROJECT
STAGE-II (1X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC NO.:CW-CM-11159-C-O-M-001**

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	 PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS			
1.00.00	GENERAL			
1.01.00	The pre-commissioning and commissioning activities including Guarantee tests, checks and initial operations of the equipment furnished and installed by the Contractor shall be the responsibility of the Contractor as detailed in relevant clauses in Technical Specification. The Contractor shall provide, in addition, test instruments, calibrating devices, etc. and labour required for successful performance of these operations. If it is anticipated that the above test may prolong for a long time, the Contractor's workmen required for the above test shall always be present at Site during such operations.			
1.02.00	It shall be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and initial operation of the equipment systems which are installed by him. The Contractor shall also be responsible for flushing & initial filling of all oils & lubricants required for the equipment furnished and installed by him so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in these specifications & documents.			
1.03.00	The Contractor upon completion of installation of equipments and systems, shall conduct pre-commissioning and commissioning activities, to make the facilities ready for sustained safe, reliable and efficient operation. All pre-commissioning/commissioning activities considered essential for such readiness of the facilities including those mutually agreed and included in the Contractors quality assurance program as well as those indicated in clauses elsewhere in the technical specifications shall be performed by the Contractor.			
2.00.00	TESTING / COMMISSIONING PROCEDURES The contractor shall submit his testing / commissioning check lists and procedures for various equipments / systems covered under the contract at least 18 months before the actual commissioning of the equipments / systems for review and approval of employer. The testing / commissioning procedures are to be of a standard format in order to maintain consistency of presentation, content and reporting. The list of commissioning check lists and procedures to be submitted and their content details shall be agreed upon during preaward discussions. An indicative list of Testing / Commissioning procedures/schedules and Standard Checklists and the details regarding the contents of testing/commissioning are enclosed as annexure at the end of this sub-section of section-VI, Part B. The actual list of such equipments / systems shall depend on the equipments / systems being supplied by the contractor. i) Annexure-I : Standard Checklist of items ii) Annexure-II : Testing / Commissioning Procedure/schedules iii) Annexure-III : Commissioning procedures requiring approval of Employer. iv) Annexure – IV : Demonstration/Acceptance test procedures during Commissioning/Initial operation v) Annexure – V : Brief write up on Contents of Testing / Commissioning Procedures Procedure/schedules shall be approved by the employer.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION- G-06 PRE-COMMISSIONING & COMMISSIONING ACTIVITIES	PAGE 1 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS				
3.00.00	PRECOMMISSIONING & COMMISSIONING ACTIVITIES				
3.01.00	General The pre-commissioning activities including some of the important checks & tests for certain major equipment/ systems (as a minimum) are described below, although it is the Contractor's responsibility to draw up a detailed sequential & systematic list of checks / tests and various activities / procedures connected with pre-commissioning of the complete facilities with all systems, sub-systems and equipment supplied and installed by him and get the same approved by the Employer.				
3.02.00	PRE-COMMISSIONING ACTIVITIES/TESTS:				
	Steam Generator				
3.02.01	Hydraulic Testing of Pressure Parts On completion of installation of the Steam Generator pressure parts and high pressure boiler external piping & non boiler external piping a hydraulic test in accordance with the requirements of the Indian Boiler Regulations, shall be performed by the Contractor. However, making use of valves/control valves supplied by others and installed on the contractor's piping system during hydraulic testing shall be subjected to the acceptance of respective valve supplier otherwise hydraulic cap/blanking arrangement as required shall be used. The procedure adopted for hydraulic test and preservation shall have the prior approval of the Employer. The detailed schemes and procedure for carrying out hydraulic testing shall be prepared and furnished by the contractor and it shall be discussed and finalized during detailed engineering stage. The water for hydraulic test shall be made alkaline by addition of suitable chemicals. After the test, the Steam Generator and high pressure external piping shall be suitably drained and preserved. All blank flanges, removable plugs, temporary valves, pipes & fittings, spools, other accessories and services required for carrying out hydraulic testing of boiler external pipings & non boiler external pipings and boiler & its pressure parts shall be furnished by the Contractor. The pressurization equipment including water piping and any chemicals for preservation, needed for the above test shall also be furnished by the Contractor. Any defect noticed during the testing shall be rectified and the unit shall be retested by the Contractor. In the case of branch connections/ tap-off piping (in others scope) from contractor's scope of piping are not ready or not erected at the time of hydrostatic testing of piping in contractor's scope, then the contractor to supply/use necessary blanking arrangement as required at these tap-off /branch connections. The hydraulic test shall be considered successful only on certification to that effect by the concerned inspecting authority as per the provision of the IBR and the Project Manager.				
3.02.02	Air & Gas Tightness Test After completion of installation of furnace tubes and/or inner skin casing wherever applicable ducts and air heaters, and before commencement of application of thermal insulation a test shall be performed on the Steam Generator by the contractor to prove or to establish the tightness of the erected equipments from the outlet of FD fan through Steam Generator to the stack. Such test shall be done, as far as possible, with all mountings like soot blowers etc. installed in position. The procedure adopted for such tests shall have the prior approval of the Employer. Normally physical leak detection method by pressurizing the section under test by running FD Fan / PA Fan / Temporary blower, as the case may be, is adopted. The contractor may adopt any other better method of testing.				
<table><tr><td>SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE</td><td>TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001</td><td>SUB-SECTION- G-06 PRE-COMMISSIONING & COMMISSIONING ACTIVITIES</td><td>PAGE 2 OF 14</td></tr></table>		SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION- G-06 PRE-COMMISSIONING & COMMISSIONING ACTIVITIES	PAGE 2 OF 14
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION- G-06 PRE-COMMISSIONING & COMMISSIONING ACTIVITIES	PAGE 2 OF 14		

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.02.03	All equipments including any temporary blanking, if required, for the above test shall be provided by the Contractor. The Contractor's air and gas tightness test procedure shall be such that it shall enable conductance of air/gas tightness test on the ducts in segmented manner (as and when these duct segments are ready), so that these duct segments can be immediately released for application of insulation after their air/gas tightness tests. Contractor shall made all necessary arrangement for conducting tests in this manner. Any blanking etc. on the duct side required for testing of duct segments shall be provided by Contractor. Contractor shall bring fan / blower (s) of adequate size / capacity and other necessary instruments so that these tests can be conducted without necessity of FD / PA fans. The above equipment shall be brought to site by the Contractor on temporary basis and shall be taken back after successful completion of air / gas tightness test.			
	Chemical Cleaning of Pressure Parts The Contractor shall perform thorough and efficient cleaning operations of all the internal parts of the boiler, like economiser, water wall / evaporator, separator, feed water line, piping, start-up recirculation lines and associated piping and all other pressure parts and associated high pressure piping covered under these specifications (except those portions which are to be steam blown). The cleaning operation shall consist of De-mineralised (DM) water flushing, the chemical cleaning using acids like hydrofluoric acid or as recommended by the manufacturer, DM water rinsing, DM water flushing, nitrogen capping etc. Complete chemical cleaning procedure, the scheme and layout including parameters of the pumps, size of tanks, materials of construction, the rate of consumption and total requirements of steam and water for such cleaning process shall have the approval of the Employer. The Contractor shall furnish all labour, materials such as the required chemicals and other consumables, all equipment such as acid/chemical transfer and acid/chemical circulating pumps complete with drive motors, acid storage and acid/chemical mixing tanks, all temporary piping, valves and specialities and local instruments for pressure, temperature and flow measurements and any other items needed to carry out the process. All equipment required for chemical cleaning of Steam Generator shall be supplied by the contractor. The Contractor shall take care to dispose off the used chemicals and the effluents from the cleaning operations, after neutralisation, meeting all the statutory regulations and in a manner acceptable to the Project Manager and which would comply with the norms of the State Pollution Control Board. This includes construction of suitable neutralization pit, channels, disposal equipments etc. The Contractor shall specifically make all necessary arrangements for prevention of any fire accidents, explosions etc. during the performance of the chemical cleaning operations. The Contractor shall ensure that during the cleaning process the procedure adopted shall be such as to consume minimum demineralized water. The cleaning procedure shall include final flushing and draining of the boiler under a nitrogen gas cap and/or filling the boiler with inhibited water or any other proven procedure recommended by the manufacturer for the preservation of the boiler which is acceptable to the Employer. The Contractor shall furnish a detailed procedure for boiler preservation during detailed engineering for Employer's approval. All equipment needed for such preservation including the nitrogen cylinders, interconnecting piping and any regulating equipment for N2 cap and other preservatives shall be provided by			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION- G-06 PRE-COMMISSIONING & COMMISSIONING ACTIVITIES	PAGE 3 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.02.04	the Contractor for the Steam Generator and the same shall also become the property of the Employer after completion of the chemical cleaning. The Contractor shall provide adequate safety and protective equipment for all his employees and ensure that they are worn at all times of danger. Specialized treatment equipment (such as required for first aid when using hydrofluoric acid/chemical) must be provided at the place of handling acid/chemical. An acid/chemical cleaning report and log of each cleaning must be provided by the Contractor to the Employer, immediately after the cleaning operation. Dry Preservation of non-drainable portion during shutdown to be provided. Steam Blowing Steam blowing of complete Superheaters, Reheaters and various boiler external piping and non boiler external piping shall be carried out by the Contractor as per requirements/scope of work (indicated in Part-A & Part-B, Section-VI) of this specification. Temporary materials as required for steam blowing of these piping systems shall be supplied by the contractor. Steam blowing of contractor's scope of piping systems shall be performed without valves/control valves supplied in steam blowing circuit otherwise valve supplier's acceptance to include these valves for steam blowing operation is to be submitted by the contractor. Based on the above the Contractor shall give recommended procedures, method of blowing and scheme for steam blowing indicating clearly additional system, if any, to be cleaned by steam blowing and furnish data/ write-up/ layouts/ drawings to that effect to the Employer for approval. The Contractor shall furnish his recommendations regarding use of various test equipments and instruments and termination/acceptance criteria for steam blowing, which in any case shall meet the steam turbine-generator requirements. The systems which should be ready and operational before steam blowing shall be made ready/operational by the Contractor by the scheduled date for starting of steam blowing. For equipments/components installed on high pressure external piping, such as various thermo-wells, flow meter, control valves, HP/LP Bypass valves etc., the Contractor shall comply with guidelines to be followed during steam blowing, with respect to removal / blanking / replacement of such items their internals etc. by spool pieces as given by the respective manufacturer/sub-contractor. Supply of all such spools (as above) and/or blanks, temporary piping and supports etc. as required, cutting / welding / edge preparation and rewelding required for blanking, temporary piping connection and/or for replacements by spool pieces shall be the responsibility of the Contractor. After steam blowing removal of spool pieces & temporary piping and reinstallation of various components, shall also be the responsibility of the Contractor. In the case of branch connections/ tap-off piping are not ready or not erected at the time of steam blowing operation then the contractor to supply/use necessary blanking arrangement as required at these tap-off / branch connections. It will be the responsibility of the Contractor to operate the Steam Generator and its accessories equipment to generate adequate steam at the parameter and quality in line with the requirements of steam blowing procedure. The Contractor shall make adequate provisions for temporary enhancement of fuel oil firing capacity of the steam generators by changing oil gun tips etc. as may be required so as to be able to conduct complete steam blowing operation by oil firing alone. All necessary precautions to avoid fires and cold end			
	SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION- G-06 PRE-COMMISSIONING & COMMISSIONING ACTIVITIES	PAGE 4 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	corrosion of Air preheater, during such oil firing at enhanced SG loads, shall be taken by the Contractor. The Contractor shall ensure successful and timely completion of steam blowing of all systems and will render all help/services as required including: (i) Services of test/operating personnel/supervisors. (ii) Extending all cooperation during erection, pre-commissioning of plant and equipment to be made ready and operational before starting steam blowing. (iii) Extending all cooperation for interface engineering of equipments/components of temporary system required for steam blowing operation. (iv) Contractor's engineers shall be available for all coordination meetings arranged by the Employer for finalizing the details of temporary system for steam blowing. For the steam blowing operation, steam conditions like pressure, temperature etc. at the Steam Generator outlet shall be so selected that a minimum cleaning ratio/ disturbance factor of more than 1.4 is achieved. A cycle of heating, cooling and blowing/ purging, is to be repeated to ensure thorough cleaning of the interior of the pipes/ tubes etc. The final indication of cleanliness shall be demonstrated by purging through target plates positioned at the discharge point.			
3.02.05	NOT USED			
3.02.06	ESP			
	Complete pre-commissioning work including tests of facilities such as air and gas tightness tests of ESP, pressure drop test of ESP, gas distribution test of ESPs etc. and all other tests as mutually agreed in the Contractor's quality assurance program as well as those identified in the specification.			
3.02.07	FGD System			
3.02.07.01	Air and Gas Tightness Test			
	After completion of installation of Booster fans (if required), ducts & absorber, and before commencement of application of thermal insulation a test shall be performed on the FGD system by the contractor to prove or to establish the tightness of the erected equipments. The procedure adopted for such tests shall have the prior approval of the Employer. Normally physical leak detection method by pressurizing the section under test by running Temporary blower is adopted. The contractor may adopt any other better method of testing. All equipments including any temporary blanking, if required, for the above test shall be provided by the Contractor. The Contractor's air and gas tightness test procedure shall be such that it shall enable conductance of air/gas tightness test on the ducts in segmented manner (as and when these duct segments are ready), so that these duct segments can be immediately released for application of insulation after their gas tightness tests. Contractor shall made all necessary arrangement for conducting tests in this manner. Any blanking etc. on the duct side required for testing of duct segments shall be provided by Contractor. Contractor shall bring fan / blower (s) of adequate size / capacity and other necessary instruments so that these tests can be conducted. The above equipment shall be brought to site by the Contractor on			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION- G-06 PRE-COMMISSIONING & COMMISSIONING ACTIVITIES	PAGE 5 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	temporary basis and shall be taken back after successful completion of air / gas tightness test.			
3.02.07.02	All pre-commissioning tests & activities as indicated in Annexure-I, II & III and elsewhere in the technical specification shall be performed by the Contractor.			
3.02.08	Any other pre-commissioning activity such as floating of safety valves etc. as considered essential for readiness of facilities for commencement of commissioning activities shall also be undertaken by the Contractor.			
3.03.00	Demonstration/Acceptance tests during Commissioning/Initial Operation The following tests shall be demonstrated during commissioning for which the bidder has to furnish the procedure and get the approval of the employer:			
3.03.01	Unit Load Ramp rate capability test: Demonstration of ± 3% per minute ramp rate for 50% to 100% load range and minimum ± 1% per minute below 50% load to minimum boiler once through load, maintaining the parameters within prescribed limits as defined in closed loop control system requirements (Refer Functional Guarantee Chapter).			
3.03.02	Start-up, Loading, Unloading and Shutdown Capabilities (For Turbine Generator) (i) Unit Start Up Start-up time (upto full load), and loading capabilities for the Turbine Generator together for cold start conditions (greater than 36 hours shutdown), warm start conditions (between 8 and 36 hours shutdown) and hot start conditions (less than 8 hours shutdown) as indicated by the Contractor in the offer and accepted by the EMPLOYER shall be demonstrated, ensuring that the various turbine operational parameters like vibration, absolute and differential expansion, eccentricity and steam-metal temperature mismatch etc. are within design limits. (ii) Sudden Total Loss of External Load On occasions, the steam turbine generator unit may experience sudden total loss of all external load. Under these conditions, the steam turbine generator unit shall not trip but shall continue to be in operation under the control of its speed governor to supply power for the plant auxiliary load with HP-LP bypass in operation while staying within the agreed limits of steam to metal temperature mismatch, exhaust hood temperature, absolute and differential expansion, vibration and eccentricity. The same shall be demonstrated. Further, the provisions of Part-B, Section-VI, shall also be complied with. (iii) Steam Metal Temperature Mismatch Limitation The steam-metal temperature differential for cold, warm and hot start up, loading / unloading and shutdown conditions shall be within the permissible limits indicated by the Bidder in the offer and accepted by the Employer.			
3.03.03	Turbine Generator Set Capability			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION- G-06 PRE-COMMISSIONING & COMMISSIONING ACTIVITIES	PAGE 6 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.03.04	The steam turbine generator unit shall be capable of delivering at generator terminals the output as indicated by the BIDDER in the heat balances submitted along with his bid, under the following condition. (a) Maximum continuous output at generator terminals corresponding to both strings of HP heaters out of service, under rated steam conditions, at condenser pressure of 89 mmHg(Abs) and 3% make-up & Aux. Steam requirement tapped from CRH, generating not less than the rated output OR output corresponding to design BMCR heat duty, whichever is less without overstressing turbine components. NOTE: While conducting the tests of (a) above the condenser pressure measurement shall be done at 300mm above the top row of condenser tubes . Turbine Auxiliaries (i) H.P./L.P. Bypass Capabilities The HP & LP Bypass system should satisfy the following functional requirements under automatic interlock action. It should come into operation automatically under the following conditions: (a) Generator circuit breaker opening. (b) HP - IP stop valves closing due to turbine tripping. (c) Sudden reduction in demand to house load. Under all these conditions, while passing the required steam flows as per the relevant heat balances, the condenser should be able to swallow the entire steam without increasing the exhaust hood temperature and condenser pressure beyond the maximum permissible value indicated by the BIDDER in his offer and accepted by the EMPLOYER. The same shall be demonstrated. (ii) Steam Condensing Plant for main turbine (a) Temperature of condensate, at outlet of condenser, shall not be less than saturation temperature corresponding to the condenser pressure at all loads. (b) Oxygen content in condensate, at hotwell outlet, shall not exceed 0.015 CC per litre over the entire load range and shall be determined according to calorimetric Indigo - Carmine method. (c) Air leakage in the condenser under full load condition shall not exceed more than 50% of design value taken for sizing the condenser air evacuation system. (d) When one half of the condenser is isolated, condenser shall be capable of taking at least 60% T.G. load under EMCR conditions. (e) The capacity of each vacuum pump in free dry air under standard conditions at a condenser pressure of 25.4 mm Hg (abs) and sub cooled to 4.17 deg.C below the temperature corresponding to absolute suction pressure shall not be less than specified elsewhere. Correction curves for establishing the capacity at site conditions shall also be furnished.			
	SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001 SUB-SECTION- G-06 PRE-COMMISSIONING & COMMISSIONING ACTIVITIES PAGE 7 OF 14			

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.03.07	Contractor shall balance the primary air as well as coal flows in the pulverised fuel pipes such that the minimum PF and PA flow imbalance in the PF pipes from each coal pulveriser does not exceed 5% of average flows. The above balancing shall be checked by the Contractor by carrying out both clean air test and dirty air test (using dirty pitot tubes).			
	Demonstration of boiler operation, rate of change of load and sudden load change withstand capability Refer Sub section-A-02 and A-03 ,Part-B (Mechanical), Section VI of Technical Specification.			
3.03.08	Steam Temperature Imbalance The Contractor shall demonstrate that at SH and RH outlets (in case of more than one outlet) the temperature imbalance between the outlets does not exceed 10 deg C under all loads including transients.			
	No fuel oil support shall be required above 40% TMCR Contractor shall demonstrate that oil support for flame stabilization shall not be required beyond 40% of TMCR load when firing the coals from the range identified. The Contractor shall demonstrate that with any combination of mills/ adjacent mills in service (to Employer's choice) the Steam Generator does not require any oil firing for stable and efficient boiler operation at and above 40% TMCR loads.			
3.03.10	Capabilities of all drives After completion of installation of drives, contractor shall demonstrate the capability of all drives as specified elsewhere in Section VI Part B of Technical Specifications.			
	Margin on Fans After completion of installation of fan drives, Fans, inlet and outlet ducting, measuring equipments etc. contractor shall demonstrate the margin on seal air fans, primary fans, Forced draft fans and induced draft fans as specified elsewhere in Section VI Part B of Technical Specifications.			
3.03.12	Cold Air Velocity Test (CAVT) A CAVT shall be conducted on each Steam Generator during commissioning before its initial operation to establish the average cold air velocity and the velocity distribution at minimum three predetermined sections (Employer's Choice) of steam generator. The data obtained from the CAVT will be used to compute the actual flue gas velocities as well as their distribution at the test sections during actual operation by correlating the CAVT data with the test/computed data from Thermal Performance Test as per Clauses 1.03.04 (iii) sub section-IV, Section-VI- Part-A. Should the CAVT results after this correlation with TPT data indicate actual localized high flue gas velocity zones/ mal-distribution of gas flow and/or flue gas laning, suitably designed stainless steel screens at required SG cross sections shall be provided by the Contractor to bring the deviation of the localized gas velocity within ± 20% of average gas velocity specified. Through this test the Contractor shall also demonstrate the compliance with the specification requirements regarding the maximum allowable flue gas velocities at various sections of the Steam Generator, refer sub-sectdion-A-03, Part-B of Technical Specifications. The detailed CAVT procedure shall be to Employer's approved. The Contractor shall submit			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION- G-06 PRE-COMMISSIONING & COMMISSIONING ACTIVITIES	PAGE 9 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.03.13	a detailed CAVT report and the computations of actual velocities after correlating CAVT data with TPT data to the Employer for approval. Capabilities of firing of 30% imported coal Contractor shall demonstrate the capability of Steam generator and its auxiliaries to operate at rated parameters safely and on sustained basis at TMCR load while firing range of Indian coal(s) as specified in Table-1(A), Annexure-IV-2 ,sub section-IB ,Part-A of Section-VI blended with imported coal up o 30% by weight specified in Table-4, Annexure-IV-4, sub section-IB ,Part-A, Section-VI. Such demonstration shall be for 72 hours of continuous operation			
3.03.13 a)	Performance characteristic of fans (PA/FD/ID fan capacity, head developed, etc.)			
3.03.14	Passenger & good elevators for steam generator – overload tests, travel and hoist speed checks.			
3.03.15	ESP Air in Leakage Contractor shall demonstrate that ESP air in leakage shall be limited to 1% of the total gas flow under guarantee point condition.			
3.03.16	Pressure Drop Across ESP Contractor shall demonstrate that the maximum flue gas pressure drop across the ESP under specified guarantee point condition shall not exceed 20 mmwc.			
3.03.17	FGD System (i) Performance characteristics of fans (capacity, head developed, etc.) and margins on fans in case Booster Fan, as specified in Part-B of technical specification, is provided by the Contractor. (ii) Capabilities of all drives (Refer Part B of Technical Specifications) (iii) Passenger cum Goods Elevator for FGD absorber & Limestone Grinding Building: Over load tests, travel and hoist speed checks.			
3.03.18	Unit startup/shutdown demonstration as per combined startup curves for cold, warm and hot conditions.			
3.03.19	Fire Detection and Protection System a) Following shall be demonstrated at Site: i) Vibration & Noise level of fire water pumps. ii) Performance test of each of systems such as Hydrant, HVW Spray, MVW Spray, Foam Injection system, Inert gas extinguishing system, fire detection and alarm system, Fire extinguishers and Fire monitors as per the design parameters/ standards/TAC. iii) Parallel Operation, vibration & noise level of the fire water pumps and diesel engines. b) All tests as required by the TAC.			
3.04.00	Pre-commissioning & Commissioning activities requiring approval of the employer:			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION- G-06 PRE-COMMISSIONING & COMMISSIONING ACTIVITIES	PAGE 10 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	(a) Hydraulic Test for STG integral piping, heat exchangers, condenser tubes & condenser, equipment cooling water system pipes and associated equipment etc. shall be done. The hydraulic test of other piping system as per statutory requirement and specified elsewhere shall also be carried out. All equipment needed for the tests shall be furnished by the Contractor. (b) Oil flushing of lube oil system, control & jacking oil system, etc. for turbines shall be done. Entire flushing oil requirement & refilling with fresh oil and other consumables along with flushing equipment shall be met by the Contractor. (c) High Pressure/Low Pressure (HP/LP) bypass tests, vacuum tightness test as per approved procedures shall be done by the Contractor after arranging & lining up of all the necessary equipment by him. (d) Steam blowing & chemical cleaning, as applicable of integral piping of the turbo-generator, Low pressure piping, Power cycle piping & other piping in the scope of the Contractor shall be done by the Contractor. (e) Steam blowing & chemical cleaning, as applicable of integral piping of CEP sets & other piping in the scope of the Contractor shall be done by the Contractor. (f) All tests and activities pertaining to the CEP and its drive as per manufacturer's recommendations and as given in the chapter and covered in the specification. (g) Steam blowing & chemical cleaning, as applicable of integral piping of Drip Pump sets & other piping (if applicable) shall be done by the Contractor. (h) All tests and activities pertaining to the Drip Pump and its drive (if applicable) as per manufacturer's recommendations and as given in the chapter and covered in the specification. (i) Steam blowing & chemical cleaning, as applicable of integral piping of the Heaters & other components shall be done by the Contractor. (j) All tests and activities pertaining to the Heater as per manufacturer's recommendations and as given in the chapter and covered in the specification. (k) Oil flushing of lube oil system, control & jacking oil system, for BFP sets shall be done. Entire flushing oil requirement & refilling with fresh oil and other consumables along with flushing equipment shall be met by the Contractor. (l) Steam blowing & chemical cleaning, as applicable of integral piping of BFP sets & other piping shall be done by the Contractor. (m) All tests and activities pertaining to the BFP and its drive as per manufacturer's recommendations and as given in the chapter and covered in the specification. (n) Hydraulic Test for all low and high pressure piping, equipment cooling water system pipes and associated equipment etc. shall be done as per statutory requirement and specified elsewhere shall be carried out. All equipment needed for the tests shall be furnished by the Contractor. (o) All tests and activities pertaining to the Generator and Excitation as per manufacturer's recommendations and covered in the specification.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION- G-06 PRE-COMMISSIONING & COMMISSIONING ACTIVITIES	PAGE 11 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS				
3.05.00	(p)	All tests and activities pertaining to the Generator Auxiliaries viz Primary water system, Seal oil system, Gas system etc., as per manufacturer's recommendations and covered in the specification.			
	(q)	Any other pre-commissioning checks/ tests and activities as described below and also those mutually agreed between the Contractor & the Employer shall be undertaken.			
	COMMISSIONING OF FACILITIES				
	General				
	Upon completion of pre-commissioning activities/test the Contractor shall initiate commissioning of facilities. During commissioning the Contractor shall carryout system checking and reliability trials on various parts of the facilities.				
	Contractor shall carry out these checks/tests at site to prove to the Employer that each equipment of the supply complies with requirements stipulated and is installed in accordance with requirements specified. Before the plant is put into initial operation the Contractor shall be required to conduct test to demonstrate to the Employer that each item of the plant is capable of correctly performing the functions for which it was specified and its performance, parameters etc. are as per the specified/approved values. These tests may be conducted concurrently with those required under commissioning sequence.				
	The Contractor shall finalize the protocol of check lists, after erection of the system and equipment, as per International Codes/Standard with the Employer.				
	The Contractor shall furnish requisite no. of copies of procedures and list of start up, pre-commissioning, commissioning and initial operation tests for Employer's approval.				
	The Contractor shall also demonstrate the performance of all C&I equipment, the tests on main equipment or prior to that as the case may be.				
	Other tests shall be conducted, if required by the Employer, to establish that the plant equipments are in accordance with requirements of the specifications.				
3.05.01	The Commissioning tests/checks shall specifically include but will not be limited to following:				
	(a)	Checks on the operation of all controls of isolating gas and air dampers.			
	(b)	Checks on operation of all fans and all rotating equipment to ascertain level of noise and vibration.			
	(c)	Test running of all pumps.			
	(d)	Checks on operation of all air heaters and adjustment of seals, if necessary when each heater is upto its working temperature.			
	(e)	Checks on operation of all soot blowers and retraction gear and the sequences control.			
	(f)	Check run on the Pulverised Fuel (P.F.) Mills including clean air flow test.			
	(g)	Standard commissioning tests and procedures as per Contractor's practice for Steam Generator, FGD System and other equipment / auxiliaries.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION- G-06 PRE-COMMISSIONING & COMMISSIONING ACTIVITIES	
				PAGE 12 OF 14	

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.05.02	(h)	Checks on operation of all individual control loops in the Steam Generator control loops in the Steam Generator control system including FGD System.		
	(i)	Checks on inter-relation between each control loop in the Steam Generator control system including FGD system. Checks on inter-relation between each control loop in the turbine generator control system.		
	(j)	Checks on correct functioning of the Burner Management System (BMS).		
	(k)	Calibration tests of orifice, flow nozzles, instruments and control equipment to the extent included in these specifications.		
	(l)	Tests on Control & Instrumentation (C&I) Equipments:		
	LIST OF TEST / ACTIVITIES TO BE PERFORMED ON TG & AUXILIARY (but not limited to folowing)			
	A)	COMMISSIONING TESTS/CHECKS		
	1.	Test running of all pumps		
	2.	Condenser vacuum test, feed water heater operational tests for establishing correct cascaded flow, heater water levels etc. & checking of all parameters as per approved heat balance diagrams.		
	3.	Test for HP/LP bypass valves operation & their control system.		
	4.	Test for operation of governing control system for turbines.		
	5.	Standard commissioning tests and procedures as per Contractor's practice for steam turbine generator and other equipment / auxiliaries within the Contractor's scope of work.		
	6.	Checks on operation of all individual control loops in the turbine generator control system.		
	7.	Checks on correct functioning of the Turbine Protection System (TPS), Turbine Supervisory Control System (TSCS) for main turbine, Automatic Turbine Run-up System (ATRS), Automatic Testing of Turbine (ATT).		
	8.	Standard commissioning tests and procedures as per Contractor's practice for CEP and other equipment / auxiliaries within the Contractor's scope of work.		
	9.	Checks on operation of all individual control loops in the CEP control system.		
	10.	Standard commissioning tests and procedures as per Contractor's practice for Drip Pump (if applicable) and other equipment / auxiliaries within the Contractor's scope of work.		
	11.	Checks on operation of all individual control loops in the Drip Pump control (if applicable) system.		
	12.	Feed water heater operational test for establishing correct cascaded flow, heater water levels and checking of all parameters as per approved heat balance diagram.		
	13.	standard commissioning tests and procedures as per contractor's practice for heaters and de-aerator and other equipment/auxiliaries within the contractor's scope of work.		
	14.	Checks on operation of all individual control loops in the heater and deaerator control system.		
	15.	Test for operation of governing control system for BFP turbines.		
	16.	Standard commissioning tests and procedures as per Contractor's practice for BFP and other equipment / auxiliaries within the Contractor's scope of work.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION- G-06 PRE-COMMISSIONING & COMMISSIONING ACTIVITIES
				PAGE 13 OF 14

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	17. Checks on operation of all individual control loops in the BFP control system. 18. Checks on correct functioning of the BFP Turbine for Turbine Protection System (TPS), Turbine Supervisory Control System (TSCS) for main turbine, Automatic Turbine Run-up System (ATRS), Automatic Testing of Turbine (ATT). 19. Calibration tests of orifice, flow nozzles, instruments and control equipment to the extent included in these specifications. 20. Checks on operation of all rotating equipments to ascertain level of noise and vibration 21. Checks on operation of all static equipments to ascertain level of noise and vibration 22. Standard commissioning tests and procedures as per manufacturer's practice for Generator, Excitation and its auxiliaries within the Contractor's scope of work.			
3.06.00	Balance of Plant equipment & systems All pre-commissioning tests &activities as required for successful running of the equipment or as mentioned in the technical specification elsewhere shall be performed by the contractor.			
4.00.00	INITIAL OPERATION Upon completion of system checking/tests and as a part of commissioning of facilities, complete plant/facilities shall be put on initial operation for a period of thirty (30) days or 720 hours as stipulated in General Technical Requirements.			
5.00.00	The Contractor shall conduct all the commissioning tests and undertake commissioning activities pertaining to all other auxiliaries and equipments including all Electrical & C&I equipment/systems not specifically brought out above but are within the scope of work and facilities being supplied & installed by the Contractor and follow the guidelines indicated above or elsewhere in these technical specifications (Section-VI).			
6.00.00	The Contractor shall conduct the comprehensive guarantee tests on the Steam Generator in co-ordination with the Steam Generator to establish the functional guarantee values at stipulated conditions as per Sub-section-IV, Part-A, Section-VI.			
7.00.00	The Contractor shall conduct all the commissioning tests and undertake commissioning activities pertaining to all other auxiliaries and equipments including all Electrical & C&I equipment/systems not specifically brought out above but are within the scope of work and facilities being supplied & installed by the Contractor and follow the guidelines indicated above or elsewhere in these technical specifications (Section-VI).			
8.00.00	COMMISSIONING SPARES			
8.01.00	It will be the responsibility of the Contractor to provide all commissioning spares including consumable spares required for initial operation till the Completion of Facilities. The Contractor shall furnish a list of all commissioning spares within 60 days from the date of Notification of Award and such list shall be reviewed by the Employer and mutually agreed to. However, such review and agreement will not absolve the Contractor of his responsibilities to supply all commissioning spares so that initial operation do not suffer for want of commissioning spares. All commissioning spares shall be deemed to be included in the scope of the Contract at no extra cost to the Employer.			
8.02.00	These spare will be received and stored by the Contractor at least 3 months prior to the schedule date of commencement of initial operation of the respective equipment and utilized as and when required. The unutilized spares and replaced parts, if any, at the end of successful completion of guarantee tests shall be the property of the Contractor and he will be allowed to take these parts back at his own cost with the permission of Employer.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION- G-06 PRE-COMMISSIONING & COMMISSIONING ACTIVITIES	PAGE 14 OF 14



SUB-SECTION – G-07

MDL AND DATA REQUIREMENT

**SINGARENI THERMAL POWER PROJECT
STAGE-II (1X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC NO.:CW-CM-11159-C-O-M-001**

CLAUSE NO.	TECHNICAL REQUIREMENTS	
1.00.00	Master Drawing List (MDL) This part describes tentative Master Drawing List (MDL). The submission schedules of drawings shall be finalized based on project schedule.	
2.00.00	Engineering Drawing Review Methodology: To reduce engineering cycle time and no. of drawings in approval category, following Engineering Drawing Review Methodology shall be adopted: Auto-archive of drawings: Contractor shall certify the following statement in all auto archive drawings. “We confirm that this document meets all the contract requirements including safety and statutory requirements and facilitate ease of operation and maintenance. In case any deviation is found, the Contractor shall carry out all required changes/ modifications without any cost implications to OWNERS ENGINEERING. In addition, Penalty on account of non-compliance of contract specification as deemed fit by the Employer shall be recovered. Endorsement of drawings: OWNERS ENGINEERING will select base for endorsement of drawings and submit list of drawings to Contractor for endorsement. The list shall be finalized after discussion with Contractor. After agreement, the approved drawings shall be taken out from DREAMS for endorsement and stamped applicable for SINGARENI STPP STAGE-II. - Dedicated Contractor and OWNERS ENGINEERING team shall be identified. - Wherever input data is not available for preparation of drawing, latest similar projects input data (with not to exceed data) will be used for further engineering. Cluster of drawings: The drawings will be identified in different clusters for submission/approval purpose depending upon the requirement at site. The submission schedule shall be decided based on proposed L2 network. The L2 network will be agreed upon with Contractor before NOA. - Latest approved drawing of earlier projects shall be the base for Rev 0 of Singareni project drawings. - After Rev 0 comments, the drawing will be locked in the system. Contractor will review the Rev 0 comments within 7 days & furnish the Comment Reply Sheet (CRS) to OWNERS ENGINEERING as an agenda point for TCM. TCM shall be conducted with Contractor on non-agreed comments of CRS. - System will not allow Contractor to submit approval category drawings before the scheduled submission date. However, documents may be unlocked on case to case basis. - Based on resolution of all comments and agreements, the document will be approved in TCM itself. The contractor will revise the document based on the resolutions and certify that all the resolutions has been taken care of.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION G-07 MDL
		PAGE 1 OF 3

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	j. Based on this certification, the document will be opened and submitted by contractor in the system for approval as Rev 01 within 10 days of TCM.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION G-07 MDL	PAGE 2 OF 3

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	Tentative Master Drawing List		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION G-07 MDL	PAGE 3 OF 3

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	Data requirement in GAD, Cross section, Scheme, Sizing calculation, datasheet, additional data specific to the equipment etc.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION G-07 MDL DATA REQUIREMENTS	PAGE 1 OF 8

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.00.00	GENERAL REQUIREMENTS			
1.00.01	This part describes the technical information and data to be furnished by the Bidder for the equipment and services described in Section-VI.			
1.00.02	The Bidder shall ensure that all information, data, performance curves, technical literature (catalogues) and drawings furnished fully describe all equipment/systems covered and fully meet the requirements of the technical specifications.			
1.00.03	The Employer reserves the right to ask for further details regarding technical features, application particulars, performance, past experience for similar applications or any other information as may be required to fully satisfy himself regarding suitability, quality, reliability and full compliance with this specification for all equipment and systems offered by the Bidder.			
1.00.04	Bidder shall be required to furnish all additional data about the equipment/system being supplied, even if such details are not specified in this section.			
2.00.00	Data Requirements			
2.01.00	Data to be necessarily included in General Arrangement Drawing of respective equipments:			
	1. Design and Test code 2. Make/Manufacturer 3. Model/Type 4. Equipment Rating/ Basic design data 5. Equipment quantity 6. Thermal/Mechanical/operational/Performance data as applicable 7. Construction data 8. Part Lists 9. MOC 10. Bill of materials (BOM) 11. Different dimensions 12. Vibration and Sound data 13. Nozzle schedule/Connection list (if applicable) 14. Allowable Force and Moments of Nozzle (if applicable) 15. Different Loads to be considered for foundation design 16. Surface preparation and painting schedule 17. Major elevations/levels 18. Weight of equipment (Empty/operating/full weight), Max weight for maintenance/Erection, Shipping dimensions (size, weight) 19. Special/Standard notes (if any)			
2.02.00	Cross-sectional Drawing Data requirement:			
	1. Bill of Materials 2. Different dimensions 3. Different Clearances 4. Model Number (if applicable) 5. Design and testing code 6. Special/Standard notes (if any)			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION G-07 MDL DATA REQUIREMENTS
PAGE 2 OF 8				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.03.00	P&ID / Scheme/Write-up data requirement: 1. Design pressure/temperature/flow/Velocity 2. Operating pressure/temperature/flow/Velocity 3. Line size/thickness 4. KKS TAG nos. 5. MOC 6. Scope & Terminal Points 7. Special/Standard notes (if any) 8. In write-up, description of each equipment shall accompany set point, rated parameters/size (as per applicability), permissive, interlock, protection, any curves for variable set point, calculation for variable set point etc.			
2.04.00	Sizing calculation 1. Design/Sizing criteria/Design Parameters 2. Codes/Standards 3. Thermal/Hydraulic/ Mechanical calculation 4. Special/Standard notes (if any) 5. Sizing related Heat Balance diagrams			
2.05.00	Datasheet 1. All the required information shall be compiled from GAD, Cross-sectional drawing, Scheme, Write-up, Sizing document etc. and any specific data for a particular equipment which is necessarily to be furnished shall be incorporated in the datasheet of the equipment. 2. Following minimum data shall be included in datasheet for respective equipment mentioned below: a. Steam turbine: 1. Details of turbine modules 2. Rating & Capabilities 3. Turbine expansion lines/diagrams as called in Sub-Section-A-07, Part-B, Section-VI of specification clearly marking pressure, temperature, mass flow, specific volume and enthalpy at various points. 4. Characteristic Curves for First stage pressure vs MW load & steam flow for constant pressure and variable pressure Regimes 5. Thermal kit data for heat balance computation 6. Campbell diagrams (typical) for blading proposed, clearly indicating the resonant points and the operating frequency range (Ref. clause 1.05.00 (a), Sub-Section-A-07, Part-B, Section-VI. 7. Life expenditure curves for TG set 8. Temporary speed rise values (To be duly supported by detailed calculations bringing out clearly all the input data correlation considered and results) and Volume of steam entrained 9. Write up on criteria for back end loading of the turbine. Also furnish complete technical data alongwith LP exhaust area, Last stage blade height, max. steam flow under VWO condition through LP annulus area, actual back end loading,			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION G-07 MDL DATA REQUIREMENTS	PAGE 3 OF 8

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	design back end loading etc. (Refer clause 1.06.00 (c), Sub-Section-A-07, Part-B, Section-VI). 10. Whether turbine is designed for overpressure operation. 11. furnish % over-pressure capability of the turbine generator under VWO condition and the corresponding continuous output and steam flow with rated steam temperature & 77 mm Hg Condenser pressure (Furnish Heat Balance Diagram) % 12. Maximum flow through LP turbine (Indicate pressure, Temp. & Wetness & condition of operation) and design back pressure 13. Number of uncontrolled extraction points 14. Operating frequency range for turbine and Limitations on number of hours of operation if any at frequency beyond this range 15. Maximum vibration level on any of the bearings of TG set 16. Maximum noise level of Main TG set and Auxiliaries including HP/LP 17. Type of blading (Impulse /Reaction) 18. Type of governing (throttle/nozzle/combined with auto change over facility) 19. Number of turbine cylinders 20. Module number and details (attach dimensioned drawings, experience details, operational feedback etc.) 21. Maximum HP exhaust pressure expected and allowable 22. Maximum permissible steam metal temperature differential during cold/warm/hot start-up, loading/unlading/shutdown/Normal operation 23. Maximum reheat steam pressure at intermediate pressure turbine inlet 24. Steam pressure drop in the reheater circuit 25. Turbine exhaust pressure 26. No-load steam flow through turbine 27. Make-up to heat cycle (at condenser hotwell) 28. Exhaust steam parameters to condenser (at condenser design conditions) 29. Enthalpy at turbine exhaust 30. Dryness fraction and max allowed dryness fraction 31. Design conditions for Extraction steam at Turbine Extraction point 32. Extraction Steam (Flow/enthalpy/pressure/temperature) to Low Pressure Feed Water Heater(s)/HP heaters/Deaerators 33. Extraction Steam (Flow/enthalpy/pressure/temperature) from Cold Reheat Line to Boiler Feed pump drive turbine at low load			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION G-07 MDL DATA REQUIREMENTS	PAGE 4 OF 8

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	34. LP turbine exhaust (Flow/enthalpy/pressure/temperature) before mixing with BFPT exhaust steam 35. Change over of steam source from IP-LP cross over to alternate steam source for boiler feed pump drive turbine during normal plant operation 36. Critical speeds for turbine bladed rotors (State for individual rotors& for combined rotor) 37. Combined critical speeds of TG set 38. Does any turbine rotor pass through critical speed coming up to rated speed? If so, what shaft and at what speed? 39. Type of turning gear and KW rating of motor (if motorised turning gear is used) 40. Turning speed 41. Is the turbine designed for full arc admission during start-up? 42. Moisture at LP last stage under normal steam conditions and with all extractions open for boiler feed pump drive turbines 43. Maximum allowable temperature at LP turbine exhaust hood 44. Temperature of exhaust hood at which spray will be initiated 45. Minimum stable load for operation of TG set at Continuous without exhaust hood spray/ With time limitation/ Continuous with exhaust hood spray 46. Coast - down time to turning gear speed standstill condition after Turbine Trip-out with Vacuum and With Vacuum broken 47. Total quantity of spray water required For Exhaust Hood Spray and Other flash Boxes 48. Thermal Kit Data 49. Losses considered in heat balance computations a. Turbine mechanical loss including bearing friction but excluding power consumed by shaft driven driven MOP b. Turbine windage losses c. Turbine Exhaust losses d. Generator losses e. Generator mechanical losses (including bearing friction losses) f. Power consumed by main oil pump g. Power consumed by other integral auxiliary services for the turbine generator (with list of auxiliaries) h. Total losses and power consumption considered for arriving at Pg for guaranteed heat rate consumption (Also indicate if all the items at serial numbers (a) to (g) considered for computation)		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION G-07 MDL DATA REQUIREMENTS	PAGE 5 OF 8

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	50. Main steam pressure at inlet to strainer/ stop valve/first stage pressure of HPT 51. Gland leakage coefficients 52. Mode of governing (Nozzle/Throttle/ combined) 53. Dead band of the governor 54. Percentage regulation and its range of adjustability 55. On-full load throw-off: a. Temporary speed rise (TSR) b. Permanent speed rise c. Time taken to reach steady state d. Overall response time of the governor from the moment of full load throw off to the moment of full closing of HP and Interceptor governor valves 56. Range of adjustability of speeder gear 57. Material of Construction 58. Construction Features a. Number and type of cylinders b. Number of Stages c. Number of rows and blades of HP/IP/LP integrally shrouded d. Number of rows of blades unshrouded of IP/LP (indicate whether free standing or with lacing wires) e. First stage diameter f. Length of longest blade g. Tip diameter of largest wheel h. Pitch circle diameter of largest wheel i. Maximum peripheral velocity of largest wheel j. LP turbine last two stages details (Blade height/ Root diameter/ Pitch diameter/ Tip diameter) (Furnish velocity triangles clearly indicating inlet and outlet angles of blades and various velocity sectors) k. Modulus of section (Z) for critical sections including root, pcd & tip sections l. Steam bending stresses at the above critical sections m. Reaction at root, pitch circle diameter and tip n. Leaving velocity at the exit of last stage blades o. Safe design bending stress of last stage blades			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION G-07 MDL DATA REQUIREMENTS	PAGE 6 OF 8	

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	p. Actual bending stress (duly supported by detailed calculations bringing out clearly all input data, correlation considered and results) q. Method of vibration test on LP stages r. LP exhaust annulus area s. Design back end loading t. Back end loading under EMCR/ VWO/ VWO+Over pressure/HP heaters out u. Method of moisture removal in the last stage v. Type of blade protection against moisture erosion w. Details substantiating the superiority of the proposed arrangement (if other than as called for in specification) x. Number of low pressure stages protected against moisture erosion y. Area of blades protected against moisture erosion z. Exhaust area at condenser neck aa. Pressure drop between LP exhaust and condenser top row tubes bb. Main steam and reheat stop & control valves nos/type cc. Strainers nos/type/ Mesh size/strainer element & body material dd. Bearings for turbine and generator- Nos/Type/Material/Radial clearances/bearing pressure/max temp permissible/ Mean coefficient of friction between journal and bearing/ Total load on the bearing/ Kilowatt loss per bearing ee. Shaft gland packing type/ adjustment method/whether replaceable or not ff. Method of mounting blades on rotor gg. Method of fastening shroud hh. Method of securing the fixed blades to the casing ii. Is turbine flange heating envisaged? jj. Is bolt heating envisaged? kk. Minimum Fixed Blade/moving Blade, Axial& Radial Clearances (Furnish clearance diagram & leakage rates as per specification) for HP/IP/LP cylinder ll. Shaft Glands type/nos/Normal running axial/radial clearance mm. Type of shaft coupling 59. Vacuum Breaker Valve number/make/type			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION G-07 MDL DATA REQUIREMENTS	PAGE 7 OF 8

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	60. Insulation details for turbine 61. Design Ramp rate (% per Minute) capability of Steam Generator and Steam Turbine Generator separately.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION G-07 MDL DATA REQUIREMENTS	PAGE 8 OF 8

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
1	4540-110-110-PVM-U-032	HEAT BALANCE DIAGRAMS	TG Pkg_sys	TG	A
2	4540-110-110-PVM-B-110	GA, CROSS SECTION ARRANGEMENT DRAWING OF STEAM TURBINE & TURBINE CLEARANCE DIAGRAM	TG Pkg_sys	TG	A
3	4540-110-110-PVM-U-021	BFP SIZING INCLUDING NPSH CALCULATION	TG Pkg_sys	TG	A
4	4540-110-110-PVM-U-010	CEP & DRIP PUMP SIZING INCLUDING NPSH CALCULATION	TG Pkg_sys	TG	A
5	4540-110-110-PVM-B-064A	HP & LP Bypass sizing	TG Pkg_sys	TG	A
6	4540-110-110-PVM-U-004	SIZING CALCULATION OF MAIN OIL TANK	TG Pkg_sys	TG	A
7	4540-110-110-PVM-U-429	SIZING CALC FOR ROPES, WHEELS, DRUM,BUFFERS, BRAKES & MOTORS-BFP HANDLING EOT CRANE	TG Pkg_sys	TG	AA
8	4540-110-110-PVM-U-397	SIZING CALC FOR ROPES, WHEELS, DRUM,BUFFERS, BRAKES & MOTORS OF TG HALL EOT CRANE	TG Pkg_sys	TG	A
9	4540-110-110-PVM-U-402	SIZING CALCULATION OF LIFTING BEAM & LIFTING BEAM ASSEMBLY DRAWING OF TG HALL EOT CRANE	TG Pkg_sys	TG	AA
10	4540-110-110-PVM-U-007A	CONDENSER & GSC THERMAL AND HYDRAULIC SIZING CALCULATION	TG Pkg_sys	TG	A
11	4540-110-110-PVM-U-014	THERMAL & HYDRAULIC CALCULATIONS OF DRAIN COOLER	TG Pkg_sys	TG	AA
12	4540-110-110-PVM-U-014B	THERMAL & HYDRAULIC DESIGN CALCULATIONS FOR LP HEATERS, HP HEATERS AND EXTERNAL DE-SUPERHEATERS	TG Pkg_sys	TG	A
13	4540-110-110-PVM-U-018A	THERMAL AND HYDRAULIC DESIGN CALCULATIONS OF DEAERATOR	TG Pkg_sys	TG	A
14	4540-110-110-PVM-N-110	CORRECTION CURVES AS PER SPECIFICATION	TG Pkg_sys	TG	AA
15	4540-110-110-PVM-U-005	TURBINE OIL COOLER - THERMAL CLACULATION	TG Pkg_sys	TG	A
16	4540-110-110-PVM-U-028	TG HALL EOT CRANE CAPACITY SELECTION CALCULATION	TG Pkg_sys	TG	A
17	4540-110-110-PVM-U-252	BFP EOT CRANE CAPACITY CALCULATION	TG Pkg_sys	TG	A
18	4540-110-110-PVM-N-004	TURBINE START UP CURVES	TG Pkg_sys	TG	A
19	4540-110-110-PVM-F-027	P & ID CONDENSATE SYSTEM	TG Pkg_sys	TG	A
20	4540-110-110-PVM-F-028	P & ID FEED WATER SYSTEM	TG Pkg_sys	TG	A
21	4540-110-110-PVM-F-029	P & ID - HP/LP BYPASS SYSTEM	TG Pkg_sys	TG	A
22	4540-110-110-PVM-F-030	P & ID EXTRACTION STEAM SYSTEM FOR HP & LP HEATERS	TG Pkg_sys	TG	A
23	4540-110-110-PVM-F-031	P & ID HEATER DRAINS & VENT SYSTEM	TG Pkg_sys	TG	A
24	4540-110-110-PVM-F-032	P & ID EXTRACTION STEAM SYSTEM FOR BFP TURBINE	TG Pkg_sys	TG	A
25	4540-110-110-PVM-F-033	P & ID STEAM DRAINS SYSTEM	TG Pkg_sys	TG	A
26	4540-110-110-PVM-L-003	HP, IP, LP SCHEME	TG Pkg_sys	TG	A
27	4540-110-110-PVM-F-009	P & ID OF TURBINE OIL PURIFIER	TG Pkg_sys	TG	AA
28	4540-110-110-PVM-F-010	P&ID FOR CENTRAL LUBE OIL STORAGE & PURIFICATION SYSTEM	TG Pkg_sys	TG	AA
29	4540-110-110-PVM-U-008	POWER/ CAPACITY CALCULATION OF VACUUM PUMP AND CHARACTERISTIC CURVES (DRY AIR AND SATURATED AIR CURVES)	TG Pkg_sys	TG	A
30	4540-110-110-PVM-L-002	WRITE UP ON TURBINE DRAIN SYSTEM WITH SCHEMATIC	TG Pkg_sys	TG	A
31	4540-110-110-PVM-B-011A	CW SCHEME - LUB OIL COOLERS	TG Pkg_sys	TG	AA
32	4540-110-110-PVM-F-008E	LUBE OIL SYSTEM SCHEME (LEAKAGE/ WASTE OIL)	TG Pkg_sys	TG	AA
33	4540-110-110-PVM-L-003A	CONDENSATE SPRAY SYSTEM SCHEME	TG Pkg_sys	TG	AA
34	4540-110-110-PVM-L-004	GOVERNING SCHEME & WRITE UP (Scheme & write up on EHA & HPSU system for Turbine Valves)	TG Pkg_sys	TG	A
35	4540-110-110-PVM-L-005	SEAL STEAM SYSTEM WRITE UP, SCHEMES AND CONTROL PHILOSOPHY	TG Pkg_sys	TG	AA
36	4540-110-110-PVM-L-006	SCHEMATIC DIAGRAM FOR SEALING AND COOLING OF CEP	TG Pkg_sys	TG	AA
37	4540-110-110-PVM-L-009	LUBE OIL & CONTROL OIL SCHEME & WRITE UP FOR BFP DRIVE TURBINE	TG Pkg_sys	TG	AA
38	4540-110-110-PVM-L-010	JACKING OIL SCHEME & WRITE UP FOR BFP DRIVE TURBINE	TG Pkg_sys	TG	AA
39	4540-110-110-PVM-L-011	GOVERNING SCHEME INCLUDING GOVERNING OIL SYSTEM FOR BFP DRIVE TURBINE AND ITS WRITE UP	TG Pkg_sys	TG	A
40	4540-110-110-PVM-L-011A	Drive turbine oil cooler scheme	TG Pkg_sys	TG	AA
41	4540-110-110-PVM-L-012	SCHEMATIC FOR DRAINING AND MAKEUP OF LUBE OIL RESERVOIRS OF BFPDT	TG Pkg_sys	TG	AA
42	4540-110-110-PVM-U-016	MECHANICAL STRENGTH CALCULATIONS FOR Condenser and GSC	TG Pkg_sys	TG	AA
43	4540-110-110-PVM-U-016A	MECHANICAL STRENGTH CALCULATIONS FOR DRAIN COOLER, LP HEATERS	TG Pkg_sys	TG	AA
44	4540-110-110-PVM-U-016B	MECHANICAL STRENGTH CALCULATIONS FOR HP HEATERS AND EXTERNAL DE-SUPERHEATERS	TG Pkg_sys	TG	AA
45	4540-110-110-PVM-U-017A	SIZING OF VENT ORIFICE OF LP HEATERS(3, 4 & 5)	TG Pkg_sys	TG	AA
46	4540-110-110-PVM-U-017B	SIZING OF VENT ORIFICE OF HP HEATERS	TG Pkg_sys	TG	AA
47	4540-110-110-PVM-U-018B	MECHANICAL DESIGN CALCULATIONS OF DEAERATOR	TG Pkg_sys	TG	AA
48	4540-110-110-PVM-U-020	SIZING CALC OF VENT ORIFICE OF DEAERATOR	TG Pkg_sys	TG	AA
49	4540-110-110-PVM-F-012	P&ID OF VACUUM PUMP	TG Pkg_sys	TG	AA
50	4540-110-110-PEM-PVM-F-199	P&ID OF COLTCS SYSTEM	TG Pkg_sys	TG	A
51	4540-110-110-PVM-F-015	PID FEED WATER AND SEALING & COOLING MDBFP AND MDBP	TG Pkg_sys	TG	AA
52	4540-110-110-PVM-F-017	PID LUB OIL & WORKING OIL MDBFP	TG Pkg_sys	TG	A
53	4540-110-110-PVM-F-018	PID LUB OIL SYS. TDBFP SET	TG Pkg_sys	TG	A
54	4540-110-110-PVM-F-019	PID FEED WATER AND SEALING & COOLING FOR TDBFP AND TDBP	TG Pkg_sys	TG	AA
55	4540-110-110-PVM-F-021B	P&ID / FLOW DIAGRAM FOR LUB OIL PURIFICATION SYSTEM FOR TDBFP	TG Pkg_sys	TG	AA
56	4540-110-110-PVM-F-023	FLOW DIAGRAM OF HP BP HYDRAULIC UNIT	TG Pkg_sys	TG	AA
57	4540-110-110-PVM-F-024	FLOW DIAGRAM OF LP BP HYDRAULIC UNIT	TG Pkg_sys	TG	AA
58	4540-110-110-PVM-W-041	STEAM AND DRAIN SCHEME & WRITE UP FOR DRIVE TURBINE	TG Pkg_sys	TG	A
59	4540-110-110-PVM-F-008A	WRITE UP ON TURBINE LUB OIL SYSTEM & P&ID AND OIL MODULE SCHEME	TG Pkg_sys	TG	A
60	4540-110-110-PVM-B-004A	GA & Assy. of Clean Oil Tank	TG Pkg_sys	TG	AA
61	4540-110-110-PVM-B-005A	GA & Assy. of Dirty Oil Tank	TG Pkg_sys	TG	AA
62	4540-110-110-PVM-B-006A	GA & Assy. of Oil Unloading vessel	TG Pkg_sys	TG	AA
63	4540-110-110-PVM-B-011	TURBINE OIL COOLER - GA DRG INCLUDING FOUNDATION PLAN, LOADING & FIXING DETAILS.	TG Pkg_sys	TG	A
64	4540-110-110-PVM-B-013	GA including Foundation Plan, loading & fixing details of MAIN OIL TANK	TG Pkg_sys	TG	AA
65	4540-110-110-PVM-B-014	GA OF TURBINE OIL PURIFIER (PLOT PLAN)	TG Pkg_sys	TG	AA
66	4540-110-110-PVM-B-025	VACUUM PUMP GA & FOUNDATION PLAN INCLUDING LOADING DETAILS	TG Pkg_sys	TG	AA
67	4540-110-110-PVM-B-030	GEN. ARRANGEMENT & Cross section of CEP AND MOTORS WITH FOUNDATION DATA	TG Pkg_sys	TG	A
68	4540-110-110-PVM-B-032A	G.A. & CROSS SECTION DRAWING OF L.P. HEATER #3 WITH FOUNDATION AND LOADING DATA	TG Pkg_sys	TG	A
69	4540-110-110-PVM-B-032B	G.A. & CROSS SECTION DRAWING OF L.P. HEATER #4 WITH FOUNDATION AND LOADING DATA	TG Pkg_sys	TG	A
70	4540-110-110-PVM-B-032C	G.A. & CROSS SECTION DRAWING OF L.P. HEATER #5 WITH FOUNDATION AND LOADING DATA	TG Pkg_sys	TG	A
71	4540-110-110-PVM-B-032D	G.A. OF DRAIN COOLER WITH FOUNDATION AND LOADING DATA	TG Pkg_sys	TG	AA
72	4540-110-110-PVM-B-032E	G.A. & CROSS SECTION OF L.P. HEATER #1& 2 WITH FOUNDATION AND LOADING DATA	TG Pkg_sys	TG	A
73	4540-110-110-PVM-B-033A	GA & CROSS SECTION DRAWING DRG. H.P. HEATER #7A & 7B WITH FOUNDATION AND LOADING DATA	TG Pkg_sys	TG	A
74	4540-110-110-PVM-B-033C	GA & CROSS SECTION DRAWING DRG. H.P. HEATER #8A & 8B WITH FOUNDATION AND LOADING DATA	TG Pkg_sys	TG	A

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 1 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
75	4540-110-110-PVM-B-033E	GA & CROSS SECTION DRAWING DRG. H.P. HEATER #9A & 9B WITH FOUNDATION AND LOADING DATA	TG Pkg_sys	TG	A
76	4540-110-110-PVM-B-033G	GA & CROSS SECTION DRAWING DRG. EXTERNAL DESUPER HEATER FOR H.P. HEATER #7A & 7B WITH FOUNDATION AND LOADING DATA	TG Pkg_sys	TG	A
77	4540-110-110-PVM-B-034	GA OF GLAND STEAM CONDENSER WITH FOUNDATION AND LOADING	TG Pkg_sys	TG	AA
78	4540-110-110-PVM-B-040	G.A. & CROSS-SECTION DRAWINGS OF DEAERATOR WITH SUPPORTING ARRANGEMENT	TG Pkg_sys	TG	A
79	4540-110-110-PVM-B-044	G.A ARRANGEMENT OF TDBFP/BP	TG Pkg_sys	TG	A
80	4540-110-110-PVM-B-044A	G.A ARRANGEMENT OF MDBFP/BP	TG Pkg_sys	TG	A
81	4540-110-110-PVM-B-046	GA OF HYD COUPLING	TG Pkg_sys	TG	AA
82	4540-110-110-PVM-B-047	GA & FOUNDATION OF MDBFP HC COOLER	TG Pkg_sys	TG	AA
83	4540-110-110-PVM-B-048	GA OF SUCTION STRAINER MD/TD BFP & BP	TG Pkg_sys	TG	AA
84	4540-110-110-PVM-B-050	GA AND DATASHEET OF BFP RC VALVE	TG Pkg_sys	TG	AA
85	4540-110-110-PVM-B-051A	GA/ DATA SHEET/ FLOW DIAGRAM/ CROSSECTIONAL DRAWING ETC. FOR MECH. SEAL FOR BOOSTER PUMP	TG Pkg_sys	TG	AA
86	4540-110-110-PVM-B-053	GA DRAWING OF COUPLING BETWEEN BFP & HYDRAULIC COUPLING	TG Pkg_sys	TG	AA
87	4540-110-110-PVM-B-054	GA DRAWING OF COUPLING BETWEEN MOTOR & BP	TG Pkg_sys	TG	AA
88	4540-110-110-PVM-B-055	GA DRAWING OF COUPLING BETWEEN HYDRAULIC COUPLING & MOTOR	TG Pkg_sys	TG	AA
89	4540-110-110-PVM-B-056	ARRANGEMENT OF CARTRIDGE WITHDRAWAL INCLUDING WRITEUP	TG Pkg_sys	TG	AA
90	4540-110-110-PVM-B-058A	GA & CROSS SECTIONAL DRAWING OF DRIVE TURBINE	TG Pkg_sys	TG	A
91	4540-110-110-PVM-B-059	CROSS SECTIONAL DRGS OF GEAR BOX FOR BOOSTER PUMP	TG Pkg_sys	TG	AA
92	4540-110-110-PVM-B-060A	GAD of coupling between TDBFP and drive turbine	TG Pkg_sys	TG	AA
93	4540-110-110-PVM-B-060B	GAD of coupling between drive turbine and gear box	TG Pkg_sys	TG	AA
94	4540-110-110-PVM-B-060C	GAD of coupling between gear box and TD Booster pump	TG Pkg_sys	TG	AA
95	4540-110-110-PVM-Y-435	GA and DATA SHEET OF HOISTS IN TG AREA	TG Pkg_sys	TG	AA
96	4540-110-110-HWR-PVM-B-022	Condenser GA and cross-section drawing	TG Pkg_sys	TG	A
97	4540-110-110-PVM-B-063B	GA DRG FOR OIL PURIFICATION SYSTEM - BFPDT	TG Pkg_sys	TG	AA
98	4540-110-110-PVM-B-158	GA of Crossover pipe and data sheet of Bellows	TG Pkg_sys	TG	AA
99	4540-110-110-PVM-B-159	GA AND DATA SHEET OF EXPANSION BELLOWES FOR CONDENSER	TG Pkg_sys	TG	AA
100	4540-110-110-PVM-B-393	GA OF BFPT - LUBE OIL SKID	TG Pkg_sys	TG	AA
101	4540-110-110-PVM-B-398	GA OF TG HALL EOT CRANE & Lifting Beam GAD	TG Pkg_sys	TG	A
102	4540-110-110-PVM-B-399	CRAB ASSEMBLY WITH CT WHEEL ASSEMBLY- TG HALL CRANE	TG Pkg_sys	TG	AA
103	4540-110-110-PVM-B-400	HOOK, NUT AND HOOK BLOCK ASSEMBLY OF MH & AH OF TG HALL EOT CRANE	TG Pkg_sys	TG	AA
104	4540-110-110-PVM-B-401	LT MACHINERY ASSEMBLY WITH WHEEL ASSEMBLY OF TG HALL EOT CRANE	TG Pkg_sys	TG	AA
105	4540-110-110-PVM-B-409	GANTRY RAIL FIXING ARRANGEMENT OF TG HALL EOT CRANE	TG Pkg_sys	TG	AA
106	4540-110-110-PVM-B-410	CRANE LUBRICATION ARRANGEMENT OF TG HALL CRANES	TG Pkg_sys	TG	AA
107	4540-110-110-PVM-B-418	GA OF BFP HANDLING EOT CRANE	TG Pkg_sys	TG	A
108	4540-110-110-PVM-B-419	CRAB ASSEMBLY WITH CT WHEEL ASSEMBLY-BFP HANDLING EOT CRANE	TG Pkg_sys	TG	AA
109	4540-110-110-PVM-B-420	HOOK, NUT AND HOOK BLOCK ASSEMBLY -BFP HANDLING EOT CRANE	TG Pkg_sys	TG	AA
110	4540-110-110-PVM-B-421	LT MACHINERY ASSEMBLY WITH WHEEL ASSEMBLY-BFP HANDLING EOT CRANE	TG Pkg_sys	TG	AA
111	4540-110-110-PVM-B-427	GANTRY RAIL FIXING ARRANGEMENT-BFP HANDLING EOT CRANE	TG Pkg_sys	TG	AA
112	4540-110-110-PVM-B-446	GA, M/C ROOM LAYOUT, SCOPE & BOM AND DIMENSIONAL DETAILS OF TG ELEVATOR	TG Pkg_sys	TG	AA
113	4540-110-110-PVM-B-151	OUTLINE GA OF CEP SUCTION STRAINER	TG Pkg_sys	TG	AA
114	4540-110-110-PVM-F-013	HP BYPASS SYSTEM DATA SHEET, GA DRAWING & CHARACTERISTIC CURVE	TG Pkg_sys	TG	A
115	4540-110-110-PVM-F-014	GA DRAWING AND DATA SHEET FOR QCNRV & CRHNRV	TG Pkg_sys	TG	AA
116	4540-110-110-PVM-B-066	GA OF HP BY PASS HYDRAULIC UNIT	TG Pkg_sys	TG	AA
117	4540-110-110-PVM-B-078	CONTROL FLUID TANK & COOLER-GA INCLUDING FOUNDATION PLAN	TG Pkg_sys	TG	AA
118	4540-110-110-PVM-B-118B	LOADING & FIXING DETAILS	TG Pkg_sys	TG	AA
119	4540-110-110-PVM-B-120	GENERAL ARRANGEMENT OF WASTE OIL TANK	TG Pkg_sys	TG	AA
120	4540-110-110-PVM-C-006A	GA of Rupture disc	TG Pkg_sys	TG	AA
121	4540-110-110-PVM-C-006B	DRAWINGS AND DATASHEET OF SHELL SIDE/ TUBE SIDE RELIEF VALVES OF DRAIN COOLER AND LP HEATERS (2,3, 4 & 5)	TG Pkg_sys	TG	AA
122	4540-110-110-PVM-C-009	DRAWINGS AND DATASHEET OF SHELL SIDE/ TUBE SIDE RELIEF VALVES OF HP HEATERS AND EXTERNAL DESUPER HEATERS	TG Pkg_sys	TG	AA
123	4540-110-110-PVM-N-033A	SECT. ASSLY OF TDBP, TDBFP , MDBFP, MDBP	TG Pkg_sys	TG	A
124	4540-110-110-PVM-N-033C	GA OF SUCTION STRAINER DRIP PUMP	TG Pkg_sys	TG	AA
125	4540-110-110-PVM-Y-512	GEN. ARRANGEMENT DRIP PUMP AND MOTORS WITH FOUNDATION DATA	TG Pkg_sys	TG	AA
126	4540-110-110H-PVM-B-017	DS and GAD of Dirty / Clean Oil Pump of Central Oil Purification System	TG Pkg_sys	TG	AA
127	4540-110-110-PEM-PVM-B-202	GENERAL ARRANGEMENT OF LEAKAGE/DIRTY OIL TANK AND PUMP	TG Pkg_sys	TG	AA
128	4540-110-110-PEM-PVM-E-201	GENERAL ARRANGEMENT OF COLTCS including ball separator	TG Pkg_sys	TG	AA
129	4540-110-110-PEM-PVM-F-203	INSTALLATION PLAN- COLTCS	TG Pkg_sys	TG	AA
130	4540-110-110-PVM-Y-026B	DETAILS OF BR SKID,BALL INJECTION PIPE & FIXING DETAILS	TG Pkg_sys	TG	AA
131	4540-110-110-PVM-Y-026C	LPBP VALVE ARRANGEMENT - PLAN	TG Pkg_sys	TG	AA
132	4540-110-110-PVM-B-064	LPBP VALVE ARRANGEMENT - SECTION	TG Pkg_sys	TG	AA
133	4540-110-110-PVM-B-008	LP BYPASS SYSTEM DATA SHEETS, GA DRAWING & CHARACTERISTIC CURVE	TG Pkg_sys	TG	A
134	4540-110-110-PVM-B-512	STEAM FLOW VS CLOSING CHARACTERSTICS OF HP/IP STOP VALVE	TG Pkg_sys	TG	AA
135	4540-110-110-PVM-F-006	Blade vibrations monitoring system(BVMS) datasheet	TG Pkg_sys	TG	A
136	4540-110-110-PVM-H-002	TURBINE FORCED COOLING SYSTEM DESCRIPTION	TG Pkg_sys	TG	AA
137	4540-110-110-PVM-H-498	VALVE DETAILS (TURBINE INTEGRAL SYSTEM)	TG Pkg_sys	TG	AA
138	4540-110-110-PVM-N-002	VALVE SCHEDULE OF BFPDT.	TG Pkg_sys	TG	AA
139	4540-110-110-PVM-N-005	THERMAL KIT DATA	TG Pkg_sys	TG	AA
140	4540-110-110-PVM-W-004	CAMPBELL DIAGRAM FOR FREE STANDING TURBINE BLADES	TG Pkg_sys	TG	AA
141	4540-110-110-PVM-W-005	W/UP ON TURBINE PROTN.	TG Pkg_sys	TG	A
142	4540-110-110-PVM-W-006	WRITE UP ON ATT	TG Pkg_sys	TG	AA
143	4540-110-110-PVM-W-007	TSI SCHEME FOR BFP Drive Turbine	TG Pkg_sys	TG	A
144	4540-110-110-PVM-W-009	W/UP ON ATRS	TG Pkg_sys	TG	AA
145	4540-110-110-PVM-W-0103	WRITE UP ON TSC	TG Pkg_sys	TG	AA
146	4540-110-110-PVM-U-025	TURBINE PRESEAVATION SYSTEM DETAILS	TG Pkg_sys	TG	AA
147	4540-110-110-PVM-W-024	CRITICAL SPEED DATA FOR MDBFP AND TDBFP, IN WATER AND AIR	TG Pkg_sys	TG	AA
148	4540-110-110-PVM-W-031	WRITE UP ON PROTECTION AND PRESERVATION DURING STORAGE OF HEATERS	TG Pkg_sys	TG	AA
149	4540-110-110-PVM-W-034	SPECIAL TOOLS AND TACKLES LIST	TG Pkg_sys	TG	A
150	4540-110-110-PVM-W-036	BFP THRUST COLLAR FIX. DETAILS & THRUST CALCULATION	TG Pkg_sys	TG	AA
151	4540-110-110-PVM-W-038	WRITE UP ON REVERSE ROTATION MONITOR SYSTEM	TG Pkg_sys	TG	AA
		WRITE UP ON HYDRAULIC COUPLING INCLUDING RAPID START DEVICE	TG Pkg_sys	TG	AA

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 2 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
152	4540-110-110-PVM-W-040	WRITE UP ON PRESERVATION AND STORAGE FOR BFP DRIVE TURBINE	TG Pkg_sys	TG	AA
153	4540-110-110-PVM-Y-050	Opening & Closing time of IV,ESV & LP Bypass valve	TG Pkg_sys	TG	AA
154	4540-110-110-PVM-F-026B	LEGEND for P& IDs -BFPDT	TG Pkg_sys	TG	AA
155	4540-110-110-PVM-N-009	CEP ESTIMATED PERFORMANCE CURVES (AT 47.5Hz; 50Hz & 51.5Hz) INCLUDING NPSHR (3%, 1%, 0% & 40,000HRS)	TG Pkg_sys	TG	A
156	4540-110-110-PVM-N-011	SPEED TORQUE CURVE CEP	TG Pkg_sys	TG	AA
157	4540-110-110-PVM-N-015	MD BFP/BP ESTIMATED PERFORMANCE CURVE INCLUDING NPSHR (3%, 1%, 0% & 40,000HRS) & DESIGN CH CURVE	TG Pkg_sys	TG	A
158	4540-110-110-PVM-N-017	TD BFP/BP ESTIMATED PERFORMANCE CURVE INCLUDING NPSHR (3%, 1%, 0% & 40,000HRS) & DESIGN CH CURVE	TG Pkg_sys	TG	A
159	4540-110-110-PVM-N-019	SPEED TORQUE CURVE MDBFP	TG Pkg_sys	TG	AA
160	4540-110-110-PVM-N-033	EST. PERFORMANCE CURVE (AT 47.5Hz; 50Hz & 51.5Hz) LP HEATER DRIP PUMP INCLUDING NPSHR (3%, 1%, 0% & 40,000HRS)	TG Pkg_sys	TG	A
161	4540-110-110-PVM-N-007	CONDENSER PERFORMANCE CURVE	TG Pkg_sys	TG	A
162	4540-110-110-PVM-W-110B	PAINTING SCHEDULE FOR TG & AUX INCLUDING HEATERS,D/A, BFPs, BPs, CEPs & DRIP PUMPS	TG Pkg_sys	TG	AA
163	4540-110-110-PVM-W-018	CONTROL OPERATION PHILOSOPHY LO PURIFIER	TG Pkg_sys	TG	AA
164	4540-110-110-PVM-W-020	CONTROL FLUID SYSTEM SCHEME AND WRITE-UP	TG Pkg_sys	TG	AA
165	4540-110-110-PVM-W-021	VACUUM PUMP WRITE UP AND CONTROL PHILOSOPHY	TG Pkg_sys	TG	AA
166	4540-110-110-PVM-W-050A	WRITE-UP FOR HP BYPASS SYSTEM	TG Pkg_sys	TG	A
167	4540-110-110-PVM-W-053	INTERLOCKS & PROTECTIONS WRITE-UP ON REGENERATIVE SYSTEM	TG Pkg_sys	TG	A
168	4540-110-110-PVM-W-057	WRITE-UP FOR CENTRAL LUBE OIL STORAGE & PURIFICATION SYS	TG Pkg_sys	TG	AA
169	4540-110-110-PVM-W-035C	TYPE TEST REPORT FOR MDBFP	TG Pkg_sys	TG	A
170	4540-110-110-PVM-W-035F	TYPE TEST REPORT FOR MDBP	TG Pkg_sys	TG	A
171	4540-110-110-PVM-W-035D	TYPE TEST REPORT FOR TDBP	TG Pkg_sys	TG	A
172	4540-110-110-PVM-W-035E	TYPE TEST REPORT FOR TDBFP	TG Pkg_sys	TG	A
173	4540-110-110-PVM-W-112	Type Test reports for CEP SUCTION Strainer	TG Pkg_sys	TG	AA
174	4540-110-110-PVM-W-116	Type Test reports for CEP	TG Pkg_sys	TG	A
175	4540-110-110-PVM-Y-025C	TYPE TEST report FOR OIL PURIFIER FOR BFPDT	TG Pkg_sys	TG	AA
176	4540-110-110-PVM-Y-017	VIBRATION DATA FOR CEP, VIBRATION PAD LOCATION FOR CEP	TG Pkg_sys	TG	AA
177	4540-110-110-PVM-Y-023	VIBRATION & SOUND LEVEL DATA MDBFP SET & TDBFP SET	TG Pkg_sys	TG	AA
178	4540-110-110-PVM-B-009A	DATA SHEET OF STEAM TURBINE	TG Pkg_sys	TG	A
179	4540-110-110-PVM-Y-013	CONDENSER DATA SHEET	TG Pkg_sys	TG	AA
180	4540-110-110-PVM-Y-200	TECHNICAL DATA SHEET-COLTCS	TG Pkg_sys	TG	AA
181	4540-110-110-PVM-Y-408	DATA SHEET OF TG HALL EOT CRANE	TG Pkg_sys	TG	A
182	4540-110-110-PVM-Y-426	DATA SHEET OF BFP HANDLING EOT CRANE	TG Pkg_sys	TG	AA
183	4540-110-110-PVM-Y-004	DATA SHEET FOR THERMAL INSULATION FOR TURBINE	TG Pkg_sys	TG	AA
184	4540-110-110-PVM-Y-006	DATA SHEET OF TURBINE OIL COOLER	TG Pkg_sys	TG	AA
185	4540-110-110-PVM-Y-007	DATA SHEET OF TURBINE OIL PURIFIER	TG Pkg_sys	TG	AA
186	4540-110-110-PVM-Y-011	DATA SHEETS FOR CF PUMP	TG Pkg_sys	TG	AA
187	4540-110-110-PVM-Y-014	VACUUM PUMP DATA SHEET	TG Pkg_sys	TG	A
188	4540-110-110-PVM-Y-016	DATA SHEET OF CEP	TG Pkg_sys	TG	A
189	4540-110-110-PVM-Y-019A	DATA SHEET OF GSC	TG Pkg_sys	TG	AA
190	4540-110-110-PVM-Y-019B	DATA SHEETS OF DRAIN COOLER, LP HEATERS 1 & 2	TG Pkg_sys	TG	AA
191	4540-110-110-PVM-Y-019C	DATA SHEETS OF LP HEATERS 3, LP HEATERS 4 & LP HEATER 5	TG Pkg_sys	TG	A
192	4540-110-110-PVM-Y-019D	DATA SHEETS OF HP HEATERS AND EXTERNAL DE-SUPERHEATERS	TG Pkg_sys	TG	A
193	4540-110-110-PVM-Y-021	DATA SHEET OF DEAEATOR	TG Pkg_sys	TG	A
194	4540-110-110-PVM-Y-022	DATA SHEET MDBFP SET	TG Pkg_sys	TG	A
195	4540-110-110-PVM-Y-022A	DATA SHEET TDBFP SET	TG Pkg_sys	TG	A
196	4540-110-110-PVM-Y-024	DATA SHEET OF DRIVE TURBINE	TG Pkg_sys	TG	A
197	4540-110-110-PVM-Y-025B	DATA SHEET OF LUB OIL PURIFICATION SYSTEM TDBFP	TG Pkg_sys	TG	AA
198	4540-110-110-PVM-Y-027	DATA SHEET FOR HP BY PASS VALVE INCLUDING HYDRAULIC UNIT	TG Pkg_sys	TG	AA
199	4540-110-110-PVM-Y-207A	SAFETY RELIEF VALVE DATA SHEET (HARDWAR - TIP SCHEDULE)	TG Pkg_sys	TG	AA
200	4540-110-110-PVM-B-012	GA and DATA SHEET AND CHARACTERISTIC CURVE OF MOP/ EOP/ JOP OF MAIN TURBINE	TG Pkg_sys	TG	AA
201	4540-110-110-PVM-B-042	DRAWING AND DATASHEET OF RELEIF VALVES FOR DEAEATOR	TG Pkg_sys	TG	AA
202	4540-110-110-PVM-B-061	DATA SHEETS & CHARACTERISTIC CURVES FOR LOPI/EOP/JOP OF DRIVE TURBINE	TG Pkg_sys	TG	AA
203	4540-110-110-PVM-X-204	O& M MANUAL -COLTCS	TG Pkg_sys	TG	AA
204	4540-110-110-PVM-X-110	O&M MANNUAL OF CONDENSER	TG Pkg_sys	TG	A
205	4540-110-110-PVM-X-110A	ERECTION PROCEDURE FOR CONDENSER	TG Pkg_sys	TG	A
206	4540-110-110-PVM-W-017	WRITE UP OF BORESCOPIC INSPECTION SYSTEM & USER MANUAL	TG Pkg_sys	TG	AA
207	4540-110-110-PVM-X-002	O&M MANUAL STEAM TURBINE	TG Pkg_sys	TG	A
208	4540-110-110-PVM-X-003	O&M MANUAL FOR TURBINE OIL PURIFIER	TG Pkg_sys	TG	AA
209	4540-110-110-PVM-X-004	O&M MANUAL FOR DRIVE TURBINE OIL PURIFIER	TG Pkg_sys	TG	AA
210	4540-110-110-PVM-X-027	O&M MANUAL FOR VACUUM PUMP	TG Pkg_sys	TG	A
211	4540-110-110-PVM-X-073	O&M MANUAL OF HEATERS	TG Pkg_sys	TG	A
212	4540-110-110-PVM-X-074	O&M MANUAL OF DEAEATOR	TG Pkg_sys	TG	A
213	4540-110-110-PVM-X-075	O&M MANUAL OF BFP AND AUX	TG Pkg_sys	TG	A
214	4540-110-110-PVM-X-076	O&M MANUAL OF CEP	TG Pkg_sys	TG	A
215	4540-110-110-PVM-X-077	O&M MANUAL OF DRIVE TURBINE AND AUX	TG Pkg_sys	TG	A
216	4540-110-110-PVM-X-078	O&M MANUAL OF TG HALL EOT CRANE	TG Pkg_sys	TG	A
217	4540-110-110-PVM-X-XXX	O&M MANUAL OF BFP EOT CRANE	TG Pkg_sys	TG	A
218	4540-110-110-PVM-X-XXX	O&M MANUAL OF HP, LP BYPASS SYSTEM	TG Pkg_sys	TG	A
219		O&M MANUAL OF DRIP PUMP	TG Pkg_sys	TG	AA
220		MANUAL OF HOISTS IN TG AREA	TG Pkg_sys	TG	AA
221	4540-110-110-PVM-B-XXX	GA & DATA SHEET OF MS & HRH STOP CUM CONTROL VALVE, OLV and STRAINER HOUSING INCLUDING PRESSURE DROP CALCULATION	TG Pkg_sys	TG	A
222	XXXX-001-110-PVI-B-001A	FDS DOCUMENT FOR CABLING, MARSHALLING, JB ENGG ETC.		C&I	AA
223	XXXX-001-110-PVI-A-032A	OGA OF TG, C& I CABINETS (SAG SCOPE)		C&I	AA
224	XXXX-001-110-PVI-B-002A	SYSTEM CONFIGURATION OF DDCMIS-Unit		C&I	A
225	XXXX-001-110-PVI-B-004	STAND PIPE DETAILS FOR INSTRUMENTS ON DEAEATOR		C&I	AA
226	XXXX-001-110-PVI-B-005	STAND PIPE DETAILS FOR INSTRUMENTS ON LP HEATER-3		C&I	AA
227	XXXX-001-110-PVI-B-006	STAND PIPE DETAILS FOR INSTRUMENTS ON LP HEATER-4		C&I	AA
228	XXXX-001-110-PVI-B-007	STAND PIPE DETAILS FOR INSTRUMENTS ON LP HEATER-5		C&I	AA
229	XXXX-001-110-PVI-B-008	STAND PIPE DETAILS FOR INSTRUMENTS ON HP HEATERS(7A, 7B, 8A, 8B, 9A, 9B)		C&I	AA
230	XXXX-001-110-PVI-B-009	STAND PIPE DETAILS FOR INSTRUMENTS ON LP HEATER-2		C&I	AA
231	XXXX-001-110-PVI-B-063B	CONTROL PANEL DETAILS & WIRING DRG OF OIL PURIFICATION SYSTEM		C&I	AA
232	XXXX-001-110-PVI-B-265	CONTROL LOGICS FOR CPU		C&I	AA
233	XXXX-001-110-PVI-B-266	HMI - LOGS, TRENDS AND BAR CHARTS FOR CPU		C&I	AA
234	XXXX-001-110-PVI-B-439	POWER & CONTROL SCHEME FOR ELECTRICAL WIRE ROPE HOISTS INCLUDING CONTROL PANEL AND PENDENT DETAILS		C&I	AA

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 3 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
235	XXXX-001-405-PVI-G-333	I/O LIST AND DRIVE LIST FOR UNIT (SG, TG, BOP) DDCMIS		C&I	AA
236	XXXX-001-110-PVI-H-008	INSTRUMENTS SCHEDULE FOR BFPDT		C&I	AA
237	XXXX-001-110-PVI-H-263	LIST OF 230V AC UPS LOAD (FOR CPU)		C&I	AA
238	XXXX-001-110-PVI-H-294	ALARM AND ANNUNCIATION LIST		C&I	AA
239	XXXX-001-110-PVI-H-297	INTERCONNECTION SCHEDULE FOR CPU		C&I	AA
240	XXXX-001-110-PVI-H-334	INSTRUMENTS SCHEDULE FOR FOR CPU		C&I	AA
241	XXXX-001-110-PVI-H-496	CABLE SCHEDULE & INTERCONNECTION		C&I	AA
242	XXXX-001-110-PVI-L-006C	Data sheet for RTDs/ Thermocouples for generator & exciter area		C&I	AA
243	XXXX-001-110-PVI-L-008A	CONTACT & SIGNAL EXCHANGE		C&I	AA
244	XXXX-001-110-PVI-L-013	LIST OF ANNUNCIATIONS		C&I	AA
245	XXXX-001-110-PVI-L-023	TURBINE GENERATOR JUNCTION BOXES - LIST AND LAYOUT		C&I	AA
246	XXXX-001-110-PVI-L-031	TURBINE VALVES SENSOR ARRANGEMENT		C&I	AA
247	XXXX-001-110-PVI-L-032	MEASURING PTS ON TURBINE & GENERATOR BRGS		C&I	AA
248	XXXX-001-110-PVI-L-033	CLOSED LOOP DIAGRAM FOR BFPDT		C&I	AA
249	XXXX-001-110-PVI-L-033A	EXPANSION,VIBRATION & VALVE POSITION MEASUREMENT		C&I	AA
250	XXXX-001-110-PVI-L-034	ATRS LOGIC DIAGRAM (SGC BFPDT OIL SYSTEM)		C&I	AA
251	XXXX-001-110-PVI-L-034A	ATRS LOGIC DIAGRAM FOR BFP DRIVE TURBINE (SGC BFP DRIVE TURBINE SYSTEM)		C&I	AA
252	XXXX-001-110-PVI-L-335	INSTRUMENTATION CABLE LIST & ICS FOR CPP		C&I	AA
253	XXXX-001-110-PVI-T-001A	EHTC BLOCK DIAGRAM - BFPDT		C&I	AA
254	XXXX-001-110-PVI-T-010A	ATRS LOGICS -OIL SUPPLY		C&I	AA
255	XXXX-001-110-PVI-T-010B	FUNCTIONAL CONTROL DIAGRAM FOR SGC SEAL STEAM SYSTEM		C&I	AA
256	XXXX-001-110-PVI-T-011	ATRS LOGICS - EVACUATION		C&I	AA
257	XXXX-001-110-PVI-T-012	FUNCTIONAL CONTROL DIAGRAM FOR ATT		C&I	AA
258	XXXX-001-110-PVI-T-013	LOGIC DIAGRAM FOR LUBE OIL PURIFICATION		C&I	AA
259	XXXX-001-110-PVI-T-014	FUNCTIONAL CONTROL DIAGRAM FOR HPSU- MAIN TURBINE		C&I	AA
260	XXXX-001-110-PVI-T-015	LOGIC FOR TURBINE PROTECTION SYSTEM INCLUDING FIRE PROTECTION SYSTEM		C&I	AA
261	XXXX-001-110-PVI-T-019	FUNCTIONAL CONTROL DIAGRAM FOR GENERATOR PROTECTION		C&I	AA
262	XXXX-001-110-PVI-T-020	FUNCTIONAL CONTROL DIAGRAM FOR PW SYSTEMS		C&I	AA
263	XXXX-001-110-PVI-T-021	FUNCTIONAL CONTROL DIAGRAM FOR SEAL OIL SYSTEMS		C&I	AA
264	XXXX-001-110-PVI-T-023	FUNCTIONAL CONTROL DIAGRAM FOR GENERATOR GAS DRYING SYSTEM		C&I	AA
265	XXXX-001-110-PVI-T-026	SGC-HPSU (LP BYPASS) LOGIC		C&I	AA
266	XXXX-001-110-PVI-T-036	LOGIC DIAGRAM FOR ACC		C&I	AA
267	XXXX-001-110-PVI-T-038	INTERCONNECTION DIAGRAM FOR ACC SYSTEM		C&I	AA
268	XXXX-001-405-PVI-J-047	ATST REPORT OF DDCMIS- UNIT		C&I	AA
269	XXXX-001-110-PVI-W-053A	GAS ANALYSER SCHEME		C&I	AA
270	XXXX-001-110-PVI-W-060	List of Instruments for BFP		C&I	AA
271	XXXX-001-110-PVI-W-061A	TYPE TEST REPORT FOR DDCMIS MODULES		C&I	AA
272	XXXX-001-110-PVI-W-381	TYPE TEST REPORT FOR ELECTRONIC TRANSMITTERS (FOR CPP)		C&I	AA
273	XXXX-001-110-PVI-W-385	TYPE TEST REPORT OF JUNCTION BOX (DEGREE OF PROTECTION) FOR CPP		C&I	AA
274	XXXX-001-110-PVI-W-387	TYPE TEST REPORT OF CV TEST FOR CONTROL VALVE (FOR CPP)		C&I	AA
275	XXXX-001-110-PVI-Y-007	CONTROL VALVE DATA SHEETS, DIMENSION DRAWING, CV CALCULATION (WITHOUT FDV-14)		C&I	AA
276	XXXX-001-110-PVI-Y-008	CONTROL VALVE DATA SHEETS, DIMENSION DRAWING, CV CALCULATION (WITH FDV-14)		C&I	AA
277	XXXX-001-110-PVI-Y-009B	DATA SHEET OF RTD & THERMOCOUPLE		C&I	AA
278	XXXX-001-110-PVI-Y-009D	Data sheet for Pressure Switch		C&I	AA
279	XXXX-001-110-PVI-Y-009F	DATA SHEET OF THERMOWELL OF DEAERATOR		C&I	AA
280	XXXX-001-110-PVI-Y-010A	LIST OF TEMPERATURE TRANSMITTERS		C&I	AA
281	XXXX-001-110-PVI-Y-010C	Data sheet of Lube oil Console RTD		C&I	AA
282	XXXX-001-110-PVI-Y-011A	FLOW NOZZLE DATA SHEETS, GA DRAWING ,DESIGN CALCULATION & BOQ		C&I	AA
283	XXXX-001-110-PVI-Y-011B	DATA SHEETS FOR ELECTRONIC FLOW METER(ELECTROMAGNETIC PRINCIPLE)		C&I	AA
284	XXXX-001-110-PVI-Y-011C	FLOW ELEMENT (NOZZLE) CALIBRATION REPORT-1		C&I	AA
285	XXXX-001-110-PVI-Y-011D	FLOW ELEMENT (NOZZLE) CALIBRATION REPORT-2		C&I	AA
286	XXXX-001-110-PVI-Y-011E	FLOW ELEMENT (NOZZLE) CALIBRATION REPORT-3		C&I	AA
287	XXXX-001-110-PVI-Y-013D	Data sheet of Lube oil Console Pressure switch & DPS		C&I	AA
288	XXXX-001-110-PVI-Y-014	CV TEST REPORT (WITHOUT FDV-14)		C&I	AA
289	XXXX-001-110-PVI-Y-014A	CV TEST REPORT (WITHOUT FDV-14) PART-II		C&I	AA
290	XXXX-001-110-PVI-Y-015	CV TEST REPORT (WITH FDV-14)		C&I	AA
291	XXXX-001-110-PVI-Y-024	DATA SHEETS FOR INSTRUMENTATION CABLES F&G TYPE USED FOR C&I SYSTEM		C&I	AA
292	XXXX-001-110-PVI-Y-027A	MEASURING POINT LIST (GENERATOR INSTRUMENT LIST)		C&I	AA
293	XXXX-001-110-PVI-Y-027B	INSTRUMENTS LIST (ST)		C&I	AA
294	XXXX-001-110-PVI-Y-049A	TYPICAL GA, WIRING DRAWINGS OF LIE/LIRs		C&I	AA
295	XXXX-001-110-PVI-Y-053	CONTROL VALVE DATA SHEET WITH DIMENSIONS (PNEUMATIC OPERATED)		C&I	AA
296	XXXX-001-110-PVI-Y-053A	CONTROL VALVE DATA SHEET WITH DIMENSIONS (SELF ACTUATED)		C&I	AA
297	XXXX-001-110-PVI-Y-054	GA drg. and Data sheet for Thermowell		C&I	AA
298	XXXX-001-110-PVI-Y-060	SPECIFICATION FOR SERVER/WORKSTAION AND OTHER HMIPIS H/W FOR DDCMIS		C&I	AA
299	XXXX-001-110-PVI-Y-061	CLCS SCHEME FOR EHTC(SPEED/LOAD/PRESSURE/ADMISSION CONTROLS) FOR MAIN TURBINE		C&I	AA
300	XXXX-001-110-PVI-Y-061B	BOM FOR TG DDCMIS SYSTEM HARDWARE (TG Controls - Siemens)		C&I	AA
301	XXXX-001-110-PVI-Y-066	RGMO Scheme		C&I	A
302	XXXX-001-110-PVI-Y-067	FUNCTIONAL CONTROL DIAGRAM MAIN EXCITER		C&I	AA
303	XXXX-001-110-PVI-Y-067A	FUNCTIONAL CONTROL DIAGRAM BEARING EXHAUST SYSTEM		C&I	AA
304	XXXX-001-110-PVI-Y-069	FUNCTIONAL CONTROL DIAGRAM FOR ATRS TURBINE		C&I	AA
305	XXXX-001-110-PVI-Y-072A	DATA SHEET FOR LEVEL SWITCHES FOR TURBINE		C&I	AA
306	XXXX-001-110-PVI-Y-269	DATA SHEET FOR ELECTRONIC TRANSMITTERS		C&I	AA
307	XXXX-001-110-PVI-Y-270	DATA SHEET FOR LEVEL TRANSMITTER - ULTRASONIC		C&I	AA
308	XXXX-001-110-PVI-Y-271	DATASHEET OF SOLENOID VALVES		C&I	AA
309	XXXX-001-110-PVI-Y-276	DATA SHEET FOR PNEUMATIC OPERATED CONTROL VALVES FOR CPP		C&I	AA
310	XXXX-001-110-PVI-Y-291	Data Sheet of Motorized Butterfly Valve		C&I	AA
311	XXXX-001-110-PVI-Y-320	DATA SHEET AND GA FOR JUNCTION BOX / ANALYZER PANEL AND JB LAYOUT		C&I	AA
312	XXXX-001-110-PVI-Y-342	DATA SHEETS OF INSTRUMENTS FOR STG BALANCE TG INSTRUMENTS (FOR CPP)		C&I	AA
313	XXXX-001-110-PVI-Y-474	GA, DATA SHEET & CIRCUIT DIAGRAM OF RECTIFIER TRANSFORMER		C&I	AA
314	XXXX-001-102-PVI-B-029	Instrument Schedule for MILL REJECT SYSTEM (CONVEYOR TYPE)		C&I	AA

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 4 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
315	XXXX-001-102-PVI-B-180	GA and data sheet of C&I Instruments for MILL REJECT SYSTEM (CONVEYOR TYPE)		C&I	AA
316	XXXX-001-102-PVI-B-183	GA & int-con wiring details for Pyrite Hopper LCP, Drag Link Chain Convr, Bucket Elevtr, Silo LCP. for MILL REJECT SYSTEM (CONVEYOR TYPE)		C&I	AA
317	XXXX-001-102-PVI-B-211	Junction Box Termination Dwgs. for Oxygen Dosing System		C&I	AA
318	XXXX-001-102-PVI-G-222	MEASUREMENT & CONTROL SCHEDULE FOR SCHEME OF APH WITH INSTRUMENTATION		C&I	AA
319	XXXX-001-102-PVI-H-001	Physical location of tappings for instruments in furnace region		C&I	AA
320	XXXX-001-102-PVI-H-003	Installation Scheme for Instruments		C&I	AA
321	XXXX-001-102-PVI-H-004	Instrument schedule (including PT,TE, TT, FT, LT, DPT; Switches and local indicators/ guages) indicating Physical locations, range, Alarm set points and Scope of Supply.		C&I	AA
322	XXXX-001-102-PVI-H-004A	Data sheet for Averaging pitot tube		C&I	AA
323	XXXX-001-102-PVI-H-008	Instrumentation and Control Cable list under SG-Scope with source and destination TB/Panel/JB details along with location of Panel/JB and field instruments in MS Excel /Access form.		C&I	AA
324	XXXX-001-102-PVI-H-011	Schedule of Control Valves		C&I	AA
325	XXXX-001-102-PVI-H-012	CALIBRATION REPORT FOR AVERAGING PITOT TUBE (CONDENSATE PUMP DISCHARGE FLOW)		C&I	AA
326	XXXX-001-102-PVI-H-023	Evaporator, separator, SH and RH metal temperature measurement points		C&I	AA
327	XXXX-001-102-PVI-H-155	Control cable schedule for compressed air system		C&I	AA
328	XXXX-001-102-PVI-H-186	Cable Schedule - Signal and Control for MILL REJECT SYSTEM (CONVEYOR TYPE)		C&I	AA
329	XXXX-001-102-PVI-K-001	Furnace Flame Viewing System: GA/Write up/ Scheme/ Data sheet/ Interconnection diagram.		C&I	AA
330	XXXX-001-102-PVI-K-002	GA/Write up/ Scheme/ Data sheet/ Interconnection diagram of Acoustic Pyrometers		C&I	AA
331	XXXX-001-102-PVI-K-003	GA drawings of ERVs		C&I	AA
332	XXXX-001-102-PVI-K-005	GA/Write up/ Scheme/ Data sheet/ Interconnection diagram of Acoustic Steam leak Detection System		C&I	AA
333	XXXX-001-102-PVI-K-008	Write up on Gravimetric feeder Control System.		C&I	AA
334	XXXX-001-102-PVI-L-001	Logic Diagram / Scheme of Burner Management System		C&I	AA
335	XXXX-001-102-PVI-L-002	Field Interconection Diagram for Burner Management System indicating cable size/ type, cable number, JB and Panel end termination details		C&I	AA
336	XXXX-001-102-PVI-L-005	Logic Diagram / Scheme of Secondary Air Damper Control.		C&I	AA
337	XXXX-001-102-PVI-L-009	Field Interconection Diagram for Soot Blower Control System indicating cable size/ type, cable number, JB and Panel End Termination details.		C&I	AA
338	XXXX-001-102-PVI-L-014	Field Interconection Diagram for Fuel Oil Pump House Control System indicating cable size/ type, cable number, JB and Panel End Termination details.		C&I	AA
339	XXXX-001-102-PVI-L-016	Logic Diagram / control Scheme for Gravimetric feeder Control System.		C&I	AA
340	XXXX-001-102-PVI-L-017	Field Interconnection Diagram for Gravimetric feeder Control System indicating cable size/ type, cable number, JB and Panel End Termination details.		C&I	AA
341	XXXX-001-102-PVI-L-026	Logic Diagram / Scheme of Fuel Oil Pump House Control System		C&I	AA
342	XXXX-001-102-PVI-L-154	TERMINAL DETAILS AND WIRING DIAGRAM OF LCP FOR COMPRESSOR CONTROLS & Air Drier CONTROLS for Compressed air system		C&I	AA
343	XXXX-001-102-PVI-L-179	Block Logic Diagram/Control Scheme of the MRHS with HMI screen for MILL REJECT SYSTEM (CONVEYOR TYPE)		C&I	AA
344	XXXX-001-102-PVI-P-001	Auto control scheme		C&I	AA
345	XXXX-001-102-PVI-P-002	Recommended Writeup of Auto controls		C&I	AA
346	XXXX-001-102-PVI-T-001	Boiler House Auxiliary Interlocks		C&I	A
347	XXXX-001-102-PVI-T-005	Main Boiler House Auxiliary Interlocks		C&I	AA
348	XXXX-001-102-PVI-W-009	Type test report of Instrumentation cable /Flame Scanner Cable / Optical fibre Cable /Thermocouple Cable		C&I	AA
349	XXXX-001-102-PVI-W-012	Type Test Report of Flow elements including orifice and Nozzle		C&I	AA
350	XXXX-001-102-PVI-W-098	APRDS-CV TEST REPORT ? LC PRV & SPRAY VALVES		C&I	AA
351	XXXX-001-102-PVI-W-098A	APRDS-CV TEST REPORT ? HC PRV		C&I	AA
352	XXXX-001-102-PVI-W-70	Type Test Report for Gravimetric feeder control panel		C&I	AA
353	XXXX-001-102-PVI-Y-002	Datasheet of fuel Oil Flow Meter		C&I	AA
354	XXXX-001-102-PVI-Y-003	Data Sheet, GA and Schedule of Dosing Panel		C&I	AA
355	XXXX-001-102-PVI-Y-004	Datasheet of Instrument (including , Temperature elements, Transmitters and Local Indicators), I/O List, BOM and Mandatory spares for compressed air system/		C&I	AA
356	XXXX-001-102-PVI-Y-006	Schedule of Control Panels		C&I	AA
357	XXXX-001-102-PVI-Y-018	Datasheet for flame Scanner Cable.		C&I	AA
358	XXXX-001-102-PVI-Y-024	Vendor Datasheet for Startup Control Valves including accessories for SG package		C&I	AA
359	XXXX-001-102-PVI-Y-025	Datasheets for flow elements - Orifice, rotameters and Nozzles including accessories		C&I	AA
360	XXXX-001-102-PVI-Y-029	Air flow device data & Characteristics curves		C&I	AA
361	XXXX-001-102-PVI-Y-035	GA DRAWING AND DATASHEET FOR METAL TEMPERATURE THERMOCOUPLE		C&I	AA
362	XXXX-001-102-PVI-Y-036	GA DRAWING AND DATASHEET FOR ACROMET TYPE MTTC		C&I	AA
363	XXXX-001-102-PVI-Y-041	Datasheet of Flame Scanner System		C&I	AA
364	XXXX-001-102-PVI-Y-40	Datasheet for control valves		C&I	AA
365	XXXX-001-102-PVI-Y-41	Data sheet of RTD and Thermowell		C&I	AA
366	XXXX-001-102-PVI-Y-61	Interface scheme of Electrical actuators (field bus and conventional)		C&I	A
367	XXXX-001-102-PVI-Y-62	Data Sheet of motorized actuators		C&I	AA
368	XXXX-001-102-PVI-Y-67	Actuator datasheet for motorised valve with wiring diagram		C&I	AA
369	XXXX-001-151-PVI-B-001	GA & Wiring Diagrams of FPS PLC		C&I	AA
370	XXXX-001-151-PVI-B-002	Data Sheet, BOQ & GA of Fire Alarm Panel & Repeater Panel		C&I	AA
371	XXXX-001-151-PVI-B-003	Data sheet of Repeater Panel		C&I	AA
372	XXXX-001-151-PVI-B-004A	G.A. & WIRING DIAGRAM FOR DELUGE VALVE CONTROL PANEL		C&I	AA
373	XXXX-001-151-PVI-B-005	Data sheet, G.A. & Schematic Drawing of Battery Charger & Battery for FPS PLC & RIO Panel		C&I	AA
374	XXXX-001-151-PVI-B-008	PANEL DOCUMENTS FOR ENGINE DRIVEN HYDRANT BOOSTER PUMPS [DATASHEET, GAD]		C&I	AA
375	XXXX-001-151-PVI-G-001	I/O List of PLC System		C&I	AA
376	XXXX-001-151-PVI-H-001	Instrument Schedule		C&I	AA
377	XXXX-001-151-PVI-L-001	Schematic Diagram for Fire Detection and Alarm System including area distribution details		C&I	AA
378	XXXX-001-151-PVI-L-002	Fire alarm panel Networking diagram		C&I	A
379	XXXX-001-151-PVI-S-001	24V DC power distribution Diagram for FPS PLC & RIO Panel		C&I	AA
380	XXXX-001-151-PVI-T-001	FPS PLC - Logic Diagrams		C&I	AA
381	XXXX-001-151-PVI-W-001	FAT procedure of FPS PLC		C&I	AA
382	XXXX-001-151-PVI-W-002	Write-Up and Configuration Diagram of FPS PLC & RIO Panel		C&I	A
383	XXXX-001-151-PVI-W-004	Type test report of Loop Cable		C&I	AA
384	XXXX-001-151-PVI-W-005	Type Test Report for Battery & Battery Charger [of FPS PLC & RIO Panel]		C&I	AA

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 5 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
385	XXXX-001-151-PVI-W-007	Type Test report of FPS PLC		C&I	AA
386	XXXX-001-151-PVI-W-009	FPS PLC Graphics & Mimics		C&I	AA
387	XXXX-001-151-PVI-X-004	Operation & Maintenance Manual		C&I	AA
388	XXXX-001-151-PVI-Y-001	Data sheet and GA drawing of Siren		C&I	AA
389	XXXX-001-151-PVI-Y-001A	Data Sheet & GA of Battery for Fire Alarm System (With Battery Sizing Calculations)		C&I	AA
390	XXXX-001-151-PVI-Y-002	DATA SHEET OF DIGITAL LHS CABLE		C&I	AA
391	XXXX-001-151-PVI-Y-003	DATA SHEET OF Infrared Detectors (IRD)		C&I	AA
392	XXXX-001-151-PVI-Y-004	Data sheet of Detectors / Devices		C&I	AA
393	XXXX-001-151-PVI-Y-008	GA & DATA SHEET FOR SOLENOID VALVE		C&I	AA
394	XXXX-001-151-PVI-Y-009	DATA SHEETS & BOQ of FPS PLC Items		C&I	AA
395	XXXX-001-151-PVI-Y-012	DATA SHEET OF FRLS CONTROL CABLE		C&I	AA
396	XXXX-001-151-PVI-Y-014	DATA SHEET OF Optical Fibre Cable		C&I	AA
397	XXXX-001-151-PVI-Y-015	Data Sheet - Short Term Fire Survival Cable		C&I	AA
398	XXXX-001-151-PVI-Y-016	Data sheets of Field instruments		C&I	AA
399	XXXX-001-151-PVI-Y-022A	Data Sheet - Ultrasonic Level Transmitter (for fire water storage tank & foam tank)		C&I	AA
400	XXXX-001-151-PVI-Y-023	Data Sheet - Differential Pressure Gauge & Differential Pressure Switch		C&I	AA
401	XXXX-001-151-PVI-Y-025	Data sheets FDA system work station & Printer		C&I	AA
402	XXXX-001-151-PVI-Y-027B	PANEL DOCUMENTS FOR ENGINE DRIVEN HYDRANT / SPRAY PUMPS [DATASHEET, GAD]		C&I	AA
403	XXXX-001-151-PVI-Y-027C	PANEL DOCUMENTS FOR ENGINE DRIVEN SPRAY BOOSTER PUMPS [DATASHEET, GAD]		C&I	AA
404	XXXX-001-151-PVI-Y-033	Power Supply calculation of FPS PLC & RIO Panel		C&I	AA
405	XXXX-001-109-PVI-B-008	GA and Wiring Oxidation Blower Local Control Panel		C&I	AA
406	XXXX-001-109-PVI-G-001	Instrument list		C&I	AA
407	XXXX-001-109-PVI-H-001	Cable Schedule for power, control & instrument cables		C&I	AA
408	XXXX-001-109-PVI-T-001	Complete Logic diagrams of FGD system with Sequence, protection and interlock schemes		C&I	AA
409	XXXX-001-109-PVI-W-003	Type Test Report of FGD control System		C&I	AA
410	XXXX-001-130-PVI-B-036	Instrument Hookup Diagram for FOHS		C&I	AA
411	XXXX-001-130-PVI-H-037	Instrument Schedule of FOHS		C&I	AA
412	XXXX-001-130-PVI-Y-012	Data Sheet- Electrical Actuator for FOHS		C&I	AA
413	XXXX-001-130-PVI-Y-013	Data Sheet- Level Transmitter for FOHS		C&I	AA
414	XXXX-001-130-PVI-Y-014	Data Sheet- Pressure / Differential Pressure Gauge		C&I	AA
415	XXXX-001-130-PVI-Y-015	Data Sheet- Pressure Transmitter / Differential Pressure transmitter		C&I	AA
416	XXXX-001-130-PVI-Y-016	Data Sheet- Level Indicator for FOHS		C&I	AA
417	XXXX-001-130-PVI-Y-017	Data Sheet - Flow Meter & Strainer for FOHS		C&I	AA
418	XXXX-001-130-PVI-Y-018	Data Sheet - Temp/ Indicator for FOHS		C&I	AA
419	XXXX-001-130-PVI-Y-019	GA & Data Sheet- Junction Box for FOHS		C&I	AA
420	XXXX-001-110-PVI-U-045	CONTROL SCHEME FOR HP-Bypass		C&I	AA
421	XXXX-001-405-PVI-B-106	Typical GA/IA ALONG WITH AC/ DC POWER DISTRIBUTION, GROUNDING SCHEME OF DDCMIS		C&I	A
422	XXXX-001-405-PVI-B-109	SCHEME OF ELECTRICAL CONTROL PANEL		C&I	A
423	XXXX-001-405-PVI-B-130	HARDWARE SCHEME OF DCS / RELAY CABINETS- WS (PT/RO)		C&I	AA
424	XXXX-001-405-PVI-B-131	HARDWARE SCHEME OF DCS / RELAY CABINETS -UNIT DDCMIS		C&I	AA
425	XXXX-001-405-PVI-B-132	HARDWARE SCHEME OF DCS / RELAY CABINETS -SAC		C&I	AA
426	XXXX-001-405-PVI-B-133	HARDWARE SCHEME OF DCS / RELAY CABINETS -AHP SYSTEM		C&I	AA
427	XXXX-001-405-PVI-B-134	HARDWARE SCHEME OF DCS / RELAY CABINETS -CHP SYSTEM		C&I	AA
428	XXXX-001-405-PVI-B-136	TEST PROCEDURE FOR DEMONSTRATION OF MAJOR DESIGN FEATURES OF DDCMIS SYSTEM		C&I	A
429	XXXX-001-405-PVI-B-136A	UPS SCHEME		C&I	AA
430	XXXX-001-405-PVI-B-137	AVAILABILITY TEST PROCEDURE		C&I	A
431	XXXX-001-405-PVI-B-142	LIST OF CIRCUIT BREAKERS FOR ELECTRICAL SYSTEM AND THEIR CONTROL LOCATION		C&I	A
432	XXXX-001-405-PVI-B-143	SYNCHRONISING SCHEME OF Electrical Control Desk (ECD)		C&I	A
433	XXXX-001-405-PVI-B-143A	INTERCONNECTION CABLE SCHEDULE - UNIT		C&I	AA
434	XXXX-001-405-PVI-B-143B	Procedure for Auto-Synchronizer and Manual Synchronizer		C&I	AA
435	XXXX-001-405-PVI-B-144A	CABLE LIST - UNIT		C&I	AA
436	XXXX-001-405-PVI-B-145	INTERCONNECTION CABLE SCHEDULE- WS (PT/DM)		C&I	AA
437	XXXX-001-405-PVI-B-146	CABLE LIST- WS (PT/DM)		C&I	AA
438	XXXX-001-405-PVI-B-147	INTERCONNECTION CABLE SCHEDULE - SAC		C&I	AA
439	XXXX-001-405-PVI-B-148	CABLE LIST- SAC		C&I	AA
440	XXXX-001-405-PVI-B-149	INTERCONNECTION CABLE SCHEDULE -AHP		C&I	AA
441	XXXX-001-405-PVI-B-150	CABLE LIST -AHP		C&I	AA
442	XXXX-001-405-PVI-B-151	UNIT CONTROL DESK (UCD AND ECD)		C&I	A
443	XXXX-001-405-PVI-B-151A	INTERCONNECTION CABLE SCHEDULE - CHP		C&I	AA
444	XXXX-001-405-PVI-B-152	GA DRAWING/DATASHEET/BOM OF PA SYSTEM and DEVICES and ACCESSORIES		C&I	AA
445	XXXX-001-405-PVI-B-152A	TYPE TEST REPORT OF PA SYSTEM and DEVICES and ACCESSORIES		C&I	AA
446	XXXX-001-405-PVI-B-152B	DRIVE CONTROL PHILOSOPHY		C&I	A
447	XXXX-001-405-PVI-B-152C	CABLE LIST - CHP		C&I	AA
448	XXXX-001-405-PVI-B-153	CONTROL SYSTEM FOR MECHANICAL AUXILIARY PACKAGES		C&I	A
449	XXXX-001-405-PVI-B-153B	CABLE LIST OF HART MANAGEMENT SYSTEM		C&I	AA
450	XXXX-001-405-PVI-B-154	CABLE LIST FOR LT POWER CABLES		C&I	AA
451	XXXX-001-405-PVI-B-162	INTERCONNECTION CABLE SCHEDULE -SG PACKAGE		C&I	AA
452	XXXX-001-405-PVI-B-168	CABLE LIST -TG PACKAGE		C&I	AA
453	XXXX-001-405-PVI-B-189	GA/IA,Network scheme and Power distribution scheme for UNITS HMIPIS		C&I	AA
454	XXXX-001-405-PVI-B-197	GA/IA,Network scheme and Power distribution scheme for HMIPIS- Station LAN		C&I	AA
455	XXXX-001-405-PVI-B-198	GA/IA,Network scheme and Power distribution scheme for HMIPIS- Stand Alone Common (SAC)		C&I	AA
456	XXXX-001-405-PVI-B-199	GA/IA,Network scheme and Power distribution scheme for HMIPIS- Water System (WS)		C&I	AA
457	XXXX-001-405-PVI-B-201	GA/IA,Network scheme and Power distribution scheme for HMIPIS- AHP		C&I	AA
458	XXXX-001-405-PVI-B-202	GA/IA,Network scheme and Power distribution scheme for HMIPIS- CHP		C&I	AA
459	XXXX-001-405-PVI-B-203	HARDWARE SCHEME OF DCS / RELAY CABINETS -FGD SYSTEM		C&I	AA
460	XXXX-001-405-PVI-B-204	INTERCONNECTION CABLE SCHEDULE - FGD SYSTEM		C&I	AA
461	XXXX-001-405-PVI-B-208A	Portable Trolley mounted System - Testing and Commissioning tool in absence of DDCMIS		C&I	AA
462	XXXX-001-405-PVI-B-210	DATA SHEET, DRG FOR BATTERY FOR 24V DC PS SYSTEM - UNIT		C&I	AA
463	XXXX-001-405-PVI-B-211	DATA SHEET, DRG FOR BATTERY FOR 24V DC PS SYSTEM - CHP		C&I	AA
464	XXXX-001-405-PVI-B-212	DATA SHEET, DRG FOR BATTERY FOR 24V DC PS SYSTEM - AHP		C&I	AA
465	XXXX-001-405-PVI-B-213	DATA SHEET, DRG FOR BATTERY FOR 24V DC PS SYSTEM - SAC		C&I	AA
466	XXXX-001-405-PVI-B-214	DATA SHEET, DRG FOR BATTERY FOR 24V DC PS SYSTEM - WS		C&I	AA
467	XXXX-001-405-PVI-B-216	DATA SHEET, DRG FOR BATTERY FOR 24V DC PS SYSTEM - FGD		C&I	AA

Si No	NTPC Drg No	DRG_TITLE	SUB-SYSTEM	Dept	CATEGORY
468	XXXX-001-405-PVI-B-217	DATA SHEET,DRG, BOM FOR VIBRATION MONITORING SYSTEM (VMS)		C&I	AA
469	XXXX-001-405-PVI-B-218	DATA SHEET ,DRAWING & BOM FOR MASTER SLAVECLOCK SYSTEM		C&I	AA
470	XXXX-001-405-PVI-B-219	DATA SHEET FOR CCTV		C&I	AA
471	XXXX-001-405-PVI-B-220	TYPE TESTS REPORT for Vibration Monitoring System		C&I	AA
472	XXXX-001-405-PVI-B-228	Analysis and Diagnostics of TSS and VMS		C&I	AA
473	XXXX-001-405-PVI-F-001	SWAS ROOM LAYOUT		C&I	AA
474	XXXX-001-405-PVI-F-002	CCR/EEER/COMPUTER ROOM LAYOUT		C&I	A
475	XXXX-001-405-PVI-F-003	UPS, BATTERY, BATTERY CHARGER ROOM LAYOUT		C&I	AA
476	XXXX-001-405-PVI-G-124	I/O ASSIGNMENT & Segmentation document - WS (PT/RO)		C&I	AA
477	XXXX-001-405-PVI-G-125	I/O ASSIGNMENT & Segmentation document - UNIT DDCMIS		C&I	A
478	XXXX-001-405-PVI-G-126	I/O ASSIGNMENT & Segmentation document- SAC		C&I	AA
479	XXXX-001-405-PVI-G-127	I/O ASSIGNMENT& Segmentation document - AHP		C&I	AA
480	XXXX-001-405-PVI-G-128	I/O ASSIGNMENT& Segmentation document - CHP		C&I	AA
481	XXXX-001-405-PVI-G-230	I/O ASSIGNMENT & Segmentation document- FGD SYSTEM		C&I	AA
482	XXXX-001-405-PVI-H-141	Overall mandatory spares DDCMIS other than AHP, CHP		C&I	AA
483	XXXX-001-405-PVI-H-142	Overall mandatory spares DDCMIS for AHP, CHP		C&I	AA
484	XXXX-001-405-PVI-H-149A	HMI documents(logs, bar, trend , group display etc) for UNIT BOP		C&I	AA
485	XXXX-001-405-PVI-H-169	BOM for Tools & Tackles		C&I	AA
486	XXXX-001-405-PVI-H-188	BOM FOR HMIPIIS-UNITS		C&I	AA
487	XXXX-001-405-PVI-H-233	BOM for HMIPIIS - Station LAN		C&I	AA
488	XXXX-001-405-PVI-H-234	BOM for HMIPIIS - Stand Alone Common (SAC)		C&I	AA
489	XXXX-001-405-PVI-H-235	BOM for HMIPIIS - Water System (WS)		C&I	AA
490	XXXX-001-405-PVI-H-237	BOM for HMIPIIS - AHP		C&I	AA
491	XXXX-001-405-PVI-H-238	BOM for HMIPIIS - CHP		C&I	AA
492	XXXX-001-405-PVI-H-239	Overall Mandatory Spares- HMIPIIS		C&I	AA
493	XXXX-001-405-PVI-H-244	BOM OF CONTROL SYSTEM - Unit BOP		C&I	AA
494	XXXX-001-405-PVI-H-245	BOM OF CONTROL SYSTEM - SAC		C&I	AA
495	XXXX-001-405-PVI-H-246	BOM OF CONTROL SYSTEM - Water System		C&I	AA
496	XXXX-001-405-PVI-H-248	BOM OF CONTROL SYSTEM - AHP		C&I	AA
497	XXXX-001-405-PVI-H-249	BOM OF CONTROL SYSTEM - CHP		C&I	AA
498	XXXX-001-405-PVI-H-250	BOM OF CONTROL SYSTEM - Aux. Boiler		C&I	AA
499	XXXX-001-405-PVI-H-251	BOM OF CONTROL SYSTEM - FGD		C&I	AA
500	XXXX-001-405-PVI-H-253	BOM WITH TAG NOS./SERVICE DETAILS FOR MOSAIC/CONSOLE ITEMS		C&I	AA
501	XXXX-001-405-PVI-J-171	ATST PROCEDURE for SG , TG & Station C&I DDCMIS		C&I	A
502	XXXX-001-405-PVI-J-172	Pre ATST Report- UNIT DDCMIS PACKAGE		C&I	A
503	XXXX-001-405-PVI-J-181	PRE ATST Report- Water System (PT/RO)		C&I	A
504	XXXX-001-405-PVI-J-182	PRE ATST Report - CHP		C&I	A
505	XXXX-001-405-PVI-J-183	Pre ATST Report-SAC		C&I	A
506	XXXX-001-405-PVI-J-184	Pre ATST Report-AHP		C&I	A
507	XXXX-001-405-PVI-J-191	ATST PROCEDURE FOR HMIPIIS SYSTEM		C&I	A
508	XXXX-001-405-PVI-J-255	ATST Report of HMIPIIS - Station LAN		C&I	AA
509	XXXX-001-405-PVI-J-256	ATST REPORT OF DDCMIS- Stand Alone Common (SAC)		C&I	AA
510	XXXX-001-405-PVI-J-257	ATST REPORT OF DDCMIS- Water System (WS)		C&I	AA
511	XXXX-001-405-PVI-J-259	ATST REPORT OF DDCMIS - AHP		C&I	AA
512	XXXX-001-405-PVI-J-260	ATST REPORT OF DDCMIS - CHP		C&I	AA
513	XXXX-001-405-PVI-L-154	TERMINAL DETAILS/ SCHEMATIC DIAGRAM FOR PA SYSTEM		C&I	AA
514	XXXX-001-405-PVI-L-270	SYSTEM CONFIGURATION OF HMIPIIS- STATION LAN		C&I	A
515	XXXX-001-405-PVI-L-271	SYSTEM CONFIGURATION OF DDCMIS-Stand Alone Common (SAC)		C&I	A
516	XXXX-001-405-PVI-L-272	SYSTEM CONFIGURATION OF DDCMIS -Water System (WS)		C&I	A
517	XXXX-001-405-PVI-L-274	SYSTEM CONFIGURATION OF DDCMIS -AHP		C&I	A
518	XXXX-001-405-PVI-L-275	SYSTEM CONFIGURATION OF DDCMIS -CHP		C&I	A
519	XXXX-001-405-PVI-L-276	OFC CABLE SEGMENT LIST		C&I	AA
520	XXXX-001-405-PVI-M-110	DDCMIS MODULE REFERENCE MANUAL		C&I	AA
521	XXXX-001-405-PVI-P-016	CO-ORDINATED MASTER CONTROL SCHEME		C&I	AA
522	XXXX-001-405-PVI-P-111	CONTROL SYSTEM FDS (HARDWARE & FEATURES, OLCS/CLCS IMPLEMENTATION, DRIVE MACROS ALONG WITH POP-UPS)		C&I	A
523	XXXX-001-405-PVI-P-190	FDS FOR HMIPIIS - UNITS		C&I	A
524	XXXX-001-405-PVI-P-280	FDS FOR HMIPIIS - STATION LAN		C&I	A
525	XXXX-001-405-PVI-P-281	FDS for optimum tuning Software, Replay Software & MOR		C&I	A
526	XXXX-001-405-PVI-T-005	SEQ. CONTROL SCHEME FOR ID FANS		C&I	AA
527	XXXX-001-405-PVI-T-007	SEQ. CONTROL SCHEME FOR FD FANS		C&I	AA
528	XXXX-001-405-PVI-T-009	SEQ. CONTROL SCHEME FOR AIR HEATER		C&I	AA
529	XXXX-001-405-PVI-T-011	SEQ.CONTROL SCHEME FOR PA FANS		C&I	AA
530	XXXX-001-405-PVI-T-027	SEQ. CONTROL SCHEME FOR HP HEATER		C&I	AA
531	XXXX-001-405-PVI-T-035	SEQ. CONTROL SCHEME FOR BFP		C&I	AA
532	XXXX-001-405-PVI-T-040	SEQ. CONTROL SCHEME FOR LP HEATERS		C&I	AA
533	XXXX-001-405-PVI-T-041	LOGIC FOR DOSING SYSTEM		C&I	AA
534	XXXX-001-405-PVI-T-042	RE-HEATER PROTECTION LOGICS		C&I	AA
535	XXXX-001-405-PVI-T-043	ANALOG CONTROL SCHEME		C&I	AA
536	XXXX-001-405-PVI-T-044	LOGIC DIGRAM FOR AUTOMATIC PLANT STARTUP		C&I	A
537	XXXX-001-405-PVI-T-045	SEQ. CONTROL SCHEME FOR CEP		C&I	AA
538	XXXX-001-405-PVI-T-050	BINARY DRIVE CONTROL SCHEME FOR MICS. DRIVE (Station C&I)		C&I	AA
539	XXXX-001-405-PVI-T-051	SEQ. CONTROL SCHEME FOR BOILER ECW PUMP		C&I	AA
540	XXXX-001-405-PVI-T-053	SEQ. CONTROL SCHEME FOR TG & COMMON ECW PUMPS		C&I	AA
541	XXXX-001-405-PVI-T-056	SEQ. CONTROL SCHEME FOR DM MAKEUP & BLR FILL PUMPS		C&I	AA
542	XXXX-001-405-PVI-T-057	SEQ. CONTROL SCHEME FOR ACWP, Station Aux, ACWP and AHS		C&I	AA
543	XXXX-001-405-PVI-T-108	LOGIC DIAGRAM FOR ELECTRICAL CONTROL SYSTEM		C&I	AA
544	XXXX-001-405-PVI-T-112	CONTROL SCHEME FOR WATER SYSTEM MISC. PUMPS		C&I	AA
545	XXXX-001-405-PVI-U-113	LIST OF CABINETS WITH - WS (PT/RO)		C&I	AA
546	XXXX-001-405-PVI-U-114	LIST OF CABINETS WITH - UNIT DDCMIS		C&I	AA
547	XXXX-001-405-PVI-U-115	LIST OF CABINETS WITH - SAC		C&I	AA
548	XXXX-001-405-PVI-U-116	LIST OF CABINETS WITH - AHP		C&I	AA
549	XXXX-001-405-PVI-U-117	LIST OF CABINETS WITH -CHP		C&I	AA
550	XXXX-001-405-PVI-U-119	FUNCTIONAL GROUPING OF CONTROLLERS - WS (PT/RO)		C&I	AA
551	XXXX-001-405-PVI-U-120	FUNCTIONAL GROUPING OF CONTROLLERS - UNIT		C&I	AA
552	XXXX-001-405-PVI-U-121	FUNCTIONAL GROUPING OF CONTROLLERS - SAC		C&I	AA
553	XXXX-001-405-PVI-U-122	FUNCTIONAL GROUPING OF CONTROLLERS - AHP		C&I	AA
554	XXXX-001-405-PVI-U-123	FUNCTIONAL GROUPING OF CONTROLLERS - CHP		C&I	AA
555	XXXX-001-405-PVI-U-186	TYPE TEST REPORT FOR DDCMIS		C&I	AA
556	XXXX-001-405-PVI-U-290	LIST OF CABINETS FOR FGD SYSTEM		C&I	AA
557	XXXX-001-405-PVI-U-291	FUNCTIONAL GROUPING OF CONTROLLERS -FGD		C&I	AA
558	XXXX-001-405-PVI-U-293	UPS, FEEDER LIST, LOAD & BATTERY SIZING CALCULATION FOR UPS SYSTEM(UNIT)		C&I	A

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
559	XXXX-001-405-PVI-U-294	UPS, FEEDER LIST, LOAD & BATTERY SIZING CALCULATION FOR UPS SYSTEM(WS)		C&I	AA
560	XXXX-001-405-PVI-U-295	UPS, FEEDER LIST, LOAD & BATTERY SIZING CALCULATION FOR UPS SYSTEM(CHP)		C&I	AA
561	XXXX-001-405-PVI-U-296	UPS, FEEDER LIST, LOAD & BATTERY SIZING CALCULATION FOR UPS SYSTEM(AHP)		C&I	AA
562	XXXX-001-405-PVI-U-297	TYPE TESTS REPORT FOR THERMOCOUPLE COMPENSATING CABLES		C&I	AA
563	XXXX-001-405-PVI-U-298	TYPE TESTS REPORT FOR OXYGEN ANALYSER(Low) temp		C&I	AA
564	XXXX-001-405-PVI-U-299	TYPE TEST REPORT FOR 24VDC CHARGER (UNIT)		C&I	AA
565	XXXX-001-405-PVI-U-300	TYPE TEST REPORT FOR 24VDC CHARGER (Offsite)		C&I	AA
566	XXXX-001-405-PVI-U-301	TYPE TEST REPORTS FOR BATTERY FOR 24V DC PS SYSTEM (UNIT)		C&I	AA
567	XXXX-001-405-PVI-U-302	TYPE TEST REPORTS FOR BATTERY FOR 24V DC PS SYSTEM (Offsite)		C&I	AA
568	XXXX-001-405-PVI-U-303	TYPE TESTS REPORT for UPS system (UNIT)		C&I	AA
569	XXXX-001-405-PVI-U-304	TYPE TESTS REPORT for UPS system (Offsite)		C&I	AA
570	XXXX-001-405-PVI-U-305	TYPE TESTS REPORT for UPS BATTERIES (UNIT)		C&I	AA
571	XXXX-001-405-PVI-U-306	TYPE TESTS REPORT for UPS BATTERIES (Offsite)		C&I	AA
572	XXXX-001-405-PVI-U-307	TYPE TESTS REPORT for MASTER SLAVE CLOCK SYSTEM		C&I	AA
573	XXXX-001-405-PVI-U-308	Charger, FEEDER LIST, LOAD & BATTERY SIZING CALCULATION FOR 24V DC CHARGER SYSTEM (UNIT)		C&I	A
574	XXXX-001-405-PVI-U-309	Charger, FEEDER LIST, LOAD & BATTERY SIZING CALCULATION FOR 24V DC CHARGER SYSTEM (WS)		C&I	AA
575	XXXX-001-405-PVI-U-311	Charger, FEEDER LIST, LOAD & BATTERY SIZING CALCULATION FOR 24V DC CHARGER SYSTEM (AHP)		C&I	AA
576	XXXX-001-405-PVI-U-312	Charger, FEEDER LIST, LOAD & BATTERY SIZING CALCULATION FOR 24V DC CHARGER SYSTEM (CHP)		C&I	AA
577	XXXX-001-405-PVI-U-313	Charger, FEEDER LIST, LOAD & BATTERY SIZING CALCULATION FOR 24V DC CHARGER SYSTEM (SAC)		C&I	AA
578	XXXX-001-405-PVI-U-314	Charger, FEEDER LIST, LOAD & BATTERY SIZING CALCULATION FOR 24V DC CHARGER SYSTEM (FGD)		C&I	AA
579	XXXX-001-405-PVI-W-002	TEST PROCEDURES FOR PA SYSTEM		C&I	AA
580	XXXX-001-405-PVI-W-003	BLOCK DIAGRAM & HANDSETS LOCATION FOR PA SYSTEM		C&I	A
581	XXXX-001-405-PVI-W-004	TYPE TEST REPORTS FOR PA SYSTEM		C&I	AA
582	XXXX-001-405-PVI-X-001	PA SYSTEM O&M MANUAL		C&I	AA
583	XXXX-001-405-PVI-Y-153	Data Sheet of PA System Cables		C&I	AA
584	XXXX-001-405-PVI-Y-196	DATA SHEET AND BOQ FOR PRESSURE AND DIFFERENTIAL PRESSURE GAUGES		C&I	AA
585	XXXX-001-405-PVI-Y-317	DATASHEET OF FIBER OPTIC CABLE		C&I	AA
586	XXXX-001-405-PVI-Y-318	DATA SHEET FOR MINI UPS FOR HMIPIs		C&I	AA
587	XXXX-001-405-PVI-Y-319	DATA SHEET FOR GRAPHICAL INTERFACE UNIT		C&I	AA
588	XXXX-001-405-PVI-Y-320	DATASHEET FOR COMPUTER FURNITURE FOR HMIPIs EQUIPMENT		C&I	AA
589	XXXX-001-405-PVI-Y-321	DATASHEET FOR CONTROL DESK, SERVER RACK, PC RACK & WS FURNITURE FOR HMIPIs EQUIPMENT		C&I	AA
590	XXXX-001-405-PVI-Y-322	DATA SHEET FOR LVS and ACCESSORIES		C&I	AA
591	XXXX-001-405-PVI-Y-323	DATA SHEET and BOM for Wireless Equipment		C&I	AA
592	XXXX-001-405-PVI-Y-328	DATA SHEET, DRAWINGS & BOM FOR 24VDC CHARGER & DCDB - UNIT		C&I	AA
593	XXXX-001-405-PVI-Y-329	DATA SHEET, DRAWINGS & BOM FOR 24VDC CHARGER & DCDB - CHP		C&I	AA
594	XXXX-001-405-PVI-Y-330	DATA SHEET, DRAWINGS & BOM FOR 24VDC CHARGER & DCDB - AHP		C&I	AA
595	XXXX-001-405-PVI-Y-331	DATA SHEET, DRAWINGS & BOM FOR 24VDC CHARGER & DCDB - SAC		C&I	AA
596	XXXX-001-405-PVI-Y-332	DATA SHEET, DRAWINGS & BOM FOR 24VDC CHARGER & DCDB - WS		C&I	AA
597	XXXX-001-405-PVI-Y-334	DATA SHEET, DRAWINGS & BOM FOR 24VDC CHARGER & DCDB - FGD		C&I	AA
598	XXXX-001-405-PVI-Y-335	DATA SHEET OF UPS SYSTEM(UNIT)		C&I	AA
599	XXXX-001-405-PVI-Y-336	DATA SHEET OF UPS SYSTEM(WS)		C&I	AA
600	XXXX-001-405-PVI-Y-337	DATA SHEET OF UPS SYSTEM(CHP)		C&I	AA
601	XXXX-001-405-PVI-Y-338	DATA SHEET OF UPS SYSTEM(AHP)		C&I	AA
602	XXXX-001-405-PVI-Y-339	DATA SHEET FOR NI CD BATTERY OF UPS(UNIT)		C&I	AA
603	XXXX-001-405-PVI-Y-340	DATA SHEET FOR NI CD BATTERY OF UPS(WS)		C&I	AA
604	XXXX-001-405-PVI-Y-341	DATA SHEET FOR NI CD BATTERY OF UPS(CHP)		C&I	AA
605	XXXX-001-405-PVI-Y-342	DATA SHEET FOR NI CD BATTERY OF UPS(AHP)		C&I	AA
606	XXXX-001-405-PVI-Y-343	DATA SHEET FOR SWAS SYSTEM		C&I	AA
607	XXXX-001-405-PVI-Y-344	DATA SHEET FOR HART MANAGEMENT SYSTEM		C&I	AA
608	XXXX-001-405-PVI-Y-345	DATA SHEET FOR INSTRUMENTATION CABLE		C&I	AA
609	XXXX-001-405-PVI-Y-346	DATA SHEET FOR THERMOCOUPLE COMPENSATING CABLES		C&I	AA
610	XXXX-001-405-PVI-Y-347	DATA SHEET & TYPE TEST REPORTS FOR OXYGEN ANALYSER(HI TEMP)		C&I	AA
611	XXXX-001-405-PVI-Y-348	DATA SHEET FOR CEMS		C&I	AA
612	XXXX-001-405-PVI-Y-349	DATA SHEET FOR DUST (OPACITY) ANALYSER		C&I	AA
613	XXXX-001-405-PVI-Y-350	DATA SHEET FOR OXYGEN ANALYSER(LO TEMP)		C&I	AA
614	XXXX-001-405-PVI-Y-351	DATASHEET FOR GUIDED WAVE RADAR TYPE LEVEL TRANSMITTER		C&I	AA
615	XXXX-001-405-PVI-Y-352	DATASHEET FOR ELECTRONIC PR / DP TRANSMITTER		C&I	AA
616	XXXX-001-405-PVI-Y-354	DATASHEET FOR TEMPERATURE TRANSMITTER(DUAL INPUT)		C&I	AA
617	XXXX-001-405-PVI-Y-355	DATA SHEET FOR FRP JUNCTION BOX		C&I	AA
618	XXXX-001-405-PVI-Y-356	BOQ FOR IMPULSE PIPES & SAMPLE PIPES		C&I	AA
619	XXXX-001-405-PVI-Y-357	BOQ of SOCKET WELD FITTINGS, Condensate Pot, Valve Manifolds, Instrument Valves		C&I	AA
620	XXXX-001-405-PVI-Y-358	DATASHEET FOR COAL BUNKER LEVEL MONITORING SYSTEM		C&I	AA
621	XXXX-001-405-PVI-Y-359	DATA SHEET FOR LIE / LIR		C&I	AA
622	XXXX-001-405-PVI-Y-360	TYPE TESTS REPORT FOR INSTRUMENTATION CABLE		C&I	AA
623	XXXX-001-405-PVI-Y-361	TYPE TESTS REPORT FOR LIE / LIR		C&I	AA
624	XXXX-001-405-PVI-Y-382	DATASHEET FOR MERCURY ANALYSER		C&I	AA
625	XXXX-001-405-PVI-Y-383	DATASHEET FOR ULTRASONIC LEVEL TRANSMITTER		C&I	AA
626	XXXX-001-405-PVI-Y-384	DATASHEET FOR TEMPERATURE ELEMENTS		C&I	AA
627	XXXX-001-405-PVI-Y-386	DATASHEET FOR TEMPERATURE GAUGES		C&I	AA
628	XXXX-001-405-PVI-Y-387	INSTALLATION SCHEME FOR LOCAL INSTRUMENTS (Covering LIE / LIR, Hook up diagram etc.)		C&I	AA
629	XXXX-001-405-PVI-Y-388	DATASHEET FOR CONDUCTIVITY TYPE LEVEL SWITCH		C&I	AA
630	XXXX-001-405-PVI-Y-389	DATASHEET FOR CABLE TRAYS		C&I	AA
631	XXXX-001-405-PVI-Y-390	DATASHEET FOR CONDUITS		C&I	AA
632	XXXX-001-405-PVI-Y-392	DATA SHEET AND BOQ FOR LEVEL SWITCHES		C&I	AA
633	XXXX-001-405-PVM-X-327	O&M Manual for HMIPIs		C&I	AA
634	XXXX-001-162-PVE-H-005	INSTRUMENT SCHEDULE FOR AHP (EXCLUDING DBA)		C&I	AA

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 8 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
635	XXXX-001-162-PVE-H-006	INSTRUMENT SCHEDULE FOR DRY BOTTOM ASH SYSTEM		C&I	AA
636	XXXX-001-162-PVE-U-002	TYPICAL VOLTAGE DROP CALCULATION IN CONTROL CABLE FOR SOLENOIDS		C&I	AA
637	XXXX-001-162-PVE-Y-001	DATASHEET OF PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES FOR AHP		C&I	AA
638	XXXX-001-162-PVE-Y-002	DATASHEET OF SOLENOID VALVES FOR AHP		C&I	AA
639	XXXX-001-162-PVE-Y-003	DATASHEET OF 3D LEVEL MONITORING SYSTEM OF SILOS FOR AHP		C&I	AA
640	XXXX-001-162-PVE-Y-004	DATASHEET OF FIELD INSTRUMENTS OF DRY BOTTOM ASH SYSTEM		C&I	AA
641	XXXX-001-162-PVE-Y-005	DATASHEET OF CONTROL VALVE FOR AHP		C&I	AA
642	XXXX-001-162-PVE-Y-006	DATASHEET OF PRESSURE TRANSMITTERS , DIFFERENTIAL PRESSURE TRANSMITTER AND DIFFERENTIAL PRESSURE TYPE FLOW TRANSMITTER FOR AHP		C&I	AA
643	XXXX-001-162-PVE-Y-007	DATASHEET OF LEVEL TRANSMITTERS (RADAR TYPE) FOR AHP		C&I	AA
644	XXXX-001-162-PVE-Y-008	DATASHEET OF LEVEL TRANSMITTERS (ULTRASONIC TYPE) FOR AHP		C&I	AA
645	XXXX-001-162-PVE-Y-009	DATASHEET OF TEMPERATURE ELEMENTS FOR AHP		C&I	AA
646	XXXX-001-162-PVE-Y-010	DATASHEET OF DEW POINT METER FOR AHP		C&I	AA
647	XXXX-001-162-PVE-Y-011	DATASHEET OF LEVEL SWITCHES (RF Type) FOR AHP		C&I	AA
648	XXXX-001-162-PVE-Y-012	DATASHEET OF ROTAMETER FOR AHP		C&I	AA
649	XXXX-001-162-PVE-Y-013	DATASHEET OF PRESSURE GAUGES FOR AHP		C&I	AA
650	XXXX-001-162-PVE-Y-014	DATASHEET OF DIFFERENTIAL PRESSURE GAUGES FOR AHP		C&I	AA
651	XXXX-001-162-PVE-Y-015	DATASHEET OF TEMPERATURE GAUGES FOR AHP		C&I	AA
652	XXXX-001-162-PVE-Y-016	DATASHEET OF LEVEL GAUGES FOR AHP		C&I	AA
653	XXXX-001-162-PVE-Y-017	DATASHEET , GA OF TEMPERATURE TRANSMITTERS INCLUDING JUNCTION BOXES FOR AHP		C&I	AA
654	XXXX-001-162-PVE-Y-018	DATASHEET OF ORIFICE PLATE FOR AHP		C&I	AA
655	XXXX-001-162-PVI-G-001	PROCESS IO LIST FOR AHP (EXCLUDING DBA)		C&I	AA
656	XXXX-001-162-PVI-G-002	PROCESS IO LIST FOR DBA		C&I	AA
657	XXXX-001-162-PVI-G-006	TYPICAL CABLING PHILOSOPHY SHOWING INTERCONNECTION FOR EACH TYPE OF DRIVE AND INSTRUMENTS.		C&I	AA
658	XXXX-001-162-PVI-G-007	LIST OF ACTUATIONS AND INDICATIONS FOR SILO UNLOADING PANEL (DRY+WET) FOR AHP		C&I	AA
659	XXXX-001-162-PVI-Q-001	INSTRUMENTS HOOK-UP DRAWINGS		C&I	AA
660	XXXX-001-162-PVI-T-001	Block Logic Drawing And Recommended HMI Graphics For 1st Stage Pressure System		C&I	AA
661	XXXX-001-162-PVI-T-002	Block Logic Drawing And Recommended HMI Graphics For ECO Hopper to BA IM Silo Pressure System		C&I	AA
662	XXXX-001-162-PVI-T-003	Block Logic Drawing And Recommended HMI Graphics For APH, Duct & SCR Pressure System		C&I	AA
663	XXXX-001-162-PVI-T-004	Block Logic Drawing And Recommended HMI Graphics For Intermediate Surge Hopper Pressure System		C&I	AA
664	XXXX-001-162-PVI-T-005	Block Logic Drawing And Recommended HMI Graphics For 2nd Stage Pressure System		C&I	AA
665	XXXX-001-162-PVI-V-001	HMI DETAILS (GRAPHICS,LOG,REPORT,ALARM ETC) INPUT FOR AHP		C&I	AA
666		Wiring schematics & hook-up diagram of INSTRUMENTS.		C&I	AA
667		GA & Datasheet of Pressure Transmitter		C&I	AA
668		GA & Datasheet of DP Transmitter		C&I	AA
669		GA & Datasheet of RRI		C&I	AA
670		GA & Datasheet of Level Gauge/ indicator		C&I	AA
671		GA & Datasheet of Ultrasonic Flowmeter		C&I	AA
672		GA & Datasheet of flow switch		C&I	AA
673		GA & Datasheet of sight flow indicator		C&I	AA
674		GA & Datasheet of Ultrasonic Level Transmitter		C&I	AA
675		Data Sheet of Instrumentation Cable		C&I	AA
676		GA & Datasheet of RTD and Temperature Transmitter		C&I	AA
677		GA and Data sheet of Solenoid valves		C&I	AA
678		Wiring Diagram and GAD of EH actuator local control panel		C&I	AA
679		List of instruments including range, set point etc. giving their location and interlock covered in the circuit		C&I	AA
680		GA & Datasheet of field JB		C&I	AA
681		GA & Schematic diagram of Power Distribution Board for Instrumentation		C&I	AA
682		Interconnection diagram from field instruments to local junction boxes		C&I	AA
683	XXXX-001-405-PVI-G-126A	I/O & DRIVE LIST- WS (DM/PT)		C&I	AA
684	XXXX-001-405-PVI-G-126A	I/O & DRIVE LIST- SAC		C&I	AA
685	XXXX-001-162-PVI-G-127A	I/O & DRIVE LIST - AHP		C&I	AA
686	XXXX-001-155-PVI-G-128A	I/O & DRIVE LIST- CHP		C&I	AA
687	XXXX-001-405-PVI-G-230A	I/O & DRIVE LIST- FGD SYSTEM		C&I	AA
688	XXXX-001-136-PVI-B-001	GA OF JUNCTION BOX - DM/PT		C&I	AA
689	XXXX-001-136-PVI-B-004	GA OF LOCAL CONTROL PANEL		C&I	AA
690	XXXX-001-136-PVI-B-007	Datasheet for Radar type level transmitter		C&I	AA
691	XXXX-001-136-PVI-G-001A	LIST OF ALARMS AND SET POINTS - CHLORINATION SYS		C&I	AA
692	XXXX-001-136-PVI-G-003A	CABLE SCHEDULE (C&I) [BRANCH CABLE]		C&I	AA
693	XXXX-001-136-PVI-G-004A	DRIVE LIST - CHLORINATION SYSTEM		C&I	AA
694	XXXX-001-136-PVI-G-005A	INSTRUMENT SCHEDULE		C&I	AA
695	XXXX-001-136-PVI-G-010	LIST OF ALARM FOR PT-DM PLANT AREA		C&I	AA
696	XXXX-001-136-PVI-G-012	I/O LIST - CHLORINATION SYSTEM		C&I	AA
697	XXXX-001-136-PVI-G-014	I/O List for Chemical Treatment Plant		C&I	AA
698	XXXX-001-136-PVI-G-015	Drive List for Chemical Treatment Plant		C&I	AA
699	XXXX-001-136-PVI-H-014	INTERCONNECTION DIAGRAM - DM/PT [FIELD TO JB/LCP]		C&I	AA
700	XXXX-001-136-PVI-H-016	INSTRUMENT SCHEDULE - DM/PT		C&I	AA
701	XXXX-001-136-PVI-H-017	INTERCONNECTION DIAGRAM		C&I	AA
702	XXXX-001-136-PVI-H-018	INSTRUMENT SCHEDULE - CHLORINATION SYSTEM		C&I	AA
703	XXXX-001-136-PVI-H-019	IO ICS - CHLORINATION SYSTEM		C&I	AA
704	XXXX-001-136-PVI-H-020	DRIVE ICS - CHLORINATION SYSTEM		C&I	AA
705	XXXX-001-136-PVI-Q-019	INSTRUMENTS HOOK UP DRAWINGS (PT-DM PLANT AREA)		C&I	AA
706	XXXX-001-136-PVI-Q-020	INSTRUMENTS HOOK UP DRAWINGS - CHLORINATION SYSTEM		C&I	AA
707	XXXX-001-136-PVI-W-007A	TYPE TEST REPORTS OF TRANSMITTERS, INST CABLES & CONTROL CABLES		C&I	AA
708	XXXX-001-136-PVI-W-024	TYPE TEST REPORT OF JUNCTION BOX (DEGREE OF PROTECTION)		C&I	AA
709	XXXX-001-136-PVI-W-143	INSTRUMENT SCHEDULE OF CW CHEMICAL DOSING SYSTEM		C&I	AA
710	XXXX-001-136-PVI-Y-008A	DATA SHEET FOR PT & DPT TRANSMITTERS for PT and DM plant		C&I	AA
711	XXXX-001-136-PVI-Y-009A	DATA SHEET FOR ULTRASONIC TYPE LEVEL TRANSMITTERS		C&I	AA
712	XXXX-001-136-PVI-Y-011A	DATA SHEET FOR TEMP.TRANSMITTER FOR DM PLANT AREA		C&I	AA
713	XXXX-001-136-PVI-Y-012A	DATA SHEET FOR PH ANALYSER		C&I	AA
714	XXXX-001-136-PVI-Y-013A	DATA SHEET FOR CONCENTRATION ANALYSER		C&I	AA

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 9 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
715	XXXX-001-136-PVI-Y-014A	DATA SHEET FOR CONDUCTIVITY ANALYSER		C&I	AA
716	XXXX-001-136-PVI-Y-015A	DATA SHEET FOR SILICA ANALYSER		C&I	AA
717	XXXX-001-136-PVI-Y-016A	DATA SHEET FOR SODIUM ANALYSER		C&I	AA
718	XXXX-001-136-PVI-Y-017A	DATA SHEET FOR BIO FOULING MONITOR		C&I	AA
719	XXXX-001-136-PVI-Y-018A	DATA SHEET OF INSTANT CORROSION RATE MONITOR		C&I	AA
720	XXXX-001-136-PVI-Y-020A	DATA SHEET OF PORTABLE ORP MONITOR		C&I	AA
721	XXXX-001-136-PVI-Y-021A	DATA SHEET OF SOLENOID VALVES		C&I	AA
722	XXXX-001-136-PVI-Y-022A	DATA SHEET FOR CONTROL VALVES, ACTUATORS AND ACCESSORIES		C&I	AA
723	XXXX-001-136-PVI-Y-023A	DATA SHEET OF INSTRUMENT & CONTROL CABLES		C&I	AA
724	XXXX-001-136-PVI-Y-026	DATA SHEET FOR PRESSURE TRANSMITTER		C&I	AA
725	XXXX-001-136-PVI-Y-031	DATA SHEET FOR TEMPERATURE TRANSMITTER		C&I	AA
726	XXXX-001-136-PVI-Y-033	DATA SHEET FOR PRESSURE /DIFFERENTIAL PR SWITCH		C&I	AA
727	XXXX-001-136-PVI-Y-037	DATA SHEET FOR TURBIDITY ANALYSER		C&I	AA
728	XXXX-001-136-PVI-Y-042	Diagram and Cable Schedule for PT & CW Chlorination Area		C&I	AA
729	XXXX-001-136-PVI-Y-051	Datasheet of Pressure Indicator & Differential Pressure Indicator		C&I	AA
730	XXXX-001-136-PVI-Y-052	Datasheet of Temperature Indicator		C&I	AA
731	XXXX-001-136-PVI-Y-054	Datasheet of Flow Indicator		C&I	AA
732	XXXX-001-136-PVI-Y-055	Datasheet of Level Indicator		C&I	AA
733	XXXX-001-136-PVI-Y-056	LOGIC DIAGRAM FOR DM		C&I	AA
734	XXXX-001-136-PVI-Y-056A	LOGIC DIAGRAM FOR PT Plant		C&I	AA
735	XXXX-001-136-PVI-Y-058	Datasheet of Pressure Switch & Level Switch		C&I	AA
736	XXXX-001-136-PVI-Y-059	Data Sheet for Local Gauges (Pressure Indicator/Differential Pressure Indicator/temperature Indicator/vacuum gauge/Level Indicator)		C&I	AA
737	XXXX-001-136-PVI-Y-060	DATA SHEET OF FLOW TRANSMITTERS		C&I	AA
738	XXXX-001-136-PVI-Y-061	DATA SHEET OF CHLORINE ANALYSERS		C&I	AA
739	XXXX-001-136-PVI-Y-061B	GA & Datasheet of Pressure Gauge		C&I	AA
740	XXXX-001-136-PVI-Y-447	Data Sheet for FIELD INSTRUMENTS		C&I	AA
741	XXXX-001-155-PVI-B-796	BLOCK LOGIC DIAGRAM TYPICAL FOR HT CONVEYOR		C&I	AA
742	XXXX-001-155-PVI-B-863	GA, I/O & WIRING DIAGRAM OF S/R PLC PANEL		C&I	AA
743	XXXX-001-155-PVI-B-886	ELECTRICAL CONTROL PANEL, MOTOR, VALVES, FIELD INSTRUMENT, DRAWING OF DFDS, DS/SW/PW/CW/SPDS/WTDS SUPPRESSION SYSTEM.		C&I	AA
744	XXXX-001-155-PVI-B-896	GA DRAWINGS, CONFIGURATION, DATASHEET FOR WIRELESS COMMUNICATION SYSTEM WITH RADIO MODEMS FOR STACKER RECLAIMER & RECLAIMER		C&I	AA
745	XXXX-001-155-PVI-B-910	DATASHEET, GA, BOM & WIRING DIAGRAM OF UPS WITH BATTERY FOR MAIN CHP & WAGON TIPPLER SYSTEM		C&I	AA
746	XXXX-001-155-PVI-B-911	GA & DATA SHEET OF CHUTE BLOCK SWITCH FOR CHP		C&I	AA
747	XXXX-001-155-PVI-B-918	DATASHEET, GA & BOM FOR INSTRUMENTS (DE SYSTEM)		C&I	AA
748	XXXX-001-155-PVI-C-856	GA, BOM & SCHEME, DATASHEET AND WIRING DIAGRAM OF WT PLC PANEL		C&I	AA
749	XXXX-001-155-PVI-H-748	CONTROL CABLE SCHEDULE (CHP)		C&I	AA
750	XXXX-001-155-PVI-H-793	CABLE INTERCONNECTION SCHEDULE OF STACKER RECLAIMER		C&I	AA
751	XXXX-001-155-PVI-H-794	ICS (Cable interconnection schedule) for drives I/O of CHP		C&I	AA
752	XXXX-001-155-PVI-H-795	ICS (Cable interconnection schedule) for Process I/O of CHP		C&I	AA
753	XXXX-001-155-PVI-L-980	SCHEMATIC DIAGRAM OF FDA SYSTEM FOR STACKER RECLAIMER		C&I	AA
754	XXXX-001-155-PVI-P-721	Data Sheet of field instruments		C&I	AA
755	XXXX-001-155-PVI-Q-774	PLC SYSTEM ARCHITECTURE FOR STACKER RECLAIMER		C&I	AA
756	XXXX-001-155-PVI-Q-774A	IO LIST FOR STACKER RECLAIMER		C&I	AA
757	XXXX-001-155-PVI-Q-889	INSTRUMENT GA & DATA SHEET FOR RING GRANULATOR		C&I	AA
758	XXXX-001-155-PVI-Q-978	SIGNAL INTERFACE PHILOSOPHY FOR S/R & PF.		C&I	AA
759	XXXX-001-155-PVI-Q-978A	FIELD DEVICE LIST FOR S/R & PF.		C&I	AA
760	XXXX-001-155-PVI-T-720	Cable Block diagram FOR CHP		C&I	AA
761	XXXX-001-155-PVI-T-797	BLOCK LOGIC DIAGRAM TYPICAL FOR LT CONVEYOR		C&I	AA
762	XXXX-001-155-PVI-T-798	BLOCK LOGIC DIAGRAM TYPICAL FOR CRUSHER		C&I	AA
763	XXXX-001-155-PVI-T-799	BLOCK LOGIC DIAGRAM TYPICAL FLAP GATE/ RPS/VSF		C&I	AA
764	XXXX-001-155-PVI-T-800	BLOCK LOGIC DIAGRAM TYPICAL FOR ILMS/SM/MD		C&I	AA
765	XXXX-001-155-PVI-T-801	BLOCK LOGIC DIAGRAM TYPICAL FOR CSU		C&I	AA
766	XXXX-001-155-PVI-T-802	BLOCK LOGIC DIAGRAM TYPICAL FOR MISC. EQUIPMENT OF CHP		C&I	AA
767	XXXX-001-155-PVI-T-803	BLOCK LOGIC DIAGRAM SEQUENCE OF CHP		C&I	AA
768	XXXX-001-155-PVI-T-901	PLC logic diagram & HMI screens for Stacker Reclaimer & Reclaimer		C&I	AA
769	XXXX-001-155-PVI-T-902	PLC logic diagram & HMI screens for Wagon Tippler & SAC		C&I	AA
770	XXXX-001-155-PVI-W-933	TYPE TEST REPORTS OF STACKER-RECLAIMER PLC		C&I	AA
771	XXXX-001-155-PVI-W-981	TYPE TEST REPORTS OF WAGON TIPPLER PLC FOR CHP		C&I	AA
772	XXXX-001-155-PVI-W-982	FAT PROCEDURE FOR WAGON TIPPLER PLC		C&I	AA
773	XXXX-001-155-PVI-X-805	FAT PROCEDURE FOR STACKER-RECLAIMER PLC		C&I	AA
774	XXXX-001-155-PVI-Y-916	DATA SHEET OF 3-D STOCKPILE VOLUME MEASUREMENT DEVICE.		C&I	AA
775	XXXX-001-155-PVI-Y-917	Data Sheet of TT Junction Box		C&I	AA
776	XXXX-001-155-PVI-Y-919	IO List of Wagon Tippler PLC		C&I	AA
777	XXXX-001-155-PVI-Y-920	PLC System Architecture Configuration & IO List for Coal Sampling System		C&I	AA
778	XXXX-001-155-PVI-Y-921	Data Sheet of field instruments for DFDS, DS/SW/PW/CW/SPDS/WTDS SUPPRESSION SYSTEM		C&I	AA
779	XXXX-001-155-PVI-Y-922	PLC System Architecture Configuration for Wagon Tippler		C&I	AA
780	XXXX-001-405-PVI-P-286	Cyber Security policy and procedure		C&I	A
781	XXXX-001-405-PVI-L-280	System Configuration of DDCMIS-FGD		C&I	A
782	XXXX-001-405-PVI-P-287	Scope variations of C&I system- DDCMIS		C&I	A
783	XXXX-001-405-PVI-P-288	Scope variations of C&I system- Non DDCMIS		C&I	A
784	XXXX-001-405-PVI-J-261	ATST report of FPS PLC		C&I	AA
785	XXXX-001-405-PVI-F-004	Write up and Configuration of SWAS system		C&I	A
786	XXXX-001-405-PVI-L-276	Write up and Configuration of CEMS System		C&I	A
787	XXXX-001-405-PVI-L-277	Write up and Configuration of AAQMS System		C&I	A
788	XXXX-001-405-PVI-L-278	Write up and Configuration of CCTV System		C&I	A
789	XXXX-405-PVI-01	FDS of APC (Advance process control)		C&I	A
790	XXXX-404-PVI-G-12	APC Site Acceptance test (SAT) Procedure		C&I	A
791	XXXX-404-PVI-15	Write up of SPMS (Smart Project management system)		C&I	A
792	XXXX-404-PVI-16	BOM of SPMS (Smart project management system)		C&I	AA
793	XXXX-001-405-PVI-B-199A	GA/IA, Network scheme and Power distribution scheme for HMI/PIIS- Water System		C&I	AA
794	XXXX-001-405-PVI-B-214A	DATA SHEET, DRG FOR BATTERY FOR 24V DC PS SYSTEM - MAKEUP		C&I	AA
795	XXXX-001-405-PVI-U-119A	FUNCTIONAL GROUPING OF CONTROLLERS - MAKEUP (PT/RO)		C&I	AA
796		BOM of Material & Services for Asset Management		C&I	A
797		FDS for Asset Management		C&I	A
798		Writeup on Integrated online project monitoring software (IOPMS)		C&I	AA
799		Writeup on Smart Project management system (SPMS)		C&I	AA
800		Unit control logics including Coordinated Master Control (CMC)		C&I	A

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 10 OF 66

Si No	NTPC Drg No	DRG_TITLE	SUB-SYSTEM	Dept	CATEGORY
801		Air flow & Furnace Draft control logic		C&I	A
802		Feed Water Flow control logic		C&I	A
803		Fuel Flow control logic		C&I	A
804		Main Steam Temperature control logic		C&I	A
805		Reheat Steam Temperature control logic		C&I	A
806		RGMO logic		C&I	A
807		AGC (Automatic Generation Control) logic		C&I	A
808		PG TEST PROCEDURE Control & Instrumentation System		C&I	A
809		O&M Manual for DDCMIS		C&I	A
810		O&M Manual for Station Lan and related Components		C&I	A
811		O&M Manual for Vibration Monitoring System		C&I	AA
812		O&M Manual for CCTV system		C&I	AA
813		O&M Manual for SWAS		C&I	AA
814		O&M Manual for Process Conneciton Piping		C&I	AA
815		O&M Manual for Measuring Instruemnts		C&I	AA
816		O&M Manual for SG RELATED C&I SYSTEMS		C&I	AA
817		O&M Manual for TG RELATED C&I SYSTEMS		C&I	AA
818		O&M Manual for Power Supply System		C&I	AA
819		O&M Manual for PADO		C&I	AA
820		O&M Manual for AAQMS / EQMS / CEMS		C&I	AA
821		O&M Manual for Simulator		C&I	AA
822		O&M Manual for Control Desks		C&I	AA
823		O&M Manual for Control Valve Actuators		C&I	AA
824		O&M Manual for Instrumentation and Special Cables		C&I	AA
825	0000-301C-POC-F-001	General Layout of Plant		Civil	A
826	0000-301C-POC-C-101	Site Levelling Works - Plan & Sections		Civil	A
827	0000-301C-POC-C-107	Layout of Roads		Civil	A
828	0000-301C-POC-C-108	Cross Section Details of Roads		Civil	AA
829	0000-301C-POC-C-111	Layout of Drains		Civil	A
830	0000-301C-POC-C-112	Cross Section Details of Drains		Civil	AA
831	0000-301C-POC-U-107	Design Calculation for Road		Civil	AA
832	0000-301C-POC-U-107	Limestone Slurry Tank foundation - Design document		Civil	AA
833	0000-301C-POC-U-107	Limestone Slurry Tank foundation Details		Civil	AA
834	0000-301C-POC-U-107	Geotechnical Investigation Scheme		Civil	A
835	0000-301C-POC-U-107	Geotechnical Investigation Report and Recommendations		Civil	A
836	0000-301C-POC-C-113	Layout of Culverts		Civil	A
837	0000-301C-POC-C-114	Details of Culverts		Civil	A
838	0000-301C-POC-C-117	Layout of Sewerage System		Civil	A
839	0000-301C-POC-C-118	Details of Sewerage System		Civil	A
840	0000-301C-POC-U-111	Design Calculation for Drain		Civil	A
841	0000-301C-POC-U-114	Design Calculation for Culvert		Civil	A
842	0000-301C-POC-U-115	Design Calculation for-Boundary wall		Civil	A
843	0000-XYZ-POG-C-0788	Boundary wall Layout		Civil	A
844	0000-XYZ-POG-C-0789	Boundary wall Details		Civil	AA
845	9578-001-301C-PGC-C-135	Sewage Treatment Plant - Layout and RC detail Equalisation Tank, Oil& Grease Chamber etc		Civil	AA
846	9578-001-301C-PGC-C-136	Sewage Treatment Plant - RC Details of Treated Water Tank		Civil	AA
847	9578-001-301C-PGC-C-137	Sewage Treatment Plant - Layout and RC Details Secondary Clarifier, Filter feed tank and Chlorine dosing tank		Civil	AA
848	9578-001-301C-PGC-C-138	Sewage Treatment Plant - Layout and RC Details of Aeration tank		Civil	AA
849	9578-001-301C-PGC-C-139	Sewage Treatment Plant - Layout and RC Details Sludge Drying bed		Civil	A
850	9578-001-301C-PGC-W-143	Design criteria document for Water Treatment System		Civil	A
851	9578-001-301C-PGC-W-144	Design criteria document for Sewage Treatment System		Civil	A
852	9578-001-301C-PGC-W-144	Design criteria document for Sewage Treatment System		Civil	A
853	XXXX-001-110-BP-PVE-B-091	OGA Drawing of Generator, GT and UT Protection Panel	TG Pkg_Elect	Electrical	A
854	XXXX-001-110-BP-PVE-B-093	OGA of 400KV Switchyard (GIS) Control and Protection (BCU/BPU) Panels	TG Pkg_Elect	Electrical	A
855	XXXX-001-110-BP-PVE-B-094	OGA of 400KV side Energy Metering Panels	TG Pkg_Elect	Electrical	A
856	XXXX-001-110-BP-PVE-B-095	Control and Protection Scheme for 400 kV side GT-Tie-ST	TG Pkg_Elect	Electrical	A
857	XXXX-001-110-BP-PVE-B-114	Vendor List of BOI for Control and Protection Panels (GRP & CRP)	TG Pkg_Elect	Electrical	AA
858	XXXX-001-110-BP-PVE-B-115	CEP Motor - Outline & General Arrangement	TG Pkg_Elect	Electrical	AA
859	XXXX-001-110-BP-PVE-B-121	BFP Motor - Outline & General Arrangement	TG Pkg_Elect	Electrical	AA
860	XXXX-001-110-BP-PVE-B-128	ACW Motor - Outline & General Arrangement	TG Pkg_Elect	Electrical	AA
861	XXXX-001-110-BP-PVE-B-134	DMCW-TG Motor - Outline & General Arrangement	TG Pkg_Elect	Electrical	AA
862	XXXX-001-110-BP-PVE-B-140	Drip Pump Motor -Outline & General Arrangement	TG Pkg_Elect	Electrical	AA
863	XXXX-001-110-BP-PVE-B-152	GT : Outline General Arrangement	TG Pkg_Elect	Electrical	AA
864	XXXX-001-110-BP-PVE-B-153	GT : OGA and Part List	TG Pkg_Elect	Electrical	A
865	XXXX-001-110-BP-PVE-B-163	GA of Cooler Control Cabinet	TG Pkg_Elect	Electrical	AA
866	XXXX-001-110-BP-PVE-B-168	Vendor list for Generator Transformer	TG Pkg_Elect	Electrical	AA
867	XXXX-001-110-BP-PVE-B-172	HV terminal Connector	TG Pkg_Elect	Electrical	AA
868	XXXX-001-110-BP-PVE-B-175	420 KV SHUNT REACTOR- OUTLINE GENERAL ARRANGEMENT	TG Pkg_Elect	Electrical	AA
869	XXXX-001-110-BP-PVE-B-188	420 KV SHUNT REACTOR-GA OF COOLER CONTROL CABINET	TG Pkg_Elect	Electrical	AA
870	XXXX-001-110-BP-PVE-B-189	ST-OUTLINE GENERAL ARRANGEMENT	TG Pkg_Elect	Electrical	AA
871	XXXX-001-110-BP-PVE-B-203	ST-G A.OF COOLER CONTROL CABINET	TG Pkg_Elect	Electrical	AA
872	XXXX-001-110-BP-PVE-B-251	NGR- OUTLINE GENERAL ARRANGEMENT	TG Pkg_Elect	Electrical	AA
873	XXXX-001-110-BP-PVE-B-253	NGR- GA OF COOLER CONTROL CABINET	TG Pkg_Elect	Electrical	AA
874	XXXX-001-110-BP-PVE-F-034	11KV-Layout , Floor Plan & Key Diagram for Unit SWBD-1UA	TG Pkg_Elect	Electrical	AA
875	XXXX-001-110-BP-PVE-F-035	11KV-Layout , Floor Plan & Key Diagram for Unit SWBD-1UB	TG Pkg_Elect	Electrical	AA
876	XXXX-001-110-BP-PVE-F-036	11KV-Layout , Floor Plan & Key Diagram for Unit SWBD-2UA	TG Pkg_Elect	Electrical	AA
877	XXXX-001-110-BP-PVE-F-037	11KV-Layout , Floor Plan & Key Diagram for Unit SWBD-2UB	TG Pkg_Elect	Electrical	AA
878	XXXX-001-110-BP-PVE-F-038	11KV-Layout , Floor Plan & Key Diagram for Station SWBD-1SA	TG Pkg_Elect	Electrical	AA
879	XXXX-001-110-BP-PVE-F-039	11KV-Layout , Floor Plan & Key Diagram for Station SWBD-1SB	TG Pkg_Elect	Electrical	AA
880	XXXX-001-110-BP-PVE-F-040	11KV-Layout , Floor Plan & Key Diagram for Station SWBD-2SA	TG Pkg_Elect	Electrical	AA
881	XXXX-001-110-BP-PVE-F-041	11KV-Layout , Floor Plan & Key Diagram for Station SWBD-2SB	TG Pkg_Elect	Electrical	AA
882	XXXX-001-110-BP-PVE-F-042	11 KV-Layout , Floor Plan & Key Diagram for AHP SWBD	TG Pkg_Elect	Electrical	AA
883	XXXX-001-110-BP-PVE-F-043	11 KV-Layout , Floor Plan & Key Diagram for CHP SWBD	TG Pkg_Elect	Electrical	AA
884	XXXX-001-110-BP-PVE-F-044	11 KV-Layout , Floor Plan & Key Diagram for WTP SWBD	TG Pkg_Elect	Electrical	AA
885	XXXX-001-110-BP-PVE-F-045	11 KV-Layout , Floor Plan & Key Diagram for FGD SWBD	TG Pkg_Elect	Electrical	AA
886	XXXX-001-110-BP-PVE-F-046	11 KV-Layout , Floor Plan & Key Diagram for Station FGD SWBD	TG Pkg_Elect	Electrical	AA
887	XXXX-001-110-BP-PVE-F-047	11 KV-Layout , Floor Plan & Key Diagram for Misc SWBD	TG Pkg_Elect	Electrical	AA
888	XXXX-001-110-BP-PVE-F-048	11 KV-Layout , Floor Plan & Key Diagram for Standalone Panels	TG Pkg_Elect	Electrical	AA
889	XXXX-001-110-BP-PVE-F-049	3.3 KV-Layout , Floor Plan & Key Diagram for Unit Aux. SWBD-1	TG Pkg_Elect	Electrical	AA
890	XXXX-001-110-BP-PVE-F-050	3.3 KV-Layout , Floor Plan & Key Diagram for Unit Aux. SWBD-2	TG Pkg_Elect	Electrical	AA
891	XXXX-001-110-BP-PVE-F-051	3.3 KV-Layout , Floor Plan & Key Diagram for AHP SWBD	TG Pkg_Elect	Electrical	AA
892	XXXX-001-110-BP-PVE-F-052	3.3 KV-Layout , Floor Plan & Key Diagram for CHP SWBD	TG Pkg_Elect	Electrical	AA
893	XXXX-001-110-BP-PVE-F-053	3.3 KV-Layout , Floor Plan & Key Diagram for FGD SWBD	TG Pkg_Elect	Electrical	AA

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 11 OF 66

Si No	NTPC Drg No	DRG_TITLE	SUB-SYSTEM	Dept	CATEGORY
894	XXXX-001-110-BP-PVE-F-054	3.3 KV-Layout , Floor Plan & Key Diagram for WTP SWBD	TG Pkg Elect	Electrical	AA
895	XXXX-001-110-BP-PVE-F-164	GT : Foundation Plan	TG Pkg Elect	Electrical	AA
896	XXXX-001-110-BP-PVE-F-171	Combined foundation Plan-GT	TG Pkg Elect	Electrical	AA
897	XXXX-001-110-BP-PVE-H-192	ST-VALVE SCHEDULE PLATE	TG Pkg Elect	Electrical	AA
898	XXXX-001-110-BP-PVE-H-193	ST-FOUNDATION PLAN	TG Pkg Elect	Electrical	AA
899	XXXX-001-110-BP-PVE-H-212	125 MVAR SHUNT REACTOR-FOUNDATION PLAN	TG Pkg Elect	Electrical	A
900	XXXX-001-110-BP-PVE-L-055	SCHEMATIC DIAGRAM FOR 11 KV UNIT INCOMER	TG Pkg Elect	Electrical	AA
901	XXXX-001-110-BP-PVE-L-056	SCHEMATIC DIAGRAM FOR 11 KV STATION INCOMER	TG Pkg Elect	Electrical	AA
902	XXXX-001-110-BP-PVE-L-057	SCHEMATIC DIAGRAM FOR 11/3.3 KV INCOMER FOR UNIT & STN AUX. SWBD	TG Pkg Elect	Electrical	AA
903	XXXX-001-110-BP-PVE-L-058	SCHEMATIC DIAGRAM FOR 11/3.3 KV INCOMER for AHP/CHP/FGD/WT/MISC SWBD	TG Pkg Elect	Electrical	AA
904	XXXX-001-110-BP-PVE-L-059	SCHEMATIC DIAGRAM FOR 11 KV UNIT END TO STN END TIE	TG Pkg Elect	Electrical	AA
905	XXXX-001-110-BP-PVE-L-060	SCHEMATIC DIAGRAM FOR 11 KV STN END TO UNIT END TIE	TG Pkg Elect	Electrical	AA
906	XXXX-001-110-BP-PVE-L-061	SCHEMATIC DIAGRAM FOR 11 KV STN END TO STN END TIE (NO TIE)	TG Pkg Elect	Electrical	AA
907	XXXX-001-110-BP-PVE-L-062	SCHEMATIC DIAGRAM FOR 11 KV STN END TO STN END TIE (NC TIE)	TG Pkg Elect	Electrical	AA
908	XXXX-001-110-BP-PVE-L-063	SCHEMATIC DIAGRAM FOR 11/3.3 KV BUS COUPLER	TG Pkg Elect	Electrical	AA
909	XXXX-001-110-BP-PVE-L-064	SCHEMATIC DIAGRAM FOR TRANSFORMER FEEDER W/O DIFF PROT	TG Pkg Elect	Electrical	AA
910	XXXX-001-110-BP-PVE-L-065	SCHEMATIC DIAGRAM FOR TRANSFORMER FEEDER WITH DIFF PROT	TG Pkg Elect	Electrical	AA
911	XXXX-001-110-BP-PVE-L-066	SCHEMATIC DIAGRAM FOR MOTOR FEEDER W/O DIFF PROT	TG Pkg Elect	Electrical	AA
912	XXXX-001-110-BP-PVE-L-067	SCHEMATIC DIAGRAM FOR MOTOR FEEDER WITH DIFF PROT	TG Pkg Elect	Electrical	AA
913	XXXX-001-110-BP-PVE-L-068	SCHEMATIC DIAGRAM FOR 11 KV OUTGOING FEEDER	TG Pkg Elect	Electrical	AA
914	XXXX-001-110-BP-PVE-L-069	SCHEMATIC DIAGRAM FOR MOTOR CONTACTOR FEEDER	TG Pkg Elect	Electrical	AA
915	XXXX-001-110-BP-PVE-L-070	SCHEMATIC DIAGRAM FOR TRANSFORMER CONTACTOR FEEDER	TG Pkg Elect	Electrical	AA
916	XXXX-001-110-BP-PVE-L-071	SCHEMATIC DIAGRAM FOR BUS PT & TRUNKING CUM BUS PT	TG Pkg Elect	Electrical	AA
917	XXXX-001-110-BP-PVE-L-072	SCHEMATIC DIAGRAM FOR DUMMY PANEL	TG Pkg Elect	Electrical	AA
918	XXXX-001-110-BP-PVE-L-073	SCHEMATIC DIAGRAM FOR 11/3.3 KV EARTHING TRUCK (FEB/BEB)	TG Pkg Elect	Electrical	AA
919	XXXX-001-110-BP-PVE-L-074	SCHEMATIC DIAGRAM FOR LV PANEL	TG Pkg Elect	Electrical	AA
920	XXXX-001-110-BP-PVE-L-075	DATASHEET OF 11/3.3KV MV SWITCHGEAR	TG Pkg Elect	Electrical	A
921	XXXX-001-110-BP-PVE-L-092	Schematic Drawing of Generator, GT and UT Protection Panel	TG Pkg Elect	Electrical	A
922	XXXX-001-110-BP-PVE-L-096	Control and Protection Scheme for 400 kV side ST-Tie-GT	TG Pkg Elect	Electrical	A
923	XXXX-001-110-BP-PVE-L-097	Control and Protection Scheme for 400 kV Line+Line Reactor-Tie-Line+Line Reactor	TG Pkg Elect	Electrical	A
924	XXXX-001-110-BP-PVE-L-098	Control and Protection Scheme for 400 kV Line-Tie-Line	TG Pkg Elect	Electrical	A
925	XXXX-001-110-BP-PVE-L-099	Control and Protection Scheme for 400 kV Bus Reactor-Tie	TG Pkg Elect	Electrical	A
926	XXXX-001-110-BP-PVE-L-100	400KV Busbar Protection Scheme	TG Pkg Elect	Electrical	A
927	XXXX-001-110-BP-PVE-L-101	400KV Energy Metering Scheme	TG Pkg Elect	Electrical	A
928	XXXX-001-110-BP-PVE-L-102	Islanding Scheme	TG Pkg Elect	Electrical	A
929	XXXX-001-110-BP-PVE-L-103	GTP - Substation Automation System	TG Pkg Elect	Electrical	A
930	XXXX-001-110-BP-PVE-L-165	SCHEMATIC DIAGRAM FOR CMB-GT (1-Ph)	TG Pkg Elect	Electrical	A
931	XXXX-001-110-BP-PVE-L-173	GA FOR CMB -GT (1-Ph)	TG Pkg Elect	Electrical	AA
932	XXXX-001-110-BP-PVE-L-174	Neutral formation and grounding	TG Pkg Elect	Electrical	AA
933	XXXX-001-110-BP-PVE-L-180	420 KV HUNT REACTOR-320 DIA TWIN BI DIRECTIONAL ROLLER	TG Pkg Elect	Electrical	AA
934	XXXX-001-110-BP-PVE-L-181	420 KV SHUNT REACTOR-FOUNDATION PLAN	TG Pkg Elect	Electrical	A
935	XXXX-001-110-BP-PVE-L-182	420 KV SHUNT REACTOR-LOADING GAUGE DIAGRAM	TG Pkg Elect	Electrical	AA
936	XXXX-001-110-BP-PVE-L-183	420 KV SHUNT REACTOR-H.V TERMINAL CONNECTOR	TG Pkg Elect	Electrical	AA
937	XXXX-001-110-BP-PVE-L-186	420 KV SHUNT REACTOR- INTERNAL DETAILS	TG Pkg Elect	Electrical	AA
938	XXXX-001-110-BP-PVE-L-188	COMBIND FOUNDATION FOR 80 MVAR	TG Pkg Elect	Electrical	A
939	XXXX-001-110-BP-PVE-L-194	ST-H.V.BUSHING	TG Pkg Elect	Electrical	AA
940	XXXX-001-110-BP-PVE-L-195	ST-H.V.NEUTRAL BUSHING	TG Pkg Elect	Electrical	AA
941	XXXX-001-110-BP-PVE-L-196	ST-LV & LVN BUSHING	TG Pkg Elect	Electrical	AA
942	XXXX-001-110-BP-PVE-L-197	ST-320 DIA TWIN DIR. ROLLER	TG Pkg Elect	Electrical	AA
943	XXXX-001-110-BP-PVE-L-198	ST-BUS DUCT MOUNTING ARRANGEMENT.	TG Pkg Elect	Electrical	AA
944	XXXX-001-110-BP-PVE-L-199	ST-LOADING GAUGE DIAGRAM	TG Pkg Elect	Electrical	AA
945	XXXX-001-110-BP-PVE-L-204	ST-DIAGRAM OF COOLER CONTROL GEAR	TG Pkg Elect	Electrical	AA
946	XXXX-001-110-BP-PVE-L-205	ST-SCHEMATIC DIAGRAM FOR INDEPENDENT TAP CHANGER CONTROL.	TG Pkg Elect	Electrical	AA
947	XXXX-001-110-BP-PVE-L-209	420KV 125 MVAR SHUNT REACTOR-H.V.BUSHING	TG Pkg Elect	Electrical	AA
948	XXXX-001-110-BP-PVE-L-211	SHUNT REACTOR-320 DIA TWIN BI DIRECTIONAL ROLLER	TG Pkg Elect	Electrical	AA
949	XXXX-001-110-BP-PVE-L-213	125MVar SHUNT REACTOR-LOADING GAUGE DIAGRAM	TG Pkg Elect	Electrical	AA
950	XXXX-001-110-BP-PVE-L-214	SHUNT REACTOR-H.V TERMINAL CONNECTOR	TG Pkg Elect	Electrical	AA
951	XXXX-001-110-BP-PVE-L-217	125MVar SHUNT REACTOR- INTERNAL DETAILS	TG Pkg Elect	Electrical	AA
952	XXXX-001-110-BP-PVE-L-218	125 MVAR BUS REACTOR- SCHEMATIC CUM WIRING DIAGRAM	TG Pkg Elect	Electrical	AA
953	XXXX-001-110-BP-PVE-L-251	NGR- SCHEMATIC CUM WIRING DIAGRAM	TG Pkg Elect	Electrical	AA
954	XXXX-001-110-BP-PVE-N-170	Overfluxing curve -GT	TG Pkg Elect	Electrical	AA
955	XXXX-001-110-BP-PVE-N-200	ST-OVERFLUXING WITHSTAND CURVE	TG Pkg Elect	Electrical	AA
956	XXXX-001-110-BP-PVE-W-146	Type Test Report for CEP Motor	TG Pkg Elect	Electrical	A
957	XXXX-001-110-BP-PVE-W-147	Type Test Report for BFP Motor	TG Pkg Elect	Electrical	A
958	XXXX-001-110-BP-PVE-W-148	Type Test Report for ACW Motor	TG Pkg Elect	Electrical	A
959	XXXX-001-110-BP-PVE-W-149	Type Test Report for DMCW-TG Motor	TG Pkg Elect	Electrical	A
960	XXXX-001-110-BP-PVE-W-150	Type Test Report for Drip Pump Motor	TG Pkg Elect	Electrical	A
961	XXXX-001-110-BP-PVE-W-153	INTERNAL SECTION SKETCH DETAILS of GT	TG Pkg Elect	Electrical	AA
962	XXXX-001-110-BP-PVE-W-154	TYPE TEST REPORTS (Including Components as per Specification)-GT	TG Pkg Elect	Electrical	A
963	XXXX-001-110-BP-PVE-W-155	TYPE TEST REPORTS (Including Components as per Specification)-ST	TG Pkg Elect	Electrical	A
964	XXXX-001-110-BP-PVE-W-156	TYPE TEST REPORTS (Including Components as per Specification)-UT	TG Pkg Elect	Electrical	A
965	XXXX-001-110-BP-PVE-W-157	TYPE TEST REPORTS (Including Components as per Specification)-REACTOR	TG Pkg Elect	Electrical	A
966	XXXX-001-110-BP-PVE-X-152	INSTRUCTION AND O&M MANUAL	TG Pkg Elect	Electrical	AA
967	XXXX-001-110-BP-PVE-Y-116	CEP Motor - Motor Tech. Data Sheet	TG Pkg Elect	Electrical	A
968	XXXX-001-110-BP-PVE-Y-117	CEP Motor - Phase Segregated Terminal Block for Direct Termination	TG Pkg Elect	Electrical	AA
969	XXXX-001-110-BP-PVE-Y-118	CEP Motor - Aux. Terminal Box for ETD's and BTD's	TG Pkg Elect	Electrical	AA
970	XXXX-001-110-BP-PVE-Y-119	CEP Motor - Aux. Terminal Box for Space Heater	TG Pkg Elect	Electrical	AA
971	XXXX-001-110-BP-PVE-Y-120	CEP Motor - Neutral Terminal Arrgt.	TG Pkg Elect	Electrical	AA
972	XXXX-001-110-BP-PVE-Y-122	BFP Motor - Motor Tech. Data Sheet	TG Pkg Elect	Electrical	A
973	XXXX-001-110-BP-PVE-Y-123	BFP Motor - Stator Terminal Box Phase Separated Type	TG Pkg Elect	Electrical	AA
974	XXXX-001-110-BP-PVE-Y-124	BFP Motor - Aux. Terminal Box for WDG, RTD & BTD	TG Pkg Elect	Electrical	AA
975	XXXX-001-110-BP-PVE-Y-125	BFP Motor - Aux. Terminal Box for Space Heater	TG Pkg Elect	Electrical	AA
976	XXXX-001-110-BP-PVE-Y-126	BFP Motor - Neutral Terminal Arrgt.	TG Pkg Elect	Electrical	AA
977	XXXX-001-110-BP-PVE-Y-127	BFP Motor - C.T. Secondary Terminal Box	TG Pkg Elect	Electrical	AA
978	XXXX-001-110-BP-PVE-Y-129	ACW Motor - Motor Tech. Data Sheet	TG Pkg Elect	Electrical	A
979	XXXX-001-110-BP-PVE-Y-130	ACW Motor - Phase Separated Terminal Box	TG Pkg Elect	Electrical	AA
980	XXXX-001-110-BP-PVE-Y-131	ACW Motor - Auxiliary Terminal Box for ETD's and BTD's	TG Pkg Elect	Electrical	AA
981	XXXX-001-110-BP-PVE-Y-132	ACW Motor - Aux. Terminal Box for Space Heater	TG Pkg Elect	Electrical	AA
982	XXXX-001-110-BP-PVE-Y-133	ACW Motor - Neutral Terminal Arrgt.	TG Pkg Elect	Electrical	AA
983	XXXX-001-110-BP-PVE-Y-135	DMCW-TG Motor -Motor Tech. Data Sheet	TG Pkg Elect	Electrical	AA

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 12 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
984	XXXX-001-110-BP-PVE-Y-136	DMCW-TG Motor -Phase Segregated Terminal Block for Direct Termination	TG Pkg_Elect	Electrical	AA
985	XXXX-001-110-BP-PVE-Y-137	DMCW-TG Motor - Aux. Terminal Box for ETD's and BTD's	TG Pkg_Elect	Electrical	AA
986	XXXX-001-110-BP-PVE-Y-138	DMCW-TG Motor -Aux. Terminal Box for Space Heater	TG Pkg_Elect	Electrical	AA
987	XXXX-001-110-BP-PVE-Y-139	DMCW-TG Motor -Neutral Terminal Arrgt.	TG Pkg_Elect	Electrical	AA
988	XXXX-001-110-BP-PVE-Y-141	Drip Pump Motor -Motor Tech. Data Sheet	TG Pkg_Elect	Electrical	AA
989	XXXX-001-110-BP-PVE-Y-142	Drip Pump Motor -Phase Segregated Terminal Block for Direct Termination	TG Pkg_Elect	Electrical	AA
990	XXXX-001-110-BP-PVE-Y-143	Drip Pump Motor -Aux. Terminal Box for ETD's and BTD's	TG Pkg_Elect	Electrical	AA
991	XXXX-001-110-BP-PVE-Y-144	Drip Pump Motor -Aux. Terminal Box for Space Heater	TG Pkg_Elect	Electrical	AA
992	XXXX-001-110-BP-PVE-Y-145	Drip Pump Motor -Neutral Terminal Arrgt.	TG Pkg_Elect	Electrical	AA
993	XXXX-001-110-BP-PVE-Y-154	Rating & Diagram Plate-GT	TG Pkg_Elect	Electrical	AA
994	XXXX-001-110-BP-PVE-Y-155	Valve Schedule Plate	TG Pkg_Elect	Electrical	AA
995	XXXX-001-110-BP-PVE-Y-156	HV Bushing	TG Pkg_Elect	Electrical	AA
996	XXXX-001-110-BP-PVE-Y-157	LV Bushing-GT	TG Pkg_Elect	Electrical	AA
997	XXXX-001-110-BP-PVE-Y-158	HV Neutral Bushing-GT	TG Pkg_Elect	Electrical	AA
998	XXXX-001-110-BP-PVE-Y-159	GT- Bus Duct Mounting Flange	TG Pkg_Elect	Electrical	AA
999	XXXX-001-110-BP-PVE-Y-160	Loading Gauge Diagram-GT	TG Pkg_Elect	Electrical	AA
1000	XXXX-001-110-BP-PVE-Y-161	320 DIA Bi-Directional Roller-GT	TG Pkg_Elect	Electrical	AA
1001	XXXX-001-110-BP-PVE-Y-162	SCHEMATIC DIAGRAM FOR MB/CCC WITH WRITEUP--GT	TG Pkg_Elect	Electrical	A
1002	XXXX-001-110-BP-PVE-Y-166	Technical Data Sheet : Generator transformer	TG Pkg_Elect	Electrical	AA
1003	XXXX-001-110-BP-PVE-Y-177	420 KV SHUNT REACTOR-RATING & DIAGRAM PLATE	TG Pkg_Elect	Electrical	AA
1004	XXXX-001-110-BP-PVE-Y-185	420 KV SHUNT REACTOR-TECHNICAL DATA SHEET	TG Pkg_Elect	Electrical	AA
1005	XXXX-001-110-BP-PVE-Y-191	ST-RATING & DIAGRAM PLATE	TG Pkg_Elect	Electrical	AA
1006	XXXX-001-110-BP-PVE-Y-201	ST-TECHNICAL DATASHEET	TG Pkg_Elect	Electrical	AA
1007	XXXX-001-110-BP-PVE-Y-208	125 MVAR BUS REACTOR-RATING & DIAGRAM PLATE	TG Pkg_Elect	Electrical	AA
1008	XXXX-001-110-BP-PVE-Y-216	125MVAR SHUNT REACTOR-TECHNICAL DATA SHEET	TG Pkg_Elect	Electrical	AA
1009	XXXX-001-110-BP-PVE-Y-251	NGR- RATING & DIAGRAM PLATE	TG Pkg_Elect	Electrical	AA
1010	XXXX-001-110-BP-PVE-Y-252	NGR- H.V.BUSHING	TG Pkg_Elect	Electrical	AA
1011	XXXX-001-110-BP-PVE-Y-253	NGR- NEUTRAL BUSHING	TG Pkg_Elect	Electrical	AA
1012	XXXX-001-110-BP-PVE-Y-254	NGR--SHIPPING DIAGRAM	TG Pkg_Elect	Electrical	AA
1013	XXXX-001-110-BP-PVE-Y-255	NGR--TECHNICAL DATA SHEET	TG Pkg_Elect	Electrical	AA
1014	XXXX-001-110-BP-PVI-B-077	GA, BOM & SCHEMATIC DRG OF BTS PANEL	TG Pkg_Elect	Electrical	AA
1015	XXXX-001-110-BP-PVI-B-078	GA, BOM & SCHEME OF DATA CONCENTRATOR PANEL	TG Pkg_Elect	Electrical	AA
1016	XXXX-001-110-BP-PVI-B-079	GA & SCHEME FOR HMI CONSOLE	TG Pkg_Elect	Electrical	AA
1017	XXXX-001-110-BP-PVI-B-080	SYSTEM ARCHITECTURE FOR DATA CONCENTRATOR	TG Pkg_Elect	Electrical	A
1018	XXXX-001-110-BP-PVI-B-081	NETWORK CONFIGURATION DIAGRAM FOR DATA CONCENTRATOR	TG Pkg_Elect	Electrical	A
1019	XXXX-001-110-BP-PVI-B-082	DATA SHEET OF MMI / DATA CONCENTRATOR	TG Pkg_Elect	Electrical	AA
1020	XXXX-001-110-BP-PVI-B-085	IP ADDRESSING DOCUMENT	TG Pkg_Elect	Electrical	AA
1021	XXXX-001-110-BP-PVI-B-106	GA of Networking Panels (SAS)	TG Pkg_Elect	Electrical	AA
1022	XXXX-001-110-BP-PVI-B-107	Schematics of Networking Panels (SAS)	TG Pkg_Elect	Electrical	A
1023	XXXX-001-110-BP-PVI-B-108	FAT & SAT Procedure (SAS)	TG Pkg_Elect	Electrical	A
1024	XXXX-001-110-BP-PVI-B-109	Equipment List (SAS)	TG Pkg_Elect	Electrical	A
1025	XXXX-001-110-BP-PVI-B-110	Functional Design Specification of SAS	TG Pkg_Elect	Electrical	A
1026	XXXX-001-110-BP-PVI-B-111	IO Signal List (SAS)	TG Pkg_Elect	Electrical	A
1027	XXXX-001-110-BP-PVI-L-076	DATA SHEET FOR ETHERNET SWITCHES	TG Pkg_Elect	Electrical	A
1028	XXXX-001-110-BP-PVI-L-104	Communication System Architecture- SAS	TG Pkg_Elect	Electrical	A
1029	XXXX-001-110-BP-PVI-U-083	FUNCTIONAL DESIGN SPECIFICATION (FDS)	TG Pkg_Elect	Electrical	A
1030	XXXX-001-110-BP-PVI-U-084	GENERAL TECHNICAL PARTICULARS (GTP)	TG Pkg_Elect	Electrical	A
1031	XXXX-001-110-BP-PVI-W-086	FACTORY ACCEPTANCE TEST (FAT) OF DATA CONCENTRATOR	TG Pkg_Elect	Electrical	A
1032	XXXX-001-110-BP-PVI-W-112	Type Test Reports -BCU/BPU	TG Pkg_Elect	Electrical	A
1033	XXXX-001-110-BP-PVI-Y-105	Control Room Furniture Drawing	TG Pkg_Elect	Electrical	A
1034	XXXX-001-110-EDN-PVE-B-001	OVERALL GENEAREAL ARRANGEMENT FOR DIGITAL AUTOMATIC VOLTAGE REGULATOR	TG Pkg_Elect	Electrical	A
1035	XXXX-001-110-EDN-PVE-W-002	SCHEMATIC DIAGRAM & BOM FOR DIGITAL AUTOMATIC VOLTAGE REGULATOR	TG Pkg_Elect	Electrical	A
1036	XXXX-001-110-EDN-PVE-W-003	WRITE UP OF GENERATOR EXCITATION SYSTEM	TG Pkg_Elect	Electrical	A
1037	XXXX-001-110-EDN-PVE-W-004	INTERCONNECTION SCHEDULE FOR EXCITATION SYSTEM	TG Pkg_Elect	Electrical	A
1038	XXXX-001-110-EDN-PVE-W-005	ELECTRICAL LOAD LIST IN AGREED FORMAT (pdf & EXCEL format) FOR ALL LOADS INCLUDING 415V, 240V, UPS, 220V DC IN EDN SCOPE FOR TG PKG	TG Pkg_Elect	Electrical	A
1039	XXXX-001-110-EDN-PVE-W-006	DETAILS OF SIMULATION TECHNIQUE AND PROCEDURE FOR PSS TUNING AT SITE.	TG Pkg_Elect	Electrical	A
1040	XXXX-001-110-EDN-PVE-W-007	LAPLACE DOMAIN TRANSFER FUNCTION BLOCK DIAGRAM THAT REPRESENTS THE GENERATOR EXCITATION SYSTEM IN ACCORDANCE WITH IEEE EXCITATION MODEL INCLUDING THE VALUES OF ALL TIME CONSTANTS AND GAINS.	TG Pkg_Elect	Electrical	AA
1041	XXXX-001-110-EDN-PVE-W-009	TYPE TEST PROCEDURE FOR EXCITATION SYSTEM	TG Pkg_Elect	Electrical	AA
1042	XXXX-001-110-EDN-PVE-W-010	TYPE TEST REPORT FOR EXCITATION SYSTEM	TG Pkg_Elect	Electrical	A
1043	XXXX-001-110-EDN-PVE-X-011A	O&M MANUAL FOR EXCITATION SYSTEM	TG Pkg_Elect	Electrical	AA
1044	XXXX-001-110-EDN-PVI-B-034	OGA for TG Panels	TG Pkg_Elect	Electrical	AA
1045	XXXX-001-110-EP-PVE-B-001	DATA SHEET FOR NUMERICAL RELAYS	TG Pkg_Elect	Electrical	AA
1046	XXXX-001-110-EP-PVE-B-002	DATA SHEET FOR ETHERNET SWITCHES	TG Pkg_Elect	Electrical	AA
1047	XXXX-001-110-EP-PVE-B-003	DATA SHEET FOR DATA CABLE, FO CABLE	TG Pkg_Elect	Electrical	AA
1048	XXXX-001-110-EP-PVE-B-004	BOM FOR FO CABLE	TG Pkg_Elect	Electrical	AA
1049	XXXX-001-110-EP-PVE-B-005	BOM OF SWITCHBOARD ETHERNET SWITCHES	TG Pkg_Elect	Electrical	AA
1050	XXXX-001-110-EP-PVE-B-006	SCHEME- INCOMER -DC MODULE	TG Pkg_Elect	Electrical	AA
1051	XXXX-001-110-EP-PVE-B-007	SCHEME- TIE -DE MODULE	TG Pkg_Elect	Electrical	AA
1052	XXXX-001-110-EP-PVE-B-008	SCHEME- MOTOR FEEDER -DA MODULE	TG Pkg_Elect	Electrical	AA
1053	XXXX-001-110-EP-PVE-B-009	SCHEME- MOTOR FEEDER -DAF MODULE	TG Pkg_Elect	Electrical	AA
1054	XXXX-001-110-EP-PVE-B-010	SCHEME- TRANSFORMER FEEDER -DB MODULE	TG Pkg_Elect	Electrical	AA
1055	XXXX-001-110-EP-PVE-B-011	SCHEME- TRANSFORMER FEEDER -DBF MODULE	TG Pkg_Elect	Electrical	AA
1056	XXXX-001-110-EP-PVE-B-012	SCHEME- BUS COUPLER -DD MODULE	TG Pkg_Elect	Electrical	AA
1057	XXXX-001-110-EP-PVE-B-013	SCHEME- MOTOR FEEDER -CC MODULE	TG Pkg_Elect	Electrical	AA
1058	XXXX-001-110-EP-PVE-B-014	SCHEME- BUS VT -G TYPE MODULE	TG Pkg_Elect	Electrical	AA
1059	XXXX-001-110-EP-PVE-B-015	Scheme for LV Panel	TG Pkg_Elect	Electrical	AA
1060	XXXX-001-110-EP-PVE-B-016	SCHEME- TRANSFORMER FEEDER -CCT MODULE	TG Pkg_Elect	Electrical	AA
1061	XXXX-001-110-EP-PVE-B-017	SCHEME- EARTHING BREAKER-FEB/BEB MODULE	TG Pkg_Elect	Electrical	AA
1062	XXXX-001-110-EP-PVE-B-018	SCHEME - TRANSFORMER FEEDER (STAND ALONE PANEL) - DB1	TG Pkg_Elect	Electrical	AA
1063	XXXX-001-110-EP-PVE-B-019	SCHEME - TRANSFORMER FEEDER (STAND ALONE PANEL) - DBF1	TG Pkg_Elect	Electrical	AA
1064	XXXX-001-110-EP-PVE-B-020	SCHEME - OUTGOING TIE - DEOG	TG Pkg_Elect	Electrical	AA
1065	XXXX-001-110-EP-PVE-B-021	RELAY SETTING DOCUMENT	TG Pkg_Elect	Electrical	A
1066	XXXX-001-110-EP-PVE-B-022	(FAT) FACTORY ACCEPTANCE TEST PROCEDURE FOR NUMERICAL RELAYS	TG Pkg_Elect	Electrical	AA
1067	XXXX-001-110-EP-PVE-B-023	TYPE TEST REPORT OF NUMERICAL RELAYS	TG Pkg_Elect	Electrical	AA
1068	XXXX-001-110-EP-PVE-B-024	TYPE TEST REPORT OF ETHERNET SWITCHES	TG Pkg_Elect	Electrical	AA
1069	XXXX-001-110-EP-PVE-B-025	CROSS SECTIONAL DRWG OF LV PANEL	TG Pkg_Elect	Electrical	AA
1070	XXXX-001-110-EP-PVE-B-026	CROSS SECTIONAL DRWG OF EARTHING TRUCK	TG Pkg_Elect	Electrical	AA

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 13 OF 66

Si No	NTPC Drg No	DRG_TITLE	SUB-SYSTEM	Dept	CATEGORY
1071	XXXX-001-110-EP-PVE-B-027	SLD & GA DRAWING FOR UNIT-1 TURBINE PMCC	TG Pkg Elect	Electrical	AA
1072	XXXX-001-110-EP-PVE-B-028	SLD & GA DRAWING FOR UNIT-2 TURBINE PMCC	TG Pkg Elect	Electrical	AA
1073	XXXX-001-110-EP-PVE-B-029	SLD & GA DRAWING FOR UNIT-1 TURBINE VLV & DAMPER DB	TG Pkg Elect	Electrical	AA
1074	XXXX-001-110-EP-PVE-B-030	SLD & GA DRAWING FOR UNIT-2 TURBINE VLV & DAMPER DB	TG Pkg Elect	Electrical	AA
1075	XXXX-001-110-EP-PVE-B-031	SLD & GA DRAWING FOR UNIT-1 SERVICE ACDB	TG Pkg Elect	Electrical	AA
1076	XXXX-001-110-EP-PVE-B-032	SLD & GA DRAWING FOR UNIT-2 SERVICE ACDB	TG Pkg Elect	Electrical	AA
1077	XXXX-001-110-EP-PVE-B-033	SLD & GA DRAWING FOR UNIT-1 VENTILLATION MCC	TG Pkg Elect	Electrical	AA
1078	XXXX-001-110-EP-PVE-B-034	SLD & GA DRAWING FOR UNIT-2 VENTILLATION MCC	TG Pkg Elect	Electrical	AA
1079	XXXX-001-110-EP-PVE-B-035	SLD & GA DRAWING FOR UNIT-1 MISC SERVICE MCC	TG Pkg Elect	Electrical	AA
1080	XXXX-001-110-EP-PVE-B-036	SLD & GA DRAWING FOR UNIT-2 MISC SERVICE MCC	TG Pkg Elect	Electrical	AA
1081	XXXX-001-110-EP-PVE-B-037	SLD & GA DRAWING FOR UNIT-1 EMERGENCY SWGR	TG Pkg Elect	Electrical	AA
1082	XXXX-001-110-EP-PVE-B-038	SLD & GA DRAWING FOR UNIT-2 EMERGENCY SWGR	TG Pkg Elect	Electrical	AA
1083	XXXX-001-110-EP-PVE-B-039	SLD & GA DRAWING FOR UNIT-1 STATION SERVICE PMCC	TG Pkg Elect	Electrical	AA
1084	XXXX-001-110-EP-PVE-B-040	SLD & GA DRAWING FOR UNIT-2 STATION SERVICE PMCC	TG Pkg Elect	Electrical	AA
1085	XXXX-001-110-EP-PVE-B-041	SLD & GA DRAWING FOR UNIT-1 MAIN DCDB	TG Pkg Elect	Electrical	AA
1086	XXXX-001-110-EP-PVE-B-042	SLD & GA DRAWING FOR UNIT-2 MAIN DCDB	TG Pkg Elect	Electrical	AA
1087	XXXX-001-110-EP-PVE-B-043	SLD & GA DRAWING FOR CCR AIR CONDITIONING MCC	TG Pkg Elect	Electrical	AA
1088	XXXX-001-110-EP-PVE-B-044	SLD & GA DRAWING FOR FUEL OIL PH SWGR	TG Pkg Elect	Electrical	AA
1089	XXXX-001-110-EP-PVE-B-045	SLD & GA DRAWING FOR FIRE WATER SWGR	TG Pkg Elect	Electrical	AA
1090	XXXX-001-110-EP-PVE-B-047	SLD & GA DRAWING FOR HYDROGEN PLANT MCC	TG Pkg Elect	Electrical	AA
1091	XXXX-001-110-EP-PVE-B-048	SLD & GA DRAWING FOR AIR COOLED CONDENSOR MCC	TG Pkg Elect	Electrical	AA
1092	XXXX-001-110-EP-PVE-B-049	SLD & GA DRAWING FOR AIR WASHER MCC UNIT-1	TG Pkg Elect	Electrical	AA
1093	XXXX-001-110-EP-PVE-B-050	SLD & GA DRAWING FOR AIR WASHER MCC UNIT-2	TG Pkg Elect	Electrical	AA
1094	XXXX-001-110-EP-PVE-B-051	SLD & GA FOR WATER SYSTEM PMCC	TG Pkg Elect	Electrical	AA
1095	XXXX-001-110-EP-PVE-B-052	SLD & GA DRAWING FOR CPU MCC	TG Pkg Elect	Electrical	AA
1096	XXXX-001-110-EP-PVE-B-053	SLD & GA DRAWING FOR WORKSHOP MCC	TG Pkg Elect	Electrical	AA
1097	XXXX-001-110-EP-PVE-B-055	SLD & GA DRAWING FOR CT, CW TREATMENT PMCC	TG Pkg Elect	Electrical	AA
1098	XXXX-001-110-EP-PVE-L-001	415V AC FUSE DB (WALL MOUNTING)	TG Pkg Elect	Electrical	AA
1099	XXXX-001-110-EP-PVE-L-002	220V DC FUSE BOARDS (WALL MOUNTING)	TG Pkg Elect	Electrical	AA
1100	XXXX-001-110-EP-PVE-L-003	LOCAL PUSH BUTTON STATION TYPE-A	TG Pkg Elect	Electrical	AA
1101	XXXX-001-110-EP-PVE-L-004	LOCAL PUSH BUTTON STATION TYPE-C (Flame Proof)	TG Pkg Elect	Electrical	AA
1102	XXXX-001-110-EP-PVE-L-005	LOCAL MOTOR STARTER	TG Pkg Elect	Electrical	AA
1103	XXXX-001-110-EP-PVE-L-006	LOCAL MOTOR STARTER (Flame Proof)	TG Pkg Elect	Electrical	AA
1104	XXXX-001-110-EP-PVE-L-007	BUSDUCT ARRANGEMENT FOR UNIT#1 TURBINE PMCC	TG Pkg Elect	Electrical	AA
1105	XXXX-001-110-EP-PVE-L-008	BUSDUCT ARRANGEMENT FOR UNIT#2 TURBINE PMCC	TG Pkg Elect	Electrical	AA
1106	XXXX-001-110-EP-PVE-L-009	SANDWITCH BUSDUCT ARRANGEMENT FOR UNIT#1 EMERGENCY MCC	TG Pkg Elect	Electrical	AA
1107	XXXX-001-110-EP-PVE-L-010	SANDWITCH BUSDUCT ARRANGEMENT FOR UNIT#2 EMERGENCY MCC	TG Pkg Elect	Electrical	AA
1108	XXXX-001-110-EP-PVE-L-011	BUSDUCT ARRANGEMENT FOR UNIT#1 STATION SERVICE PMCC	TG Pkg Elect	Electrical	AA
1109	XXXX-001-110-EP-PVE-L-012	BUSDUCT ARRANGEMENT FOR UNIT#2 STATION SERVICE PMCC	TG Pkg Elect	Electrical	AA
1110	XXXX-001-110-EP-PVE-L-013	BUSDUCT ARRANGEMENT FOR TRANSFORMER FED OFFSITE PCC	TG Pkg Elect	Electrical	AA
1111	XXXX-001-110-EP-PVE-L-014	Control Scheme for 2 Incomer +1 Bus Coupler (2 DAE+ 1 DAE)	TG Pkg Elect	Electrical	AA
1112	XXXX-001-110-EP-PVE-L-015	Control Scheme for 2 Incomer +1 Bus Coupler (2 DAE+ 1 DAE)	TG Pkg Elect	Electrical	AA
1113	XXXX-001-110-EP-PVE-L-016	Control Scheme for 2 Incomer (2 DAE)	TG Pkg Elect	Electrical	AA
1114	XXXX-001-110-EP-PVE-L-017	Control Scheme for PCC Outgoing Breaker Feeder Type DAE	TG Pkg Elect	Electrical	AA
1115	XXXX-001-110-EP-PVE-L-018	Control Scheme for ACB controlled motor feeder (110KW & above) - Type DM	TG Pkg Elect	Electrical	AA
1116	XXXX-001-110-EP-PVE-L-019	Control Scheme for Incoming MCCB (DO+FIXED) (MCCB)	TG Pkg Elect	Electrical	AA
1117	XXXX-001-110-EP-PVE-L-020	Control Scheme for Control Transformer Module Type CS	TG Pkg Elect	Electrical	AA
1118	XXXX-001-110-EP-PVE-L-021	Control Scheme for BUS PT MODULE FOR PCC/PMCC (Module - G1)	TG Pkg Elect	Electrical	AA
1119	XXXX-001-110-EP-PVE-L-022	Control Scheme for BUS PT MODULE FOR DG SWGR (Module - G2)	TG Pkg Elect	Electrical	AA
1120	XXXX-001-110-EP-PVE-L-023	Control Scheme for METERING MODULE FOR MCC (Module - VM) DO/FIXED	TG Pkg Elect	Electrical	AA
1121	XXXX-001-110-EP-PVE-L-024	Control Scheme for DC Metering & Protection Module Type S	TG Pkg Elect	Electrical	AA
1122	XXXX-001-110-EP-PVE-L-025	Control Scheme for 220V DCDB I/C & B/C (Type DC + DB + CH+HD)	TG Pkg Elect	Electrical	AA
1123	XXXX-001-110-EP-PVE-L-026	Control Scheme for Contactor Changeover Between Two Incomer Module Type CC (DO/FIXED)	TG Pkg Elect	Electrical	AA
1124	XXXX-001-110-EP-PVE-L-027	Control Scheme for Outgoing TIE (DAE) FROM TPMCC TO UES	TG Pkg Elect	Electrical	AA
1125	XXXX-001-110-EP-PVE-L-028	Control Scheme for 3 Phase + Neutral Fuse Switch Outgoing Feeder Type E (Drawout/Fixed)	TG Pkg Elect	Electrical	AA
1126	XXXX-001-110-EP-PVE-L-029	Control Scheme for 2 Phase Fuse Switch Outgoing Feeder Type E2 (Drawout/Fixed)	TG Pkg Elect	Electrical	AA
1127	XXXX-001-110-EP-PVE-L-030	Control Scheme for 1 Phase Fuse Switch Outgoing Feeder Type E1 (Drawout/Fixed)	TG Pkg Elect	Electrical	AA
1128	XXXX-001-110-EP-PVE-L-031	Control Scheme for Motors Type DK2 (Below 30KW)	TG Pkg Elect	Electrical	AA
1129	XXXX-001-110-EP-PVE-L-032	Control Scheme for Motors Type DK21 (30KW & upto 100KW)	TG Pkg Elect	Electrical	AA
1130	XXXX-001-110-EP-PVE-L-033	Control Scheme for Heaters Type DK2* (Below 30KW)	TG Pkg Elect	Electrical	AA
1131	XXXX-001-110-EP-PVE-L-034	Control Scheme for Buscoupler Module Type MCCB (Drawout/Fixed)	TG Pkg Elect	Electrical	AA
1132	XXXX-001-110-EP-PVE-L-035	Control Scheme for Reversible Motor Type DN1 (Below 30KW)	TG Pkg Elect	Electrical	AA
1133	XXXX-001-110-EP-PVE-P-001	Control Scheme for Panel space heater and Plugs & Sockets	TG Pkg Elect	Electrical	AA
1134	XXXX-001-110-EP-PVE-P-002	CONTROL SCHEME FOR EMERGENCY SWITCH BOARD (2 DG IC+2 TIE IC+1 BC)	TG Pkg Elect	Electrical	AA
1135	XXXX-001-110-EP-PVE-P-003	Control Scheme for 3 Phase Fuse Switch Outgoing Feeder Type MCCB (Drawout/Fixed)	TG Pkg Elect	Electrical	AA
1136	XXXX-001-110-EP-PVE-P-004	Control Scheme for Motors Type K2 (Upto 30KW)	TG Pkg Elect	Electrical	AA
1137	XXXX-001-110-EP-PVE-P-005	control scheme for rotary blower-DN2	TG Pkg Elect	Electrical	AA
1138	XXXX-001-110-EP-PVE-P-006	control scheme for rotary blower-DN3	TG Pkg Elect	Electrical	AA
1139	XXXX-001-110-EP-PVE-P-007	Control Scheme for 2 Incomer +1 Buscoupler (2 DAE+1 DAE) GREEN BUILDING MCC	TG Pkg Elect	Electrical	AA
1140	XXXX-001-110-EP-PVE-P-008	Control Scheme for RE-ACCELERATION Motors MODULE Type DK2E (Upto 30KW)	TG Pkg Elect	Electrical	AA
1141	XXXX-001-110-EP-PVE-P-009	Control Scheme for RE-ACCELERATION Motors MODULE Type DK21E (above 30KW & below 100KW)	TG Pkg Elect	Electrical	AA
1142	XXXX-001-110-EP-PVE-P-010	Control Scheme for 3 Phase MCCB Outgoing with MFM Feeder Type MCCB (Draw out) for GREEN Building	TG Pkg Elect	Electrical	AA
1143	XXXX-001-110-EP-PVE-P-011	MANDATORY SPARE FOR LT Switchgear	TG Pkg Elect	Electrical	AA
1144	XXXX-001-110-EP-PVE-P-012	TYPE TEST REPORT FOR - LT SWITCHGEAR	TG Pkg Elect	Electrical	A
1145	XXXX-001-110-EP-PVE-P-013	TYPE TEST REPORT FOR - LT Busduct	TG Pkg Elect	Electrical	A
1146	XXXX-001-110-EP-PVE-P-014	TYPE TEST REPORT FOR - SANDWICH Busduct	TG Pkg Elect	Electrical	AA
1147	XXXX-001-110-EP-PVE-P-015	DATA SHEETS FOR LT SWITCHGEAR	TG Pkg Elect	Electrical	AA
1148	XXXX-001-110-EP-PVE-P-016	DATA SHEETS FOR SANDWICH BUS DUCT	TG Pkg Elect	Electrical	AA
1149	XXXX-001-110-EP-PVE-P-017	Data sheet for Ethernet switches on IEC61850	TG Pkg Elect	Electrical	AA
1150	XXXX-001-110-EP-PVE-P-018	MQP for LT Switchgear Panel alongwith FAT procedure of numerical relays	TG Pkg Elect	Electrical	AA
1151	XXXX-001-110-EP-PVE-P-019	MQP FOR LT BUSDUCT	TG Pkg Elect	Electrical	AA
1152	XXXX-001-110-EP-PVE-P-020	CROSS SECTIONAL DRWG OF PROTOTYPE PANELS	TG Pkg Elect	Electrical	A
1153	XXXX-001-110-HWR-PVE-B-012	Exciter outline drawing of brushless exciter	TG Pkg Elect	Electrical	A

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 14 OF 66

Si No	NTPC Drg No	DRG_TITLE	SUB-SYSTEM	Dept	CATEGORY
1154	XXXX-001-110-HWR-PVE-B-013	GA / SCHEME OF GENERATOR MONITORING SYSTEM (OVERHANG VIBRATION+ROTOR FLUX AND SAFT VOLTAGE).	TG Pkg_Elect	Electrical	AA
1155	XXXX-001-110-HWR-PVE-B-0135	OGA FOR TURBINE- GENERATOR AUXILIARY CONTROL CABINETS	TG Pkg_Elect	Electrical	A
1156	XXXX-001-110-HWR-PVE-B-019	WRITE UP,GA,SCHEME, DATA SHEET AND WIRING DIAGRAM OF HYDROGEN DRIER	TG Pkg_Elect	Electrical	A
1157	XXXX-001-110-HWR-PVE-B-019A	WRITEUP OF AIR DRYER FOR GENERATOR (FOR PROLONGED SHUTDOWN)	TG Pkg_Elect	Electrical	A
1158	XXXX-001-110-HWR-PVE-B-020	WRITEUP OF GENERATOR ROTOR FLUX MONITORING SYSTEM	TG Pkg_Elect	Electrical	A
1159	XXXX-001-110-HWR-PVE-B-024	SCHEMATIC WIRING DIAGRAM OF TURBINE LUBE OIL PURIFICATION & CENTRAL LUBE OIL PURIFIER	TG Pkg_Elect	Electrical	A
1160	XXXX-001-110-HWR-PVE-L-006B	EXCITER INSTRUMENTATION SCHEME	TG Pkg_Elect	Electrical	A
1161	XXXX-001-110-HWR-PVE-L-010	GENERATOR WASTE FLUID SYSTEM SCHEME	TG Pkg_Elect	Electrical	A
1162	XXXX-001-110-HWR-PVE-L-011	GENERATOR WASTE GAS SYSTEM SCHEME	TG Pkg_Elect	Electrical	A
1163	XXXX-001-110-HWR-PVE-L-014	DC JOP STARTER PANEL SCHEME	TG Pkg_Elect	Electrical	A
1164	XXXX-001-110-HWR-PVE-L-015	DC EOP STARTER PANEL SCHEME	TG Pkg_Elect	Electrical	A
1165	XXXX-001-110-HWR-PVE-L-016	DC SOP STARTER PANEL SCHEME	TG Pkg_Elect	Electrical	A
1166	XXXX-001-110-HWR-PVE-L-132	GAS ANALYSER SCHEME	TG Pkg_Elect	Electrical	A
1167	XXXX-001-110-HWR-PVE-V-150E	Generator outline drawing	TG Pkg_Elect	Electrical	A
1168	XXXX-001-110-HWR-PVE-W-015	W/U/ON PW & COLD GAS TEMP CONTROL	TG Pkg_Elect	Electrical	AA
1169	XXXX-001-110-HWR-PVE-W-019	TYPE TEST REPORTS FOR AC MOTOR FOR LUBE OIL SYSTEM.	TG Pkg_Elect	Electrical	AA
1170	XXXX-001-110-HWR-PVE-W-027	TYPE TEST PROCEDURE FOR VACUUM PUMP MOTOR	TG Pkg_Elect	Electrical	AA
1171	XXXX-001-110-HWR-PVE-W-028	TYPE TEST REPORT FOR VACUUM PUMP MOTOR	TG Pkg_Elect	Electrical	AA
1172	XXXX-001-110-HWR-PVE-W-1059	TYPE TEST PROCEDURE FOR GENERATOR	TG Pkg_Elect	Electrical	A
1173	XXXX-001-110-HWR-PVE-W-1060	TYPE TEST REPORTS FOR GENERATOR	TG Pkg_Elect	Electrical	A
1174	XXXX-001-110-HWR-PVE-X-005	O&M MANUAL - GENERATOR & ITS AUXILIARIES	TG Pkg_Elect	Electrical	AA
1175	XXXX-001-110-HWR-PVE-Y-007	MOTOR DATA SHEET & CURVES FOR JOP AC MOTOR	TG Pkg_Elect	Electrical	AA
1176	XXXX-001-110-HWR-PVE-Y-007A	MOTOR DATA SHEET & CURVES FOR JOP DC MOTOR	TG Pkg_Elect	Electrical	AA
1177	XXXX-001-110-HWR-PVE-Y-008	MOTOR DATA SHEET & CURVES FOR EOP DC MOTOR	TG Pkg_Elect	Electrical	AA
1178	XXXX-001-110-HWR-PVE-Y-009	GENERATOR - DATA SHEETS AND CURVES	TG Pkg_Elect	Electrical	A
1179	XXXX-001-110-HWR-PVE-Y-010	Data sheet & curves, OGA and Terminal box arrangement of AC seal oil pump motor.	TG Pkg_Elect	Electrical	AA
1180	XXXX-001-110-HWR-PVE-Y-011	Data sheet & curves, OGA and Terminal box arrangement of DC seal oil pump motor.	TG Pkg_Elect	Electrical	AA
1181	XXXX-001-110-HWR-PVE-Y-012	Data sheet & curves, OGA and Terminal box arrangement of generator primary water pump motor.	TG Pkg_Elect	Electrical	AA
1182	XXXX-001-110-HWR-PVE-Y-019	MOTOR DATA SHEET FOR LUBE OIL PURIFIER PUMP	TG Pkg_Elect	Electrical	AA
1183	XXXX-001-110-HWR-PVM-F-013	P & ID AND LEGENDS OF GAS COOLING SYSTEM OF GENERATOR	TG Pkg_Elect	Electrical	AA
1184	XXXX-001-110-HWR-PVM-F-014	P & ID AND LEGENDS OF SEAL OIL SYSTEM OF GENERATOR	TG Pkg_Elect	Electrical	AA
1185	XXXX-001-110-HWR-PVM-F-015	P & ID AND LEGENDS OF STATOR COOLING WATER SYSTEM OF GENERATOR	TG Pkg_Elect	Electrical	AA
1186	XXXX-001-110-HWR-PVM-H-003	LIST OF VALVES FOR GENERATOR AUXILIARIES SYSTEM	TG Pkg_Elect	Electrical	AA
1187	XXXX-001-110-HYD-PVE-B-022	GAD, Data sheet and performance curve for LOP AC motor	TG Pkg_Elect	Electrical	AA
1188	XXXX-001-110-HYD-PVE-B-039	GA & BOM OF DC STARTER PANEL (FOR EOP OF BFP DRIVE TURBINE)	TG Pkg_Elect	Electrical	AA
1189	XXXX-001-110-HYD-PVE-B-040	SCHEMATIC OF DC STARTER PANEL (FOR EOP OF BFP DRIVE TURBINE)	TG Pkg_Elect	Electrical	AA
1190	XXXX-001-110-HYD-PVE-V-042	ELECTRICAL LOAD LIST - BFPDT	TG Pkg_Elect	Electrical	A
1191	XXXX-001-110-HYD-PVE-V-043	UTILITY CONSUMPTION LIST - BFPDT	TG Pkg_Elect	Electrical	AA
1192	XXXX-001-110-ISG-PVM-B-002	DG SETS - GA DRAWING & DETAILS OF ALTERNATOR, ENGINE, DG SET , BASE FRAME,ACOUSTIC ENCLOSURE, FUEL TANK, TERMINAL BOX	TG Pkg_Elect	Electrical	AA
1193	XXXX-001-110-ISG-PVM-B-003	DG SETS - GA DRAWING & SCHEME OF DG AMF PANEL	TG Pkg_Elect	Electrical	AA
1194	XXXX-001-110-ISG-PVM-B-004	DG SETS - GA DRAWING & DETAILS OF EXHAUST PIPE SUPPORT STRUCTURE	TG Pkg_Elect	Electrical	AA
1195	XXXX-001-110-ISG-PVM-B-006	DG SETS - LAYOUT DRAWINGS & SECTIONAL DETAILS	TG Pkg_Elect	Electrical	AA
1196	XXXX-001-110-ISG-PVM-B-012	DG SETS - GA DRAWING & SCHEME OF BATTERY CHARGER	TG Pkg_Elect	Electrical	AA
1197	XXXX-001-110-ISG-PVM-W-007	DG SETS - TYPE TEST REPORTS OF ALTERNATOR	TG Pkg_Elect	Electrical	A
1198	XXXX-001-110-ISG-PVM-W-008	DG SETS - TYPE TEST REPORTS OF ENGINE	TG Pkg_Elect	Electrical	A
1199	XXXX-001-110-ISG-PVM-W-009	DG SETS - TYPE TEST REPORTS OF DG AMF PANEL	TG Pkg_Elect	Electrical	A
1200	XXXX-001-110-ISG-PVM-W-010	DG SETS - TYPE TEST REPORTS OF BATTERY	TG Pkg_Elect	Electrical	A
1201	XXXX-001-110-ISG-PVM-W-011	DG SETS - TYPE TEST REPORTS OF BATTERY CHARGER	TG Pkg_Elect	Electrical	A
1202	XXXX-001-110-ISG-PVM-Y-001	DG SETS - DATA SHEETS	TG Pkg_Elect	Electrical	AA
1203	XXXX-001-110-ISG-PVM-Y-005	DG SETS - FOUNDATION DRAWING AND DETAILS OF ACOUSTIC ENCLOSURE	TG Pkg_Elect	Electrical	AA
1204	XXXX-001-110-JHS-PVE-B-220	2500 KVA, 11/0.433 KV CAST RESIN DRY TYPE TRANSFORMER- Outline General Arrangement	TG Pkg_Elect	Electrical	AA
1205	XXXX-001-110-JHS-PVE-B-226	2000 KVA, 11/0.433 KV CAST RESIN DRY TYPE TRANSFORMER - Outline General Arrangement	TG Pkg_Elect	Electrical	AA
1206	XXXX-001-110-JHS-PVE-B-232	1600 KVA, 11/0.433 KV CAST RESIN DRY TYPE TRANSFORMER - Outline General Arrangement	TG Pkg_Elect	Electrical	AA
1207	XXXX-001-110-JHS-PVE-B-245	UNIT TRANSFORMER - OUTLINE GENERAL ARRANGEMENT	TG Pkg_Elect	Electrical	AA
1208	XXXX-001-110-JHS-PVE-W-225	2500 KVA, 11/0.433 KV CAST RESIN DRY TYPE TRANSFORMER - Type Test Report	TG Pkg_Elect	Electrical	A
1209	XXXX-001-110-JHS-PVE-W-231	2000 KVA, 11/0.433 KV CAST RESIN DRY TYPE TRANSFORMER - Type Test Report	TG Pkg_Elect	Electrical	A
1210	XXXX-001-110-JHS-PVE-W-237	1600 KVA, 11/0.433 KV CAST RESIN DRY TYPE TRANSFORMER - Type Test Report	TG Pkg_Elect	Electrical	A
1211	XXXX-001-110-JHS-PVE-Y-221	2500 KVA, 11/0.433 KV CAST RESIN DRY TYPE TRANSFORMER -OGA & List of Fittings for OGA	TG Pkg_Elect	Electrical	AA
1212	XXXX-001-110-JHS-PVE-Y-223	2500 KVA, 11/0.433 KV CAST RESIN DRY TYPE TRANSFORMER - Rating and Diagram Plate	TG Pkg_Elect	Electrical	AA
1213	XXXX-001-110-JHS-PVE-Y-227	2000 KVA, 11/0.433 KV CAST RESIN DRY TYPE TRANSFORMER - OGA & List of Fittings for OGA	TG Pkg_Elect	Electrical	AA
1214	XXXX-001-110-JHS-PVE-Y-229	2000 KVA, 11/0.433 KV CAST RESIN DRY TYPE TRANSFORMER - Rating and Diagram Plate	TG Pkg_Elect	Electrical	AA
1215	XXXX-001-110-JHS-PVE-Y-233	1600 KVA, 11/0.433 KV CAST RESIN DRY TYPE TRANSFORMER - OGA & List of Fittings for OGA	TG Pkg_Elect	Electrical	AA
1216	XXXX-001-110-JHS-PVE-Y-235	1600 KVA, 11/0.433 KV CAST RESIN DRY TYPE TRANSFORMER - Rating and Diagram Plate	TG Pkg_Elect	Electrical	AA
1217	XXXX-001-110-JHS-PVE-Y-238	Common Drawings/Documents for all ratings Main & Mirror - Technical Data Sheet	TG Pkg_Elect	Electrical	AA
1218	XXXX-001-110-JHS-PVE-Y-239	Common Drawings/Documents for all ratings Main & Mirror - Marshalling Box	TG Pkg_Elect	Electrical	AA
1219	XXXX-001-110-JHS-PVE-Y-240	Common Drawings/Documents for all ratings Main & Mirror - H.V Cable Box	TG Pkg_Elect	Electrical	AA
1220	XXXX-001-110-JHS-PVE-Y-241	Common Drawings/Documents for all ratings Main & Mirror - Wiring Diagram	TG Pkg_Elect	Electrical	AA
1221	XXXX-001-110-JHS-PVE-Y-242	Common Drawings/Documents for all ratings Main & Mirror - H.V Bushing Epoxy	TG Pkg_Elect	Electrical	AA
1222	XXXX-001-110-JHS-PVE-Y-243	UNIT TRANSFORMER - Technical Data Sheet	TG Pkg_Elect	Electrical	AA
1223	XXXX-001-110-JHS-PVE-Y-246	UNIT TRANSFORMER - RATING & DIAGRAM PLATE	TG Pkg_Elect	Electrical	AA

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 15 OF 66

Si No	NTPC Drg No	DRG_TITLE	SUB-SYSTEM	Dept	CATEGORY
1224	XXXX-001-110-JHS-PVE-Y-248	UNIT TRANSFORMER - HV BUSHING	TG Pkg_Elect	Electrical	AA
1225	XXXX-001-110-JHS-PVE-Y-249	UNIT TRANSFORMER - LV BUSHING	TG Pkg_Elect	Electrical	AA
1226	XXXX-001-110-PEM-PVE-B-045	TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES	TG Pkg_Elect	Electrical	AA
1227	XXXX-001-110-PEM-PVE-B-053	FRONT VIEW OF ELECTRICAL CONTROL PANEL (ECD) #1 & 2	TG Pkg_Elect	Electrical	AA
1228	XXXX-001-110-PEM-PVE-B-060	GA OF CABLE TREFOIL CLAMP	TG Pkg_Elect	Electrical	AA
1229	XXXX-001-110-PEM-PVE-B-064	GA DRG. OF ABOVE GROUND EARTHING & LIGHTNING PROTECTION MATERIALS	TG Pkg_Elect	Electrical	AA
1230	XXXX-001-110-PEM-PVE-B-095	CIRCUIT DIAGRAM AND GA OF BATTERY FUSE BOX	TG Pkg_Elect	Electrical	AA
1231	XXXX-001-110-PEM-PVE-B-096	CIRCUIT DIAGRAM AND GA OF BATTERY DISCHARGE PANEL	TG Pkg_Elect	Electrical	AA
1232	XXXX-001-110-PEM-PVE-B-107	GA OF DC BATTERY BANK	TG Pkg_Elect	Electrical	AA
1233	XXXX-001-110-PEM-PVE-B-108	GA OF BATTERY CHARGER	TG Pkg_Elect	Electrical	AA
1234	XXXX-001-110-PEM-PVE-B-118	GA DRAWING OF FIXTURES	TG Pkg_Elect	Electrical	AA
1235	XXXX-001-110-PEM-PVE-B-119	GA DRAWING OF SWITCH BOARD-TYPE SWB1 , SWB2 , SWB3	TG Pkg_Elect	Electrical	AA
1236	XXXX-001-110-PEM-PVE-B-120	GA DRAWING OF JB TYPE- JB-F , FE , (S)	TG Pkg_Elect	Electrical	AA
1237	XXXX-001-110-PEM-PVE-B-121	GA DRAWING OF RECEPTACLES	TG Pkg_Elect	Electrical	AA
1238	XXXX-001-110-PEM-PVE-B-122	GA DRAWING OF CEILING FAN 1200MM	TG Pkg_Elect	Electrical	AA
1239	XXXX-001-110-PEM-PVE-B-123	GA DRAWING OF 24V AC SUPPLY MODULE-FIXED	TG Pkg_Elect	Electrical	AA
1240	XXXX-001-110-PEM-PVE-B-124	GA DRAWING OF 24V AC SUPPLY MODULE-PORTABLE	TG Pkg_Elect	Electrical	AA
1241	XXXX-001-110-PEM-PVE-B-125	GA DRAWING OF HAND LAMP	TG Pkg_Elect	Electrical	AA
1242	XXXX-001-110-PEM-PVE-B-126	GA DRAWING OF 5A,24V SWITCHED PLUG	TG Pkg_Elect	Electrical	AA
1243	XXXX-001-110-PEM-PVE-B-127	GA DRAWING OF EMERGENCY EXIT LAMP	TG Pkg_Elect	Electrical	AA
1244	XXXX-001-110-PEM-PVE-B-128	GA DRAWING OF GALVANISED POLE-PS1 , PS2 , PF1 , PF2	TG Pkg_Elect	Electrical	AA
1245	XXXX-001-110-PEM-PVE-B-164	GA OF NGR	TG Pkg_Elect	Electrical	AA
1246	XXXX-001-110-PEM-PVE-B-619	LIGHTING MASTS - OUTLINE DIMENSIONS DRAWING/GA DRAWINGS & DATASHEET	TG Pkg_Elect	Electrical	AA
1247	XXXX-001-110-PEM-PVE-B-620	GA & DATASHEET FOR LIGHTING PANELS (LP1, LP2, LP3 & LPD TYPE)	TG Pkg_Elect	Electrical	AA
1248	XXXX-001-110-PEM-PVE-B-621	EPOXY COATED STEEL RIGID CONDUIT & ACCESSORIES - OUTLINE DIMENSION, GA DRAWINGS & DATASHEET	TG Pkg_Elect	Electrical	AA
1249	XXXX-001-110-PEM-PVE-C-046	INSTALLATION DETAILS FOR CABLE TRAY SUPPORT SYSTEM	TG Pkg_Elect	Electrical	AA
1250	XXXX-001-110-PEM-PVE-C-047	TYPICAL ABOVE GROUND EARTHING DETAILS	TG Pkg_Elect	Electrical	AA
1251	XXXX-001-110-PEM-PVE-C-048	TYPICAL BELOW GROUND EARTHING DETAILS	TG Pkg_Elect	Electrical	AA
1252	XXXX-001-110-PEM-PVE-C-049	TYPICAL LIGHTNING PROTECTION DETAILS	TG Pkg_Elect	Electrical	AA
1253	XXXX-001-110-PEM-PVE-C-068	INSTALLATION DRGS. OF CABLE FIRE SEALING SYSTEM Type-A	TG Pkg_Elect	Electrical	AA
1254	XXXX-001-110-PEM-PVE-C-071	INSTALLATION DRGS. OF CABLE FIRE SEALING SYSTEM Type-B	TG Pkg_Elect	Electrical	AA
1255	XXXX-001-110-PEM-PVE-C-129	MOUNTING ARRANGEMENT OF LIGHTING FIXTURE IN FALSE CEILING AREA	TG Pkg_Elect	Electrical	AA
1256	XXXX-001-110-PEM-PVE-F-020	BELOW GROUND EARTH MAT LAYOUT FOR MAIN PLANT AREA	TG Pkg_Elect	Electrical	AA
1257	XXXX-001-110-PEM-PVE-F-021	LAYOUT OF TRANSFORMER YARD	TG Pkg_Elect	Electrical	A
1258	XXXX-001-110-PEM-PVE-F-022	LAYOUT OF MV SWITCHGEAR ROOM UNIT #1 & 2	TG Pkg_Elect	Electrical	AA
1259	XXXX-001-110-PEM-PVE-F-023	LAYOUT OF LV SWITCHGEAR ROOM UNIT#1 & 2	TG Pkg_Elect	Electrical	AA
1260	XXXX-001-110-PEM-PVE-F-024	LAYOUT OF DC EQUIPMENT ROOM #1 & 2	TG Pkg_Elect	Electrical	AA
1261	XXXX-001-110-PEM-PVE-F-025	CABLING LAYOUT BELOW MV SWGR ROOM #1 & 2	TG Pkg_Elect	Electrical	AA
1262	XXXX-001-110-PEM-PVE-F-026	CABLING LAYOUT BELOW LV SWGR ROOM #1 & 2	TG Pkg_Elect	Electrical	AA
1263	XXXX-001-110-PEM-PVE-F-027	CABLING LAYOUT BELOW DC BATTERY ROOM #1 & 2	TG Pkg_Elect	Electrical	AA
1264	XXXX-001-110-PEM-PVE-F-028	ELECTRICAL EQUIPMENT & CABLING LAYOUT IN AIR WASHER ROOM #1 & 2	TG Pkg_Elect	Electrical	AA
1265	XXXX-001-110-PEM-PVE-F-029	ELECTRICAL EQUIPMENT & CABLING LAYOUT IN AC PLANT ROOM & AHU AREA UNIT 1 & 2	TG Pkg_Elect	Electrical	AA
1266	XXXX-001-110-PEM-PVE-F-031	ELECTRICAL EQUIPMENT & CABLING LAYOUT IN CPU	TG Pkg_Elect	Electrical	AA
1267	XXXX-001-110-PEM-PVE-F-032	CABLING LAYOUT IN TG HALL, (GROUND FLOOR) #1	TG Pkg_Elect	Electrical	AA
1268	XXXX-001-110-PEM-PVE-F-033	CABLING LAYOUT IN TG HALL, (BELOW OPERATING FLOOR) #1	TG Pkg_Elect	Electrical	AA
1269	XXXX-001-110-PEM-PVE-F-034	CABLING LAYOUT IN TG HALL, (DEAERATOR FLOOR, ADJOINING AREAS & RE UNITS) #1	TG Pkg_Elect	Electrical	AA
1270	XXXX-001-110-PEM-PVE-F-098	INTERNAL LAYOUT DRAWING FOR BATTERY CHARGER AND COMPONENT SIZING	TG Pkg_Elect	Electrical	AA
1271	XXXX-001-110-PEM-PVE-F-288	EARTHING LAYOUT OF CPU SERVICE VESSEL AREA	TG Pkg_Elect	Electrical	AA
1272	XXXX-001-110-PEM-PVE-F-289	EARTHING LAYOUT OF CPU REGENERATION AREA	TG Pkg_Elect	Electrical	AA
1273	XXXX-001-110-PEM-PVE-F-292	CABLE TRAY/TRENCH & CONDUIT ROUTING DIAGRAM FOR CONDENSATE POLISHING UNIT(REGENERATION AREA)	TG Pkg_Elect	Electrical	AA
1274	XXXX-001-110-PEM-PVE-F-623	CABLING LAYOUT IN TG HALL, (DEAERATOR FLOOR, ADJOINING AREAS & RE UNITS ABOVE OPERATING FLOOR) UNIT # 2	TG Pkg_Elect	Electrical	AA
1275	XXXX-001-110-PEM-PVE-F-625	CABLING LAYOUT IN B-C-D-E BAY EL. 13.5/14.0M	TG Pkg_Elect	Electrical	AA
1276	XXXX-001-110-PEM-PVE-G-130	Lighting layout of Complete TG building	TG Pkg_Elect	Electrical	AA
1277	XXXX-001-110-PEM-PVE-G-132	Lighting layout of CPU Building building	TG Pkg_Elect	Electrical	AA
1278	XXXX-001-110-PEM-PVE-G-151	Lighting layout of AIR WASHER BUILDING	TG Pkg_Elect	Electrical	AA
1279	XXXX-001-110-PEM-PVE-H-009	LIST OF CIRCUIT BREAKERS FOR ELECTRICAL SYSTEM AND THEIR CONTROL LOCATION	TG Pkg_Elect	Electrical	A
1280	XXXX-001-110-PEM-PVE-H-010	ANALOG INPUT/OUTPUT LIST FOR ELECTRICAL SYSTEM	TG Pkg_Elect	Electrical	A
1281	XXXX-001-110-PEM-PVE-H-011	BINARY INPUT/OUTPUT LIST FOR ELECTRICAL SYSTEM	TG Pkg_Elect	Electrical	A
1282	XXXX-001-110-PEM-PVE-H-110	BILL OF MATERIAL FOR BATTERY	TG Pkg_Elect	Electrical	AA
1283	XXXX-001-110-PEM-PVE-H-286	ELECTRICAL LOAD LIST FOR CPU	TG Pkg_Elect	Electrical	A
1284	XXXX-001-110-PEM-PVE-H-287	CABLE SCHEDULE (POWER) FOR CPU	TG Pkg_Elect	Electrical	AA
1285	XXXX-001-110-PEM-PVE-H-551	CABLE SCHEDULE FOR 11KV STATION SWITCHBOARD UNIT#1	TG Pkg_Elect	Electrical	AA
1286	XXXX-001-110-PEM-PVE-H-552	CABLE SCHEDULE FOR 11KV UNIT SWITCHBOARD UNIT#1	TG Pkg_Elect	Electrical	AA
1287	XXXX-001-110-PEM-PVE-H-553	CABLE SCHEDULE FOR 11KV STATION SWITCHBOARD UNIT#2	TG Pkg_Elect	Electrical	AA
1288	XXXX-001-110-PEM-PVE-H-554	CABLE SCHEDULE FOR 11KV UNIT SWITCHBOARD UNIT#2	TG Pkg_Elect	Electrical	AA
1289	XXXX-001-110-PEM-PVE-H-555	CABLE SCHEDULE FOR 3.3KV UNIT AUXILIARY SWITCHBOARD UNIT#1	TG Pkg_Elect	Electrical	AA
1290	XXXX-001-110-PEM-PVE-H-556	CABLE SCHEDULE FOR 3.3KV UNIT AUXILIARY SWITCHBOARD UNIT#2	TG Pkg_Elect	Electrical	AA
1291	XXXX-001-110-PEM-PVE-H-557	CABLE SCHEDULE FOR STATION SERVICE SWBD.-1	TG Pkg_Elect	Electrical	AA
1292	XXXX-001-110-PEM-PVE-H-558	CABLE SCHEDULE FOR STATION SERVICE SWBD.-2	TG Pkg_Elect	Electrical	AA
1293	XXXX-001-110-PEM-PVE-H-559	CABLE SCHEDULE FOR AIR WASHER MCC-1	TG Pkg_Elect	Electrical	AA
1294	XXXX-001-110-PEM-PVE-H-560	CABLE SCHEDULE FOR AIR WASHER MCC-2	TG Pkg_Elect	Electrical	AA
1295	XXXX-001-110-PEM-PVE-H-561	CABLE SCHEDULE FOR VENTILATION MCC-1	TG Pkg_Elect	Electrical	AA
1296	XXXX-001-110-PEM-PVE-H-562	CABLE SCHEDULE FOR VENTILATION MCC-2	TG Pkg_Elect	Electrical	AA
1297	XXXX-001-110-PEM-PVE-H-563	CABLE SCHEDULE FOR AIR CONDITIONING MCC	TG Pkg_Elect	Electrical	AA
1298	XXXX-001-110-PEM-PVE-H-564	CABLE SCHEDULE FOR UNIT EMERGENCY MCC-1	TG Pkg_Elect	Electrical	AA
1299	XXXX-001-110-PEM-PVE-H-565	CABLE SCHEDULE FOR UNIT EMERGENCY MCC-2	TG Pkg_Elect	Electrical	AA
1300	XXXX-001-110-PEM-PVE-H-566	CABLE SCHEDULE FOR UNIT SERVICE ACDB-1	TG Pkg_Elect	Electrical	AA
1301	XXXX-001-110-PEM-PVE-H-567	CABLE SCHEDULE FOR UNIT SERVICE ACDB-2	TG Pkg_Elect	Electrical	AA
1302	XXXX-001-110-PEM-PVE-H-568	CABLE SCHEDULE FOR UNIT SERVICE SWBD.-1	TG Pkg_Elect	Electrical	AA
1303	XXXX-001-110-PEM-PVE-H-569	CABLE SCHEDULE FOR UNIT SERVICE SWBD.-2	TG Pkg_Elect	Electrical	AA
1304	XXXX-001-110-PEM-PVE-H-570	CABLE SCHEDULE FOR TURBINE MCC-1	TG Pkg_Elect	Electrical	AA
1305	XXXX-001-110-PEM-PVE-H-571	CABLE SCHEDULE FOR TURBINE MCC-2	TG Pkg_Elect	Electrical	AA
1306	XXXX-001-110-PEM-PVE-H-572	CABLE SCHEDULE FOR TURBINE VALVE ACDB-1	TG Pkg_Elect	Electrical	AA
1307	XXXX-001-110-PEM-PVE-H-573	CABLE SCHEDULE FOR TURBINE VALVE ACDB-2	TG Pkg_Elect	Electrical	AA

PART-B

Si No	NTPC Drg No	DRG_TITLE	SUB-SYSTEM	Dept	CATEGORY
1308	XXXX-001-110-PEM-PVE-H-574	CABLE SCHEDULE FOR SERVICE BLDG. PMCC	TG Pkg_Elect	Electrical	AA
1309	XXXX-001-110-PEM-PVE-H-575	CABLE SCHEDULE FOR CPU REGENERATION. MCC	TG Pkg_Elect	Electrical	AA
1310	XXXX-001-110-PEM-PVE-H-576	CABLE SCHEDULE FOR MISC MCC	TG Pkg_Elect	Electrical	AA
1311	XXXX-001-110-PEM-PVE-H-577	CABLE SCHEDULE FOR 220V MAIN DCDB-1	TG Pkg_Elect	Electrical	AA
1312	XXXX-001-110-PEM-PVE-H-578	CABLE SCHEDULE FOR 220V MAIN DCDB-2	TG Pkg_Elect	Electrical	AA
1313	XXXX-001-110-PEM-PVE-H-580	CABLE SCHEDULE FOR ECP-1	TG Pkg_Elect	Electrical	AA
1314	XXXX-001-110-PEM-PVE-H-581	CABLE SCHEDULE FOR ECP-2	TG Pkg_Elect	Electrical	AA
1315	XXXX-001-110-PEM-PVE-H-584	CABLE INTERCONNECTION FOR 11KV STATION SWITCHBOARD UNIT#1	TG Pkg_Elect	Electrical	AA
1316	XXXX-001-110-PEM-PVE-H-585	CABLE INTERCONNECTION FOR 11KV UNIT SWITCHBOARD UNIT#1	TG Pkg_Elect	Electrical	AA
1317	XXXX-001-110-PEM-PVE-H-586	CABLE INTERCONNECTION FOR 11KV STATION SWITCHBOARD UNIT#2	TG Pkg_Elect	Electrical	AA
1318	XXXX-001-110-PEM-PVE-H-587	CABLE INTERCONNECTION FOR 11KV UNIT SWITCHBOARD UNIT#2	TG Pkg_Elect	Electrical	AA
1319	XXXX-001-110-PEM-PVE-H-588	CABLE INTERCONNECTION FOR 3.3KV UNIT AUXILIARY SWITCHBOARD UNIT#1	TG Pkg_Elect	Electrical	AA
1320	XXXX-001-110-PEM-PVE-H-589	CABLE INTERCONNECTION FOR 3.3KV UNIT AUXILIARY SWITCHBOARD UNIT#2	TG Pkg_Elect	Electrical	AA
1321	XXXX-001-110-PEM-PVE-H-590	CABLE INTERCONNECTION FOR STATION SERVICE SWBD.-1	TG Pkg_Elect	Electrical	AA
1322	XXXX-001-110-PEM-PVE-H-591	CABLE INTERCONNECTION FOR STATION SERVICE SWBD.-2	TG Pkg_Elect	Electrical	AA
1323	XXXX-001-110-PEM-PVE-H-592	CABLE INTERCONNECTION FOR AIR WASHER MCC-1	TG Pkg_Elect	Electrical	AA
1324	XXXX-001-110-PEM-PVE-H-593	CABLE INTERCONNECTION FOR AIR WASHER MCC-2	TG Pkg_Elect	Electrical	AA
1325	XXXX-001-110-PEM-PVE-H-594	CABLE INTERCONNECTION FOR VENTILATION MCC-1	TG Pkg_Elect	Electrical	AA
1326	XXXX-001-110-PEM-PVE-H-595	CABLE INTERCONNECTION FOR VENTILATION MCC-2	TG Pkg_Elect	Electrical	AA
1327	XXXX-001-110-PEM-PVE-H-596	CABLE INTERCONNECTION FOR AIR CONDITIONING MCC	TG Pkg_Elect	Electrical	AA
1328	XXXX-001-110-PEM-PVE-H-597	CABLE INTERCONNECTION FOR UNIT EMERGENCY MCC-1	TG Pkg_Elect	Electrical	AA
1329	XXXX-001-110-PEM-PVE-H-598	CABLE INTERCONNECTION FOR UNIT EMERGENCY MCC-2	TG Pkg_Elect	Electrical	AA
1330	XXXX-001-110-PEM-PVE-H-599	CABLE INTERCONNECTION FOR UNIT SERVICE ACDB-1	TG Pkg_Elect	Electrical	AA
1331	XXXX-001-110-PEM-PVE-H-600	CABLE INTERCONNECTION FOR UNIT SERVICE ACDB-2	TG Pkg_Elect	Electrical	AA
1332	XXXX-001-110-PEM-PVE-H-601	CABLE INTERCONNECTION FOR UNIT SERVICE SWBD.-1	TG Pkg_Elect	Electrical	AA
1333	XXXX-001-110-PEM-PVE-H-602	CABLE INTERCONNECTION FOR UNIT SERVICE SWBD.-2	TG Pkg_Elect	Electrical	AA
1334	XXXX-001-110-PEM-PVE-H-603	CABLE INTERCONNECTION FOR TURBINE MCC-1	TG Pkg_Elect	Electrical	AA
1335	XXXX-001-110-PEM-PVE-H-604	CABLE INTERCONNECTION FOR TURBINE MCC-2	TG Pkg_Elect	Electrical	AA
1336	XXXX-001-110-PEM-PVE-H-605	CABLE INTERCONNECTION FOR TURBINE VALVE ACDB-1	TG Pkg_Elect	Electrical	AA
1337	XXXX-001-110-PEM-PVE-H-606	CABLE INTERCONNECTION FOR TURBINE VALVE ACDB-2	TG Pkg_Elect	Electrical	AA
1338	XXXX-001-110-PEM-PVE-H-607	CABLE INTERCONNECTION FOR SERVICE BLDG. PMCC	TG Pkg_Elect	Electrical	AA
1339	XXXX-001-110-PEM-PVE-H-608	CABLE INTERCONNECTION FOR CPU REGENERATION. MCC	TG Pkg_Elect	Electrical	AA
1340	XXXX-001-110-PEM-PVE-H-609	CABLE INTERCONNECTION FOR MISC MCC	TG Pkg_Elect	Electrical	AA
1341	XXXX-001-110-PEM-PVE-H-610	CABLE INTERCONNECTION FOR 220V MAIN DCDB-1	TG Pkg_Elect	Electrical	AA
1342	XXXX-001-110-PEM-PVE-H-611	CABLE INTERCONNECTION FOR 220V MAIN DCDB-2	TG Pkg_Elect	Electrical	AA
1343	XXXX-001-110-PEM-PVE-H-613	CABLE INTERCONNECTION FOR ECP-1	TG Pkg_Elect	Electrical	AA
1344	XXXX-001-110-PEM-PVE-H-614	CABLE INTERCONNECTION FOR ECP-2	TG Pkg_Elect	Electrical	AA
1345	XXXX-001-110-PEM-PVE-H-615	CABLE INTERCONNECTION FOR DDCMIS-1	TG Pkg_Elect	Electrical	AA
1346	XXXX-001-110-PEM-PVE-H-616	CABLE INTERCONNECTION FOR DDCMIS-2	TG Pkg_Elect	Electrical	AA
1347	XXXX-001-110-PEM-PVE-L-035	INTERPLANT CABLING- ZONE A	TG Pkg_Elect	Electrical	AA
1348	XXXX-001-110-PEM-PVE-L-051	LIGHTNING PROTECTION ARRANGEMENT FOR MAIN PH BUILDING	TG Pkg_Elect	Electrical	AA
1349	XXXX-001-110-PEM-PVE-L-052	SYNCHRONISING SCHEME FOR ELECTRICAL CONTROL PANEL (ECD) #1 & 2	TG Pkg_Elect	Electrical	A
1350	XXXX-001-110-PEM-PVE-L-054	INTERFACE SCHEME FOR ELECTRICAL CONTROL PANEL (ECD) #1 & 2	TG Pkg_Elect	Electrical	A
1351	XXXX-001-110-PEM-PVE-L-057	PLANT ELECTRICAL SCHEMATICS FOR DDCMIS #1 & 2	TG Pkg_Elect	Electrical	A
1352	XXXX-001-110-PEM-PVE-L-093	SCHEMATIC/ POWER CIRCUIT DIAGRAM FOR BATTERY CHARGER	TG Pkg_Elect	Electrical	AA
1353	XXXX-001-110-PEM-PVE-L-421	SCHEMATIC CIRCUIT DIAGRAM OFA) PROTECTIVE PANEL, MAIN AND LIGHTING CIRCUIT & BOM B) MAIN HOIST PANEL & BOM C) AUX/ HOIST PANEL & BOM D) CROSS TRAVERSE & BOM E) LONG TRAVERSE & BOM , INCLUDING EARTHING DIAGRAM AND CONTROL WRITE UP	TG Pkg_Elect	Electrical	AA
1354	XXXX-001-110-PEM-PVE-L-444	POWER & CONTROL SCHEME FOR ELECTRICAL WIRE ROPE HOISTS INCLUDING CONTROL PANEL AND PENDENT DETAILS	TG Pkg_Elect	Electrical	AA
1355	XXXX-001-110-PEM-PVE-N-109	BATTERY CATALOGUES, PERFORMANCE CURVES, CAPACITY CURVES, DERATING FACTOR FOR AMBIENT TEMPERATURE	TG Pkg_Elect	Electrical	AA
1356	XXXX-001-110-PEM-PVE-P-058	ELECTRICAL SINGLE LINE DIAGRAM FOR AUXILIARY POWER DISTRIBUTION	TG Pkg_Elect	Electrical	A
1357	XXXX-001-110-PEM-PVE-U-001	DESIGN PHILOSOPHY FOR ELECTRICAL EQUIPMENT LAYOUT	TG Pkg_Elect	Electrical	A
1358	XXXX-001-110-PEM-PVE-U-002	DESIGN CALCULATIONS FOR MV CABLES SELECTION & SIZING	TG Pkg_Elect	Electrical	A
1359	XXXX-001-110-PEM-PVE-U-003	DESIGN CALCULATIONS FOR LV CABLES SELECTION & SIZING	TG Pkg_Elect	Electrical	A
1360	XXXX-001-110-PEM-PVE-U-004	CABLE ERECTION PHILOSOPHY	TG Pkg_Elect	Electrical	A
1361	XXXX-001-110-PEM-PVE-U-005	Design Memorandum for Fire Sealing System	TG Pkg_Elect	Electrical	A
1362	XXXX-001-110-PEM-PVE-U-007	DESIGN MEMORANDUM FOR GROUNDING SYSTEM	TG Pkg_Elect	Electrical	A
1363	XXXX-001-110-PEM-PVE-U-008	DESIGN MEMORANDUM FOR LIGHTNING PROTECTION SYSTEM	TG Pkg_Elect	Electrical	A
1364	XXXX-001-110-PEM-PVE-U-012	DESIGN MEMORANDUM FOR LIGHTING SYSTEM	TG Pkg_Elect	Electrical	A
1365	XXXX-001-110-PEM-PVE-U-019	DESIGN CALCULATIONS FOR LV AC SYSTEM	TG Pkg_Elect	Electrical	A
1366	XXXX-001-110-PEM-PVE-U-040	CT/VT SIZING CALCULATIONS FOR MV SWITCHBOARDS	TG Pkg_Elect	Electrical	A
1367	XXXX-001-110-PEM-PVE-U-411	DSL VOLTAGE DROP & CABLE SIZE CALCULATION OF TG HALL EOT CRANE	TG Pkg_Elect	Electrical	AA
1368	XXXX-001-110-PEM-PVE-U-412	DSL VOLTAGE DROP & CABLE SIZE CALCULATION-BFP HANDLING EOT CRANE	TG Pkg_Elect	Electrical	AA
1369	XXXX-001-110-PEM-PVE-W-044	CONTROL LOGIC FOR 415V PCC/ MCC INCOMER, BUS COUPLER & OUTGOING FEEDERS	TG Pkg_Elect	Electrical	A
1370	XXXX-001-110-PEM-PVE-W-055	LOGIC DIAGRAM FOR ELECTRICAL CONTROL DESK AND ASSOCIATED DDCMIS	TG Pkg_Elect	Electrical	A
1371	XXXX-001-110-PEM-PVE-W-056	LOGIC DIAGRAM FOR CIRCUIT BREAKERS CONTROLLED FROM DDCMIS ONLY	TG Pkg_Elect	Electrical	A
1372	XXXX-001-110-PEM-PVE-W-061	TYPE TEST REPORT OF CABLE TREFOIL CLAMP	TG Pkg_Elect	Electrical	AA
1373	XXXX-001-110-PEM-PVE-W-066	TYPE TEST CERTIFICATES OF CABLE TERMINATION & JOINTING KITS	TG Pkg_Elect	Electrical	AA
1374	XXXX-001-110-PEM-PVE-W-069	TYPE TEST CERTIFICATES OF CABLE FIRE SEALING SYSTEM Type-A	TG Pkg_Elect	Electrical	AA
1375	XXXX-001-110-PEM-PVE-W-072	TYPE TEST CERTIFICATES OF CABLE FIRE SEALING SYSTEM TYPE-B	TG Pkg_Elect	Electrical	AA
1376	XXXX-001-110-PEM-PVE-W-074	TYPE TEST REPORTS FOR TEST CONDUCTED- HT XLPE CABLES	TG Pkg_Elect	Electrical	AA
1377	XXXX-001-110-PEM-PVE-W-076	TYPE TEST REPORTS FOR TEST CONDUCTED - LT XLPE POWER CABLES	TG Pkg_Elect	Electrical	AA
1378	XXXX-001-110-PEM-PVE-W-078	TYPE TEST REPORTS FOR TEST CONDUCTED - LT PVC CABLES	TG Pkg_Elect	Electrical	AA
1379	XXXX-001-110-PEM-PVE-W-094	Bill of Material for Battery Charger with list of makes	TG Pkg_Elect	Electrical	AA
1380	XXXX-001-110-PEM-PVE-W-097	OPERATIONAL WRITE UP FOR BATTERY CHARGER	TG Pkg_Elect	Electrical	AA
1381	XXXX-001-110-PEM-PVE-W-100	LIST OF E & C SPARES FOR BATTERY CHARGER	TG Pkg_Elect	Electrical	AA
1382	XXXX-001-110-PEM-PVE-W-101	LIST OF O&M SPARES FOR BATTERY CHARGER	TG Pkg_Elect	Electrical	AA
1383	XXXX-001-110-PEM-PVE-W-102	LIST OF MANDATORY SPARES FOR BATTERY CHARGER	TG Pkg_Elect	Electrical	AA
1384	XXXX-001-110-PEM-PVE-W-103	TYPE TEST CERTIFICATES FOR BATTERY CHARGER	TG Pkg_Elect	Electrical	AA
1385	XXXX-001-110-PEM-PVE-W-112	LIST OF E & C SPARES FOR BATTERY	TG Pkg_Elect	Electrical	AA

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 17 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
1386	XXXX-001-110-PEM-PVE-W-113	LIST OF O&M SPARES FOR BATTERY	TG Pkg_Elect	Electrical	AA
1387	XXXX-001-110-PEM-PVE-W-114	LIST OF MANDATORY SPARES FOR BATTERY	TG Pkg_Elect	Electrical	AA
1388	XXXX-001-110-PEM-PVE-W-162	TYPE TEST PROCEDURE OF NGR	TG Pkg_Elect	Electrical	AA
1389	XXXX-001-110-PEM-PVE-W-163	TYPE TEST CERTIFICATES OF NGR	TG Pkg_Elect	Electrical	AA
1390	XXXX-001-110-PEM-PVE-W-290	TYPE TEST REPORT OF CV TEST FOR CONTROL VALVE (FOR CPP)	TG Pkg_Elect	Electrical	AA
1391	XXXX-001-110-PEM-PVE-W-291	TYPE TEST REPORT FOR FLOW NOZZLES & ORIFICE PLATES (FOR CPP)	TG Pkg_Elect	Electrical	AA
1392	XXXX-001-110-PEM-PVE-W-413	TYPE TEST REPORT OF MOTORS ABOVE 50 KW TG HALL DG EOT CRANE	TG Pkg_Elect	Electrical	AA
1393	XXXX-001-110-PEM-PVE-W-617	LIGHTING FIXTURE TYPE TEST REPORTS	TG Pkg_Elect	Electrical	AA
1394	XXXX-001-110-PEM-PVE-W-618	TYPE TEST REPORTS FOR JUNCTION BOX	TG Pkg_Elect	Electrical	AA
1395	XXXX-001-110-PEM-PVE-W-622	TYPE TEST REPORT FOR CABLE TRAY SUPPORT SYSTEM	TG Pkg_Elect	Electrical	AA
1396	XXXX-001-110-PEM-PVE-Y-016	RELAY SETTINGS CHART FOR MV /LV SYSTEM (OTHER THAN MOTORS)	TG Pkg_Elect	Electrical	A
1397	XXXX-001-110-PEM-PVE-Y-017	RELAY SETTINGS CHART FOR MV MOTORS	TG Pkg_Elect	Electrical	A
1398	XXXX-001-110-PEM-PVE-Y-018	RELAY SETTINGS CHART FOR LV MOTORS	TG Pkg_Elect	Electrical	A
1399	XXXX-001-110-PEM-PVE-Y-059	TECHNICAL DATA SHEET OF CABLE TREFOIL CLAMP	TG Pkg_Elect	Electrical	AA
1400	XXXX-001-110-PEM-PVE-Y-062	TECHNICAL DATA SHEET & GA DRG.FOR CABLE TRAYS & ACCESSORIES	TG Pkg_Elect	Electrical	AA
1401	XXXX-001-110-PEM-PVE-Y-063	TECHNICAL DATA SHEET FOR ABOVE GROUND EARTHING & LIGHTNING PROTECTION MATERIALS	TG Pkg_Elect	Electrical	AA
1402	XXXX-001-110-PEM-PVE-Y-065	TECHNICAL DATA SHEET AND GA OF CABLE TERMINATION & JOINTING KITS	TG Pkg_Elect	Electrical	AA
1403	XXXX-001-110-PEM-PVE-Y-067	TECHNICAL DATA SHEET OF CABLE FIRE SEALING SYSTEM Type-A	TG Pkg_Elect	Electrical	AA
1404	XXXX-001-110-PEM-PVE-Y-070	TECHNICAL DATA SHEET OF CABLE FIRE SEALING SYSTEM Type-B	TG Pkg_Elect	Electrical	AA
1405	XXXX-001-110-PEM-PVE-Y-073	TECHNICAL DATA SHEET AND CROSS SECTION DRGS.- HT XLPE CABLES	TG Pkg_Elect	Electrical	AA
1406	XXXX-001-110-PEM-PVE-Y-075	TECHNICAL DATA SHEET & CROSS SECTION DRGS - LT XLPE POWER CABLES	TG Pkg_Elect	Electrical	AA
1407	XXXX-001-110-PEM-PVE-Y-077	TECHNICAL DATA SHEET & CROSS SECTION DRGS - LT PVC CONTROL CABLES	TG Pkg_Elect	Electrical	AA
1408	XXXX-001-110-PEM-PVE-Y-105	TDS FOR BATTERY	TG Pkg_Elect	Electrical	AA
1409	XXXX-001-110-PEM-PVE-Y-106	TDS FOR BATTERY CHARGER	TG Pkg_Elect	Electrical	AA
1410	XXXX-001-110-PEM-PVE-Y-161	DATA SHEET OF NGR	TG Pkg_Elect	Electrical	AA
1411	XXXX-001-110-PEM-PVE-Y-194	ACTUATOR DATA SHEET OF BUTTERFLY VALVES (STEAM SERVICE)	TG Pkg_Elect	Electrical	AA
1412	XXXX-001-110-PEM-PVE-Y-308	TECHNICAL DATA SHEET, GA DRAWING AND PERFORMANCE CURVES OF MOTOR FOR CENTRIFUGAL FAN & PUMPS	TG Pkg_Elect	Electrical	AA
1413	XXXX-001-110-PEM-PVE-Y-309	TECHNICAL DATA SHEET, GA DRAWING & PERFORMANCE CURVES OF MOTOR FOR AXIAL FLOW & ROOF EXTRACTOR FANS	TG Pkg_Elect	Electrical	AA
1414	XXXX-001-110-PEM-PVE-Y-310	TECHNICAL DATA SHEET & GA DRAWING FOR ROOF EXTRACTOR ALONGWITH FIXING DETAILS	TG Pkg_Elect	Electrical	AA
1415	XXXX-001-110-PEM-PVE-Y-311	TECHNICAL DATA SHEET & GA DRAWING OF CENTRIFUGAL FAN FOR AIR WASHER	TG Pkg_Elect	Electrical	AA
1416	XXXX-001-110-PEM-PVE-Y-348	TECHNICAL DATA SHEET, GA DRAWING AND PERFORMANCE CURVES OF MOTOR FOR PUMPS, COOLING TOWER & CENTRIFUGAL FAN	TG Pkg_Elect	Electrical	AA
1417	XXXX-001-110-PEM-PVE-Y-390	TECHNICAL DATA SHEET FOR VFD	TG Pkg_Elect	Electrical	AA
1418	XXXX-001-110-PEM-PVM-B-422	TG -EOT CRANE (GA OF A) PROTECTIVE PANELS) MAIN HOIST PANEL.C) AUX HOIST PANEL.D) CROSS TRAVEL PANEL.E) LONG TRAVEL PANEL.F) PENDENT, G) RRC	TG Pkg_Elect	Electrical	AA
1419	XXXX-001-110-PEM-PVM-B-430	BFP HALL EOT CRANE -SCHEMATIC CIRCUIT DIAGRAM OF A) PROTECTIVE PANEL, MAIN AND LIGHTING CIRCUIT & BOM B) MAIN HOIST PANEL & BOM C) CROSS TRAVERSE & BOM D) LONG TRAVERSE & BOM , INCLUDING EARTHING DIAGRAM AND CONTROL WRITE UP	TG Pkg_Elect	Electrical	AA
1420	XXXX-001-110-PEM-PVM-B-431	BFP HALL EOT CRANE -GA OF A) PROTECTIVE PANELS) MAIN HOIST PANEL.C) CROSS TRAVEL PANEL.D) LONG TRAVEL PANEL.E) PENDENT,	TG Pkg_Elect	Electrical	AA
1421	XXXX-001-110-PESD-PVE-B-019	DATA SHEET OF POWER CABLE	TG Pkg_Elect	Electrical	AA
1422	XXXX-001-110-RU-PVE-B-004	General Arrangement and wiring diagram of PTSP Cubicle for IPB	TG Pkg_Elect	Electrical	AA
1423	XXXX-001-110-RU-PVE-B-005	General Arrangement and wiring diagram of Neutral Grounding Cubicle for IPB	TG Pkg_Elect	Electrical	AA
1424	XXXX-001-110-RU-PVE-B-009	General Arrangement and wiring diagram of CT Marshalling Box for IPB	TG Pkg_Elect	Electrical	AA
1425	XXXX-001-110-RU-PVE-B-010	General Arrangement and wiring diagram of Pressurisation System for IPB	TG Pkg_Elect	Electrical	AA
1426	XXXX-001-110-RU-PVE-C-100	EKD of IPB (Main, delta and tap-off run) for unit 1,2	TG Pkg_Elect	Electrical	AA
1427	XXXX-001-110-RU-PVE-C-101	EKD of segregated phase busduct	TG Pkg_Elect	Electrical	AA
1428	XXXX-001-110-RU-PVE-F-012	Layout of IPB (Main, Delta & Tap-Off Run) for Unit-1, 2	TG Pkg_Elect	Electrical	A
1429	XXXX-001-110-RU-PVE-F-020	Earthing Layout of Isolated Phase Busduct for Unit-1,2	TG Pkg_Elect	Electrical	AA
1430	XXXX-001-110-RU-PVE-F-107	Layout of Segregated Phase Busduct	TG Pkg_Elect	Electrical	AA
1431	XXXX-001-110-RU-PVE-F-120	O&M Manual for Busducts	TG Pkg_Elect	Electrical	AA
1432	XXXX-001-110-RU-PVE-L-100	termination details of IPB on main equipments	TG Pkg_Elect	Electrical	AA
1433	XXXX-001-110-RU-PVE-L-101	termination details of SPBD on main equipments	TG Pkg_Elect	Electrical	AA
1434	XXXX-001-110-RU-PVE-V-017	Structure and Foundation Layout of IPB for Unit-1, 2	TG Pkg_Elect	Electrical	AA
1435	XXXX-001-110-RU-PVE-V-108	Foundation and Structure of Segregated Phase Busduct	TG Pkg_Elect	Electrical	AA
1436	XXXX-001-110-RU-PVE-W-023	Type test report for Main run IPBD	TG Pkg_Elect	Electrical	AA
1437	XXXX-001-110-RU-PVE-W-024	Type test report for Delta run IPBD	TG Pkg_Elect	Electrical	AA
1438	XXXX-001-110-RU-PVE-W-025	Type test report for Tap-off run IPBD	TG Pkg_Elect	Electrical	AA
1439	XXXX-001-110-RU-PVE-W-100	Design calculation IPB	TG Pkg_Elect	Electrical	A
1440	XXXX-001-110-RU-PVE-W-101	Design calculation of IPB supporting structure	TG Pkg_Elect	Electrical	AA
1441	XXXX-001-110-RU-PVE-W-102	Design calculation SPB	TG Pkg_Elect	Electrical	A
1442	XXXX-001-110-RU-PVE-W-103	Design calculation of SPB supporting structure	TG Pkg_Elect	Electrical	AA
1443	XXXX-001-110-RU-PVE-W-139	Type Test Report of Segregated Phase Busduct.	TG Pkg_Elect	Electrical	AA
1444	XXXX-001-110-RU-PVE-Y-006	Technical Data Sheet of Generator Busduct & Associated equipment	TG Pkg_Elect	Electrical	AA
1445	XXXX-001-110-RU-PVE-Y-103	Technical Data Sheet of Segregated Phase Busduct	TG Pkg_Elect	Electrical	AA
1446	XX15-370-102-PVE-B-009	GA Drawing for LV Transformers	SG-Elect Equip	ELECTRICAL	AA
1447	XX15-370-102-PVE-B-009A	GA & Foundation Drawing For 11/0.433 kV, 2.5 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	AA
1448	XX15-370-102-PVE-B-010	GA Drawing for LV Busduct	SG-Elect Equip	ELECTRICAL	AA
1449	XX15-370-102-PVE-B-011	Termination Drawing of LV Busduct	SG-Elect Equip	ELECTRICAL	AA
1450	XX15-370-102-PVE-B-056	GA & Foundation Drawing For 11/11.5 kV, 0.63 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	AA
1451	XX15-370-102-PVE-B-057	GA & Foundation Drawing For 11/11.5 kV, 12.5 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	AA
1452	XX15-370-102-PVE-B-058	GA & Foundation Drawing For 11/3.45 kV, 16 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	AA
1453	XX15-370-102-PVE-B-059	GA & Foundation Drawing For 11/3.45 kV, 12.5 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	AA
1454	XX15-370-102-PVE-B-060	GA & Foundation Drawing For 11/3.45 kV, 5 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	AA
1455	XX15-370-102-PVE-B-061	GA & Foundation Drawing For 11/0.433 kV, 1.6 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	AA
1456	XX15-370-102-PVE-B-062	GA & Foundation Drawing For 11/0.433 kV, 1 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	AA
1457	XX15-370-102-PVE-B-063	GA & Foundation Drawing For 11/0.433 kV, 0.63 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	AA
1458	XX15-370-102-PVE-B-064	GA & Foundation Drawing For 11/3.45 kV, 7.5 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	AA
1459	XX15-370-102-PVE-B-065	GA & Foundation Drawing For 11/0.433 kV, 2 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	AA
1460	XX15-370-102-PVE-B-006	Mandatory Spare List for LV Busduct	SG-Elect Equip	ELECTRICAL	AA

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 18 OF 66

Si No	NTPC Drg No	DRG_TITLE	SUB-SYSTEM	Dept	CATEGORY
1461	XX15-370-102-PVE-H-007	Mandatory Spare List for LV Transformers	SG-Elect Equip	ELECTRICAL	AA
1462	XX15-370-102-PVE-H-007A	Painting Procedure For Oil Type Transformers	SG-Elect Equip	ELECTRICAL	AA
1463	XX15-370-102-PVE-H007	Mandatory Spare List for LV Transformers	SG-Elect Equip	ELECTRICAL	AA
1464	XX15-370-102-PVE-W-150	Miscellaneous Documents For 11/11.5 kV, 0.63 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	A
1465	XX15-370-102-PVE-W-151	Miscellaneous Documents For 11/11.5 kV, 12.5 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	A
1466	XX15-370-102-PVE-W-152	Miscellaneous Documents For 11/3.45 kV, 16 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	A
1467	XX15-370-102-PVE-W-153	Miscellaneous Documents For 11/3.45 kV, 12.5 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	A
1468	XX15-370-102-PVE-W-154	Miscellaneous Documents For 11/3.45 kV, 7.5 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	A
1469	XX15-370-102-PVE-W-155	Miscellaneous Documents For 11/3.45 kV, 5 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	A
1470	XX15-370-102-PVE-W-156	Miscellaneous Documents For 11/0.433 kV, 2.5 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	A
1471	XX15-370-102-PVE-W-157	Miscellaneous Documents For 11/0.433 kV, 2 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	A
1472	XX15-370-102-PVE-W-158	Miscellaneous Documents For 11/0.433 kV, 1.6 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	A
1473	XX15-370-102-PVE-W-159	Miscellaneous Documents For 11/0.433 kV, 1 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	A
1474	XX15-370-102-PVE-W-160	Miscellaneous Documents For 11/0.433 kV, 0.63 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	A
1475	XX15-370-102-PVE-W-161	Type Test Procedure For Oil Type Transformers	SG-Elect Equip	ELECTRICAL	A
1476	XX15-370-102-PVE-W-162	Type Test Report For Oil Type Transformers	SG-Elect Equip	ELECTRICAL	A
1477	XX15-370-102-PVE-W-163	Catalogue of Accessories For Oil Type Transformers	SG-Elect Equip	ELECTRICAL	A
1478	XX15-370-102-PVE-W-164	List of Mandatory Spares For Oil Type Transformers	SG-Elect Equip	ELECTRICAL	A
1479	XX15-370-102-PVE-X-002	Erection, Installation & Commissioning Manual For Oil Type Transformers	SG-Elect Equip	ELECTRICAL	A
1480	XX15-370-102-PVE-X-003	Operation & Maintenance Manual For Oil Type Transformers	SG-Elect Equip	ELECTRICAL	A
1481	XX15-370-102-PVE-Y-034	Data Sheet for LV Transformers	SG-Elect Equip	ELECTRICAL	AA
1482	XX15-370-102-PVE-Y-034A	Datasheet For 11/0.433 kV, 2.5 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	A
1483	XX15-370-102-PVE-Y-036	Data Sheet for Earthing Material	SG BLR	ELECTRICAL	AA
1484	XX15-370-102-PVE-Y-037	Data Sheet for Illumination - Fixtures & Accessories	SG BLR	ELECTRICAL	A
1485	XX15-370-102-PVE-Y-038	Data Sheet for Illumination - Lighting Panels	SG BLR	ELECTRICAL	A
1486	XX15-370-102-PVE-Y-044	Datasheet For 11/11.5 kV, 0.63 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	A
1487	XX15-370-102-PVE-Y-045	Datasheet For 11/11.5 kV, 12.5 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	A
1488	XX15-370-102-PVE-Y-046	Datasheet For 11/3.45 kV, 16 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	A
1489	XX15-370-102-PVE-Y-047	Datasheet For 11/3.45 kV, 12.5 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	A
1490	XX15-370-102-PVE-Y-048	Datasheet For 11/3.45 kV, 7.5 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	A
1491	XX15-370-102-PVE-Y-049	Datasheet For 11/3.45 kV, 5 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	A
1492	XX15-370-102-PVE-Y-050	Datasheet For 11/0.433 kV, 1.6 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	A
1493	XX15-370-102-PVE-Y-051	Datasheet For 11/0.433 kV, 1 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	A
1494	XX15-370-102-PVE-Y-052	Datasheet For 11/0.433 kV, 0.63 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	A
1495	XX15-370-102-PVE-Y-053	Datasheet For 11/0.433 kV, 2 MVA, Oil Filled Transformer	SG-Elect Equip	ELECTRICAL	A
1496	XX15-370-215-PVE-B-002	CABLE TREFOIL CLAMPS - DETAILS, DRAWINGS & MANUFACTURER'S CATALOGUE	SG-Elect Equip	ELECTRICAL	AA
1497	XX15-370-215-PVE-B-118	GA DRG, GTP OF NEUTRAL GROUNDING RESISTORS (NGRs)	SG-Elect Equip	ELECTRICAL	AA
1498	XX15-370-215-PVE-Y-004	LEAD COATED STEEL FLEXIBLE CONDUIT & ACCESSORIES - OUTLINE	SG-Elect Equip	ELECTRICAL	AA
1499	XX15-370-215-PVE-Y-011	CABLE LUGS/FERRULES - DATA SHEETS & MANUFACTURER'S CATALOGUE	SG-Elect Equip	ELECTRICAL	AA
1500	XX15-370-215-PVE-Y-036	EPOXY COATED STEEL RIGID CONDUIT & ACCESSORIES - OUTLINE DRAWING	SG-Elect Equip	ELECTRICAL	AA
1501	4540-XXXX-PVE	CLAMPS & CONNECTORS (GT / ST / BUS REACTOR) - GA DRAWING & T	BOP Switchyard	Electrical	AA
1502	4540-XXXX-PVE	Type Test Reports of 48V Battery Charger for Switchyard Package	BOP Switchyard	Electrical	AA
1503	4540-XXXX-PVE	Type Test Reports of Battery Charger	BOP Switchyard	Electrical	AA
1504	4540-XXXX-PVE	Mandatory Spares List for Battery	BOP Switchyard	Electrical	AA
1505	4540-XXXX-PVE	Electrical Wiring Diagram & Motor Datasheet for EOT Crane	BOP Switchyard	Electrical	AA
1506	4540-XXXX-PVE	Gas Monitoring / Alarm System for 400kV GIS	BOP Switchyard	Electrical	AA
1507	4540-XXXX-PVE	GTP & BOQ for Energy Metering System	BOP Switchyard	Electrical	AA
1508	4540-XXXX-PVE	Mandatory Spare List for 400kV GIS	BOP Switchyard	Electrical	AA
1509	4540-XXXX-PVE	Mandatory Maintenance and Monitoring Equipments	BOP Switchyard	Electrical	AA
1510	4540-XXXX-PVE	BOQ - SAS for Switchyard	BOP Switchyard	Electrical	AA
1511	4540-XXXX-PVE	Relay Setting Calculation-400kV Line	BOP Switchyard	Electrical	A
1512	4540-XXXX-PVE	Relay Setting Calculation- Generator, Generator Transformer and Unit Transformer	BOP Switchyard	Electrical	A
1513	4540-XXXX-PVE	Control Cable Schedule for 400kV Tie bay	BOP Switchyard	Electrical	AA
1514	4540-XXXX-PVE	GA , BOM & Schematics of Relay Panel - 400kV Tie (Line-Line)	BOP Switchyard	Electrical	A
1515	4540-XXXX-PVE	GA , BOM & Schematics of Relay Panel - 400kV Tie (Line-GT)	BOP Switchyard	Electrical	A
1516	4540-XXXX-PVE	GA , BOM & Schematics of Relay Panel - 400kV Tie (Line-ST)	BOP Switchyard	Electrical	A
1517	4540-XXXX-PVE	GA , BOM & Schematics of Relay Panel - 400kV Tie (GT-FUT)	BOP Switchyard	Electrical	A
1518	4540-XXXX-PVE	GA , BOM & Schematics of Relay Panel - 400kV Tie (ST-BR)	BOP Switchyard	Electrical	A
1519	4540-XXXX-PVE	Mandatory Spares List for CRP	BOP Switchyard	Electrical	AA
1520	4540-XXXX-PVE	Board formation & Panel construction document	BOP Switchyard	Electrical	AA
1521	4540-XXXX-PVE	Mandatory Spare List for Switchyard Package	BOP Switchyard	Electrical	AA
1522	4540-XXXX-PVE	Earthing & Cable Trench Layout for Switchyard Control Room Building	BOP Switchyard	Electrical	AA
1523	4540-XXXX-PVE	Outdoor Cable Trench Arrangement Layout	BOP Switchyard	Electrical	AA
1524	4540-XXXX-PVE	Switchyard Outdoor, Swyd Control Room and GIS Building - Lighting Calculation	BOP Switchyard	Electrical	AA
1525	4540-XXXX-PVE	400 KV GIS Design memorandum	BOP Switchyard	Electrical	AA
1526	4540-XXXX-PVE	400 KV GIS Earthing Circuit Principle	BOP Switchyard	Electrical	AA
1527	4540-XXXX-PVE	400 KV GIS Seismic Study	BOP Switchyard	Electrical	AA
1528	4540-XXXX-PVE	400 KV GIS LCC Overall View diagram	BOP Switchyard	Electrical	AA
1529	4540-XXXX-PVE	400 KV GIS Bay Interlocking logic diagram	BOP Switchyard	Electrical	AA
1530	4540-XXXX-PVE	400 KV GIS Line Bay LCC Scheme Drawing (Typical)	BOP Switchyard	Electrical	AA
1531	4540-XXXX-PVE	400 KV GIS Tie Bay LCC Scheme Drawing (Typical)	BOP Switchyard	Electrical	AA
1532	4540-XXXX-PVE	400 KV GIS ST Bay LCC Scheme Drawing	BOP Switchyard	Electrical	AA
1533	4540-XXXX-PVE	400 KV GIS Bus Reactor & Bus VT Bay LCC Scheme Drawing (Typical)	BOP Switchyard	Electrical	AA
1534	4540-XXXX-PVE	Insulation Coordination Study	BOP Switchyard	Electrical	A
1535	4540-XXXX-PVE	400 kV CVT - Drawings & Data sheet	BOP Switchyard	Electrical	AA
1536	4540-XXXX-PVE	GA of Structure for 400 kV SF6/Air Bushing	BOP Switchyard	Electrical	AA
1537	4540-XXXX-PVE	400 KV GIS Heat load calculation	BOP Switchyard	Electrical	A
1538	4540-XXXX-PVE	400 kV LA - Drawings & Data sheet	BOP Switchyard	Electrical	AA
1539	4540-XXXX-PVE	400 kV WAVE TRAP - Drawings & Data sheet	BOP Switchyard	Electrical	AA
1540	4540-XXXX-PVE	Bay Marshalling Kiosk, CT & CVT Junction Box - Drawings & Data Sheet	BOP Switchyard	Electrical	AA
1541	4540-XXXX-PVE	EOT Crane for GIS Building -GA Drawing	BOP Switchyard	Electrical	AA
1542	4540-XXXX-PVE	Name Plates of all GIS Equipment	BOP Switchyard	Electrical	AA
1543	4540-XXXX-PVE	Description of Current leakage analyzer	BOP Switchyard	Electrical	AA
1544	4540-XXXX-PVE	GIS Building - Indoor Lighting Layout	BOP Switchyard	Electrical	AA
1545	4540-XXXX-PVE	Over-all architecture diagram of SAS for Switchyard	BOP Switchyard	Electrical	A
1546	4540-XXXX-PVE	String Insulators Drawings & Data Sheet	BOP Switchyard	Electrical	AA
1547	4540-XXXX-PVE	400 kV String Hardware - GA , Part Drawings & Data Sheet	BOP Switchyard	Electrical	AA
1548	4540-XXXX-PVE	400kV Clamps & Connectors - Drawings & Datasheets	BOP Switchyard	Electrical	AA
1549	4540-XXXX-PVE	Conductor Drawing & Data Sheet	BOP Switchyard	Electrical	AA
1550	4540-XXXX-PVE	IPS Al Tube Drawing & Data Sheet	BOP Switchyard	Electrical	AA
1551	4540-XXXX-PVE	Electrical Load List -AC	BOP Switchyard	Electrical	AA
1552	4540-XXXX-PVE	Electrical Load List -DC	BOP Switchyard	Electrical	AA
1553	4540-XXXX-PVE	Lighting Panels Drawing & data Sheet	BOP Switchyard	Electrical	AA
1554	4540-XXXX-PVE	400kV Long Rod Insulator - GA and Datasheet	BOP Switchyard	Electrical	AA
1555	4540-XXXX-PVE	400 kV Layout Plan & Section	BOP Switchyard	Electrical	A
1556	4540-XXXX-PVE	GAS Single Line Diagram	BOP Switchyard	Electrical	A

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 19 OF 66

Si No	NTPC Drg No	DRG_TITLE	SUB-SYSTEM	Dept	CATEGORY
1557	4540-XXXX-PVE	400 kV Structure Layout Plan & Section	BOP Switchyard	Electrical	A
1558	4540-XXXX-PVE	400 kV EKD - Plan, Section & BOM	BOP Switchyard	Electrical	AA
1559	4540-XXXX-PVE	400 kV Clearance Check Diagram	BOP Switchyard	Electrical	AA
1560	4540-XXXX-PVE	Earthmat Layout - 400 kV Switchyard	BOP Switchyard	Electrical	AA
1561	4540-XXXX-PVE	Equipment Earthing Philosophy & Details	BOP Switchyard	Electrical	AA
1562	4540-XXXX-PVE	Switchyard Control Room Building - Lighting Layout	BOP Switchyard	Electrical	AA
1563	4540-XXXX-PVE	DSLP Calculation & Layout - Overall	BOP Switchyard	Electrical	A
1564	4540-XXXX-PVE	GIS Building - Cable Trench & Earthing Layout	BOP Switchyard	Electrical	AA
1565	4540-XXXX-PVE	GIS Layout Plan & Section	BOP Switchyard	Electrical	AA
1566	4540-XXXX-PVE	Gas compartment sectionalisation Arrangement	BOP Switchyard	Electrical	AA
1567	4540-XXXX-PVE	Platform Arrangement and access arrangement	BOP Switchyard	Electrical	AA
1568	4540-XXXX-PVE	Lighting Layout - outdoor	BOP Switchyard	Electrical	AA
1569	4540-XXXX-PVE	Control Cable Schedule for 400kV Line bay	BOP Switchyard	Electrical	AA
1570	4540-XXXX-PVE	Control Cable Schedule for Auxiliary panel	BOP Switchyard	Electrical	AA
1571	4540-XXXX-PVE	Control Cable Schedule for 400kV Bus Reactor bay	BOP Switchyard	Electrical	AA
1572	4540-XXXX-PVE	Control Cable Schedule for 400kV Generator Transformer bay	BOP Switchyard	Electrical	AA
1573	4540-XXXX-PVE	Control Cable Schedule for 400kV Station Transformer bay	BOP Switchyard	Electrical	AA
1574	4540-XXXX-PVE	Control Cable Schedule for 400kV Islanding Scheme	BOP Switchyard	Electrical	AA
1575	4540-XXXX-PVE	Control cable schedule for 400kV Bus-bar	BOP Switchyard	Electrical	AA
1576	4540-XXXX-PVE	Power Cable Schedule	BOP Switchyard	Electrical	AA
1577	4540-XXXX-PVE	GA, BOM & Schematics of Busbar Protection for Switchyard - 400kV voltage	BOP Switchyard	Electrical	A
1578	4540-XXXX-PVE	GA, BOM & Schematics of Energy Metering System for Switchyard	BOP Switchyard	Electrical	A
1579	4540-XXXX-PVE	GA, BOM & Schematics of Station Auxiliary Control and Relay Panel	BOP Switchyard	Electrical	A
1580	4540-XXXX-PVE	GA, BOM & Schematics of Control Panel - GT - Tie - Line Dia (400kV System)	BOP Switchyard	Electrical	AA
1581	4540-XXXX-PVE	GA, BOM & Schematics of Control Panel - GT - Tie - Future Dia (400kV System)	BOP Switchyard	Electrical	AA
1582	4540-XXXX-PVE	GA, BOM & Schematics of Control Panel - ST-TIE-Bus Reactor Dia (400kV System)	BOP Switchyard	Electrical	AA
1583	4540-XXXX-PVE	GA, BOM & Schematics of Control Panel - Line - Tie - Line Dia (400kV System)	BOP Switchyard	Electrical	AA
1584	4540-XXXX-PVE	GA, BOM & Schematics of Control Panel - ST - Tie - Line Dia (400kV System)	BOP Switchyard	Electrical	AA
1585	4540-XXXX-PVE	GA, BOM & Schematics of Relay Panel - Generator, GT & UT (GRP)	BOP Switchyard	Electrical	A
1586	4540-XXXX-PVE	GA, BOM & Schematics of Relay Panel - 400kV Generator Transformer Bay	BOP Switchyard	Electrical	A
1587	4540-XXXX-PVE	GA, BOM & Schematics of Relay Panel - 400kV Station Transformer Bay	BOP Switchyard	Electrical	A
1588	4540-XXXX-PVE	GA, BOM & Schematics of Relay Panel - 400kV Bus Reactor Bay	BOP Switchyard	Electrical	A
1589	4540-XXXX-PVE	GA, BOM & Schematics of Relay Panel - 400kV Busbar	BOP Switchyard	Electrical	A
1590	4540-XXXX-PVE	GA, BOM & Schematics of Relay Panel - 400kV Line Feeder	BOP Switchyard	Electrical	A
1591	4540-XXXX-PVE	GA, BOM & Schematics of 400kV Islanding Scheme	BOP Switchyard	Electrical	A
1592	4540-XXXX-PVE	Functional Design Specification of SAS	BOP Switchyard	Electrical	AA
1593	4540-XXXX-PVE	400 kV Single Line Diagram	BOP Switchyard	Electrical	A
1594	4540-XXXX-PVE	400 kV Protection SLD	BOP Switchyard	Electrical	A
1595	4540-XXXX-PVE	Short Circuit Force & Critical Span Calculation - Flexible Bus	BOP Switchyard	Electrical	A
1596	4540-XXXX-PVE	Short Circuit Force & Cantilever Strength Calculation - Rigid Bus & Equipment	BOP Switchyard	Electrical	A
1597	4540-XXXX-PVE	Earthing Design Calculation	BOP Switchyard	Electrical	A
1598	4540-XXXX-PVE	Lighting Design Calculation	BOP Switchyard	Electrical	A
1599	4540-XXXX-PVE	Sag Tension Calculation	BOP Switchyard	Electrical	A
1600	4540-XXXX-PVE	Technical Datasheet, GA and Rating Plate of GIS LA	BOP Switchyard	Electrical	AA
1601	4540-XXXX-PVE	Type Test Procedure for 400kV GIS	BOP Switchyard	Electrical	A
1602	4540-XXXX-PVE	Type Test Reports for GIS	BOP Switchyard	Electrical	A
1603	4540-XXXX-PVE	EOT Crane - Mandatory Spares	BOP Switchyard	Electrical	AA
1604	4540-XXXX-PVE	Relay Setting Calculation-400kV Bus Reactor	BOP Switchyard	Electrical	A
1605	4540-XXXX-PVE	Relay Setting Calculation- 400/11/11kV Station Transformer	BOP Switchyard	Electrical	A
1606	4540-XXXX-PVE	Relay Setting Calculation-400kV Bus Bar	BOP Switchyard	Electrical	A
1607	4540-XXXX-PVE	Control Cable Schedule for 400kV Tie bay	BOP Switchyard	Electrical	AA
1608	4540-XXXX-PVE	400 kV CVT - Type Test Repots	BOP Switchyard	Electrical	A
1609	4540-XXXX-PVE	400 kV LA - Type Test Repots	BOP Switchyard	Electrical	A
1610	4540-XXXX-PVE	400 kV WAVE TRAP - Type Test Repots	BOP Switchyard	Electrical	AA
1611	4540-XXXX-PVE	Bay Marshalling Kiosk, CT & CVT Junction Box - Type Test Reports	BOP Switchyard	Electrical	AA
1612	4540-XXXX-PVE	Control & Protection Panel - Relays - Type Test Reports	BOP Switchyard	Electrical	AA
1613	4540-XXXX-PVE	SAS Pre-FAT (Factory Acceptance Testing) and FAT procedure	BOP Switchyard	Electrical	A
1614	4540-XXXX-PVE	String Insulator Type Test Repots	BOP Switchyard	Electrical	AA
1615	4540-XXXX-PVE	400 kV String Hardware - Type Test Repots	BOP Switchyard	Electrical	A
1616	4540-XXXX-PVE	400kV Clamps & Connectors - Type Test Repots	BOP Switchyard	Electrical	AA
1617	4540-XXXX-PVE	Conductors Type Test Repots	BOP Switchyard	Electrical	AA
1618	4540-XXXX-PVE	Power and control cable Type Test Repots	BOP Switchyard	Electrical	AA
1619	4540-XXXX-PVE	Instrumentation cable Type Test Repots	BOP Switchyard	Electrical	AA
1620	4540-XXXX-PVE	LCC Type Test Report	BOP Switchyard	Electrical	AA
1621	4540-XXXX-PVE	Lighting Panels Type Test Reports	BOP Switchyard	Electrical	AA
1622	4540-XXXX-PVE	TYPE TEST REPORTS FOR GIS LA & BUS VT	BOP Switchyard	Electrical	A
1623	4540-XXXX-PVE	O&M Manual of AIS Equipments	BOP Switchyard	Electrical	AA
1624	4540-XXXX-PVE	O&M Manual for GIS	BOP Switchyard	Electrical	AA
1625	4540-XXXX-PVE	Configuration files of SAS	BOP Switchyard	Electrical	AA
1626	4540-XXXX-PVE	O&M Manual of major SAS components	BOP Switchyard	Electrical	AA
1627	4540-XXXX-PVE	Relay Tool Kit-BOM, Instruction manual & License	BOP Switchyard	Electrical	AA
1628	4540-XXXX-PVE	400kV SF6 AIR BUSHING-Terminal Connectors with Parameters	BOP Switchyard	Electrical	AA
1629	4540-XXXX-PVE	DIMENSIONS OF GIS	BOP Switchyard	Electrical	AA
1630	4540-XXXX-PVE	Guaranteed Technical particulars of GIS	BOP Switchyard	Electrical	AA
1631	4540-XXXX-PVE	Technical Data Sheet,TSE,DR,Energy meters,SAS Equipments & Catalogues	BOP Switchyard	Electrical	AA
1632	4540-XXXX-PVE	Power and control cable Data Sheet	BOP Switchyard	Electrical	AA
1633	4540-XXXX-PVE	GA of Burnt oil pit in Switchyard area	BOP Switchyard	Electrical	AA
1634	4540-XXXX-PVE	Instrumentation cable Data Sheet	BOP Switchyard	Electrical	AA
1635	4540-XXXX-PVE	GA and data sheet of dewatering pump at GIS	BOP Switchyard	Electrical	AA
1636	9585-001-102-PVM-F-007	HFO & LDO piping layout from FOPH to Boiler Area	LAYOUT-SG	LAYOUT	A
1637	9585-001-110-PVM-F-068A	LAYDOWN SPACE FOR STEAM TURBINE AND GENERATOR COMPONENTS.	LAYOUT-TG	LAYOUT	A
1638	9585-001-110-PVM-B-395	CRANE CLEARANCE DIAGRAM OF TG HALL EOT CRANES	LAYOUT-TG	LAYOUT	A
1639	9585-001-110-PVM-F-068	STORAGE SPACE (LAYDOWN SPACE FOR STEAM TURBINE COMPONENTS)	LAYOUT-TG	LAYOUT	A
1640	9585-001-110-PVM-B-118A	OIL ROOM EQUIPMENT ARRANGEMENT	LAYOUT-TG	LAYOUT	A
1641	9585-001-110-PVM-F-053	MAIN PLANT TG HALL CROSS SECTION	LAYOUT-TG	LAYOUT	A
1642	9585-001-110-PVM-F-049	TG EQUIPMENT LAYOUT DRAWING AT 0 M	LAYOUT-TG	LAYOUT	A
1643	9585-001-110-PVM-F-050	TG EQUIPMENT LAYOUT DRAWING AT MEZANINE FLOOR 9 M	LAYOUT-TG	LAYOUT	A
1644	9585-001-110-PVM-F-051	TG EQUIPMENT LAYOUT DRAWING AT OPERATING GLOOR, 18M	LAYOUT-TG	LAYOUT	A
1645	9585-001-110-PVM-F-052	TG EQUIPMENT PLAN AT UPPER FLOORS IN B-C BAY	LAYOUT-TG	LAYOUT	A
1646	9585-001-110-PVM-B-040A	approach and maintenance platform details for equipment, valves,Instruments etc for deareator	LAYOUT-TG	LAYOUT	A
1647	9585-001-999-PGM-F-001	Main Plant Equipment Layout at EL(+/-) 0.0M	LAYOUT-TG	LAYOUT	A
1648	9585-001-110-PVM-B-416	CRANE CLEARANCE DIAGRAM OF BFP HANDLING EOT CRANE	LAYOUT-TG	LAYOUT	A

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 20 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
1649	9585-001-110-PVM-F-055	COMPOSITE PIPING LAYOUT PLAN BELOW MEZANINE FLOOR IN A-B & B-C BAY	LAYOUT-TG	LAYOUT	A
1650	9585-001-110-PVM-F-056	COMPOSITE PIPING LAYOUT PLAN BELOW OPERATING FLOOR IN A-B & B-C BAY	LAYOUT-TG	LAYOUT	A
1651	9585-001-110-PVM-F-057	COMPOSITE PIPING LAYOUT PLAN ABOVE OPERATING FLOOR IN A-B & B-C BAY	LAYOUT-TG	LAYOUT	A
1652	9585-001-110-PVM-F-002C	GA & PIPING LAYOUT OF CEP BELOW ACC AREA	LAYOUT-TG	LAYOUT	A
1653	9585-001-110-PVM-F-073	SEAL STEAM PIPING LAYOUTS	LAYOUT-TG	LAYOUT	AA
1654	9585-001-999-PGM-F-010	Yard piping and trestle layout	LAYOUT-TG	LAYOUT	A
1655	9585-001-999-PGM-F-010A	Yard piping and trestle layout-1 (Area near Aux. Boiler and Water Treatment Facilities)	LAYOUT-TG	LAYOUT	A
1656	9585-001-999-PGM-F-010B	Yard piping and trestle layout-2 (Area Near Boiler, ESP Unit-2, Gypsum & Limestone Bldg.))	LAYOUT-TG	LAYOUT	A
1657	9585-001-999-PGM-F-010C	Yard piping and trestle layout-3 & 4 (Area From Boiler, ESP Unit-1 to FOPH Facilities)	LAYOUT-TG	LAYOUT	A
1658	9585-001-999-PGM-F-010D	Yard piping and trestle layout-5 (C-Row Cantilever Pipe Rack)	LAYOUT-TG	LAYOUT	A
1659	9585-001-110-PVM-Y-434	GA DATA SHEET OF HOISTS IN ELEVATOR M/C ROOM	LAYOUT-TG	LAYOUT	AA
1660		Interconnection Platforms between Boiler and TG Bay	LAYOUT-TG	LAYOUT	AA
1661		Piping Layout of Aux Steam Piping Layout in BC Bay	LAYOUT-TG	LAYOUT	AA
1662	9585-001-102-PVM-U-031	PRESSURE DROP CALCULATION FOR MS,CRH AND HRH PIPING.	EPC-SG_sys	PIPING	A
1663	9585-001-102-PVM-U-036	STRESS ANALYSIS REPORT FOR MAIN STEAM & HP BYPASS PIPING	SG Package_Piping System	PIPING	A
1664	9585-001-102-PVM-U-036A	STRESS ANALYSIS REPORT OF COLD REHEAT SYSTEM & HP BYPASS PIPING	SG Package_Piping System	PIPING	A
1665	9585-001-102-PVM-U-037	STRESS ANALYSIS REPORT OF HOT REHEAT PIPING & LP BYPASS PIPING	SG Package_Piping System	PIPING	A
1666	9585-001-102-PVM-C-003A	ISOMETRIC OF MAIN STEAM SYSTEM	SG Package_Piping System	PIPING	A
1667	9585-001-102-PVM-C-007A	ISOMETRIC OF HP BYPASS PIPING SYSTEM	SG Package_Piping System	PIPING	A
1668	9585-001-102-PVM-C-008A	ISOMETRIC OF HOT REHEAT SYSTEM	SG Package_Piping System	PIPING	A
1669	9585-001-102-PVM-C-010A	ISOMETRIC OF LP BYPASS PIPING SYSTEM	SG Package_Piping System	PIPING	A
1670	9585-001-102-PVM-C-011A	ISOMETRIC OF COLD REHEAT SYSTEM	SG Package_Piping System	PIPING	A
1671	9585-001-102-PVM-B-098	HANGER DATA SHEET MS PIPING	SG Package_Piping System	PIPING	A
1672	9585-001-102-PVM-B-099	HANGER DATA SHEET HRH PIPING	SG Package_Piping System	PIPING	A
1673	9585-001-102-PVM-Y-222	HANGER DATA SHEET CRH PIPING	SG Package_Piping System	PIPING	A
1674	9585-001-102-PVM-F-008	P&ID for Chemical Dosing System	EPC-SG_sys	PIPING	AA
1675	9585-001-102-PVM-Y-008	Technical Data Sheet for Chemical Dosing System	EPC-SG_sys	PIPING	AA
1676	9585-001-102-PVM-U-036C	STRESS ANALYSIS REPORT OF MS & CRH STEAM PIPING TO APRDS, HT & LT UNIT AUX STEAM HEADER	SG Package_Piping System	PIPING	A
1677	9585-001-102-PVM-U-035	STRESS ANALYSIS REPORT OF AUX. STEAM LT STATION HEADER	SG Package_Piping System	PIPING	A
1678	9585-001-102-PVM-C-014A	STRESS ANALYSIS REPORT OF AUX. STEAM TO BFPT, AUX STEAM TO DEAEATOR, EXTN STEAM PIPING FROM CRH TO HPH 8A/8B & TO BFPT, EXTN STEAM PIPING TO DEAEATOR INCLUDING DEAEATOR PEGGING & HEATING, EXTN STEAM PIPING TO BFPT-'A' & 'B', SAFETY VALVE ESCAPE PIPING OF EXTN. LINE TDBFPT, START UP VENT FROM EXTN. STEAM TO BFPT-'A' & 'B'	SG Package_Piping System	PIPING	A
1679	9585-001-102-PVM-B-097	HANGER DATA SHEET LP BYPASS PIPING	SG Package_Piping System	PIPING	A
1680	9585-001-102-PVM-B-101	HANGER DATA SHEET HP BYPASS PIPING	SG Package_Piping System	PIPING	A
1681	9585-001-102-PVM-C-016A	ISOMETRIC DRAWING OF LT AUX STEAM STATION HEADER	SG Package_Piping System	PIPING	A
1682	9585-001-102-PVM-C-20	ISOMETRIC OF MS & CRH STEAM PIPING TO APRDS, HT & LT UNIT AUX STEAM HEADER	SG Package_Piping System	PIPING	A
1683	9585-001-102-PVM-P-210A	ISOMETRIC OF AUX. STEAM TO BFPT	SG Package_Piping System	PIPING	A
1684	9585-001-102-PVM-P-211	ISOMETRIC OF AUX. STEAM TO DEAEATOR.	SG Package_Piping System	PIPING	A
1685	9585-001-102-PVM-C-003	MS piping from Super heater outlet to ESV inlet(Fabrication drawing)	SG Package_Piping System	PIPING	AA
1686	9585-001-102-PVM-C-007	HP Bypass piping from MS to HP Bypass valve inlet and from HP Bypass valve outlet to CRH piping(Fabrication drawing)	SG Package_Piping System	PIPING	AA
1687	9585-001-102-PVM-C-008	HRH piping from reheater outlet to turbine inlet(Fabrication drawing)	SG Package_Piping System	PIPING	AA
1688	9585-001-102-PVM-C-010	LP Bypass valve upstream and downstream piping(Fabrication drawing)	SG Package_Piping System	PIPING	AA
1689	9585-001-102-PVM-C-011	CRH piping from Turbine to RH inlet header(Fabrication drawing)	SG Package_Piping System	PIPING	AA
1690	9585-001-102-PVM-B-001A	PAINTING SCHEME FOR PIPING	EPC-SG_sys	PIPING	A
1691	9585-001-102-PVM-B-001B	PAINTING SCHEME FOR LP PIPING	EPC-SG_sys	PIPING	A

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
1692	9585-001-102-PVM-C-020A	ISOMETRIC DRAWING FOR AUX. STEAM HEADERS SAFETY VALVE EXHAUST TO ATMOSPHERE	SG Package_Piping System	PIPING	AA
1693	9585-001-102-PVM-C-015A	ISOMETRIC OF AUX. STEAM PIPING TO BOILER AUXILIARIES	SG Package_Piping System	PIPING	AA
1694	9585-001-102-PVM-Y-0011	HANGER DATA SHEET OF MS & CRH STEAM PIPING TO APRDS, HT & LT UNIT AUX STEAM HEADER	SG Package_Piping System	PIPING	AA
1695	9585-001-102-PVM-Y-001A	HANGER DATA SHEET OF AUX. STEAM TO BFPT	SG Package_Piping System	PIPING	AA
1696	9585-001-102-PVM-Y-002A	HANGER DATA SHEET OF AUX. STEAM LT STATION HEADER	SG Package_Piping System	PIPING	AA
1697	9585-001-102-PVM-Y-003A	HANGER DATA SHEET OF AUX. STEAM PIPING TO BOILER AUXILIARIES	SG Package_Piping System	PIPING	AA
1698	9585-001-102-PVM-Y-004A	HANGER DATA SHEET OF AUX. STEAM TO DEAERATOR.	SG Package_Piping System	PIPING	AA
1699	9585-001-102-PVM-C-014	MS piping to Aux.PRDS and CRH piping to Aux. PRDS(Fabrication drawing)	SG Package_Piping System	PIPING	AA
1700	9585-001-102-PVM-C-015	HT & LT Aux steam Unit header(Fabrication drawing)	SG Package_Piping System	PIPING	AA
1701	9585-001-102-PVM-C-017	HT & LT Aux steam station header(Fabrication drawing)	SG Package_Piping System	PIPING	AA
1702	9585-001-102-PVM-C-020	HT & LT Aux steam unit header SV exhaust to Atmosphere(Fabrication drawing)	SG Package_Piping System	PIPING	AA
1703		Piping layout for Critical piping drains and vents	SG Package_Piping System	PIPING	AA
1704	9585-001-110-PVM-P-050	COMPOSITE CRITICAL PIPING LAYOUT	TG Package_Piping System	PIPING	A
1705	9585-001-110-PVM-H-008	PIPE SCHEDULE FOR POWER CYCLE PIPING WITH DESIGN PARAMETER CALCULATIONS INCLUDING DM & CT SYSTEM	TG Package_Piping System	PIPING	A
1706	9585-001-110-PVM-H-009	THERMAL INSULATION SCHEDULE & APPLICATION PROCEDURE FOR THERMAL INSULATION	TG Package_Piping System	PIPING	A
1707	9585-001-110-PVM-Y-091	DESIGN MEMO FOR THERMAL INSULATION OF PIPING AND EQUIPMENTS	SG Package_Piping System	PIPING	A
1708	9585-001-110-PVM-B-001A	General Arrangement of Flash Tank-A	TG Package_Piping System	PIPING	AA
1709	9585-001-110-PVM-B-002A	General Arrangement of Flash Tank-B	TG Package_Piping System	PIPING	AA
1710	9585-001-110-PVM-B-003A	General Arrangement of Unit Flash Tank	TG Package_Piping System	PIPING	AA
1711	9585-001-110-PVM-H-007	VALVE SCHEDULE FOR POWER CYCLE PIPING INCLUDING DM WATER SYSTEM	TG Package_Piping System	PIPING	A
1712	9585-001-110-PVM-B-007A	GA of DMCW Tank	TG Package_Piping System	PIPING	AA
1713	9585-001-110-PVM-U-202	STRESS ANALYSIS REPORT OF BOILER FEED SUCTION PIPING FOR TDBFP	TG Package_Piping System	PIPING	A
1714	9585-001-110-PVM-U-202B	STRESS ANALYSIS REPORT OF BOILER FEED SUCTION PIPING FOR MDBFP	TG Package_Piping System	PIPING	A
1715	9585-001-110-PVM-U-204	STRESS ANALYSIS REPORT OF BFP DISCHARGE PIPING SYSTEM INCLUDING RECIRCULATION	TG Package_Piping System	PIPING	A
1716	9585-001-110-PVM-U-206	STRESS ANALYSIS REPORT OF FEED WATER SPRAY PIPING TO RH ATTEMPERATION	TG Package_Piping System	PIPING	A
1717	9585-001-110-PVM-P-202B	ISOMETRIC FOR BOILER FEED SUCTION PIPING FOR MDBFP	TG Package_Piping System	PIPING	A
1718	9585-001-110-PVM-P-202	ISOMETRIC FOR BOILER FEED SUCTION PIPING FOR TDBFP	TG Package_Piping System	PIPING	A
1719	9585-001-110-PVM-P-203	ISOMETRICFOR BFPs RECIRCULATION PIPING	TG Package_Piping System	PIPING	A
1720	9585-001-110-PVM-P-204	ISOMETRIC FOR BFP DISCHARGE PIPING	TG Package_Piping System	PIPING	A
1721	9585-001-110-PVM-P-205	ISOMETRIC FOR FEED WATER SPRAY PIPING TO HP BYPASS SYSTEM	TG Package_Piping System	PIPING	A
1722	9585-001-110-PVM-P-206	ISOMETRIC FOR FEED WATER SPRAY PIPING TO RH ATTEMPERATION UP TO FIRST BLOCK VALVE OF CONTROL STATION	TG Package_Piping System	PIPING	A
1723	9585-001-110-PVM-Y-207	SAFETY RELIEF VALVE DATA SHEET (PEM SCHEDULE)	TG Package_Piping System	PIPING	AA
1724	9585-001-110-PVM-B-190	GA DRG. FOR BUTTERFLY VALVE (STEAM SERVICE)	TG Package_Piping System	PIPING	A
1725	9585-001-110-PVM-F-011	Yard Piping Layout Over Pedestals	TG Package_Piping System	PIPING	A

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
1726	9585-001-110-PVM-F-059	DMCW AND ACW PIPING LAYOUT WITHIN TG HALL	TG Package_Piping System	PIPING	AA
1727	9585-001-110-PVM-U-221	STRESS ANALYSIS REPORT OF CEP DISCHARGE TO DEAERATOR, CONDENSATE SPRAY PIPING TO LPBYPASS SYSTEM, CEP MINIMUM FLOW RECIRCULATION, GSC MINIMUM FLOW RECIRCULATION	TG Package_Piping System	PIPING	A
1728	9585-001-110-PVM-U-205	STRESS ANALYSIS REPORT OF SPRAY WATER PIPING TO HPBP VALVES	TG Package_Piping System	PIPING	A
1729	9585-001-110-PVM-P-208A	ISOMETRIC OF EXTN STEAM PIPING TO HPH 9A/9B	TG Package_Piping System	PIPING	A
1730	9585-001-110-PVM-P-208B	ISOMETRIC OF EXTN STEAM PIPING FROM CRH TO HPH 8A/8B & TO BFPT	TG Package_Piping System	PIPING	A
1731	9585-001-110-PVM-P-208C	ISOMETRIC OF EXTN STEAM PIPING TO HPH 7A/7B THROUGH DESUPERHEATER 7A/7B	TG Package_Piping System	PIPING	A
1732	9585-001-110-PVM-P-209A	ISOMETRIC OF EXTN STEAM TO LPH 4	TG Package_Piping System	PIPING	A
1733	9585-001-110-PVM-Y-030	GA OF STEAM TRAP	TG Package_Piping System	PIPING	AA
1734	9585-001-110-PVM-B-083	GA DRGS FOR ME BELLOWES	TG Package_Piping System	PIPING	A
1735	9585-001-110-PVM-U-208A	STRESS ANALYSIS REPORT OF EXTN STEAM PIPING TO HPH 9A/9B	TG Package_Piping System	PIPING	A
1736	9585-001-110-PVM-U-208C	STRESS ANALYSIS REPORT OF EXTN STEAM PIPING TO HPH 7A/7B THROUGH DESUPERHEATER 7A/7B	TG Package_Piping System	PIPING	A
1737	9585-001-110-PVM-U-209A	STRESS ANALYSIS REPORT OF EXTN STEAM TO LPH 4	TG Package_Piping System	PIPING	A
1738	9585-001-110-PVM-P-209B	ISOMETRIC OF EXTN STEAM TO LPH 3	TG Package_Piping System	PIPING	A
1739	9585-001-110-PVM-P-209C	ISOMETRIC OF EXTN STEAM TO LPH 2	TG Package_Piping System	PIPING	A
1740	9585-001-110-PVM-P-209D	ISOMETRIC OF EXTN STEAM TO LPH 5	TG Package_Piping System	PIPING	A
1741	9585-001-110-PVM-P-211	ISOMETRIC OF EXTN STEAM PIPING TO DEAERATOR INCLUDING DEAERATOR PEGGING & HEATING	TG Package_Piping System	PIPING	A
1742	9585-001-110-PVM-F-059A	LAYOUT OF ACW PIPING FROM ACW PUMPING STATION TO TG BUILDING (INCLUDING ECW PIPING NEAR PUMPING STATION)	TG Package_Piping System	PIPING	A
1743	9585-001-110-PVM-F-048A	SERVICE WATER PIPING LAYOUT INSIDE TG BUILDING	TG Package_Piping System	PIPING	AA
1744	9585-001-110-PVM-B-009B	GA of dia 900 BF valve with Manual Operator	TG Package_Piping System	PIPING	AA
1745	9585-001-110-PVM-B-010A	GA of dia 700 BF valve with Electrical actuator	TG Package_Piping System	PIPING	A
1746	9585-001-110-PVM-B-011B	GA of dia 800 BF valve with Manual Operator	TG Package_Piping System	PIPING	AA
1747	9585-001-110-PVM-B-012C	GA of dia 600 BF valve with Electrical actuator	TG Package_Piping System	PIPING	A
1748	9585-001-110-PVM-B-013C	GA of dia 600 BF valve with Manual Operator	TG Package_Piping System	PIPING	AA
1749	9585-001-110-PVM-U-209B	STRESS ANALYSIS REPORT OF EXTN STEAM TO LPH 3	TG Package_Piping System	PIPING	A
1750	9585-001-110-PVM-U-209D	STRESS ANALYSIS REPORT OF EXTN STEAM TO LPH 5	TG Package_Piping System	PIPING	A
1751	9585-001-110-PVM-U-209C	STRESS ANALYSIS REPORT OF EXTN STEAM TO LPH 2	TG Package_Piping System	PIPING	A
1752	9585-001-110-PVM-P-221	ISOMETRIC FOR CEP DISCHARGE PIPING TO DEAERATOR	TG Package_Piping System	PIPING	A
1753	9585-001-110-PVM-P-212	ISOMETRIC OF AUX. STEAM AND CRH PIPING TO TURBINE GLAND SEALING	TG Package_Piping System	PIPING	AA
1754	9585-001-110-PVM-P-210	ISOMETRIC OF EXTN STEAM PIPING TO BFPT-'A' & 'B'	TG Package_Piping System	PIPING	A
1755	9585-001-110-PVM-Y-202	HANGER DATA SHEET OF BOILER FEED SUCTION PIPING FOR TDBFP	TG Package_Piping System	PIPING	A
1756	9585-001-110-PVM-Y-202B	HANGER DATA SHEET OF BOILER FEED SUCTION PIPING FOR MD BFP	TG Package_Piping System	PIPING	A
1757	9585-001-110-PVM-Y-204	HANGER DATA SHEET OF BFPs DISCHARGE PIPING	TG Package_Piping System	PIPING	A
1758	9585-001-110-PVM-Y-205	HANGER DATA SHEET OF SPRAY WATER PIPING TO HPBP VALVES	TG Package_Piping System	PIPING	A
1759	9585-001-110-PVM-Y-206	HANGER DATA SHEET OF FEED WATER SPRAY PIPING TO RH ATTEMPERATION	TG Package_Piping System	PIPING	A

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
1760	9585-001-110-PVM-Y-203	HANGER DATA SHEET OF BFPs RECIRCULATION PIPING	TG Package_Piping System	PIPING	A
1761	9585-001-110-PVM-B-014A	GA of dia 600 BF valve with Manual Operator with Limit switch	TG Package_Piping System	PIPING	A
1762	9585-001-110-PVM-B-015	GA of dia 500 BF valve with Electrical actuator	TG Package_Piping System	PIPING	A
1763	9585-001-110-PVM-B-016	GA of dia 500 BF valve with Manual Operator with Limit switch	TG Package_Piping System	PIPING	A
1764	9585-001-110-PVM-U-212	STRESS ANALYSIS REPORT OF AUX. STEAM AND CRH PIPING TO TURBINE GLAND SEALING	TG Package_Piping System	PIPING	AA
1765	9585-001-110-PVM-U-267	STRESS ANALYSIS REPORT OF BFPT EXHAUST TO Condenser	TG Package_Piping System	PIPING	A
1766	9585-001-110-PVM-U-236A	STRESS ANALYSIS REPORT OF HPH 9A DRAIN TO HPH 8A & F/T-A	TG Package_Piping System	PIPING	AA
1767	9585-001-110-PVM-U-236B	STRESS ANALYSIS REPORT OF HPH 9B DRAIN TO HPH 8B & F/T-A	TG Package_Piping System	PIPING	AA
1768	9585-001-110-PVM-U-236C	STRESS ANALYSIS REPORT OF HPH 8A DRAIN TO HPH 7A & F/T-A	TG Package_Piping System	PIPING	AA
1769	9585-001-110-PVM-U-236D	STRESS ANALYSIS REPORT OF HPH 8B DRAIN TO HPH 7B & F/T-A	TG Package_Piping System	PIPING	AA
1770	9585-001-110-PVM-U-236E	STRESS ANALYSIS REPORT OF HPH 7A DRAIN TO DEAERATOR & ALT. DRAIN TO F/T-A	TG Package_Piping System	PIPING	AA
1771	9585-001-110-PVM-U-237E	STRESS ANALYSIS REPORT OF LPH 5 DRAIN TO LPH 4 & F/T-B	TG Package_Piping System	PIPING	AA
1772	9585-001-110-PVM-P-145	ISOMETRIC OF BFPT EXHAUST TO Condenser	TG Package_Piping System	PIPING	A
1773	9585-001-110-PVM-P-222	ISOMETRIC FOR CEP MINIMUM FLOW RECIRCULATION PIPING	TG Package_Piping System	PIPING	A
1774	9585-001-110-PVM-P-223	ISOMETRIC FOR GSC MINIMUM FLOW RECIRCULATION PIPING	TG Package_Piping System	PIPING	AA
1775	9585-001-110-PVM-P-224	ISOMETRIC FOR CONDENSATE SPRAY PIPING TO LPBYPASS SYSTEM	TG Package_Piping System	PIPING	A
1776	9585-001-110-PVM-P-236A	ISOMETRIC OF HPH 9A DRAIN TO HPH 8A & ALT.DRAIN TO F/T-A	TG Package_Piping System	PIPING	AA
1777	9585-001-110-PVM-P-236B	ISOMETRIC OF HPH 9B DRAIN TO HPH 8B & ALT.DRAIN TO F/T-A	TG Package_Piping System	PIPING	AA
1778	9585-001-110-PVM-P-236C	ISOMETRIC OF HPH 8A DRAIN TO HPH 7A & F/T-A	TG Package_Piping System	PIPING	AA
1779	9585-001-110-PVM-P-236D	ISOMETRIC OF HPH 8B DRAIN TO HPH 7B & F/T-A	TG Package_Piping System	PIPING	AA
1780	9585-001-110-PVM-P-236E	ISOMETRIC OF HPH 7A DRAIN TO DEAERATOR & ALT. DRAIN TO F/T-A	TG Package_Piping System	PIPING	AA
1781	9585-001-110-PVM-P-236F	ISOMETRIC OF HPH 7B DRAIN TO DEAERATOR & ALT. DRAIN TO F/T-A	TG Package_Piping System	PIPING	AA
1782	9585-001-110-PVM-P-248	ISOMETRIC FOR DRAIN MANIFOLDS OF FLASH TANKS	TG Package_Piping System	PIPING	AA
1783	9585-001-110-PVM-Y-208A	HANGER DATA SHEET OF EXTN STEAM PIPING TO HPH 9A/9B	TG Package_Piping System	PIPING	AA
1784	9585-001-110-PVM-Y-208B	HANGER DATA SHEET OF EXTN STEAM PIPING FROM CRH TO HPH 8A/8B & TO BFPT	TG Package_Piping System	PIPING	AA
1785	9585-001-110-PVM-Y-208C	HANGER DATA SHEET OF EXTN STEAM PIPING TO HPH 7A/7B THROUGH DESUPERHEATER 7A/7B	TG Package_Piping System	PIPING	AA
1786	9585-001-110-PVM-B-022	GA of dia 400 BF valve with Manual Operator with Limit switch	TG Package_Piping System	PIPING	A
1787	9585-001-110-PVM-B-022E	GA of dia 800 BF valve with Electrical Operator	TG Package_Piping System	PIPING	A
1788	9585-001-110-PVM-B-023A	GA of dia 500 BF valve with Manual Operator	TG Package_Piping System	PIPING	AA
1789	9585-001-110-PVM-B-023B	GA of dia 400 BF valve with Electrical Operator (16 ATA)	TG Package_Piping System	PIPING	A
1790	9585-001-110-PVM-B-023D	GA of dia 450 BF valve with Electrical Operator (16 ATA)	TG Package_Piping System	PIPING	A
1791	9585-001-110-PVM-W-002A	PAINTING SCHEME FOR BF VALVES	TG Package_Piping System	PIPING	AA
1792	9585-001-110-PVM-Y-209A	HANGER DATA SHEET OF EXTN STEAM TO LPH 4	TG Package_Piping System	PIPING	AA
1793	9585-001-110-PVM-Y-209B	HANGER DATA SHEET OF EXTN STEAM TO LPH 3	TG Package_Piping System	PIPING	AA

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
1794	9585-001-110-PVM-Y-209C	HANGER DATA SHEET OF EXTN STEAM TO LPH 2	TG Package_Piping System	PIPING	AA
1795	9585-001-110-PVM-Y-209E	HANGER DATASHEET OF EXTN STEAM TO LPH-5	TG Package_Piping System	PIPING	AA
1796	9585-001-110-PVM-Y-211	HANGER DATA SHEET OF EXTN STEAM PIPING TO DEAERATOR INCLUDING DEAERATOR PEGGING & HEATING	TG Package_Piping System	PIPING	AA
1797	9585-001-110-PVM-U-214	STRESS ANALYSIS REPORT OF GSC EMERGENCY EXHAUST PIPING TO ATMOSPHERE	TG Package_Piping System	PIPING	AA
1798	9585-001-110-PVM-U-235	STRESS ANALYSIS REPORT OF HP/LP HTR. SAFETY VALVE DISCHARGE TO HP/LP FLASH PIPE, HP/LP FLASH PIPE VENT & DRAIN	TG Package_Piping System	PIPING	AA
1799	9585-001-110-PVM-U-237A	STRESS ANALYSIS REPORT OF LPH 4 DRAIN TO LPH 3 & F/T-B	TG Package_Piping System	PIPING	AA
1800	9585-001-110-PVM-U-237B	STRESS ANALYSIS REPORT OF LPH 3 DRAIN TO LPH 2 & F/T-B	TG Package_Piping System	PIPING	AA
1801	9585-001-110-PVM-U-237C	STRESS ANALYSIS REPORT OF LPH 2 DRAIN TO LPH 1 & F/T-B	TG Package_Piping System	PIPING	AA
1802	9585-001-110-PVM-U-237D	STRESS ANALYSIS REPORT OF LPH 1 DRAIN TO F/T-B THROUGH DRAIN COOLER	TG Package_Piping System	PIPING	AA
1803	9585-001-110-PVM-U-239	STRESS ANALYSIS REPORT OF GSC DRAIN TO F/T-B	TG Package_Piping System	PIPING	AA
1804	9585-001-110-PVM-P-220	ISOMETRIC FOR CONDENSATE SUCTION PIPING	TG Package_Piping System	PIPING	A
1805	9585-001-110-PVM-P-214	ISOMETRIC OF GSC EMERG. EXHAUST TO ATMOSPHERE	TG Package_Piping System	PIPING	AA
1806	9585-001-110-PVM-P-235	ISOMETRIC OF HP/LP HTR. SAFETY VALVE DISCHARGE TO HP/LP FLASH PIPE	TG Package_Piping System	PIPING	AA
1807	9585-001-110-PVM-P-237A	ISOMETRIC OF LPH 4 DRAIN TO LPH 3 & F/T-B	TG Package_Piping System	PIPING	AA
1808	9585-001-110-PVM-P-237B	ISOMETRIC OF LPH 3 DRAIN TO LPH 2 & F/T-B	TG Package_Piping System	PIPING	AA
1809	9585-001-110-PVM-P-237C	ISOMETRIC OF LPH 2 DRAIN TO LPH 1 & F/T-B	TG Package_Piping System	PIPING	AA
1810	9585-001-110-PVM-P-237D	ISOMETRIC OF LPH 1 DRAIN TO F/T-B THROUGH DRAIN COOLER	TG Package_Piping System	PIPING	AA
1811	9585-001-110-PVM-P-237E	ISOMETRIC OF LPH 5 DRAIN TO LPH 4 & F/T-B	TG Package_Piping System	PIPING	AA
1812	9585-001-110-PVM-P-239	ISOMETRIC OF GSC DRAIN TO F/T-B	TG Package_Piping System	PIPING	AA
1813	9585-001-110-PVM-B-017A	GA of dia 450 BF valve with Electrical actuator	TG Package_Piping System	PIPING	A
1814	9585-001-110-PVM-B-018A	GA of dia 450 BF valve with Manual Operator	TG Package_Piping System	PIPING	AA
1815	9585-001-110-PVM-B-019A	GA of dia 500 BF valve with Manual Operator	TG Package_Piping System	PIPING	AA
1816	9585-001-110-PVM-B-020A	GA of dia 400 BF valve with Electrical actuator	TG Package_Piping System	PIPING	A
1817	9585-001-110-PVM-B-021	GA of dia 400 BF valve with Manual Operator	TG Package_Piping System	PIPING	AA
1818	9585-001-110-PVM-Y-221	HANGER DATA SHEET OF CEP DISCHARGE PIPING TO DEAERATOR	TG Package_Piping System	PIPING	A
1819	9585-001-110-PVM-Y-212	HANGER DATA SHEET OF AUX. STEAM AND CRH PIPING TO TURBINE GLAND SEALING	TG Package_Piping System	PIPING	AA
1820	9585-001-110-PVM-Y-210	HANGER DATA SHEET OF EXTN STEAM PIPING TO BFPT-'A' & 'B'	TG Package_Piping System	PIPING	AA
1821	9585-001-110-PVM-Y-220	HANGER DATA SHEET OF CONDENSATE SUCTION PIPING	TG Package_Piping System	PIPING	AA
1822	9585-001-110-PVM-U-243	STRESS ANALYSIS REPORT OF FLASH TANK VENTS AND DRAINS	TG Package_Piping System	PIPING	AA
1823	9585-001-110-PVM-U-246	STRESS ANALYSIS REPORT OF UNIT/ ATMOSPHERIC FLASH TANK VENT TO ATMOSPHERE & DRAIN TO WASTE	TG Package_Piping System	PIPING	AA
1824	9585-001-110-PVM-U-249D	STRESS ANALYSIS REPORT OF BFPT-'A' & 'B' RUPTURE DISC EXHAUST PIPING	TG Package_Piping System	PIPING	AA
1825	9585-001-110-PVM-U-250	Stress analysis report of Start up vent from extn steam to TDBFP A and B	TG Package_Piping System	PIPING	AA
1826	9585-001-110-PVM-U-220	STRESS ANALYSIS REPORT OF CONDENSATE SUCTION PIPING	TG Package_Piping System	PIPING	A
1827	9585-001-110-PVM-P-243	ISOMETRIC OF FLASH TANK VENTS AND DRAINS	TG Package_Piping System	PIPING	AA

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
1828	9585-001-110-PVM-P-246	ISOMETRIC FOR UNIT FLASH TANK VENT TO ATMOSPHERE & DRAIN TO WASTE	TG Package_Piping System	PIPING	AA
1829	9585-001-110-PVM-P-249	ISOMETRIC OF DEAERATOR SAFETY VALVE ESCAPE PIPING	TG Package_Piping System	PIPING	AA
1830	9585-001-110-PVM-P-249B	ISOMETRIC OF SAFETY VALVE ESCAPE PIPING OF EXTN. LINE TDBFPT.	TG Package_Piping System	PIPING	AA
1831	9585-001-110-PVMP-249C	ISOMETRIC OF BFPT-'A' & 'B' RUPTURE DISC EXHAUST PIPING	TG Package_Piping System	PIPING	AA
1832	9585-001-110-PVMP-249E	ISOMETRIC OF START UP VENT FROM EXTN. STEAM TO BFPT-'A' & 'B'	TG Package_Piping System	PIPING	AA
1833	9585-001-110-PVM-Y-209D	HANGER DATA SHEET OF BFPT EXHAUST TO Condenser	TG Package_Piping System	PIPING	AA
1834	9585-001-110-PVM-Y-236A	HANGER DATA SHEET OF HPH 9A DRAIN TO HPH 8A & ALT. DRAIN TO F/T-A	TG Package_Piping System	PIPING	AA
1835	9585-001-110-PVM-Y-236B	HANGER DATA SHEET OF HPH 9B DRAIN TO HPH 8B & ALT. DRAIN TO F/T-A	TG Package_Piping System	PIPING	AA
1836	9585-001-110-PVM-Y-236C	HANGER DATA SHEET OF HPH 8A DRAIN TO HPH 7A & ALT. DRAIN TO F/T-A	TG Package_Piping System	PIPING	AA
1837	9585-001-110-PVM-Y-236D	HANGER DATA SHEET OF HPH 8B DRAIN TO HPH 7B & ALT. DRAIN TO F/T-A	TG Package_Piping System	PIPING	AA
1838	9585-001-110-PVM-Y-236E	HANGER DATA SHEET OF HPH 7A DRAIN TO DEAERATOR & ALT. DRAIN TO F/T-A	TG Package_Piping System	PIPING	AA
1839	9585-001-110-PVM-Y-236F	HANGER DATA SHEET OF HPH 7B DRAIN TO DEAERATOR & ALT. DRAIN TO F/T-A	TG Package_Piping System	PIPING	AA
1840	9585-001-110-PVM-Y-214	HANGER DATA SHEET OF GSC EMERG. EXHAUST TO ATMOSPHERE	TG Package_Piping System	PIPING	AA
1841	9585-001-110-PVM-Y-222	HANGER DATA SHEET OF CEP MINIMUM FLOW RECIRCULATION	TG Package_Piping System	PIPING	AA
1842	9585-001-110-PVM-Y-223	HANGER DATA SHEET OF GSC MINIMUM FLOW RECIRCULATION PIPING	TG Package_Piping System	PIPING	AA
1843	9585-001-110-PVM-Y-237A	HANGER DATA SHEET OF LPH 4 DRAIN TO LPH 3 & F/T-B	TG Package_Piping System	PIPING	AA
1844	9585-001-110-PVM-Y-237B	HANGER DATA SHEET OF LPH 3 DRAIN TO LPH 2 & F/T-B	TG Package_Piping System	PIPING	AA
1845	9585-001-110-PVM-Y-237C	HANGER DATA SHEET OF LPH 2 DRAIN TO LPH 1 & F/T-B	TG Package_Piping System	PIPING	AA
1846	9585-001-110-PVM-Y-237D	HANGER DATA SHEET OF LPH 1 DRAIN TO F/T-B	TG Package_Piping System	PIPING	AA
1847	9585-001-110-PVM-Y-237E	HANGER DATA SHEET OF LPH 5 DRAIN TO LPH 3 & F/T-B	TG Package_Piping System	PIPING	AA
1848	9585-001-110-PVM-Y-239	HANGER DATA SHEET OF GSC DRAIN TO F/T-B	TG Package_Piping System	PIPING	AA
1849	9585-001-110-PVM-Y-243	HANGER DATA SHEET OF FLASH TANK VENTS AND DRAINS	TG Package_Piping System	PIPING	AA
1850	9585-001-110-PVM-Y-246	HANGER DATA SHEET OF UNIT/ ATMOSPHERIC FLASH TANK VENT TO ATMOSPHERE & DRAIN TO WASTE	TG Package_Piping System	PIPING	AA
1851	9585-001-110-PVM-Y-247	HANGER DATA SHEET OF HP/LP FLASH PIPE VENT AND DRAIN	TG Package_Piping System	PIPING	AA
1852	9585-001-110-PVM-Y-249B	HANGER DATA SHEET OF SAFETY VALVE ESCAPE PIPING OF EXTN. LINE TDBFPT.	TG Package_Piping System	PIPING	AA
1853	9585-001-110-PVM-Y-249C	HANGER DATA SHEET OF BFPT A AND B RUPTURE DISC EXHAUST PIPING	TG Package_Piping System	PIPING	AA
1854	9585-001-110-PVM-Y-249D	HANGER DATA SHEET OF HT UNIT HEADER SV EXHAUST TO ATMOSPHERE	TG Package_Piping System	PIPING	AA
1855	9585-001-110-PVM-Y-250	Hanger data sheet of Start up vent from extn steam to TDBFP A and B	TG Package_Piping System	PIPING	AA
1856	XXXX-001-147-PVM-B-059	STANDARD DRAWING FOR DUCT FABRICATION & SUPPORTING ARRANGEMENT		PU	AA
1857	XXXX-001-147-PVM-B-061	GA DRAWING OF EXPANSION TANKS / MAKE UP TANK / STORAGE TANK FOR AIR-CONDITIONING SYSTEM		PU	AA
1858	XXXX-001-147-PVM-B-062	GA OF AIR TERMINALS LIKE SUPPLY / RETURN AIR DIFFUSER / GRILL, NRD, VCD ETC.		PU	AA
1859	XXXX-001-147-PVM-B-068	A/C EQUIPMENT LAYOUT WITH FOUNDATION DETAILS FOR WATER SYSTEM CONTROL BUILDING		PU	AA
1860	XXXX-001-147-PVM-B-069	A/C EQUIPMENT LAYOUT WITH FOUNDATION DETAILS FOR GIS SWITCHYARD CONTROL BUILDING		PU	AA
1861	XXXX-001-147-PVM-B-070	A/C EQUIPMENT LAYOUT WITH FOUNDATION DETAILS FOR CANTEEN		PU	AA
1862	XXXX-001-147-PVM-F-063	A/C DUCT LAYOUT FOR MAIN POWER HOUSE AT EL 8.5 M & 17 M AND 0.0M		PU	A
1863	XXXX-001-147-PVM-F-063	A/C PLANT ROOM LAYOUT & COOLING TOWER AREA LAYOUT WITH COMPLETE FOUNDATION DETAIL ALONGWITH PIPING LAYOUT FOR MAIN POWER HOUSE		PU	AA
1864	XXXX-001-147-PVM-F-064	A/C PLANT ROOM LAYOUT WITH COMPLETE FOUNDATION DETAIL ALONGWITH PIPING LAYOUT COMMON FOR ESP CONTROL ROOM, FGD CONTROL ROOM, ASH HANDLING CONTROL ROOM		PU	AA

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 26 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
1865	XXXX-001-147-PVM-F-067	AHU ROOM LAYOUT WITH FOUNDATION DETAIL FOR MAIN POWER HOUSE		PU	AA
1866	XXXX-001-147-PVM-F-068	CHILLED WATER PIPING LAYOUT DRAWING FROM A/C PLANT ROOM TO VARIOUS AHU ROOMS FOR MAIN PLANT		PU	AA
1867	XXXX-001-147-PVM-F-071	A/C DUCT LAYOUT DRAWING COMMON FOR ESP CONTROL ROOM, FGD CONTROL ROOM, ASH HANDLING CONTROL ROOM		PU	AA
1868	XXXX-001-147-PVM-F-074	A/C DUCT LAYOUT DRAWING FOR WATER SYSTEM CONTROL BUILDING		PU	AA
1869	XXXX-001-147-PVM-F-075	A/C DUCT LAYOUT DRAWING FOR GIS SWITCHYARD CONTROL BUILDING		PU	AA
1870	XXXX-001-147-PVM-F-076	A/C DUCT LAYOUT DRAWING FOR CANTEN		PU	AA
1871	XXXX-001-147-PVM-H-080	SPLIT AC SCHEDULE		PU	AA
1872	XXXX-001-147-PVM-L-076	P & I DIAGRAM FOR A/C SYSTEM FOR MAIN POWER HOUSE		PU	A
1873	XXXX-001-147-PVM-L-077	P & I DIAGRAM FOR A/C SYSTEM COMMON FOR ESP CONTROL ROOM, FGD CONTROL ROOM, ASH HANDLING CONTROL ROOM		PU	A
1874	XXXX-001-147-PVM-L-080	P & I DIAGRAM FOR A/C SYSTEM FOR WATER SYSTEM CONTROL BUILDING, GIS SWITCHYARD CONTROL BUILDING, CANTEN		PU	A
1875	XXXX-001-147-PVM-U-001	DESIGN PHILOSOPY, HEAT LOAD CALCULATION FOR A/C SYSTEM FOR MAIN POWER HOUSE, ESP/AHP/FGD BUILDINGS		PU	A
1876	XXXX-001-147-PVM-U-005	DESIGN PHILOSOPY, HEAT LOAD CALCULATION FOR A/C SYSTEM OF WATER SYSTEM CONTROL BUILDING AND GIS SWITCHYARD CONTROL BUILDING		PU	A
1877	XXXX-001-147-PVM-U-007	PRESSURE DROP CALCULATION OF CONDENSER WATER PIPING AND CHILLED WATER PIPING FOR MAIN PLANT A/C SYSTEM		PU	AA
1878	XXXX-001-147-PVM-U-014	PRESSURE DROP CALCULATION OF CHILLED WATER PIPING FOR AC SYSTEM COMMON FOR ESP CONTROL ROOM, FGD CONTROL ROOM, ASH HANDLING CONTROL ROOM		PU	AA
1879	XXXX-001-147-PVM-X-129	OPERATION & MAINTENANCE MANUAL		PU	A
1880	XXXX-001-147-PVM-Y-032	TECHNICAL DATA SHEETS & G/A/DRAWING OF COOLING TOWERS		PU	AA
1881	XXXX-001-147-PVM-Y-033	TECHNICAL DATA SHEET & GA DRAWING FOR CONDENSER WATER PUMPS AND CHILLED WATER PUMPS		PU	AA
1882	XXXX-001-147-PVM-Y-035	TECHNICAL DATA SHEET OF AHU WITH COLING COIL AND CENTRIFUGAL FANS FOR AIR HANDLING UNITS		PU	AA
1883	XXXX-001-147-PVM-Y-036	TECHNICAL DATA SHEET OF D-X UNITS WATER SYSTEM CONTROL BUILDING, GIS SWITCHYARD CONTROL BUILDING, CANTEN BUILDING		PU	AA
1884	XXXX-001-147-PVM-Y-036	TECHNICAL DATA SHEET & G/A/ DRAWING FOR HEATER PACKAGE		PU	AA
1885	XXXX-001-147-PVM-Y-037	TECHNICAL DATA SHEET & G/A/ DRAWING OF PAN HUMIDIFIER		PU	AA
1886	XXXX-001-147-PVM-Y-038	TECHNICAL DATA SHEET & G/A/ DRAWING OF FRESH AIR FAN		PU	AA
1887	XXXX-001-147-PVM-Y-039	TECHNICAL DATA SHEET FOR HI-WALL TYPE SPLIT AIR CONDITIONER		PU	AA
1888	XXXX-001-147-PVM-Y-040	TECHNICAL DATA SHEET FOR CASSETTE TYPE AIR CONDITIONER		PU	AA
1889	XXXX-001-147-PVM-Y-042	TECHNICAL DATA SHEET FOR Y-STRAINERS		PU	AA
1890	XXXX-001-147-PVM-Y-043	TECHNICAL DATA SHEET & G/A/DRWG/ FOR CAST IRON VALVES(GATE VALVE,CHECK VALVE, GLOBE VALVE,BUTTER FLY VALVE (MANUAL)		PU	AA
1891	XXXX-001-147-PVM-Y-045	TECHNICAL DATA SHEET & GA FOR BUTTER FLY VALVE (MOTORISED)		PU	AA
1892	XXXX-001-147-PVM-Y-046	TECHNICAL DATA SHEET & GA FOR 3-WAY & 2 WAY MIXING VALVE		PU	AA
1893	XXXX-001-147-PVM-Y-047	TECHNICAL DATA SHEET& G/A/DRWG/ FOR BALANCING VALVE		PU	AA
1894	XXXX-001-147-PVM-Y-048	TECHNICAL DATA SHEET FOR THERMAL & ACCOUSTIC INSULATION FOR DUCTING/PIPES		PU	AA
1895	XXXX-001-147-PVM-Y-049	TECHNICAL DATA SHEET & G/A/ DRAWING OF PRE-FILTER,FINE FILTER,HEPA FILTER&WATER REPELLANT FILTER		PU	AA
1896	XXXX-001-147-PVM-Y-050	TECHNICAL DATA SHEET & G/A/ DRAWING OF FIRE DAMPER WITH ACTUATOR		PU	AA
1897	XXXX-001-147-PVM-Y-051	TECHNICAL DATA SHEET OF G/I SHEET		PU	AA
1898	XXXX-001-147-PVM-Y-052	TECHNICAL DATA SHEET OF PIPES		PU	AA
1899	XXXX-001-102-PVM-B-088	TDS, GA & CRANE CLEARANCE DIAGRAM OF EOT CRANE COMPRESSOR HOUSE		PU	AA
1900	XXXX-001-102-PVM-B-089	TDS & GA OF EOT CRANE FOR COMPRESSOR HOUSE		PU	AA
1901	XXXX-001-102-PVM-F-009	Compressor House layout including civil foundation details of various equipments		PU	AA
1902	XXXX-001-102-PVM-H-152	Valve schedule for CAS inside Compressor House		PU	AA
1903	XXXX-001-102-PVM-K-153	Control System write up & Config drg/ for Compressed Air System		PU	AA
1904	XXXX-001-102-PVM-L-144	P & I DIAGRAM OF Compressed Air System		PU	A
1905	XXXX-001-102-PVM-U-027	DESIGN PHILOSOPHY FOR COMPRESSED AIR SYSTEM ALONG WITH SIZING CALCULATION FOR COMPRESSOR		PU	A
1906	XXXX-001-102-PVM-U-030	MECHANISM SIZING CALCULATION FOR SINGLE GIRDER EOT CRANE FOR COMPRESSOR HOUSE		PU	AA
1907	XXXX-001-102-PVM-X-222A	O&M MANUAL-COMPRESSED AIR SYSTEM		PU	A
1908	XXXX-001-102-PVM-Y-011	TDS & GA AND P&ID OF AIR COMPRESSOR		PU	AA
1909	XXXX-001-102-PVM-Y-014	TDS & GA AND P&ID OF AIR DRYER		PU	AA
1910	XXXX-001-102-PVM-Y-015	TDS & GA of Valves for Compressed Air System.		PU	AA
1911	XXXX-001-102-PVM-Y-021	TDS & GA OF AIR Receiver		PU	AA
1912	XXXX-001-151-PVM-B-015	ENGINE DOCUMENTS FOR ENGINE DRIVEN FIRE WATER MAIN & BOOSTER PUMPS [GAD, DATASHEET,FUEL TANK DRAWING]		PU	AA
1913	XXXX-001-151-PVM-B-001	GA of Fire water storage tank alongwith nozzle orientation		PU	AA
1914	XXXX-001-151-PVM-B-002	Fabrication details for shell, bottom and roof plates alongwith roof structure and staircase details of fire water storage tanks		PU	AA
1915	XXXX-001-151-PVM-B-003	GA & DATA SHEET OF BLADDER FOAM TANK SKID OF FOAM SYSTEM		PU	AA
1916	XXXX-001-151-PVM-B-006	G.A. OF DELUGE VALVE HOUSING, CENTRAL HOSE STATION & VALVE CHAMBER		PU	AA
1917	XXXX-001-151-PVM-B-013	PUMP DOCUMENTS FOR FIRE WATER MAIN & BOOSTER PUMPS, JOCKEY PUMPS [GAD, DATASHEET,CURVE]		PU	AA
1918	XXXX-001-151-PVM-F-002	Layout of LHS & IR Detection System for Coal Conveyors		PU	A
1919	XXXX-001-151-PVM-F-004	FDA Layout at El. 0.0 M, 5.1M, 8.5M, 12.5M, 17M, 24.0M, 28 M of TG Building Unit 1 & 2		PU	AA
1920	XXXX-001-151-PVM-F-010	FDA Layout of Boiler		PU	AA
1921	XXXX-001-151-PVM-F-011	FDA Layout of Smoke Detectors inside Panels/Cubicles of CCR/CER Area in Main Plant at El. 17 M and CER / UPS area at EL. 8.5M for Unit 1 & 2		PU	A
1922	XXXX-001-151-PVM-F-016	Layout of Fire Detection & Alarm System for ESP/VFD Control Room & SWGR room (for unit-1 & 2 including FGD Switchgear & control room)		PU	AA
1923	XXXX-001-151-PVM-F-017	FDA Layout of Fuel Oil Pump House with Electrical Annex.		PU	AA
1924	XXXX-001-151-PVM-F-018	Layout of Fire Detection & Alarm System for Fire water pump house Control Room/SWGR		PU	AA
1925	XXXX-001-151-PVM-F-019	Layout of Fire Detection & Alarm System for Booster Pump House Control Room		PU	AA
1926	XXXX-001-151-PVM-F-020	Layout of Fire Detection & Alarm System for Foam pump house Control Room		PU	AA
1927	XXXX-001-151-PVM-F-022	FDA Layout of PT & Plant Water Control Building		PU	AA

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 27 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
1928	XXXX-001-151-PVM-F-024	Layout of Fire Detection & Alarm System for Control Equipment Room of Water system bldg.		PU	AA
1929	XXXX-001-151-PVM-F-025	FDA Layout of Canteen		PU	AA
1930	XXXX-001-151-PVM-F-026	Layout of Fire Detection and Alarm System for MCC/remote I/O room for CSSP		PU	AA
1931	XXXX-001-151-PVM-F-028	Layout of Fire Detection & Alarm System for DM plant Lab and Office areas		PU	AA
1932	XXXX-001-151-PVM-F-030	Layout of Fire Detection & Alarm System for CHP Control Room & MCCs in CHP area		PU	AA
1933	XXXX-001-151-PVM-F-036	FDA Layout of Chemical House		PU	AA
1934	XXXX-001-151-PVM-F-037	Layout of LHS Cable & FDA for Cable Gallery at El. 0.0 M of TG Building Unit 1,2		PU	AA
1935	XXXX-001-151-PVM-F-038	Layout of LHS Cable & FDA for Cable Gallery at El. 5.1M of TG Building Unit 1, 2		PU	AA
1936	XXXX-001-151-PVM-F-039	Layout of LHS Cable & FDA for Cable Gallery at El. 8.5 M of TG Building Unit 1, 2		PU	AA
1937	XXXX-001-151-PVM-F-040	Layout of LHS Cable & FDA for Cable Gallery at El. 13.5 M of TG Building Unit 1, 2		PU	AA
1938	XXXX-001-151-PVM-F-041	Layout of LHS Cable & FDA for Cable Gallery at El. 24.0 M of TG Building Unit 1, 2		PU	AA
1939	XXXX-001-151-PVM-F-042	Layout of LHS Cable & FDA for Cable Gallery of ESP Control Building Unit 1 & 2		PU	AA
1940	XXXX-001-151-PVM-F-043	FDA Layout of Ash Transfer Points		PU	AA
1941	XXXX-001-151-PVM-F-044	FDA Layout of Gypsum Transfer Points		PU	AA
1942	XXXX-001-151-PVM-F-044A	FDA Layout of Limestone Transfer Points and crusher House		PU	AA
1943	XXXX-001-151-PVM-F-048	FDA Layout of Coal Stock Pile		PU	AA
1944	XXXX-001-151-PVM-F-054	LHS CABLE LAYOUT FOR ASH CONVEYORS		PU	AA
1945	XXXX-001-151-PVM-F-055	LHS CABLE LAYOUT FOR GYPSUM CONVEYORS		PU	AA
1946	XXXX-001-151-PVM-F-055A	LHS CABLE LAYOUT FOR Limestone CONVEYORS		PU	AA
1947	XXXX-001-151-PVM-F-059	FDA Layout for Auxillary Boiler with Electrical Annex.		PU	AA
1948	XXXX-001-151-PVM-F-060	FDA Layout of Fuel Oil Tanks		PU	AA
1949	XXXX-001-151-PVM-F-062	FDA Layout of CPU Regeneration, MCC/Control room with Electrical Annex.		PU	AA
1950	XXXX-001-151-PVM-F-064	FDA Layout of Chemical Lab		PU	AA
1951	XXXX-001-151-PVM-F-066	FDA Layout of Fire Station		PU	AA
1952	XXXX-001-151-PVM-F-067	FDA Layout of Indoor Stores		PU	AA
1953	XXXX-001-151-PVM-F-068	FDA Layout of Workshop		PU	AA
1954	XXXX-001-151-PVM-F-070	FAD Layout of Transformer Yard		PU	AA
1955	XXXX-001-151-PVM-F-071	FAD Layout of Silo Utility Building		PU	AA
1956	XXXX-001-151-PVM-F-073	LAYOUT OF PIPING FOR FOAM SYSTEM IN TANK (HFO & LDO) FARM AREA (INCLUDING ISOMETRIC)		PU	AA
1957	XXXX-001-151-PVM-F-074	EQUIPMENT LAYOUT & FOUNDATION DETAILS OF FOAM SHED.		PU	AA
1958	XXXX-001-151-PVM-F-075	FDA Layout of AHP Electrical Building		PU	AA
1959		FDA Layout for external CHP Area at Mine End		PU	AA
1960	XXXX-001-151-PVM-F-076	FDA Layout of Coal Transfer Points		PU	AA
1961	XXXX-001-151-PVM-G-002	PAINT SCHEDULE		PU	AA
1962	XXXX-001-151-PVM-G-005	Commissioning Check List for Fire Detection and Protection System		PU	AA
1963	XXXX-001-151-PVM-G-006	Design philosophy and Sizing Calculations for Inert Gas System		PU	A
1964	XXXX-001-151-PVM-H-002	Extinguisher Schedule		PU	AA
1965	XXXX-001-151-PVM-L-001	Schematic Diagram for Fire Hydrant System		PU	AA
1966	XXXX-001-151-PVM-L-002	P&ID OF HVWS & MVWS		PU	AA
1967	XXXX-001-151-PVM-L-006	P&ID OF FIRE WATER PUMPING SYSTEM AND BOOSTER PUMPING SYSTEM		PU	A
1968	XXXX-001-151-PVM-P-001	Layout of Hydrant and Spray System for Transformer Yard (Area-1)		PU	A
1969	XXXX-001-151-PVM-P-002	Layout of Hydrant and Spray System for TG & Boiler Area (Area-2)		PU	A
1970	XXXX-001-151-PVM-P-003	LAYOUT OF HYDRANT AND SPRAY SYSTEM IN ESP, CHIMNEY & FGD AREA (AREA LAYOUT-3)		PU	A
1971	XXXX-001-151-PVM-P-004	Layout of Hydrant and Spray System for CHP Area (Area-5)		PU	A
1972		Layout of Hydrant and Spray System for external CHP Area at Mine End		PU	A
1973		LAYOUT OF HVW SPRAY SYSTEM FOR TRANSFORMERS & MVW SPRAY SYSTEM FOR CABLE GALLERIES AND HYDRAULIC CALCULATIONS AT MINE END		PU	A
1974	XXXX-001-151-PVM-P-009	Piping & Equipment Layout for Fire water Pump House		PU	AA
1975	XXXX-001-151-PVM-P-012	LAYOUT OF HVWS SYSTEM & HYDRAULIC CALCULATION FOR GENERATOR TRANSFORMERS (GT), ST, UT, UAT		PU	A
1976	XXXX-001-151-PVM-P-016	LAYOUT OF HVWS SYSTEM & HYDRAULIC CALCULATION FOR AUX TRANSFORMERS (AHP/CHP/OTHERS)		PU	A
1977	XXXX-001-151-PVM-P-021	LAYOUT OF HVW SPRAY SYSTEM & HYDRAULIC CALCULATION FOR BOILER BURNER FRONT ALONG WITH FUEL OIL STATION		PU	A
1978		LAYOUT OF HVW SPRAY SYSTEM & HYDRAULIC CALCULATION FOR VARIOUS SYSTEM IN TG BUILDING (BFP, MOT, CLEAN & DIRTY OIL TANK, OIL CANAL, GENERATOR SEAL OIL SYSTEM, ETC.)		PU	A
1979	XXXX-001-151-PVM-P-027	LAYOUT OF INTERNAL HYDRANT FOR TG BUILDING		PU	A
1980	XXXX-001-151-PVM-P-028	LAYOUT OF INTERNAL HYDRANT FOR BOILER AREA		PU	A
1981	XXXX-001-151-PVM-P-032A	LAYOUT OF INTERNAL HYDRANT FOR FQA building		PU	AA
1982	XXXX-001-151-PVM-P-032B	LAYOUT OF INTERNAL HYDRANT FOR Gypsum Dewatering Building		PU	AA
1983	XXXX-001-151-PVM-P-033	LAYOUT OF INTERNAL HYDRANT FOR TRACK HOPPER		PU	A
1984	XXXX-001-151-PVM-P-034B	MVW SPRAY SYSTEM, INTERNAL HYDRANTS & HYDRAULIC CALCULATION FOR CRUSHER HOUSES		PU	A
1985	XXXX-001-151-PVM-P-035	Layout of MVW SPRAY SYSTEM, INTERNAL HYDRANTS & HYDRAULIC CALCULATION FOR BUNKER TPs & CONVEYORS		PU	A
1986	XXXX-001-151-PVM-P-036	LAYOUT OF MVW SPRAY SYSTEM & HYDRAULIC CALCULATION FOR COAL CONVEYORS OF CHP PLANT		PU	A
1987	XXXX-001-151-PVM-P-037	LAYOUT OF MVW SPRAY SYSTEM, INTERNAL HYDRANT & HYDRAULIC CALCULATION FOR COAL TRANSFER POINTS OF CHP PLANT		PU	A
1988		LAYOUT OF MVW SPRAY SYSTEM & HYDRAULIC CALCULATION FOR TG BLDG CABLE GALLERY ROOM AT EL. 0.0 M, 5.1M, 8.5M, 13.5M AND 24M		PU	A
1989		LAYOUT OF MVW SPRAY SYSTEM, INTENAL HYDRANTS & HYDRAULIC CALCULATION FOR CABLE VAULT AT ESP COTROL BUILDING AT EL. 0.0 M & 8.5M		PU	A
1990	XXXX-001-151-PVM-P-051	Layout of MVW Spray System & HYDRAULIC CALCULATION for Fuel Oil Unloading Pump House and Fuel Oil Pressurising Pump House		PU	A
1991	XXXX-001-151-PVM-P-055	LAYOUT OF MVW SPRAY SYSTEM & HYDRAULIC CALCULATION FOR DG SET OIL TANKS		PU	A
1992	XXXX-001-151-PVM-P-057	LAYOUT OF MVW SPRAY SYSTEM & HYDRAULIC CALCULATION FOR LDO TANKS and Day oil tank		PU	A
1993		Layout of Inert Gas Extinguishing System, GA of Inert Gas Cylinder Storgae Room & Flow Calculations for Common Control Room & Control Equipment Rooms Located in Main Plant at El. 17.0m and UPS/Battery Charger room at El. 8.5 m for unit-1& 2		PU	A
	XXXX-001-151-PVM-P-058				

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 28 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
1994	XXXX-001-151-PVM-P-080	COMPOSITE LAYOUT OF HYDRANT AND SPRAY SYSTEM INLCUDING HUME PIPES LOCATION		PU	A
1995	XXXX-001-151-PVM-P-085	LAYOUT OF HYDRANT AND SPRAY SYSTEM CW PUMP HOUSE, PT PLANT & SWITCHYARD AREA (AREA-4)		PU	A
1996	XXXX-001-151-PVM-P-099	Layout of MVW Spray System & HYDRAULIC CALCULATION for Boom & Tripper Conveyors of Stacker-Reclaimer Machines		PU	A
1997	XXXX-001-151-PVM-U-001	Block Diagram and Pressure Drop Calculation of Hydrant System		PU	AA
1998	XXXX-001-151-PVM-U-002	Block Diagram and Pressure Drop Calculation of Spray System		PU	AA
1999	XXXX-001-151-PVM-U-003	Design Calculation for Fire Water Storage Tanks		PU	AA
2000	XXXX-001-151-PVM-W-001	DESIGN PHILOSOPHY AND SIZING CALCULATIONS FOR HYDRANT, SPRAY & FOAM PROTECTION SYSTEM		PU	A
2001	XXXX-001-151-PVM-Y-003	DATASHEET AND GA DRG OF BASKET TYPE STRAINER		PU	AA
2002	XXXX-001-151-PVM-Y-004	Data Sheet - Valves (Gate Valve & Check Valve)		PU	AA
2003	XXXX-001-151-PVM-Y-005	GA & Datasheet for Motorised Gate valve.		PU	AA
2004	XXXX-001-151-PVM-Y-007	DATASHEET AND GA DRG OF HYDRANT VALVES, BRANCH PIPES AND NOZZLEAND 4-WAY VALVES, WATER MONITOR (75NB) & FOAM MONITOR, Multipurpose Nozzle		PU	AA
2005	XXXX-001-151-PVM-Y-008	DATASHEET AND GA DRG OF FIRE HOSE (15 METER AND 7.5 METER) AND COUPLING		PU	AA
2006	XXXX-001-151-PVM-Y-010	DATASHEET AND GA DRG OF HOSE BOX		PU	AA
2007	XXXX-001-151-PVM-Y-013	GA & DATASHEET FOR DELUGE VALVE WITH TRIMS		PU	AA
2008	XXXX-001-151-PVM-Y-014	DATASHEET AND GA DRG OF Y-TYPE STRAINER		PU	AA
2009	XXXX-001-151-PVM-Y-015A	GA & DATASHEET FOR H.V.W. SPRAY NOZZLES, M.V.W. SPRAY NOZZLES & QUARTZOID BULB DETECTORS		PU	AA
2010	XXXX-001-151-PVM-Y-018	Data Sheet - Pipes & Fittings (MS, GI, Seamless, SS)		PU	AA
2011	XXXX-001-151-PVM-Y-019	TECHNICAL DATA SHEET OF FIRE EXTINGUISHERS		PU	AA
2012	XXXX-001-151-PVM-Y-024	DATA SHEET FOR FOAM CONCENTRATE OF FOAM SYSTEM		PU	AA
2013	XXXX-001-151-PVM-Y-027	Data Sheet for S.S. Flexible Hoses & Quick camlock type coupling		PU	AA
2014	XXXX-001-151-PVM-Y-028	Data Sheet & G.A. of Pressure relief damper for inert gas protected areas		PU	AA
2015	XXXX-001-151-PVM-Y-045	DATA SHEET FOR FOAM BRANCH PIPE WITH NOZZLE & FOAM CHAMBER WITH DEFLECTOR OF FOAM SYSTEM		PU	AA
2016	XXXX-001-151-PVM-Y-077	DATA SHEETS OF INERT GAS COMPONENTS (INDIGENOUS) OF IGES		PU	AA
2017	XXXX-001-151-PVM-Y-081	GA & Datasheet for Butterfly valve		PU	AA
2018	XXXX-001-151-PVM-Y-089	DATA SHEETS OF INERT GAS COMPONENTS (IMPORTED) OF IGES		PU	AA
2019	XXXX-001-148-PVM-B-001	STANDARD DRAWING FOR DUCT FABRICATION & SUPPORTING ARRANGEMENT AND ERECTION & APPLICATION DETAIL OF INSULATION		PU	AA
2020	XXXX-001-148-PVM-F-001	TG HALL VENTILATION DUCT LAYOUT FROM A-ROW SIDE AIR WASHER		PU	AA
2021	XXXX-001-148-PVM-F-002	TG HALL VENTILATION DUCT LAYOUT FROM B-C BAY AIR WASHER		PU	AA
2022	XXXX-001-148-PVM-F-003	EQUIPMENT LAYOUT OF AIR WASHER UNIT ALONGWITH FOUNDATION DETAIL ALONG A-ROW		PU	AA
2023	XXXX-001-148-PVM-F-004	EQUIPMENT LAYOUT OF AIR WASHER UNIT ALONGWITH FOUNDATION DETAIL ALONG BC-BAY AND BOILER MCC ROOM		PU	AA
2024	XXXX-001-148-PVM-F-005	EQUIPMENT LAYOUT OF UAF UNIT ALONGWITH FOUNDATION DETAIL FOR ESP & FGD BUILDING		PU	AA
2025	XXXX-001-148-PVM-F-006	VENTILATION DUCT LAYOUT OF UAF UNIT FOR ESP & FGD CONTROL BUILDINGS		PU	AA
2026	XXXX-001-148-PVM-H-001	SIZING CALCULATIONS FOR VENTILATION FANS FOR ALL BUILDING		PU	A
2027	XXXX-001-148-PVM-K-001	WRITE UP & CONTROL PHILOSOPHY FOR VENTILATION SYSTEM		PU	A
2028	XXXX-001-148-PVM-X-001	OPERATION & MAINTENANCE MANUAL		PU	A
2029	XXXX-001-148-PVM-X-003	DESIGN PHILOSOPHY, HEAT LOAD CALCULATION AND SCHEME OF AIR DISTRIBUTION FOR EVAPORATIVE COOLING SYSTEM		PU	A
2030	XXXX-001-148-PVM-Y-001	TECHNICAL DATA SHEET & GA DRAWING FOR ROOF EXTRACTOR ALONGWITH FIXING DETAILS		PU	AA
2031	XXXX-001-148-PVM-Y-003	TECHNICAL DATA SHEET & GA DRAWING OF MODULAR AIR WASHER & UAF INCLUDING FAN & PUMP DETAILS		PU	AA
2032	XXXX-001-148-PVM-Y-005	TECHNICAL DATA SHEET & GA DRAWING FOR AXIAL FANS ALONGWITH FIXING DETAILS		PU	AA
2033	XXXX-001-148-PVM-Y-006	TECHNICAL DATA SHEET FOR Y TYPE STRAINER		PU	AA
2034	XXXX-001-148-PVM-Y-007	TECHNICAL DATA SHEET & G/A/DRWG/ FOR CAST IRON VALVES(GATE VALVE,CHECK VALVE, GLOBE VALVE)		PU	AA
2035	XXXX-001-148-PVM-Y-009	TECHNICAL DATA SHEET FOR THERMAL & ACCOUSTIC INSULATION FOR DUCTING		PU	AA
2036	XXXX-001-148-PVM-Y-010	TECHNICAL DATA SHEET & G/A/ DRAWING OF PRE-FILTER,FINE FILTER&WATER REPELLANT FILTER (AIR WASHER & UAF)		PU	AA
2037	XXXX-001-148-PVM-Y-011	TECHNICAL DATA SHEET OF G/I SHEET		PU	AA
2038	XXXX-001-148-PVM-Y-012	TECHNICAL DATA SHEET OF PIPES		PU	AA
2039	XXXX-001-148-PVM-Y-013	DATA SHEET & GA OF FIRE DAMPER WITH ACTUATOR DETAILS		PU	AA
2040	0000-001-102-PVM-U-001	Furnace performance & sizing criteria & calculation	EPC-SG_sys	SG	A
2041	0000-001-102-PVM-U-002	BOILER HEAT DUTY CALCULATION	EPC-SG_sys	SG	A
2042	0000-001-102-PVM-U-004	Duct design data & calculation	EPC-SG_sys	SG	A
2043	0000-001-102-PVM-U-006	Boiler efficiency calculation	EPC-SG_sys	SG	A
2044	0000-001-102-PVM-U-008	Furnace Residence Time calculation	EPC-SG_sys	SG	A
2045	0000-001-102-PVM-U-009	NOX CALCULATION	EPC-SG_sys	SG	A
2046	0000-001-102-PVM-U-009A	Design Document for Operation Flexibility	EPC-SG_sys	SG	A
2047	0000-001-102-PVM-U-018	Mill Sizing Calculation & Performance Curves	EPC-SG_sys	SG	A
2048	0000-001-102-PVM-U-025	APH sizing calculation	EPC-SG_sys	SG	A
2049	0000-001-102-PVM-W-010	BOILER PERFORMANCE PARAMETER	EPC-SG_sys	SG	A
2050	0000-001-102-PVM-W-011	Predicted performance for indigeneous best coal, design coal & worst coal and variable pressure operation for 50,60,80, & 100% TMCR load and 60% BMCR & 100% BMCR load and HP heaters out condition	EPC-SG_sys	SG	A
2051	0000-001-102-PVM-W-012	Predicted performance for best coal, design coal & worst indigeneous coal blended with best & worst imported coal (individually) for variable pressure operation for 100% and 105% TMCR load and 60% BMCR & 100% BMCR load and HP heaters out condition	EPC-SG_sys	SG	A
2052	0000-001-102-PVM-U-003	AIR AND GAS WEIGHT CALCULATION	EPC-SG_sys	SG	A
2053	0000-001-102-PVM-U-005	Circulation calculation	EPC-SG_sys	SG	A
2054	0000-001-102-PVM-U-010	Buckstay arrangement and sizing calculations	EPC-SG_sys	SG	A
2055	0000-001-102-PVM-U-015	Coal drying calculations	EPC-SG_sys	SG	A
2056	0000-001-102-PVM-U-016	Fuel piping sizing data	EPC-SG_sys	SG	A
2057	0000-001-102-PVM-U-017	Fuel oil system sizing calculations including pressure drop calculations, NPSH, Fuel oil heaters,coolers, drain oil system etc.	EPC-SG	SG	A
2058	0000-001-102-PVM-U-020	Fan (ID,FD,PA and Seal Air) sizing calculation	EPC-SG_sys	SG	A
2059	0000-001-102-PVM-U-026	Steam coil Air heater selection data	EPC-SG_sys	SG	A
2060	0000-001-102-PVM-W-019	Requirement of Equipment cooling water (SG and Auxiliaries)	EPC-SG_sys	SG	A
2061	0000-001-102-PVM-B-007	GEN. ARR'G'T OF BOILER-PLAN-	EPC-SG	SG	A
2062	0000-001-102-PVM-B-007A	GEN. ARR'G'T OF BOILER-PLAN-"C-C"	EPC-SG	SG	A
2063	0000-001-102-PVM-B-011A	GEN. ARR'G'T OF BOILER-FRONT ELEVATION-	EPC-SG	SG	A
2064	0000-001-102-PVM-B-012	GEN. ARR'G'T OF BOILER-FRONT ELEVATION-"G-G"	EPC-SG	SG	A

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 29 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
2065	0000-001-102-PVM-B-013	GEN. ARRGT ID SYSTEM -ELEVATION	EPC-SG	SG	A
2066	0000-001-102-PVM-B-444	GEN. ARRGT ID SYSTEM-PLAN	EPC-SG	SG	A
2067	0000-001-102-PVM-B-019	GA drawing for PA Fan and motor with foundation plan and loading Details	EPC-SG_sys	SG	A
2068	0000-001-102-PVM-B-003	MILL GA DRAWING	EPC-SG	SG	A
2069	0000-001-102-PVM-F-010A	GEN. ARRGT-DUCT LAYOUT-COLD PRI. AIR DUCT TO APH & MILLS	EPC-SG	SG	AA
2070	0000-001-102-PVM-F-010B	GEN. ARRGT-DUCT LAYOUT-COLD SEC. AIR DUCT TO APH	EPC-SG	SG	AA
2071	0000-001-102-PVM-F-011A	GEN. ARRGT-DUCT LAYOUT-HOT PRI. AIR DUCT TO MILLS	EPC-SG	SG	AA
2072	0000-001-102-PVM-F-011B	GEN. ARRGT-DUCT LAYOUT-HOT SEC. AIR DUCT TO WINDBOX CONN. DUCT	EPC-SG	SG	AA
2073	0000-001-102-PVM-F-011C	GEN. ARRGT-DUCT LAYOUT-HOT SEC. AIR DUCT TO SOFA-	EPC-SG	SG	AA
2074	0000-001-102-PVM-F-012A	GEN. ARRGT-DUCT LAYOUT-GAS DUCT FROM ECO. DUCT TO APH	EPC-SG	SG	A
2075	0000-001-102-PVM-F-012B	GEN. ARRGT-DUCT LAYOUT-GAS DUCT FROM APH TO BOF	EPC-SG	SG	A
2076	0000-001-102-PVM-B-008	BOILER PLAN AT 0.0M LEVEL	EPC-SG	SG	A
2077	0000-001-102-PVM-H-030	Pressure parts schedule along with metal temprature calculation of Auxilliary Boiler	EPC-SG_sys	SG	A
2078	0000-001-102-PVM-U-043	Furnace sizing of Aux. boiler	EPC-SG_sys	SG	A
2079	0000-001-102-PVM-F-001	P & I Diagram for Water and steam circuit with valves, Fittings and Instrumentation	EPC-SG_sys	SG	A
2080	0000-001-102-PVM-F-002	P & I Diagram for flue gas path with instrumentation	EPC-SG_sys	SG	A
2081	0000-001-102-PVM-F-003	P & I diagram for fuel oil system	EPC-SG_sys	SG	A
2082	0000-001-102-PVM-L-004	P&ID of fuel oil system in FOPH area from terminal point including write-up/ procedure	EPC-SG_sys	SG	A
2083	0000-001-102-PVM-L-006	P&ID of Fuel oil system in Boiler front area	EPC-SG	SG	A
2084	0000-001-102-PVM-L-007	Scheme of Air Heater(s) with instrumentation	EPC-SG_sys	SG	A
2085	0000-001-102-PVM-L-010	P&ID of pulveriser system	EPC-SG_sys	SG	A
2086	0000-001-102-PVM-L-022	P&ID High Pressure Boiler Startup and Warmup System	EPC-SG_sys	SG	A
2087	0000-001-102-PVM-L-025	P&ID Sootblower System - 1 of 2	EPC-SG_sys	SG	A
2088	0000-001-102-PVM-L-036A	P&ID OF Reheater System - 1 of 2	EPC-SG_sys	SG	A
2089	0000-001-102-PVM-L-036C	P&ID OF SuperHeater System - 1	EPC-SG_sys	SG	A
2090	0000-001-102-PVM-L-036G	P&ID OF Evaporator System	EPC-SG_sys	SG	A
2091	0000-001-102-PVM-L-036H	P&ID OF Water Separator System	EPC-SG_sys	SG	A
2092	0000-001-102-PVM-L-036J	P&ID OF Economiser System	EPC-SG_sys	SG	A
2093	0000-001-102-PVM-L-041	P&ID for Boiler Water Circulation Pump System	EPC-SG_sys	SG	A
2094	0000-001-102-PVM-L-208	P&ID for Oxygen Dosing System	EPC-SG_sys	SG	A
2095	0000-001-102-PVM-U-013A	Safety valve and ERV sizing & selection for SH, RH	EPC-SG_sys	SG	A
2096	0000-001-102-PVM-U-024	Detail calculation of fan shafts, impeller hubs and impeller as per specification for all fans	EPC-SG_sys	SG	A
2097	0000-001-102-PVM-B-017	GA drawing for FD Fan and motor with foundation plan and loading Details	EPC-SG_sys	SG	A
2098	0000-001-102-PVM-H-002	Pressure part schedule along with summary of pr drop for SH system, RH system , Eco system, seperator , Circulation system/ evaporator system	EPC-SG_sys	SG	A
2099	0000-001-102-PVM-W-037	Soot blower selection sheets	EPC-SG_sys	SG	A
2100	0000-001-102-PVM-B-001	Wind box arrangement details	EPC-SG_sys	SG	A
2101	0000-001-102-PVM-B-015	GA of Air Preheater (Sheet 1) & GAD Notes for Air Preheater (Sheet 2)	EPC-SG	SG	A
2102	0000-001-102-PVM-B-032	Pressure parts arrangement	EPC-SG_sys	SG	A
2103	0000-001-102-PVM-L-029	Scheme of Instrument Air system	EPC-SG_sys	SG	A
2104	0000-001-102-PVM-L-031A	Scheme of APH water wash and fire fighting	EPC-SG_sys	SG	A
2105	0000-001-102-PVM-U-012	Steam / Water cooled hanger strength calculations	EPC-SG_sys	SG	A
2106	0000-001-102-PVM-U-028	Sizing criteria for Start-up flash tank, Flash tank drain tank and Condensate pumps	EPC-SG_sys	SG	A
2107	0000-001-102-PVM-W-333	Write-up for APH with instrumentation	EPC-SG_sys	SG	A
2108	0000-001-102-PVM-B-024	GA of bottom hopper including load cell arrangement details (if applicable) and bottom hopper movement diagram	EPC-SG	SG	A
2109	0000-001-102-PVM-B-027	Bottom hopper arrangement details to establish hopper is designed for 50% full of ash along with calculation	EPC-SG_sys	SG	A
2110	0000-001-102-PVM-B-018	GA drawing for ID Fan and motor with foundation plan and loading Details	EPC-SG	SG	A
2111	0000-001-102-PVM-L-003	Combustion air & Flue gas system along with instrumentation - Write up /Procedure	EPC-SG_sys	SG	A
2112	0000-001-102-PVM-L-030	Scheme of service air system	EPC-SG_sys	SG	A
2113	0000-001-102-PVM-Y-002	Pulverizer Data Sheet	EPC-SG_sys	SG	AA
2114	0000-001-102-PVM-B-020	GA drawing for Seal Air fan and motor with foundation plan and loading Details	EPC-SG	SG	AA
2115	0000-001-102-PVI-K-003	GA drawings of ERVs	EPC-SG_sys	SG	AA
2116	0000-001-102-PVM-B-004	GA drawing and foundation detail for Chemical Dosing System	EPC-SG	SG	AA
2117	0000-001-102-PVM-B-011	GA of gravimetric feeder	EPC-SG	SG	AA
2118	0000-001-102-PVM-B-037	FLOOR PLAN ARRGT-SHEET-1	EPC-SG	SG	AA
2119	0000-001-102-PVM-B-038	FLOOR PLAN ARRGT-SHEET-2	EPC-SG	SG	AA
2120	0000-001-102-PVM-B-039	FLOOR PLAN ARRGT-SHEET-3	EPC-SG	SG	AA
2121	0000-001-102-PVM-B-040	FLOOR PLAN ARRGT-SHEET-4	EPC-SG	SG	AA
2122	0000-001-102-PVM-B-041	FLOOR PLAN ARRGT-SHEET-5	EPC-SG	SG	AA
2123	0000-001-102-PVM-B-042	FLOOR PLAN ARRGT-SHEET-6	EPC-SG	SG	AA
2124	0000-001-102-PVM-B-043	FLOOR PLAN ARRGT-SHEET-7	EPC-SG	SG	AA
2125	0000-001-102-PVM-B-044	FLOOR PLAN ARRGT-SHEET-8	EPC-SG	SG	AA
2126	0000-001-102-PVM-B-045	FLOOR PLAN ARRGT-SHEET-9	EPC-SG	SG	AA
2127	0000-001-102-PVM-B-046	FLOOR PLAN ARRGT-SHEET-10	EPC-SG	SG	AA
2128	0000-001-102-PVM-L-046	P&IDs Lub. Oil system for PA , FD and ID fans	EPC-SG_sys	SG	A
2129	0000-001-102-PVM-L-064	Scheme for arrangement of Nitrogen Blanketing of Pressure Parts	EPC-SG_sys	SG	A
2130	0000-001-102-PVM-N-003	Performance curves for PA , FD ,ID and Seal Air fans	EPC-SG_sys	SG	A
2131	0000-001-102-PVM-N-005	Boiler correction curves	EPC-SG_sys	SG	A
2132	0000-001-102-PVM-U-032	SUMMARY OF START UP AND WARM UP SYSTEM, FTDT DESIGN & CONDENSATE PUMP DESIGN	EPC-SG_sys	SG	A
2133	0000-001-102-PVM-B-081	LOCATION OF FURNACE OPENINGS & BUCKSTAYS SHEET	EPC-SG	SG	A
2134	0000-001-102-PVM-L-024	P&ID for Sampling System including write-up/ procedure	EPC-SG_sys	SG	A
2135	0000-001-102-PVM-L-025A	P&ID Sootblower System - 2 of 2	EPC-SG_sys	SG	A
2136	0000-001-102-PVM-L-037	SCHEME and Write-up/Procedure OF BLOW DOWN SYSTEM	EPC-SG_sys	SG	A
2137	0000-001-102-PVM-L-038	Scheme of Cooling water supply and return	EPC-SG_sys	SG	A
2138	0000-001-102-PVM-Y-016	DATA SHEET FOR BOILER WATER CIRCULATION PUMP	EPC-SG_sys	SG	AA
2139	0000-001-102-PVM-Y-054	TDS,GA and Performance Curve for Condensate Transfer Pump	EPC-SG_sys	SG	AA
2140	0000-001-102-PVM-B-077	Layout of Fuel oil pressurising pump house with Foundation plan including write-up/ procedure	EPC-SG	SG	A
2141	0000-001-102-PVM-H-001	Schedule of Dampers & Gates(except SCR & Economizer Bypass system)	EPC-SG_sys	SG	AA
2142	0000-001-102-PVM-H-001A	Schedule of all Dampers & Gates for SCR & Economizer Bypass system (BAP Ranipet scope of supply)	EPC-SG_sys	SG	AA
2143	0000-001-102-PVM-L-031	Scheme of service water and Aux. Steam to mills	EPC-SG_sys	SG	AA
2144	0000-001-102-PVM-L-036	Scheme of Aux. steam to SCAPH and SCAPH Drain	EPC-SG_sys	SG	AA
2145	0000-001-102-PVM-U-007	Insulation Thickness calculations	EPC-SG_sys	SG	AA
2146	0000-001-102-PVM-X-002	P&ID OF MILL LUBE OIL SYSTEM INCLUDING OPERATING PROCEDURE	EPC-SG_sys	SG	A
2147	0000-001-102-PVM-Y-001	Oil/Coal Burner data	EPC-SG_sys	SG	A

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 30 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
2148	0000-001-102-PVM-Y-003	Scanner air fan data sheets	EPC-SG_sys	SG	AA
2149	0000-001-102-PVM-K-009	Write-up for Burner Management System.	EPC-SG_sys	SG	A
2150	0000-001-102-PVM-K-010	Functional Write-up for Secondary Air Damper Control System	EPC-SG_sys	SG	A
2151	0000-001-102-PVM-K-011	Functional Write-up for Soot Blower Control System	EPC-SG_sys	SG	A
2152	0000-001-102-PVM-K-013	Functional Write-up for Fuel Oil Pump House Control System.	EPC-SG_sys	SG	A
2153	0000-001-102-PVM-L-006A	BOILER AREA OIL FIRING SYSTEM ? WRITE-UP/ PROCEDURE	EPC-SG_sys	SG	A
2154	0000-001-102-PVM-B-024A	LOAD CELL ARRANGEMENT	EPC-SG	SG	AA
2155	0000-001-102-PVM-B-105	Air Receiver Location for Air Preheater	EPC-SG	SG	AA
2156	0000-001-102-PVM-B-070	Mill plant (seal air) arrangement for location of Seal Air Fan including write-up/ procedure	EPC-SG	SG	AA
2157	0000-001-102-PVM-B-072	Boiler start up and recirculation pump arrangement and fixing	EPC-SG	SG	A
2158	0000-001-102-PVM-B-146	Data sheet for LDO pressurising pump including GA/Cross-sectional drawing	EPC-SG_sys	SG	AA
2159	0000-001-102-PVM-H-006A	Painting scheme for SG & Auxiliaries	EPC-SG_sys	SG	A
2160	0000-001-102-PVM-L-209	Anti Vibration baffles location data	EPC-SG_sys	SG	AA
2161	0000-001-102-PVM-U-013	SAFETY VALVE SETTING FOR SEPEARATORE, SH,RH AND SB -OTSC	EPC-SG_sys	SG	A
2162	0000-001-102-PVM-U-014	ERV Setting for Superheater and Reheater Outlet	EPC-SG_sys	SG	A
2163	0000-001-102-PVM-U-104	GA Drawings for Gates & Dampers (except SCR & Economizer Bypass system)	EPC-SG_sys	SG	A
2164	0000-001-102-PVM-W-001	Combined performance test procedures of PA,FD,ID fans	EPC-SG_sys	SG	A
2165	0000-001-102-PVM-W-004	Performance test procedures of Gates & Dampers	EPC-SG_sys	SG	A
2166	0000-001-102-PVM-W-005	TYPE TEST PROCEDURE FOR BOILER WATER CIRCULATION PUMP	EPC-SG_sys	SG	A
2167	0000-001-102-PVM-W-031	Performance test procedures of Boiler re-circulation pump (as applicable)	EPC-SG_sys	SG	A
2168	0000-001-102-PVM-W-101	Type test procedure for Gravimetric feeder-Explosion test	EPC-SG_sys	SG	AA
2169	0000-001-102-PVM-Y-007	Data sheet for HFO pressurising pump including GA/Cross-sectional drawing	EPC-SG_sys	SG	AA
2170	0000-001-102-PVM-Y-036	Datasheet of expansion joints	EPC-SG_sys	SG	AA
2171	0000-001-102-PVM-Y-018	Data sheet of furnace maintenance cradle	EPC-SG_sys	SG	AA
2172	0000-001-102-PVM-B-031	GA OF ELEVATOR With Lift machine room details	EPC-SG	SG	AA
2173	0000-001-102-PVM-B-060	FAN HANDLING ARRANGEMENT including write-up/ procedure	EPC-SG	SG	AA
2174	0000-001-102-PVM-B-064	MILL HANDLING ARRANGEMENT DRG. ALONGWITH WRITE UP/ PROCEDURE & LOADING DETAILS	EPC-SG	SG	AA
2175	0000-001-102-PVM-B-065	Air heater element handling arrangemnt including write-up/ procedure	EPC-SG	SG	AA
2176	0000-001-102-PVM-B-066	SCAPH handling arrangement including write-up/ procedure	EPC-SG	SG	AA
2177	0000-001-102-PVM-B-067	Circulating water pump handling arrangement Maintenance Information including write-up/ procedure	EPC-SG	SG	AA
2178	0000-001-102-PVM-B-068	Handling details - LDO, HFO P&H unit including write up / procedures	EPC-SG	SG	AA
2179	0000-001-102-PVM-H-034	Schedule, content and programme of Training as identified in the contract	EPC-SG_sys	SG	A
2180	0000-001-102-PVM-W-008	Type test report of PA fan	EPC-SG_sys	SG	A
2181	0000-001-102-PVM-W-009	Type test report of FD fan	EPC-SG_sys	SG	A
2182	0000-001-102-PVM-W-057	Type test report of ID fan	EPC-SG_sys	SG	A
2183	0000-001-102-PVM-W-067	Type test report for Seal Air Fan	EPC-SG_sys	SG	A
2184	0000-001-102-PVM-W-068	TYPE TEST REPORT FOR CIRCULATING WATER PUMP	EPC-SG_sys	SG	A
2185	0000-001-102-PVM-Y-005	DATA SHEET FOR ELEVATORS (Passenger/Good)	EPC-SG_sys	SG	AA
2186	0000-001-102-PVM-Y-009	Data sheets for insulation materials	EPC-SG_sys	SG	AA
2187	0000-001-102-PVM-Y-019	Data sheet for Quick Erect scaffolding	EPC-SG_sys	SG	AA
2188	0000-001-102-PVM-Y-037	Details/Data sheets of all special tools & tackles	EPC-SG_sys	SG	AA
2189	0000-001-102-PVM-B-002	GA of Separator internal	EPC-SG_sys	SG	AA
2190	0000-001-102-PVM-B-023	Bottom seal plate assembly details	EPC-SG_sys	SG	AA
2191	0000-001-102-PVM-B-026	GA of Burner along with HEA Ignitor Assy.	EPC-SG_sys	SG	AA
2192	0000-001-102-PVM-B-075	GA with Foundationplan/loading data/foundation bolts/fixing details for Atmospheric flash and drain receiving tank including write-up/ procedure	EPC-SG_sys	SG	AA
2193	0000-001-102-PVM-B-079	Silencer arrangement for FD , PA Fan	EPC-SG_sys	SG	AA
2194	0000-001-102-PVM-B-083	Cross sectional drawing of steam generator showing the maximum gas velocities in m/s at 100% BMCR.	EPC-SG_sys	SG	AA
2195	0000-001-102-PVM-B-086	Furnace maintenance platforms with layout and loading data	EPC-SG_sys	SG	AA
2196	0000-001-102-PVM-B-087	Coal pipe/flue duct - openings/penetrations marked in elevation with loading in mill and bunker building	EPC-SG_sys	SG	AA
2197	0000-001-102-PVM-B-087	GA drawing and foundation detail for Oxygen Dosing System	EPC-SG_sys	SG	AA
2198	0000-001-102-PVM-B-130	GA Drgs. for CRH & HRH Isolator	EPC-SG_sys	SG	AA
2199	0000-001-102-PVM-B-140	GA , datasheet of Dozing skid of Auxiliary Boiler	EPC-SG_sys	SG	AA
2200	0000-001-102-PVM-B-141	GA, datasheet of LDO Pump of Auxiliary Boiler	EPC-SG	SG	AA
2201	0000-001-102-PVM-B-142	GA drawing of underlung crane	EPC-SG_sys	SG	AA
2202	0000-001-102-PVM-B-150	GA & foundation details of condensate transfer pump	EPC-SG	SG	AA
2203	0000-001-102-PVM-B-224	GAD of knife gate valves for Mills	EPC-SG_sys	SG	AA
2204	0000-001-102-PVM-B-224A	GAD of Knife gate valve for burner i/l.	EPC-SG_sys	SG	AA
2205	0000-001-102-PVM-F-003	Details of Air Ducting support columns location and their foundation detail.	EPC-SG_sys	SG	AA
2206	0000-001-102-PVM-F-004	Layout of pulverised fuel piping incl. loading data	EPC-SG	SG	AA
2207	0000-001-102-PVM-F-005	Layout of F.O. Forwarding system - Boiler front	EPC-SG_sys	SG	AA
2208	0000-001-102-PVM-F-006	Layout of F.O. Forwarding system within FOPH	EPC-SG_sys	SG	AA
2209	0000-001-102-PVM-F-019	Layout of boiler safety valve exhaust piping	EPC-SG_sys	SG	AA
2210	0000-001-102-PVM-H-003	Insulation schedule for boiler	EPC-SG_sys	SG	AA
2211	0000-001-102-PVM-H-004	Schedule of valves and fittings of steam & water for Main Boiler	EPC-SG_sys	SG	AA
2212	0000-001-102-PVM-H-005	Schedule of expansion joints	EPC-SG_sys	SG	AA
2213	0000-001-102-PVM-H-016	VALVE SCHEDULE OF FUEL OIL SYSTEM	EPC-SG_sys	SG	AA
2214	0000-001-102-PVM-H-016A	VALVE SCHEDULE FOR LDO PRESSURIZING SYSTEM(LTP SCOPE)	EPC-SG_sys	SG	AA
2215	0000-001-102-PVM-K-003	Boiler design dossier	EPC-SG_sys	SG	AA
2216	0000-001-102-PVM-K-004	WRITE-UP FOR STEAM BLOWING SCHEME	EPC-SG_sys	SG	AA
2217	0000-001-102-PVM-L-025B	Soot Blower and Start UP P&ID Valve List	EPC-SG_sys	SG	AA
2218	0000-001-102-PVM-L-041B	BCP P&ID Valve List	EPC-SG_sys	SG	AA
2219	0000-001-102-PVM-L-057	Steam and water circuit alongwith valves, fittings and instruments of Auxiliary Boiler	EPC-SG_sys	SG	AA
2220	0000-001-102-PVM-L-058	Air & Flue gas path with instrumentation of Auxiliary Boiler	EPC-SG_sys	SG	AA
2221	0000-001-102-PVM-L-059	Fuel oil scheme along with valves ,fittings and instrumentation of Auxiliary Boiler	EPC-SG_sys	SG	AA
2222	0000-001-102-PVM-N-007	Characteristics curves for fuel burners	EPC-SG_sys	SG	AA
2223	0000-001-102-PVM-U-011	Pressure part calculation as submitted/approved to/by IBR	EPC-SG_sys	SG	AA
2224	0000-001-102-PVM-U-044	Calculation as submitted to IBR for approval for Aux. boiler	EPC-SG_sys	SG	AA
2225	0000-001-102-PVM-U-045	Feed storage tank capacity calculations of Auxiliary Boiler	EPC-SG_sys	SG	AA
2226	0000-001-102-PVM-V-005	GA & FOUNDATION DETAILS FOR START-UP and Condensate FLASH TANK	EPC-SG_sys	SG	AA
2227	0000-001-102-PVM-W-015	Legends and symbols	EPC-SG_sys	SG	AA
2228	0000-001-102-PVM-W-016	Boiler equipment designation- Plan view of major equipment	EPC-SG_sys	SG	AA
2229	0000-001-102-PVM-W-023	Requirement of boiler fill water (per unit & total)	EPC-SG_sys	SG	AA
2230	0000-001-102-PVM-W-029	Pressure parts expansion movement diagram	EPC-SG_sys	SG	AA
2231	0000-001-102-PVM-X-003	MILL O&M MANUAL	EPC-SG_sys	SG	AA
2232	0000-001-102-PVM-Y-010	Data Sheets of Trip Valves for Oil system	EPC-SG_sys	SG	AA

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 31 OF 66

Sl No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
2233	0000-001-102-PVM-Y-015	Data sheet/GA drawing for air traps	EPC-SG_sys	SG	AA
2234	0000-001-102-PVM-Y-020	Data sheet of Dirty pitot tube	EPC-SG_sys	SG	AA
2235	0000-001-102-PVM-Y-022	List and detail of complete lifting tools and tackles	EPC-SG_sys	SG	AA
2236	0000-001-102-PVM-Y-028	Data sheets for FD , ID, PA Fan LOS including GA/Cross-sectional drawing	EPC-SG_sys	SG	AA
2237	0000-001-102-PVM-Y-031	Data sheets of Emergency retract drive (pneumatic) for Soot Blower System	EPC-SG_sys	SG	AA
2238	0000-001-102-PVM-Y-033	Coal abrasion test apparatus (YGP)	EPC-SG_sys	SG	AA
2239	0000-001-102-PVM-Y-039	LT DESUPERHEATER SPECIFICATION SHEET	EPC-SG_sys	SG	AA
2240	0000-001-102-PVM-Y-041	DATA SHEET & GA DRG. OF STEAM TRAPS	EPC-SG_sys	SG	AA
2241	0000-001-102-PVM-Y-050A	Data sheet of BFP of Auxiliary Boiler	EPC-SG_sys	SG	AA
2242	0000-001-102-PVM-Y-051	Data sheet of crane	EPC-SG_sys	SG	AA
2243	0000-001-102-PVM-B-022	Assembly of SCAPH Secondary	EPC-SG_sys	SG	AA
2244	0000-001-102-PVM-B-025	Duct Hopper GA/Movement Diagram	EPC-SG_sys	SG	AA
2245	0000-001-102-PVM-B-073	Assembly of SH/RH De-super heaters including write-up/ procedure	EPC-SG_sys	SG	AA
2246	0000-001-102-PVM-B-074	GA of de-superheater for Aux. PRDS including write-up/ procedure	EPC-SG_sys	SG	AA
2247	0000-001-102-PVM-B-084B	GA of Expansion Joints for Boiler Duct	EPC-SG_sys	SG	AA
2248	0000-001-102-PVM-B-127	GA of BFP of Auxiliary Boiler	EPC-SG_sys	SG	AA
2249	0000-001-102-PVM-B-145	GA of Dampers for Boiler Duct	EPC-SG_sys	SG	AA
2250	0000-001-102-PVM-B-151	Bunker emptying arrangement	EPC-SG	SG	AA
2251	0000-001-102-PVM-C-002	MILL ERECTION DRAWINGS & MANUAL	EPC-SG_sys	SG	AA
2252	0000-001-102-PVM-F-001	Details of Size of flue gas duct opening in the chimney shell & level of the center line in the duct entering chimney	EPC-SG_sys	SG	AA
2253	0000-001-102-PVM-F-002	Details of Fixing arrangement with chimney	EPC-SG_sys	SG	AA
2254	0000-001-102-PVM-H-009	VALVE SCHEDULE OF AUX. STEAM TO SCAPH & SCAPH DRAIN	EPC-SG_sys	SG	AA
2255	0000-001-102-PVM-H-010	VALVE SCHEDULE OF AUX. STEAM TO MILL INERTING & SERVICE WATER TO MILL	EPC-SG_sys	SG	AA
2256	0000-001-102-PVM-H-021	Testing schedule	EPC-SG_sys	SG	AA
2257	0000-001-102-PVM-H-033	VALVE SCHEDULE OF CONDENSATE FLASH TANK FOR START-UP DRAIN RECIRCULATION SYSTEM	EPC-SG_sys	SG	AA
2258	0000-001-102-PVM-L-063B	Aux P&ID Valve List (Boiler Area)	EPC-SG_sys	SG	AA
2259	0000-001-102-PVM-W-066	Painting procedure of Auxiliary Boiler	EPC-SG_sys	SG	AA
2260	0000-001-102-PVM-X-001	O&M manual of fans	EPC-SG_sys	SG	AA
2261	0000-001-102-PVM-X-010	O &M manual of Auxiliary Boiler	EPC-SG_sys	SG	AA
2262	0000-001-102-PVM-X-012	O&M Manual for Condensate Transfer Pump	EPC-SG_sys	SG	AA
2263	0000-001-102-PVM-Y-006	Data sheet & GA drawing for strainers for F.O. System (Boiler & FOPH Area)	EPC-SG_sys	SG	AA
2264	0000-001-102-PVM-Y-013	Data sheet for drain pump including GA/Cross-sectional drawing - Boiler area	EPC-SG_sys	SG	AA
2265	0000-001-102-PVM-Y-017	DATA SHEET FOR HOISTS for SG area	EPC-SG_sys	SG	AA
2266	0000-001-102-PVM-Y-027	Data Sheet for Lube Oil Pump of Mills incl. Motor including GA/Cross-sectional drawing	EPC-SG_sys	SG	AA
2267	0000-001-102-PVM-Y-032	Data sheets for Ignitor Testing Kit	EPC-SG_sys	SG	AA
2268	0000-001-102-PVM-Y-050	Data sheet and GA of FD fan of Auxiliary Boiler	EPC-SG_sys	SG	AA
2269	0000-001-102-PVM-Y-050B	Data sheet of Safety valve and shut off valves of Auxiliary Boiler	EPC-SG_sys	SG	AA
2270	0000-001-102-PVM-X-XXX	Essential Data pertaining to Steam Generator	EPC-SG_sys	SG	AA
2271	0000-001-104-PVM-B-001	GA of ESP including platforms and staircases, roof, canopy, funnel and hopper flange details etc.	ESP_sys	SG	A
2272	0000-001-104-PVM-H-001	Schedule of ESP insulation & Insulation thickness calculation	ESP_sys	SG	A
2273	0000-001-104-PVM-N-001	ESP correction Curves	ESP_sys	SG	A
2274	0000-001-104-PVM-U-001	ESP sizing calculation & performance data along with hopper sizing calculation	ESP_sys	SG	A
2275	0000-001-104-PVM-W-111	ESP Physical Modelling Procedure	ESP_sys	SG	A
2276	0000-001-104-PVM-W-222	Procedure of Ash Flowability study of ESP Hoppers	ESP_sys	SG	A
2277	0000-001-104-PVM-W-333	Report of Ash Flowability study of ESP Hoppers	ESP_sys	SG	A
2278	0000-001-104-PVM-W-444	Test report of physical flow modeling	ESP_sys	SG	A
2279	0000-001-104-PVM-Y-003	Data sheet & Arrangement of panel type hopper heater	ESP_sys	SG	A
2280	0000-001-104-PVM-Y-004	Data sheet for lightly bonded wool insulation material	ESP_sys	SG	A
2281	0000-001-104-PVM-U-002	Ash distribution data in various fields of ESP hopper	ESP_sys	SG	AA
2282	0000-001-104-PVM-B-003	ESP hopper & funnel movement diagrams.	ESP_sys	SG	AA
2283	0000-001-104-PVM-W-007	Erection strategy for ESP	ESP_sys	SG	AA
2284	0000-001-104-PVM-B-004	Collecting rapping arrangement	ESP_sys	SG	AA
2285	0000-001-104-PVM-B-005	Frame of emitting system	ESP_sys	SG	AA
2286	0000-001-104-PVM-B-006	Emitting rapping arrangements	ESP_sys	SG	AA
2287	0000-001-104-PVM-X-001	O&M Manuals	ESP_sys	SG	AA
2288	0000-109-PVM-F-047	Process Flow Diagram of FGD System	FGD MECH-MAIN	SG	A
2289	0000-109-PVM-W-002	Mass Flow Balance (Design Point & Guarantee point) data and FGD System Design Basis - PROCESS	FGD MECH-MAIN	SG	A
2290	0000-109-PVM-U-003	ABSORBER DESIGN BASIS/CRITERIA	FGD MECH-MAIN	SG	A
2291	0000-109-PVM-U-002	Flue gas system design, Chimney and Duct Sizing Calculation	FGD MECH-MAIN	SG	A
2292	0000-109-PVM-B-049	General Layout of FGD Ducting	FGD MECH-MAIN	SG	A
2293	0000-109-PVM-U-011	Sizing Calculation & Selection parameter for Wet ball Mill	FGD MECH-MAIN	SG	A
2294	0000-109-PVM-F-020	P&ID - Primary & secondary Dewatering,Waste Water Discharge System	FGD MECH-MAIN	SG	A
2295	0000-109-PVM-F-001	P&ID along with process description - Absorber ,Oxidation Blower,Gypsum Bleed Pump & Filtrate Water System ,Mist Eliminator	FGD MECH-MAIN	SG	A
2296	0000-109-PVM-B-201	P&ID along with process description - All sump & pump	FGD MECH-MAIN	SG	A
2297	0000-109-PVM-F-017	P&ID along with process description - Limestone Pulverizer-Wet Ball Mill & ,Reagent Preparation System, Feed tank& Pump	FGD MECH-MAIN	SG	A
2298	0000-109-PVM-F-046	P&ID along with process description ,Sizing Calculation and selection Criteria of waste water Neutralization system	FGD MECH-MAIN	SG	A
2299	0000-109-PVM-F-079	P&ID along with process description- Flue Gas Ducting and Dampers System	FGD MECH-MAIN	SG	A
2300	0000-109-PVM-B-010	Data sheet & General Arrangement and Foundation load data for Absorber along with staircase and platform	FGD MECH-MAIN	SG	A
2301	0000-109-PVM-B-066	Sizing Calculation for Primary & Secondary Hydro-cyclone	FGD MECH-MAIN	SG	AA
2302	0000-109-PVM-U-016	Sizing Calculation & Selection parameter for BOOSTER FANS	FGD MECH-MAIN	SG	A
2303	0000-109-PVM-U-006	Sizing Calculation & Selection parameter for Oxidation Air Blower	FGD MECH-MAIN	SG	A
2304	0000-109-PVM-U-012	Sizing Calculation & Selection parameter for Vacuum Belt filters	FGD MECH-MAIN	SG	A
2305	0000-109-PVM-U-005	Sizing Calculation & Selection parameter for Slurry Recirculation Pumps	FGD MECH-MAIN	SG	A
2306	0000-109-PVM-B-203	Sizing Calculation for Gypsum Dewatering System	FGD MECH-MAIN	SG	A
2307	0000-109-PVM-B-004	Data sheet & General Arrangement of Limestone Pulverizer(Wet ball Mill)	FGD MECH-MAIN	SG	AA
2308	0000-109-PVM-H-002	Sizing Calculation of Limestone day silo	FGD MECH-MAIN	SG	AA
2309	0000-109-PVM-U-009	Sizing Calculation ,Selection parameter for all tanks (Slurry & Water)	FGD MECH-MAIN	SG	A
2310	0000-109-PVM-U-007	Sizing Calculation& Selection parameter for Emergency Quench Water System	FGD MECH-MAIN	SG	A
2311	0000-109-PVM-B-137	Sizing of Equipment Closed Water Cooling System	FGD MECH-MAIN	SG	A
2312	0000-109-PVM-B-011	Data sheet & General Arrangement for Slurry Recirculation Pumps	FGD MECH-MAIN	SG	AA
2313	0000-109-PVM-B-047	General arrangement of Ball Mill Building & gypsum De-water Building	FGD MECH-MAIN	SG	AA
2314	0000-109-PVM-B-012	Data sheet & General Arrangement for Oxidation Air Blower	FGD MECH-MAIN	SG	AA

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 32 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
2315	0000-109-PVM-B-021	GA &Data sheet of Primary & Secondary Dewatering Hydrocyclone	FGD MECH-MAIN	SG	AA
2316	0000-109-PVM-U-008	Sizing Calculation & Selection parameter for all slurry pumps	FGD MECH-MAIN	SG	A
2317	0000-109-PVM-U-014	Sizing Calculation & Selection parameter for all Water Pumps	FGD MECH-MAIN	SG	A
2318	0000-109-PVM-U-017	Sizing Calculation & Selection parameter for Sump pumps	FGD MECH-MAIN	SG	A
2319	0000-109-PVM-B-143	GA and load data of all tanks (Slurry tanks, Filtrate tank & Water tanks)	FGD MECH-MAIN	SG	A
2320	0000-109-PVM-B-005	General Arrangement and Load data of Auxiliary Absorbent (Storage) Tank	FGD MECH-MAIN	SG	A
2321	0000-109-PVM-U-030	Condensate Study for Low Height Chimney	FGD MECH-MAIN	SG	A
2322	0000-109-PVM-B-022	Data sheet & General Arrangement of Vacuum Belt filters		SG	AA
2323	0000-109-PVM-B-099	Data sheet of Borosilicate	FGD MECH-MAIN	SG	AA
2324	0000-109-PVM-Y-008	GA & Data sheet of Mist Eliminator	FGD MECH-MAIN	SG	AA
2325	0000-109-PVM-B-014	Data sheet & General Arrangement for all slurry pumps	FGD MECH-MAIN	SG	AA
2326	0000-109-PVM-B-006	Data sheet & General Arrangement of All water pumps	FGD MECH-MAIN	SG	AA
2327	0000-109-PVM-B-028	Data Sheet & GA for Sump Pumps for FGD ,Milling and Dewatering Area	FGD MECH-MAIN	SG	AA
2328	0000-109-PVM-B-060	Documents for Seal Air System of Guillotine Damper	FGD MECH-MAIN	SG	AA
2329	0000-109-PVM-B-045	General arrangement of Recycle Pump & Oxidation Blower Building	FGD MECH-MAIN	SG	AA
2330	0000-109-PVM-B-206	Data sheet & General Arrangement of Agitators (Horizontal & Vertical) for Absorber Reaction Tank & all other tanks	FGD MECH-MAIN	SG	AA
2331	0000-109-PVM-H-003	GA & Datasheet of Condensate System of Chimney	FGD MECH-MAIN	SG	AA
2332	0000-109-PVM-H-001	Painting schedule of FGD System	FGD MECH-MAIN	SG	A
2333	0000-109-PVM-B-204	Sizing & General Arrangement of Mill circuit Tank	FGD MECH-MAIN	SG	A
2334	0000-109-PVM-B-034	General Arrangement for Piping - Dewatering area (Belt filter and Hydrocyclone area etc)	FGD MECH-MAIN	SG	AA
2335	0000-109-PVM-B-059	General Arrangement for Piping - FGD area (Absorber, Recycle Pump, Aux storage tank area etc)Lime Preparation Area (Ball Mill & Lime handling area etc)	FGD MECH-MAIN	SG	AA
2336	0000-109-PVM-B-058	General Arrangement of Limestone Day Silos	FGD MECH-MAIN	SG	AA
2337	0000-109-PVM-B-121	General Arrangement Bag Filter for Limestone Day Silos	FGD MECH-MAIN	SG	AA
2338	0000-109-PVM-H-004	Insulation Schedule	FGD MECH-MAIN	SG	AA
2339	0000-109-PVM-L-040	Pipe Schedule including LHS & GHS	FGD MECH-MAIN	SG	AA
2340	0000-109-PVM-W-012	Type Test Performance Procedure for BOOSTER FANS	FGD MECH-MAIN	SG	A
2341	0000-109-PVM-W-011	Type test procedure for Gates & Dampers	FGD MECH-MAIN	SG	A
2342	0000-109-PVM-Y-009	General Arrangement & Data Sheet of Limestone Weigh Feeder	FGD MECH-MAIN	SG	AA
2343	0000-109-PVM-Y-039	General Arrangement for Cake wash Pump	FGD MECH-MAIN	SG	AA
2344	0000-109-PVM-Y-041	Data Sheet for Spray Nozzles	FGD MECH-MAIN	SG	AA
2345	0000-109-PVM-L-038	GA & Data Sheet for Butterfly Valves,Globe, Ball,Gate	FGD MECH-MAIN	SG	AA
2346	0000-109-PVM-B-001	General Arrangement & Data sheet of Elevator	FGD MECH-MAIN	SG	A
2347	0000-109-PVM-B-033	General Arrangement & Schedule of expansion joint	FGD MECH-MAIN	SG	A
2348	0000-109-PVM-Y-040	G.A OF ELECTRIC HOIST	FGD MECH-MAIN	SG	AA
2349	0000-109-PVM-B-139	GA & Data Sheet for Air Cannon	FGD MECH-MAIN	SG	AA
2350	0000-109-PVM-W-016	Leak tightness performance test Report of damper/gates	FGD MECH-MAIN	SG	A
2351	0000-109-PVM-W-013	Type Test Performance Report for BOOSTER FANS	FGD MECH-MAIN	SG	A
2352	0000-109-PVM-F-045	GA of Gates and dampers	FGD MECH-MAIN	SG	A
2353	0000-109-PVM-B-037	General Arrangement & Data sheet for Booster fan	FGD MECH-MAIN	SG	A
2354	0000-109-PVM-B-202	Predicted Performance of FGD System at 50% 60%. 80% and 100% for a) Design coal , b) worst coal & C) best coal	FGD MECH-MAIN	SG	A
2355	0000-109-PVM-B-020	Valve Schedules including LHS & GHS	FGD MECH-MAIN	SG	AA
2356	9585-001-101-PROVENNESS-001	Provenness for SCR System	SCR	SG	A
2357	9585-001-101-PVM-L-001	P&ID and Write-up for SCR system - Key Diagram	SCR	SG	AA
2358	9585-001-101-PVM-L-002	P&ID and Write-up for SCR system - Ammonia unloading & storage system	SCR	SG	AA
2359	9585-001-101-PVM-L-003	P&ID and Write-up for SCR system - Ammonia Forwarding/Vapouriser systems	SCR	SG	AA
2360	9585-001-101-PVM-L-004	P&ID and Write-up for SCR system - Boiler island	SCR	SG	AA
2361	9585-001-101-PVM-L-005	P&ID and Write-up for SCR system - Waste ammonia handling & Safety systems	SCR	SG	AA
2362	9585-001-101-PVM-L-006	P&ID and Write-up for SCR system - Flue gas path associated with SCR system	SCR	SG	AA
2363	9585-001-101-PVM-L-007	P&ID and Write-up for SCR system - Ammonia injection and dilution air system	SCR	SG	AA
2364	9585-001-101-PVM-L-008	P&ID and Write-up for SCR system - Sampling System	SCR	SG	AA
2365	9585-001-101-PVM-L-009	P&ID and Write-up for SCR system - Catalyst de-dusting System (sootblower/sonic horn & air cannon) with piping, valves, fittings & instrumentation	SCR	SG	AA
2366	9585-001-101-PVM-L-010	P&ID and Write-up for SCR system - Fire spray water, service water, potable water system	SCR	SG	AA
2367	9585-001-101-PVM-L-011	P&ID and Write-up for SCR system - Service and instrument air system	SCR	SG	AA
2368	9585-001-101-PVM-L-012	P&ID and Write-up for SCR system - Nitrogen purging	SCR	SG	AA
2369	9585-001-101-PVM-L-013	P&ID of safety system of SCR including ammonia	SCR	SG	AA
2370	9585-001-101-PVM-U-003	SCR Reactor and duct sizing calculation	SCR	SG	A
2371	9585-001-101-PVM-U-004	Catalyst selection basis, sizing criteria and calculation	SCR	SG	A
2372	9585-001-101-PVM-U-005	Selection Criteria for Ammonia Injection Grid nozzle type and duct mixing length alongwith previous experience details	SCR	SG	A
2373	9585-001-101-PVM-U-006	Catalyst de-dusting system selection and sizing criteria and justification for frequency and cleaning effectiveness alongwith previous experience details	SCR	SG	A
2374	9585-001-101-PVM-U-007	Ammonia unloading compressor sizing calculation & performance data	SCR	SG	A
2375	9585-001-101-PVM-U-008	Ammonia storage tank sizing calculation	SCR	SG	A
2376	9585-001-101-PVM-U-009	Ammonia forwarding pump sizing calculation and performance data	SCR	SG	A
2377	9585-001-101-PVM-U-010	Ammonia vapouriser sizing calculation and performance data	SCR	SG	A
2378	9585-001-101-PVM-U-011	Ammonia injection and dilution air system sizing calculation	SCR	SG	A
2379	9585-001-101-PVM-W-017	Functional write up on the proposed SCR design features with recent design modifications, if any, and their specific advantages over the previous designs.	SCR	SG	A
2380	9585-001-101-PVM-W-018	Functional Write-up for Ammonia unloading, storage and handling Control System.	SCR	SG	A
2381	9585-001-101-PVM-B-005	GA of Ammonia unloading and storage system	SCR	SG	AA
2382	9585-001-101-PVM-B-007	GA of Air dilution system	SCR	SG	AA
2383	9585-001-101-PVM-B-008	GA of Ammonia Injection system	SCR	SG	AA
2384	9585-001-101-PVM-B-009	GA of SCR Reactor	SCR	SG	AA
2385	9585-001-101-PVM-B-012	Piping layout of anhydrous ammonia from storage tank to SCR reactors	SCR	SG	AA
2386	9585-001-101-PVM-B-014	FLOOR PLAN ARRANGEMENT for ammonia storage tank area	SCR	SG	AA
2387	9585-001-101-PVM-N-001	SCR Predicted Performance Curves and data	SCR	SG	A
2388	9585-001-101-PVM-Y-001	Data sheet of SCR Catalysts	SCR	SG	AA
2389	9585-001-101-PVM-Y-003	Data sheet for SCR reactor including static mixer	SCR	SG	AA
2390	9585-001-101-PVM-Y-004	Data sheet and GA for ammonia injection grid, ammonia/air mixer, dilution air fan, air heater	SCR	SG	AA
2391	9585-001-101-PVM-Y-005	Data sheet, GA and foundation details for ammonia forwarding pump	SCR	SG	AA
2392	9585-001-101-PVM-Y-006	Data sheet, GA and foundation details for ammonia vapouriser including circulating pump along with glycol water heater, make up tank system	SCR	SG	AA

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 33 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
2393	9585-001-101-PVM-Y-007	Data Sheet and GA of Pressure Relief Valve for ammonia system	SCR	SG	AA
2394	9585-001-101-PVM-Y-008	Data Sheet & GA of Valves for ammonia system	SCR	SG	AA
2395	9585-001-101-PVM-Y-009	GA of dampers and gate of SCR system	SCR	SG	AA
2396	9585-001-101-PVM-Y-010	Data Sheet & GA of nitrogen purging system	SCR	SG	AA
2397	9585-001-101-PVM-B-022	List of Special Tools & Tackles for SCR system including tools & tackles for Ammonia Unloading, Storage & handling system	SCR	SG	AA
2398	9585-001-101-PVM-U-002	Predicted performance of SCR system for all specified coal at load 50%, 60%, 80%, 100% and 105% TMCR load & 100% BMCR load	SCR	SG	A
2399	9585-001-101-PVM-W-003	SCR System- CFD and Physical Modelling Procedure	SCR	SG	A
2400	9585-001-101-PVM-W-004	Test report of CFD modeling and Simulation	SCR	SG	A
2401	9585-001-101-PVM-W-005	Test report of physical flow modeling	SCR	SG	A
2402	9585-001-101-PVM-W-009	Test report of laboratory /shop test for catalyst activity test for Indian coal/ash	SCR	SG	A
2403	9585-001-101-PVM-W-011	Write-up on safety procedure, Specification and details of Safety Equipments,	SCR	SG	A
2404	9585-001-101-PVM-W-012	Procedure for handling emergency situation due to leakage of ammonia	SCR	SG	A
2405	9585-001-101-PVM-W-013	Procedure for Handling & Disposal of Used Catalyst	SCR	SG	AA
2406	9585-001-101-PVM-W-015	Functional Write-up to save the catalyst from erection debris	SCR	SG	AA
2407	9585-001-101-PVM-W-016	Procedure for storage of catalyst	SCR	SG	AA
2408	9585-001-101-PVM-W-019	Schedule of SCR System including ammonia system insulation & Insulation thickness calculation	SCR	SG	AA
2409	9585-001-101-PVM-W-022	Catalyst management plan (CMP) to reduce the overall consumption of the catalyst over the entire service life of the SCR system	SCR	SG	AA
2410	9585-001-101-PVM-W-023	Type Test Procedure for damper & gate and Reports	SCR	SG	A
2411	9585-001-101-PVM-B-001	Valve schedule - SCR system	SCR	SG	AA
2412	9585-001-101-PVM-B-010	Floor Plan arrangement for SCR Reactor	SCR	SG	AA
2413	9585-001-101-PVM-B-011	GA for catalyst handling system	SCR	SG	AA
2414	9585-001-101-PVM-B-013	Piping layout of fire spray, potable, service water	SCR	SG	AA
2415	9585-001-101-PVM-B-019	Damper & Gate schedule	SCR	SG	AA
2416	9585-001-101-PVM-B-020	Piping Schedule of ammonia unloading, storage and handling, air, ammonia, water of SCR system	SCR	SG	AA
2417	9585-001-101-PVM-B-021	Valve Schedule of ammonia unloading, storage and handling, air, nitrogen and water of SCR system	SCR	SG	AA
2418	9585-001-101-PVM-W-001	Ash distribution data in various duct & SCR hoppers (if applicable)	SCR	SG	AA
2419	9585-001-101-PVM-W-002	Utility requirements for SCR system	SCR	SG	AA
2420	9585-001-101-PVM-X-001	O&M Manuals	SCR	SG	AA
2421	9585-001-101-PVM-Y-002	Data sheet of SCR De-dusting system	SCR	SG	AA
2422	XXXX-135-PVM-B-102	GENERAL ARRANGEMENT OF INDUCED DRAUGHT COOLING TOWER	IDCT	WS	A
2423	XXXX-135-PVM-B-104	GA OF C.W. BASIN OF COOLING TOWER	IDCT	WS	A
2424	XXXX-135-PVM-U-101	THERMAL DESIGN & FRICTION LOSS CALCULATIONS AND CHARACTERISTIC & PERFORMANCE CURVES FOR IDCT	IDCT	WS	A
2425	XXXX-135-PVM-B-106	PITOT TUBE INSTALLATION & PIT DETAILS FOR COOLING TOWER	IDCT	WS	A
2426	XXXX-135-PVI-B-004	Control & Operation Philosophy	IDCT	WS	A
2427	XXXX-135-PVM-B-108	SCHEMATIC ARRANGEMENT OF FILL & FILL SUPPORTING DETAILS FOR MAIN COOLING TOWER	IDCT	WS	A
2428	XXXX-135-PVM-B-109	SCHEMATIC ARRANGEMENT OF INTERNAL DISTRIBUTION SYSTEM FOR COOLING TOWER	IDCT	WS	A
2429	XXXX-135-PVM-B-111	SCHEMATIC ARRANGEMENT OF EXTERNAL HW DISTRIBUTION SYSTEM OF COOLING TOWER	IDCT	WS	A
2430	XXXX-135-PVM-B-114	SCHEMATIC ARRANGEMENT OF DRIFT ELIMINATORS FOR COOLING TOWER	IDCT	WS	A
2431	XXXX-135-PVM-B-117	SCHEMATIC ARRANGEMENT OF MECHANICAL EQUIPMENT OF COOLING TOWER	IDCT	WS	A
2432	XXXX-135-PVM-Y-115	TDS FOR DRIFT ELIMINATOR FOR IDCT	IDCT	WS	A
2433	XXXX-135-PVM-Y-121	TDS FOR FILL FOR IDCT	IDCT	WS	A
2434	XXXX-135-PVM-Y-122	TDS FOR DISTRIBUTION PIPES	IDCT	WS	A
2435	XXXX-135-BBU-002	BBU for supply of IDCT component main	IDCT	WS	A
2436	XXXX-135-PVM-B-120	GAD AND DATA SHEET OF DRIVESHAFT ASSY. FOR IDCT	IDCT	WS	A
2437	XXXX-135-PVM-B-129	SLUDGE PUMPS-GA & DATA SHEET .	IDCT	WS	A
2438	XXXX-135-PVM-B-130	VENTILATION FANS- GA & DATA SHEET	IDCT	WS	AA
2439	XXXX-135-PVM-B-131	CHAIN PULLEY BLOCKS-DATA SHEET AND GA FOR IDCT	IDCT	WS	A
2440	XXXX-135-PVM-W-127	PG TEST PROCEDURE	IDCT	WS	A
2441	XXXX-135-PVM-X-128	O&M MANUAL	IDCT	WS	A
2442	XXXX-135-PVM-Y-126	TDS FOR FAN MAINTENANCE FACILITIES FOR IDCT	IDCT	WS	A
2443	XXXX-135-PVM-B-123	GAD AND DATA SHEET FOR BFV'S	IDCT	WS	A
2444	XXXX-135-PVM-Y-125	GA & TDS FOR CI GATE VALVE .	IDCT	WS	A
2445	XXXX-135-PVM-B-119	GAD AND DATA SHEET OF FAN ASSY FOR IDCT	IDCT	WS	A
2446	XXXX-135-PVM-B-124	GAD AND DATA SHEET OF GEARBOX FOR IDCT	IDCT	WS	A
2447	XXXX-110-PVM-W-XXX	DESIGN PHILOSOPHY & SYSTEM CONTROL WRITE UP OF ECW SYSTEM	ECW	WS	A
2448	XXXX-110-PVM-U-XXX	ECW EQUIPMENT SIZING CALCULATION WITH TECHNICAL DETAILS	ECW	WS	A
2449	XXXX-110-PVM-F-XXX	SYSTEM P&ID OF ECW SYSTEM	ECW	WS	A
2450	XXXX-110-PVM-B-XXX	GA & DATASHEET OF NAOH DOZING SYSTEM	ECW	WS	AA
2451	XXXX-110-PVM-B-XXX	GA OF ECW TANK FOR TG & SG AUXILIARIES	ECW	WS	AA
2452	XXXX-110-PVM-B-XXX	GA, CROSS SECTION & DATA SHEET OF PHE	ECW	WS	AA
2453	XXXX-110-PVM-B-XXX	PERFORMANCE CURVES & TDS OF PHE	ECW	WS	A
2454	XXXX-110-PVM-B-XXX	GA, CROSS SECTION & DATA SHEET OF ALL ECW SYSTEM PUMPS	ECW	WS	AA
2455	XXXX-110-PVM-B-XXX	PERFORMANCE CURVES & TDS OF ALL ECW SYSTEM PUMPS	ECW	WS	A
2456	XXXX-110-PVM-W-XXX	PROOF OF DESIGN TEST REPORT FOR BUTTERFLY VALVES	ECW	WS	AA
2457	XXXX-110-PVM-B-XXX	GA, CROSS SECTION & DATA SHEET OF SELF CLEANING STRAINERS	ECW	WS	AA
2458	XXXX-110-PVM-B-XXX	GA, CROSS SECTION & DATA SHEET OF PRESSURE REDUCING VALVES	ECW	WS	AA
2459	XXXX-110-PVM-B-XXX	GA, CROSS SECTION & DATA SHEET OF ECW SYSTEM VALVES	ECW	WS	AA
2460	XXXX-110-PVM-B-XXX	GA & DATA SHEET FOR ACTUATOR	ECW	WS	AA
2461	XXXX-110-PVM-B-XXX	GA & DATA SHEET OF MOTOR	ECW	WS	AA
2462	XXXX-110-PVM-X-XXX	O&M MANUAL FOR PLATE HEAT EXCHANGER	ECW	WS	AA
2463	XXXX-110-PVM-X-XXX	O&M MANUAL FOR PUMPS	ECW	WS	AA
2464	XXXX-110-PVM-X-XXX	O&M MANUAL FOR SELF CLEANING STRAINER	ECW	WS	AA
2465	XXXX-110-PVM-W-XXX	CONTROL PHILOSOPHY OF SELF CLEANING STRAINER INCLUDING PIPING LAYOUT	ECW	WS	AA
2466	XXXX-110-PVM-H-XXX	PAINTING SCHEDULE	ECW	WS	AA
2467	XXXX-110-PVM-W-XXX	PG TEST PROCEDURE FOR PHE	ECW	WS	AA
2468	XXXX-133-PVM-H-031	PROVENNESS/SUB-QR OF CW CHEMICAL TREATMENT	CW	WS	AA
2469	XXXX-133-PVM-R-032	PROVENNESS/SUB-QR OF CW PUMPS	CW	WS	AA
2470	XXXX-133-PVM-W-033	VALVE SCHEDULE OF CW SYSTEM	CW	WS	AA
2471	XXXX-133-PVM-W-034	PIPE SCHEDULE OF CW SYSTEM	CW	WS	AA
2472	XXXX-133-PVM-B-035	GA, CROSS SECTION & DATASHEET OF CW PUMP ALONG WITH FOUNDATION AND LOAD DETAILS	CW	WS	A

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 34 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
2473	XXXX-133-PVM-N-035	PERFORMANCE CHARACTERISTICS CURVES OF CW PUMP	CW	WS	A
2474	XXXX-133-PVM-B-036	GA, CROSS SECTION & DATA SHEET OF HOPDV WITH FOUNDATION DETAILS FOR CW SYSTEM	CW	WS	AA
2475	XXXX-133-PVM-U-036	DESIGN CALCULATIONS OF HOPDV	CW	WS	A
2476	XXXX-133-PVM-B-037	GA AND LAYOUT OF ALL EQUIPMENTS COMPRISING EH ACTUATOR POWER PACK	CW	WS	AA
2477	XXXX-133-PVM-W-038	HYDRAULIC CIRCUIT DIAGRAM AND WRITE-UP OF POWER PACK FOR CW PUMP DISCHARGE BFV	CW	WS	AA
2478	XXXX-133-PVM-B-039	GA, CROSS SECTION AND DATA SHEET OF ELECTRICALLY OPERATED BFV'S ALONG WITH FOUNDATION AND POD DETAILS.	CW	WS	AA
2479	XXXX-133-PVM-B-040	GA, CROSS SECTION & DATA SHEET OF RUBBER EXPANSION JOINTS	CW	WS	AA
2480	XXXX-133-PVM-B-041	GA & DATA SHEET OF EOT CRANE FOR CW PUMP HOUSE & RAW WATER PUMP HOUSE	CW	WS	AA
2481	XXXX-133-PVM-U-042	SIZING CALCULATION OF EOT CRANE FOR CW PUMP HOUSE AND RAW WATER PUMP HOUSE	CW	WS	AA
2482	XXXX-133-PVM-B-043	GA, CROSS SECTION AND DATA SHEET OF HORIZONTAL PUMPS (LUBE/SEAL WATER PUMPS)	CW	WS	AA
2483	XXXX-133-PVM-B-044	GA & DATASHEET FOR DUPLEX FILTERS IN LUB LINE OF CW PUMP	CW	WS	AA
2484	XXXX-133-PVM-B-045	GA & DATASHEET OF CI VALVES FOR CW SYSTEM	CW	WS	AA
2485	XXXX-133-PVM-B-046	MECHANICAL GA OF CW PUMP HOUSE	CW	WS	AA
2486	XXXX-133-PVM-F-047	P&ID FOR CW PUMPING SYSTEM (INCLUDING THRUST BEARING COOLING SYSTEM, DRAIN ARRANGEMENT AND COMPLETE DETAIL OF ALL INSTRUMENT)	CW	WS	A
2487	XXXX-133-PVM-U-048	SIZING CALCULATIONS OF THRUST BEARING OF CW PUMP	CW	WS	AA
2488	XXXX-133-PVM-U-049	SIZING CALCULATION OF CW SYSTEM	CW	WS	A
2489	XXXX-133-PVM-U-050	CALCULATION FOR CW PIPE THICKNESS	CW	WS	AA
2490	XXXX-133-PVM-W-051	TRANSIENT ANALYSIS PROCEDURE OF CW SYSTEM	CW	WS	AA
2491	XXXX-133-PVM-W-052	REPORT OF TRANSIENT ANALYSIS OF CW SYSTEM SHOWING ARV LOCATIONS	CW	WS	AA
2492	XXXX-133-PVM-W-053	CW PUMP MODEL TEST - REPORT	CW	WS	A
2493	XXXX-133-PVM-W-054	PG TEST PROCEDURE OF CW PUMPS	CW	WS	AA
2494	XXXX-133-PVM-W-055	OPERATION AND CONTROL PHILOSOPHY OF CW PUMP.	CW	WS	A
2495	XXXX-133-PVM-W-056	PAINTING PROCEDURE-CW PUMP	CW	WS	AA
2496	XXXX-133-PVM-X-057	O&M MANUAL FOR CW SYSTEM.	CW	WS	A
2497	XXXX-133-PVM-W-078	PROCEDURE FOR PHYSICAL SUMP MODEL & CFD STUDY OF CW SYSTEM	CW	WS	A
2498	XXXX-133-PVM-W-079	REPORT FOR PHYSICAL SUMP MODEL & CFD STUDY OF CW SYSTEM	CW	WS	AA
2499	XXXX-133-PVM-X-058	O&M MANUAL OF RAW WATER SYSTEM	AWS	WS	AA
2500	XXXX-133-PVM-U-059	SIZING CALCULATION OF AUXILIARY WATER SYSTEM PUMPS	AWS	WS	A
2501	XXXX-133-PVM-B-060	PG TEST PROCEDURE OF VERTICAL PUMPS	AWS	WS	AA
2502	XXXX-133-PVM-W-061	PROCEDURE OF WRAPPING & COATING FOR UNDERGROUND PIPING- RW AND CW MAKEUP	AWS	WS	AA
2503	XXXX-133-PVM-B-062	DATA SHEET, GA & CS OF LUBRICATION PUMP FOR RAW WATER PUMPS	AWS	WS	AA
2504	XXXX-133-PVM-F-063	P&ID OF RAW WATER SYSTEM	AWS	WS	A
2505	XXXX-133-PVM-F-064	P&ID OF AUXILIARY WATER SYSTEM PUMPS	AWS	WS	A
2506	XXXX-133-PVM-B-065	GA, CROSS SECTION & DATASHEET OF AUXILIARY WATER SYSTEM PUMPS	AWS	WS	AA
2507	XXXX-133-PVM-N-065	PERFORMANCE CHARACTERISTICS CURVES & TDS OF AUXILIARY WATER SYSTEM PUMPS	AWS	WS	A
2508	XXXX-133-PVM-B-066	AUXILIARY WATER SYSTEM BUTTERFLY VALVES- GA & DATASHEET	AWS	WS	AA
2509	XXXX-133-PVM-B-067	AUXILIARY WATER SYSTEM MISCELLANEOUS VALVES- GA & DATASHEET	AWS	WS	AA
2510	XXXX-133-PVM-B-068	RAW WATER SYSTEM BUTTERFLY VALVES- GA & DATASHEET	AWS	WS	AA
2511	XXXX-133-PVM-B-069	RAW WATER SYSTEM MISCELLANEOUS VALVES- GA & DATASHEET	AWS	WS	AA
2512	XXXX-133-PVM-B-070	GA, CROSS SECTION & DATASHEET OF RAW WATER SYSTEM PUMPS (PT & ASH)	AWS	WS	AA
2513	XXXX-133-PVM-N-070	PERFORMANCE CHARACTERISTICS CURVES & TDS OF RAW WATER SYSTEM PUMPS (PT & ASH)	AWS	WS	A
2514	XXXX-133-PVM-B-071	MECHANICAL GA OF RAW WATER PUMP HOUSE	AWS	WS	AA
2515	XXXX-133-PVM-B-072	MECHANICAL GA OF AUXILIARY WATER SYSTEM PUMP HOUSES	AWS	WS	AA
2516	XXXX-133-PVM-H-073	VALVE SCHEDULE OF AUXILIARY WATER SYSTEM	AWS	WS	AA
2517	XXXX-133-PVM-H-074	VALVE SCHEDULE OF RAW WATER SYSTEM	AWS	WS	AA
2518	XXXX-133-PVM-H-075	PIPE SCHEDULE OF AUXILIARY WATER SYSTEM	AWS	WS	AA
2519	XXXX-133-PVM-H-076	PIPE SCHEDULE OF RAW WATER SYSTEM	AWS	WS	AA
2520	XXXX-133-PVM-H-077	PROVENNESS/SUB-QR OF CW CHEMICAL TREATMENT	CW	WS	AA
2521	xxxx-136-PVM-B-001	GA of Burnt oil pit in transformer yard area	PT Plant	WS	AA
2522	xxxx-136-PVM-B-003	G.A of Inlet Chamber for PT CW System (Valve Chamber, Stilling Chamber, if	PT Plant	WS	AA
2523	xxxx-136-PVM-B-004	G.A of Sludge Sump & Pump arrangement	PT Plant	WS	AA
2524	xxxx-136-PVM-B-005	G.A of Filter Backwash Pit & Pump arrangement	PT Plant	WS	AA
2525	xxxx-136-PVM-B-006	G.A drawing & data sheet for Reactor Clarifier for PTCW System	PT Plant	WS	AA
2526	xxxx-136-PVM-B-007	G.A of Waste Service Tank & Pump House (Open pump house)	PT Plant	WS	AA
2527	xxxx-136-PVM-B-009	G.A of CMB & Pump House	PT Plant	WS	AA
2528	xxxx-136-PVM-B-010	G.A of Clarified Water Tank & Pump arrangement	PT Plant	WS	AA
2529	xxxx-136-PVM-B-011	G.A of Chemical House including Overhead Tank (Top of Chemical House)	PT Plant	WS	AA
2530	xxxx-136-PVM-B-013	GA and datasheet of HRCC Drive Mechanisam	PT Plant	WS	AA
2531	xxxx-136-PVM-B-014	GA & data sheet for basket strainer (before U Fskid)	PT Plant	WS	AA
2532	xxxx-136-PVM-B-016	GA DRAWING FOR UF SKID (WWRO UF)	PT Plant	WS	AA
2533	xxxx-136-PVM-B-017	GA DRAWING FOR RO SKID (WWRO RO)	PT Plant	WS	AA
2534	xxxx-136-PVM-B-018	GA DRAWING FOR CARTRIDGE FILTER FOR RO (HOUSING) of WWRO	PT Plant	WS	AA
2535	xxxx-136-PVM-B-019	GA DRAWING FOR CARTRIDGE FILTER FOR CIP (HOUSING) of WWRO	PT Plant	WS	AA
2536	xxxx-136-PVM-B-020	GA DRAWING FOR RO CIP TANK for WWRO	PT Plant	WS	AA
2537	xxxx-136-PVM-B-021	GA, cross section, performance curve and datasheet of CHP Dust Suppression	PT Plant	WS	AA
2538	xxxx-136-PVM-B-022	GA DRAWING FOR CEB II (NaOCl) DOSING TANK of WWRO	PT Plant	WS	AA
2539	xxxx-136-PVM-B-023	GA DRAWING FOR CEB III (NaOH) DOSING TANK of WWRO	PT Plant	WS	AA
2540	xxxx-136-PVM-B-024	GA DRAWING FOR ANTISCALANT DOSING TANK of WWRO	PT Plant	WS	AA
2541	xxxx-136-PVM-B-025	GA DRAWING FOR ANTIOXIDANT DOSING TANK of WWRO	PT Plant	WS	AA
2542	xxxx-136-PVM-B-026	GA of RO reject collection tank for WWRO	PT Plant	WS	AA
2543	xxxx-136-PVM-U-028	Process Design & Equipment sizing calculation for WWRO	PT Plant	WS	A
2544	xxxx-136-PVM-F-029	P&ID for PT & WWRO system	PT Plant	WS	A
2545	xxxx-136-PVM-B-030	Equipment Layout For WWRO	PT Plant	WS	A
2546	xxxx-136-PVM-B-031	GA OF STILLING CHAMBER, PARSHALL FLUME, INLET CHAMBER AND	PT Plant	WS	AA
2547	xxxx-136-PVM-B-032	GA & DATASHEET OF CLARIFIER FOR ETP	PT Plant	WS	AA
2548	xxxx-136-PVM-B-033	GA OF BACKWASH SUMP & PUMP HOUSE	PT Plant	WS	AA
2549	xxxx-136-PVM-B-034	GA DRAWING OF SERVICE WATER TANK	PT Plant	WS	AA
2550	xxxx-136-PVM-B-035	Valve schedule for WWRO Plant	PT Plant	WS	AA
2551	xxxx-136-PVM-B-036	G.A of CSSP Sump & Pump House	PT Plant	WS	AA

PART-B

Si No	NTPC Drg No	DRG_TITLE	SUB-SYSTEM	Dept	CATEGORY
2552	xxxx-136-PVM-U-037	Process Design & Equipment Sizing Calculation for PT-WWRO	PT Plant	WS	A
2553	xxxx-136-PVM-U-038	Hydraulic Flow Diagram & Hydraulic Calculation for PT-WWRO	PT Plant	WS	A
2554	xxxx-136-PVM-U-039	Process Design & Equipment Sizing Calculation for CSSP treatment system	PT Plant	WS	A
2555	xxxx-136-PVM-U-040	Hydraulic Flow Diagram & Hydraulic Calculation for CSSP treatment system	PT Plant	WS	A
2556	xxxx-136-PVM-F-042	P&ID for Effluent water collection & transfer system to WSWT	PT Plant	WS	A
2557	xxxx-136-PVM-B-043	G.A & Datasheet of Agitator for LET Plant	PT Plant	WS	AA
2558	xxxx-136-PVM-B-044	G.A & Datasheet of Agitator for WWRO Plant	PT Plant	WS	AA
2559	xxxx-136-PVM-B-045	G.A & Datasheet of Manual Butterfly valve for WWRO	PT Plant	WS	AA
2560	xxxx-136-PVM-B-046	G.A & Datasheet of Pneumatic Butterfly valve for WWRO	PT Plant	WS	AA
2561	xxxx-136-PVM-B-047	G.A & Datasheet of Non Return Valve for LET Plant	PT Plant	WS	AA
2562	xxxx-136-PVM-B-048	G.A & Datasheet of Non Return Valve for WWRO Plant	PT Plant	WS	AA
2563	xxxx-136-PVM-B-049	G.A & Datasheet of Manual Plug valves for LET Plant	PT Plant	WS	AA
2564	xxxx-136-PVM-B-050	G.A & Datasheet of Motorised Plug valves for LET Plant	PT Plant	WS	AA
2565	xxxx-136-PVM-B-051	G.A & Datasheet of Manual & Motorised Gate valves for LET Plant	PT Plant	WS	AA
2566	xxxx-136-PVM-B-052	G.A & Datasheet of Auto Backwash Filter	PT Plant	WS	AA
2567	xxxx-136-PVM-B-053	Painting Schedule for ETP	PT Plant	WS	AA
2568	xxxx-136-PVM-B-054	GAD for CEB I (HCL) Dosing Tank for WWRO	PT Plant	WS	AA
2569	xxxx-136-PVM-B-055	GAD for Poly-Electrolyte Dosing Tank for LET	PT Plant	WS	AA
2570	xxxx-136-PVM-B-056	GAD for FeCl3 Coagulant Storage Tank for LET	PT Plant	WS	AA
2571	xxxx-136-PVM-B-057	GAD for FeCl3 Dosing Tank for LET	PT Plant	WS	AA
2572	xxxx-136-PVM-B-058	Datasheet & GAD of Manual Diaphragm Valve for LET Plant	PT Plant	WS	AA
2573	xxxx-136-PVM-B-059	GAD of Acid Dosing Tank for WWRO	PT Plant	WS	AA
2574	xxxx-136-PVM-F-060	Piping Layout of ETP	PT Plant	WS	AA
2575	xxxx-136-PVM-B-061	GAD & Datasheet of HRSCC drive mechanism	PT Plant	WS	AA
2576	xxxx-136-PVM-H-062	Pipe schedule for PT-WWRO, LET & CSSP Plant	PT Plant	WS	AA
2577	xxxx-136-PVM-B-063	Datasheet & GAD of Motorised Diaphragm Valve for LET Plant	PT Plant	WS	AA
2578	xxxx-136-PVM-B-064	Datasheet & GAD of Manual Ball Valve for LET Plant	PT Plant	WS	AA
2579	xxxx-136-PVM-B-065	Datasheet & GAD of Non-return Valve (Flap Type) for LET Plant	PT Plant	WS	AA
2580	xxxx-136-PVM-H-066	Pipe schedule for WWRO Plant	PT Plant	WS	AA
2581	xxxx-136-PVM-B-067	Datasheet, GAD & Performance curve of Inter Stage Booster Pump	PT Plant	WS	AA
2582	xxxx-136-PVM-B-068	Datasheet & GAD of Manual Diaphragm Valve for WWRO	PT Plant	WS	AA
2583	xxxx-136-PVM-B-069	Datasheet & GAD of Pneumatic Diaphragm Valve for WWRO	PT Plant	WS	AA
2584	xxxx-136-PVM-B-070	Datasheet & GAD of Non-return Valve (Flap Type) for WWRO	PT Plant	WS	AA
2585	xxxx-136-PVM-B-071	Datasheet & GAD of Manual Ball Valve for WWRO	PT Plant	WS	AA
2586	xxxx-136-PVM-F-072	Piping Layout for WWRO Plant	PT Plant	WS	AA
2587	xxxx-136-PVM-F-073	Layout of chemical house piping	PT Plant	WS	AA
2588	xxxx-136-PVM-B-074	Electrical Hoist GA and Data sheet for Chemical house	PT Plant	WS	AA
2589	xxxx-136-PVM-B-075	TDC, GA drawing & Motor & LCP for Vertical sump pumps oily water transfer	PT Plant	WS	AA
2590	xxxx-136-PVM-B-076	TDC, GA drawing & Motor & LCP for Vertical sump pumps for oily water trans	PT Plant	WS	AA
2591	xxxx-136-PVM-B-077	TDC, GA drawing & Motor & LCP for portable submersible pumps in CW pump	PT Plant	WS	AA
2592	xxxx-136-PVM-B-078	TDC, GA drawing & Motor & LCP for Fixed submersible pumps for Sewage tr	PT Plant	WS	AA
2593	xxxx-136-PVM-W-079	CV type test report for Globe control valve	PT Plant	WS	AA
2594	xxxx-136-PVM-B-080	Foundation drawing of Sludge transfer pump, Filter feed pump, Treated water	PT Plant	WS	AA
2595	xxxx-136-PVM-B-081	G.A and Datasheet for chemical dosing system agitators	PT Plant	WS	AA
2596	xxxx-136-PVM-F-082	P & I Diagram for Liquid Effluent Treatment System, Waste service water treat	PT Plant	WS	A
2597	xxxx-136-PVM-F-084	Design basis report for waste water RO system	PT Plant	WS	A
2598	xxxx-136-PVM-H-085	Valve schedule for LET Plant	PT Plant	WS	AA
2599	xxxx-136-PVM-H-086	Pipe Schedule	PT Plant	WS	AA
2600	xxxx-136-PVM-U-087	Hydraulic Flow Diagram & Hydraulic Calculation for LET Plant (For waste serv	PT Plant	WS	A
2601	xxxx-136-PVM-U-088	Write up for Effluent water collection & transfer system to WSWT plant (In W	PT Plant	WS	AA
2602	xxxx-136-PVM-R-089	LOAD LIST for LET facilities	PT Plant	WS	AA
2603	xxxx-136-PVM-R-090	LOAD LIST for WWRO	PT Plant	WS	AA
2604	xxxx-136-PVM-U-091	Process Design & Equipment Sizing Calculation for PT Plant CW system	PT Plant	WS	A
2605	xxxx-136-PVM-U-092	Hydraulic Calculation & Hydraulic Flow Diagram for PreTreatment Plant for C	PT Plant	WS	A
2606	xxxx-136-PVM-U-093	Pressure Drop calculation for PT Plant ,LET Plant	PT Plant	WS	A
2607	xxxx-136-PVM-W-095	GA, cross section, ch curve and datasheet for RO reject transfer pumps to CH	PT Plant	WS	AA
2608	xxxx-136-PVM-W-096	GA, cross section, ch curve and datasheet for CHP Dust Suppression system p	PT Plant	WS	AA
2609	xxxx-136-PVM-W-097	GA, cross section, ch curve and datasheet for UF BACKWASH PUMP for WW	PT Plant	WS	AA
2610	xxxx-136-PVM-W-098	GA, cross section, ch curve and datasheet for RO HIGH PRESSURE PUMP f	PT Plant	WS	AA
2611	xxxx-136-PVM-W-099	GA, cross section, ch curve and datasheet for UF feed pumps motor for WW	PT Plant	WS	AA
2612	xxxx-136-PVM-W-100	GA, cross section, ch curve and datasheet for UF feed pumps for WWRO	PT Plant	WS	AA
2613	xxxx-136-PVM-W-101	GA, cross section, ch curve and datasheet for RO CIP PUMP for WWRO	PT Plant	WS	AA
2614	xxxx-136-PVM-W-102	GA, cross section, ch curve and datasheet for RO PERMEATE WATER TRAN	PT Plant	WS	AA
2615	xxxx-136-PVM-W-103	GA, cross section, ch curve and datasheet for Treated effluent feed pumps to	PT Plant	WS	AA
2616	xxxx-136-PVM-W-104	GA, cross section, ch curve and datasheet for Lime Slurry Transfer and lime d	PT Plant	WS	AA
2617	xxxx-136-PVM-W-105	GA, cross section, ch curve and datasheet for Drainage Pump in LET facilities	PT Plant	WS	AA
2618	xxxx-136-PVM-X-106	Operation & Maintenance Manual for WWRO	PT Plant	WS	A
2619	xxxx-136-PVM-X-107	Operation & Maintenance Manual for WTP	PT Plant	WS	A
2620	xxxx-136-PVM-X-108	Operation & Maintenance Manual for Waste service water treatment plant	PT Plant	WS	A
2621	xxxx-136-PVM-Y-109	GA & data sheet of Portable centrifuge for waste service water treatment plan	PT Plant	WS	AA
2622	xxxx-136-PVM-Y-110	GA, and datasheet for drinking water supply pumps motors	PT Plant	WS	AA
2623	xxxx-136-PVM-Y-111	DATA SHEETS FOR UF MEMBRANE of WWRO	PT Plant	WS	AA
2624	xxxx-136-PVM-Y-112	DATA SHEETS FOR RO MEMBRANE of WWRO	PT Plant	WS	AA
2625	xxxx-136-PVM-Y-113	DATA SHEETS FOR RO PRESSURE TUBE of WWRO	PT Plant	WS	AA
2626	xxxx-136-PVM-Y-114	GA & data sheet of Air blowers for WWRO gravity filters	PT Plant	WS	AA
2627	xxxx-136-PVM-Y-115	GA, and datasheet of Air blowers motor for for WWRO gravity filters	PT Plant	WS	AA
2628	xxxx-136-PVM-Y-116	DATA SHEET FOR CEB I DOSING PUMP of WWRO	PT Plant	WS	AA
2629	xxxx-136-PVM-Y-117	DATA SHEET FOR CEB II DOSING PUMP of WWRO	PT Plant	WS	AA
2630	xxxx-136-PVM-Y-118	DATA SHEET FOR CEB III DOSING PUMP of WWRO	PT Plant	WS	AA
2631	xxxx-136-PVM-Y-119	DATA SHEET FOR ANTISCALANT DOSING PUMP of WWRO	PT Plant	WS	AA
2632	xxxx-136-PVM-Y-120	DATA SHEET FOR ANTIOXIDANT DOSING PUMP of WWRO	PT Plant	WS	AA
2633	xxxx-136-PVM-Y-121	DATA SHEET FOR ACID DOSING PUMP (RO) of WWRO	PT Plant	WS	AA
2634	xxxx-136-PVM-Y-122	GA, and datasheet FOR RO reject transfer pumps motor for PT DM	PT Plant	WS	AA
2635	xxxx-136-PVM-Y-123	GA and datasheet FOR RO CIP PUMP (PTDM) motor	PT Plant	WS	AA
2636	xxxx-136-PVM-Y-124	GA and datasheet FOR RO permeate transfer pump motor for WWRO	PT Plant	WS	AA
2637	xxxx-136-PVM-Y-125	GA & data sheet of Air blowers for filter back wash sump	PT Plant	WS	AA
2638	xxxx-136-PVM-Y-126	Datasheet for Platform type weighing scale	PT Plant	WS	AA
2639	xxxx-136-PVM-Y-127	Datasheet and GA of Manual and Motor Operated Butterfly Valve	PT Plant	WS	AA
2640	xxxx-136-PVM-Y-128	Datasheet and GA of Plug Valve	PT Plant	WS	AA
2641	xxxx-136-PVM-Y-129	GA and datasheet FOR RO CIP PUMP (PTDM) motor	PT Plant	WS	AA
2642	xxxx-136-PVM-Y-130	GA and datasheet FOR RO permeate transfer pump motor for WWRO	PT Plant	WS	AA
2643	xxxx-136-PVM-Y-131	GA & data sheet of Air blowers for filter back wash sump	PT Plant	WS	AA
2644	xxxx-136-PVM-Y-132	GA, and datasheet FOR RO reject transfer pumps motor for WWRO	PT Plant	WS	AA
2645	xxxx-136-PVM-Y-133	Datasheet for Platform type weighing scale	PT Plant	WS	AA
2646	xxxx-136-PVM-Y-134	Datasheet and GA of Manual and Motor Operated Butterfly Valve	PT Plant	WS	AA
2647	xxxx-136-PVM-Y-135	Datasheet and GA of Plug Valve	PT Plant	WS	AA

PART-B

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
2648	xxxx-136-PVM-R-001	Sub QR data for Water Pre-treatment Plant & Liquid Effluent Treatment Plant	PT Plant	WS	AA
2649	xxxx-136-PVM-B-001	G.A. OF ACF	DM Plant	WS	AA
2650	xxxx-136-PVM-B-002	G.A. OF CATION EXCHANGERS	DM Plant	WS	AA
2651	xxxx-136-PVM-B-003	G.A. OF ANION EXCHANGER	DM Plant	WS	AA
2652	xxxx-136-PVM-B-004	G.A. OF MB EXCHANGER	DM Plant	WS	AA
2653	xxxx-136-PVM-B-005	G.A. OF HOT WATER TANK	DM Plant	WS	AA
2654	xxxx-136-PVM-B-006	G.A. OF AC FILTER FOR ALKALI	DM Plant	WS	AA
2655	xxxx-136-PVM-B-007	G.A. OF ACID (HCl) MEASURING TANKS.	DM Plant	WS	AA
2656	xxxx-136-PVM-B-008	G.A. OF ALKALI DAY TANKS	DM Plant	WS	AA
2657	xxxx-136-PVM-B-009	G.A. OF ALKALI SOLN PREPARATION TANKS.	DM Plant	WS	AA
2658	xxxx-136-PVM-B-010	G.A. OF DEGASSER TOWER & TANK	DM Plant	WS	AA
2659	xxxx-136-PVM-B-011	G.A. OF BRINE SOLUTION PREPARATION TANK	DM Plant	WS	AA
2660	xxxx-136-PVM-B-012	G.A. OF N.Pit and B/W pit	DM Plant	WS	AA
2661	xxxx-136-PVM-B-013	G.A. OF Priming tank chamber	DM Plant	WS	AA
2662	xxxx-136-PVM-B-014	G.A. OF Bulk acid/alkali storage tank	DM Plant	WS	AA
2663	xxxx-136-PVM-B-015	G.A. OF Lime Neutralization tank	DM Plant	WS	AA
2664	xxxx-136-PVM-B-016	G.A. OF DM STORAGE TANK	DM Plant	WS	AA
2665	xxxx-136-PVM-B-017	GA, cross-section, ch curve & datasheet of alkali unloading pumps	DM Plant	WS	AA
2666	xxxx-136-PVM-B-018	GA of sluice gates- Clarified water storage tank	DM Plant	WS	AA
2667	xxxx-136-PVM-B-019	GA of polyelectrolyte solution preparation tank	DM Plant	WS	AA
2668	xxxx-136-PVM-B-020	GA of overhead filter water tank (DM area)	DM Plant	WS	AA
2669	xxxx-136-PVM-B-021	GA, cross-section, ch curve & datasheet of DM Transfer Pump	DM Plant	WS	AA
2670	xxxx-136-PVM-B-022	GA & DATASHEET FOR MOTORISED BUTTERFLY VALVE FOR CWT	DM Plant	WS	AA
2671	xxxx-136-PVM-B-023	GA & DS OF AGITATORS for Chemical TANKS of CWT	DM Plant	WS	AA
2672	xxxx-136-PVM-B-024	G.A. OF ACID(H2SO4) MEASURING TANKS	DM Plant	WS	AA
2673	xxxx-136-PVM-B-025	G.A. OF SCALE CORROSION TANKS	DM Plant	WS	AA
2674	xxxx-136-PVM-B-026	G.A. OF ACID (H2SO4)STORAGE TANK	DM Plant	WS	AA
2675	xxxx-136-PVM-B-027	GA OF DISPERSENT DOSING TANK	DM Plant	WS	AA
2676	xxxx-136-PVM-B-028	GA & DS FOR DILUTION WATER PUMP	DM Plant	WS	AA
2677	xxxx-136-PVM-B-029	GA & DS OF AGITATORS for Chemical TANKS for CWT	DM Plant	WS	AA
2678	xxxx-136-PVM-B-030	Thickness calculation for DM tanks	DM Plant	WS	A
2679	xxxx-136-PVM-B-031	Pressure drop calculation for DM Plant	DM Plant	WS	A
2680	xxxx-136-PVM-B-032	Thickness calculation for Pressure vessels for DM plant	DM Plant	WS	A
2681	xxxx-136-PVM-B-033	GA of DM building area including CPU regeneration	DM Plant	WS	AA
2682	xxxx-136-PVM-B-034	Datasheet & GA of Isolation gate- DM	DM Plant	WS	AA
2683	xxxx-136-PVM-B-035	Datasheet & GA for MB BLOWER	DM Plant	WS	AA
2684	xxxx-136-PVM-B-036	Area GA Drawing of CWT Plant (Civil Input GA)	DM Plant	WS	AA
2685	xxxx-136-PVM-B-037	GA, CRD,RAIL FIXING, DATA SHEET OF EOT GANTRY CRANE FOR FILT	DM Plant	WS	AA
2686	xxxx-136-PVM-N-037	MECHANISM CALCULATION, OF EOT GANTRY CRANE FOR FILTER HOL	DM Plant	WS	AA
2687	xxxx-136-PVM-B-038	GA, CRD,RAIL FIXING, DATA SHEET OF GANTRY CRANE FOR FILTER B	DM Plant	WS	AA
2688	xxxx-136-PVM-N-038	MECHANISM CALCULATION OF GANTRY CRANE FOR FILTER BACKWASH	DM Plant	WS	AA
2689	xxxx-136-PVM-B-039	GA, CRD,RAIL FIXING, DATA SHEET OF GANTRY CRANE FOR SLUDGE	DM Plant	WS	AA
2690	xxxx-136-PVM-N-039	MECHANISM CALCULATION OF GANTRY CRANE FOR SLUDGE PUMP A	DM Plant	WS	AA
2691	xxxx-136-PVM-B-040	GA, CRD,RAIL FIXING, DATA SHEET OF GANTRY CRANE FOR DM BACK	DM Plant	WS	AA
2692	xxxx-136-PVM-B-041	Datasheet for SS NRV	DM Plant	WS	AA
2693	xxxx-136-PVM-B-042	Datasheet for Lift type Check Valve	DM Plant	WS	AA
2694	xxxx-136-PVM-N-040	MECHANISM CALCULATION OF GANTRY CRANE FOR DM BACKWASH F	DM Plant	WS	AA
2695	xxxx-136-PVM-B-043	GA Drawing, Data Sheet of Single Girder Crane for Effluent Treatment Area	DM Plant	WS	AA
2696	xxxx-136-PVM-N-043	Sizing Calculation of Single Girder Crane for Effluent Treatment Area	DM Plant	WS	AA
2697	xxxx-136-PVM-B-044	GA of coagulant aid dosing tank	DM Plant	WS	AA
2698	xxxx-136-PVM-B-045	Datasheet of Mobile Crane -DM & PT Area	DM Plant	WS	AA
2699	xxxx-136-PVM-F-046	P&I Diagram for DM Plant	DM Plant	WS	A
2700	xxxx-136-PVM-F-047	P&I DIAGRAM (CWT PLANT)	DM Plant	WS	A
2701	xxxx-136-PVM-F-048	EQUIPMENT LAYOUT- CWT PLANT & LET	DM Plant	WS	A
2702	xxxx-136-PVM-H-050	VALVE SCHEDULE FOR DM	DM Plant	WS	AA
2703	xxxx-136-PVM-H-051	PAINTING SCHEDULE FOR DM & CWT	DM Plant	WS	AA
2704	xxxx-136-PVM-H-052	Pipe Schedule for DM Plant	DM Plant	WS	AA
2705	xxxx-136-PVM-H-053	Valve Schedule for CWT	DM Plant	WS	AA
2706	xxxx-136-PVM-H-054	Painting Schedule for CWT	DM Plant	WS	AA
2707	xxxx-136-PVM-H-055	Valve Schedule for LET	DM Plant	WS	AA
2708	xxxx-136-PVM-H-056	Pipe Schedule for LET	DM Plant	WS	AA
2709	xxxx-136-PVM-H-057	Painting Schedule for LET	DM Plant	WS	AA
2710	xxxx-136-PVM-L-058	PIPING LAYOUT FOR DM EXCHANGER AREA	DM Plant	WS	AA
2711	xxxx-136-PVM-L-059	PIPING LAYOUT FOR DM REGENERATION AREA	DM Plant	WS	AA
2712	xxxx-136-PVM-L-060	PIPING LAYOUT FOR DEGASSER AREA	DM Plant	WS	AA
2713	xxxx-136-PVM-L-061	DM WATER STORAGE TANK AREA- PIPING LAYOUT	DM Plant	WS	AA
2714	xxxx-136-PVM-L-062	ACID & ALKALI STORAGE AREA- PIPING LAYOUT	DM Plant	WS	AA
2715	xxxx-136-PVM-L-063	NEUTRALIZATION PIT AREA- PIPING LAYOUT DRAWINGS	DM Plant	WS	AA
2716	xxxx-136-PVM-L-064	PIPING LAYOUT DRG- CWT area	DM Plant	WS	AA
2717	xxxx-136-PVM-L-065	Piping Layout for LET	DM Plant	WS	AA
2718	xxxx-136-PVM-P-066	Pipe support layout drawings for LET area piping	DM Plant	WS	AA
2719	xxxx-136-PVM-U-067	Process Design & Equipment Sizing Calculation (DM Plant & CWT)	DM Plant	WS	A
2720	xxxx-136-PVM-U-068	Calculation for Emergency DM Water Make up System	DM Plant	WS	A
2721	xxxx-136-PVM-U-069	Process Design & Equipment Sizing Calculation for CWT	DM Plant	WS	A
2722	xxxx-136-PVM-U-070	Pressure drop calculation for LET	DM Plant	WS	A
2723	xxxx-136-PVM-U-071	Hydraulic Calculation and Hydraulic Flow Diagram for LET	DM Plant	WS	A
2724	xxxx-136-PVM-W-072	PG TEST PROCEDURE for DM Plant	DM Plant	WS	AA
2725	xxxx-136-PVM-W-073	GA, cross-section, ch curve & datasheet of acid unloading pumps	DM Plant	WS	AA
2726	xxxx-136-PVM-W-075	DATASHEET OF Y TYPE STRAINER FOR DM PLANT	DM Plant	WS	AA
2727	xxxx-136-PVM-W-076	DATASHEET OF Y TYPE STRAINER FOR CWT	DM Plant	WS	AA
2728	xxxx-136-PVM-X-077	System Description & Control Write up for DM Plant	DM Plant	WS	A
2729	xxxx-136-PVM-X-078	Operation & Maintenance Manual-DM Plant	DM Plant	WS	A
2730	xxxx-136-PVM-X-079	System Description & Control Write up for LET	DM Plant	WS	A
2731	xxxx-136-PVM-X-080	Operation & Maintenance Manual for LET	DM Plant	WS	A
2732	xxxx-136-PVM-Y-081	GA & DS FOR FILTER WATER SUPPLY PUMP.	DM Plant	WS	AA
2733	xxxx-136-PVM-Y-082	GA & DS FOR DEGASSED WATER PUMP	DM Plant	WS	AA
2734	xxxx-136-PVM-Y-083	GA & DS FOR DM REGN. PUMP.	DM Plant	WS	AA
2735	xxxx-136-PVM-Y-084	GA & DS FOR NEUTRALIZED EFFLUENT DISPOSAL PUMP	DM Plant	WS	AA
2736	xxxx-136-PVM-Y-085	GA & DS FOR ALKALI TRANSFER CUM RECIRCULATION PUMP	DM Plant	WS	AA
2737	xxxx-136-PVM-Y-086	GA & DS FOR BRINE SOLUTION TRANSFER PUMPS	DM Plant	WS	AA
2738	xxxx-136-PVM-Y-087	GA & Data Sheet of Backwash Disposal Pump	DM Plant	WS	AA
2739	xxxx-136-PVM-Y-089	GA & DS FOR Degasser & MB BLOWER	DM Plant	WS	AA
2740	xxxx-136-PVM-Y-090	GA & DS OF AGITATORS for Chemical TANKS (for DM)	DM Plant	WS	AA
2741	xxxx-136-PVM-Y-091	DATA SHEET FOR ACTIVATED CARBON	DM Plant	WS	AA
2742	xxxx-136-PVM-Y-092	DATASHEET FOR RESINS	DM Plant	WS	AA
2743	xxxx-136-PVM-Y-093	GA&DATASHEET FOR MANUAL DIAPHRAGM VALVE	DM Plant	WS	AA

PART-B

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
2744	xxxx-136-PVM-Y-094	GA&DATASHEET FOR MANUAL DIAPHRAGM VALVE-CWT	DM Plant	WS	AA
2745	xxxx-136-PVM-Y-095	GA & DATASHEET FOR MANUAL BUTTERFLY VALVE	DM Plant	WS	AA
2746	xxxx-136-PVM-Y-096	GA & DATASHEET FOR CHECK VALVES for DM Plant	DM Plant	WS	AA
2747	xxxx-136-PVM-Y-097	Data Sheet & GA Drawing of Manual Ball Valve - DM Plant	DM Plant	WS	AA
2748	xxxx-136-PVM-Y-098	GA & Datasheet for PRV	DM Plant	WS	AA
2749	xxxx-136-PVM-Y-099	GA & Data Sheet of Plug Valve	DM Plant	WS	AA
2750	xxxx-136-PVM-Y-100	GA & DS FOR ACID (H2SO4) UNLOADING PUMP	DM Plant	WS	AA
2751	xxxx-136-PVM-Y-101	GA & DS FOR ACID(H2SO4) METERING PUMPS.	DM Plant	WS	AA
2752	xxxx-136-PVM-Y-102	GA & DS FOR SCALE INHIBITOR DOSING PUMPS	DM Plant	WS	AA
2753	xxxx-136-PVM-Y-103	GA & DS FOR DISPERSANT DOSING PUMPS.	DM Plant	WS	AA
2754	xxxx-136-PVM-Y-104	Data sheet of corrosion test rack and coupon	DM Plant	WS	AA
2755	xxxx-136-PVM-Y-105	GA & DS FOR PNEUMATIC ACTUATOR OPERATED ON - OFF BUTTERFLY	DM Plant	WS	AA
2756	xxxx-136-PVM-Y-106	GA & DS FOR PNEUMATIC ACTUATOR OPERATED ON - OFF BUTTERFLY	DM Plant	WS	AA
2757	xxxx-136-PVM-Y-107	GA & DS FOR PNEUMATIC ACTUATOR OPERATED ON - OFF DIAPHRAGM	DM Plant	WS	AA
2758	xxxx-136-PVM-Y-108	Datasheet & GA of Acid dosing tank for LET	DM Plant	WS	AA
2759	xxxx-136-PVM-Y-109	GA, cross-section, ch curve & datasheet of Miscellaneous Centrifugal Pumps	DM Plant	WS	AA
2760	xxxx-136-PVM-Y-110	GA, cross-section, ch curve & datasheet of Positive Displacement Pumps(LET)	DM Plant	WS	AA
2761	xxxx-136-PVM-R-002	Sub QR data for Ion Exchange Demineralization Plant		WS	AA
2762	xxxx-136-PVM-B-111	G.A. OF MB EXCHANGER	DM Plant	WS	AA
2763	xxxx-136-PVM-B-112	G.A. OF HOT WATER TANK with Heater	DM Plant	WS	AA
2764	xxxx-136-PVM-B-113	G.A. OF ACID MEASURING TANKS.	DM Plant	WS	AA
2765	xxxx-136-PVM-B-114	G.A. OF ALKALI MEASURING TANKS	DM Plant	WS	AA
2766	xxxx-136-PVM-B-115	G.A. OF ALKALI SOLN PREPARATION TANKS.	DM Plant	WS	AA
2767	xxxx-136-PVM-B-116	G.A. OF N.Pit	DM Plant	WS	AA
2768	xxxx-136-PVM-B-117	G.A. OF Priming tank (for N.pit Effluent disposal pumps)	DM Plant	WS	AA
2769	xxxx-136-PVM-B-118	G.A. OF Bulk alkali storage tank	DM Plant	WS	AA
2770	xxxx-136-PVM-B-119	G.A. OF Lime tank for Neutralization pit	DM Plant	WS	AA
2771	xxxx-136-PVM-B-120	G.A. OF Acid /alkali storage area	DM Plant	WS	AA
2772	xxxx-136-PVM-B-121	G.A. OF ACID(H2SO4) MEASURING TANKS	DM Plant	WS	AA
2773	xxxx-136-PVM-B-122	G.A. OF SCALE /CORROSION inhibitor TANKS	DM Plant	WS	AA
2774	xxxx-136-PVM-B-123	GA OF DISPERSANT DOSING TANK	DM Plant	WS	AA
2775	xxxx-136-PVM-B-124	GA of FeCl3 Dosing Tank (PTDM)	DM Plant	WS	AA
2776	xxxx-136-PVM-B-125	GA for Polyelectrolyte Dosing Tank for PTDM	DM Plant	WS	AA
2777	xxxx-136-PVM-B-126	GA FOR BULK FeCl3 Storage Tank (PTDM)	DM Plant	WS	AA
2778	xxxx-136-PVM-B-127	GA OF BULK ALKALI STORAGE TANK	DM Plant	WS	AA
2779	xxxx-136-PVM-B-128	G.A. OF ACID (H2SO4) STORAGE TANK (Bulk Acid storage tank)	DM Plant	WS	AA
2780	xxxx-136-PVM-B-129	G.A. OF ACID (HCl) MEASURING TANKS(RO & MB)	DM Plant	WS	AA
2781	xxxx-136-PVM-B-130	G.A. OF ALKALI MEASURING TANKS(RO & MB)	DM Plant	WS	AA
2782	xxxx-136-PVM-B-131	GA DRAWING FOR CARTRIDGE FILTER FOR CIP (HOUSING)	DM Plant	WS	AA
2783	xxxx-136-PVM-B-132	GA DRAWING FOR CEB I (HCL) DOSING TANK for PTDMUF	DM Plant	WS	AA
2784	xxxx-136-PVM-B-133	GA DRAWING FOR CEB II (NaOH) DOSING TANK for PTDMUF	DM Plant	WS	AA
2785	xxxx-136-PVM-B-134	GA DRAWING FOR CEB III (NaOCL) DOSING TANK for PTDMUF	DM Plant	WS	AA
2786	xxxx-136-PVM-B-135	GA DRAWING FOR ANTISCALANT DOSING TANK for PTDM RO	DM Plant	WS	AA
2787	xxxx-136-PVM-B-136	GA DRAWING FOR ANTIOXIDANT DOSING TANK for PTDM RO	DM Plant	WS	AA
2788	xxxx-136-PVM-B-137	GA DRAWING FOR UF SKID (PTDM UF)	DM Plant	WS	AA
2789	xxxx-136-PVM-B-138	GA DRAWING FOR RO SKID (PTDM RO)	DM Plant	WS	AA
2790	xxxx-136-PVM-B-139	GA OF DEGASSER TOWER (DM Plant)	DM Plant	WS	AA
2791	xxxx-136-PVM-B-140	GA DRAWING OF DM BUILDING & SHED AREA (DM PLANT)	DM Plant	WS	AA
2792	xxxx-136-PVM-B-141	GA DRAWING FOR RO CIP TANK	DM Plant	WS	AA
2793	xxxx-136-PVM-B-142	GA DRAWING FOR UF PERMEATE WATER STORAGE TANK(S)	DM Plant	WS	AA
2794	xxxx-136-PVM-B-143	GA DRAWING FOR RO PERMEATE WATER STORAGE TANK(S)	DM Plant	WS	AA
2795	xxxx-136-PVM-B-144	GA DRAWING FOR CARTRIDGE FILTER FOR RO (HOUSING)	DM Plant	WS	AA
2796	xxxx-136-PVM-B-145	AWTS GA & DS FOR PUMP & MOTOR	DM Plant	WS	AA
2797	xxxx-136-PVM-F-146	Equipment layout plan of UFRODM Plant (Steel shed)	DM Plant	WS	AA
2798	xxxx-136-PVM-F-147	P&I Diagram for DM Plant (UF,RO and MB)	DM Plant	WS	A
2799	xxxx-136-PVM-L-149	ACID & ALKALI STORAGE AREA PIPING LAYOUT	DM Plant	WS	AA
2800	xxxx-136-PVM-L-150	FILTER WATER PUMP PIPING LAYOUT & INSTALLATION (for UF feed of f	DM Plant	WS	AA
2801	xxxx-136-PVM-L-151	PIPING LAYOUT DRG CWT area	DM Plant	WS	AA
2802	xxxx-136-PVM-U-152	Process Design & Equipment Sizing Calculation (PT DM Plant)including UF,	DM Plant	WS	A
2803	xxxx-136-PVM-U-154	FILTER WATER PUMP PIPING LAYOUT & INSTALLATION (for UF feed of f	DM Plant	WS	A
2804	xxxx-136-PVM-U-155	PRESSURE VESSEL DESIGN CALCULATION & THICKNESS CALCULATION	DM Plant	WS	A
2805	xxxx-136-PVM-W-156	GA, cross-section, ch curve & datasheet of EFFLUENT DISPOSAL PUMP (to	DM Plant	WS	AA
2806	xxxx-136-PVM-W-157	GA, cross-section, ch curve & datasheet of Alkali transfer cum recirculation pur	DM Plant	WS	AA
2807	xxxx-136-PVM-Y-158	GA, cross-section, ch curve & datasheet of FILTER WATER SUPPLY PUMP.	DM Plant	WS	AA
2808	xxxx-136-PVM-Y-159	GA & DATA SHEET FOR ACTIVATED CARBON	DM Plant	WS	AA
2809	xxxx-136-PVM-Y-160	GA&DATASHEET FOR MANUAL DIAPHRAGM VALVE	DM Plant	WS	AA
2810	xxxx-136-PVM-Y-161	GA & DATASHEET FOR CHECK VALVES	DM Plant	WS	AA
2811	xxxx-136-PVM-Y-162	Data Sheet & GA Drawing of Manual Globe Valve	DM Plant	WS	AA
2812	xxxx-136-PVM-Y-163	GA & DS FOR ACID (H2SO4) UNLOADING PUMP.	DM Plant	WS	AA
2813	xxxx-136-PVM-Y-164	GA & DS FOR ACID METERING PUMPS.	DM Plant	WS	AA
2814	xxxx-136-PVM-Y-165	GA & DS FOR SCALE INHIBITOR DOSING PUMPS.	DM Plant	WS	AA
2815	xxxx-136-PVM-Y-166	GA & DS FOR DISPERSANT DOSING PUMPS.	DM Plant	WS	AA
2816	xxxx-136-PVM-Y-167	DATA SHEETS FOR UF MEMBRANE	DM Plant	WS	AA
2817	xxxx-136-PVM-Y-168	DATA SHEETS FOR RO MEMBRANE	DM Plant	WS	AA
2818	xxxx-136-PVM-Y-169	DATA SHEETS FOR RO PRESSURE TUBE	DM Plant	WS	AA
2819	xxxx-136-PVM-Y-170	GA, cross section and datasheet for UF BACKWASH PUMP for PTDM	DM Plant	WS	AA
2820	xxxx-136-PVM-N-171	Performance curve for UF BACKWASH PUMP for PTDM	DM Plant	WS	AA
2821	xxxx-136-PVM-H-173	Painting Schedule for LET	DM Plant	WS	AA
2822	xxxx-136-PVM-Y-178	Datasheet & GA of Acid dosing tank for LET	DM Plant	WS	AA
2823	xxxx-136-PVM-Y-179	GA, Cross section,Performance curve and datasheet of Miscellaneous Centrif	DM Plant	WS	AA
2824	xxxx-136-PVM-Y-180	GA, Cross section,Performance curve and datasheet of Positive Displacement	DM Plant	WS	AA
2825	xxxx-136-PVM-R-003	Sub QR data for Reverse Osmosis Plant	DM Plant	WS	AA
2826	xxxx-110-PVM-F-xxx	GENERAL LAYOUT OF CONDENSATE POLISHING PLANT (CPP)	CPU	WS	AA
2827	xxxx-110-PVM-F-xxx	P & I DIAGRAM OF CONDENSATE POLISHING PLANT (CPP)	CPU	WS	A
2828	xxxx-110-PVM-F-xxx	P & I DIAGRAM OF REGENERATION SYSTEM OF CPP	CPU	WS	A
2829	xxxx-110-PVM-U-xxx	PROCESS DESIGN & EQUIPMENT SIZING CALCULATION FOR CPP	CPU	WS	A
2830	xxxx-110-PVM-U-xxx	PRESSURE & ATMOSPHERIC VESSELS/TANKS DESIGN CALCULATIONS OF CPP(INCLUDING DM TANKS IF APPLICABLE).	CPU	WS	A
2831	xxxx-110-PVM-Y-xxx	GA DRAWING OF REGENERATION VESSELS (TYPE WISE)	CPU	WS	AA
2832	xxxx-110-PVM-Y-xxx	DATA SHEET OF RESINS WITH CURVES	CPU	WS	AA
2833	xxxx-110-PVM-Y-xxx	DATASHEET & GA OF STRAINERS FOR CPU	CPU	WS	AA
2834	xxxx-110-PVM-Y-xxx	GA DRAWING OF RESIN HOPPER	CPU	WS	AA
2835	xxxx-110-PVM-Y-xxx	DATA SHEET OF AC FILLER MEDIA	CPU	WS	AA
2836	xxxx-110-PVM-Y-xxx	GA DRAWING OF DM WATER STORAGE TANKS (IF APPLICABLE)	CPU	WS	AA
2837	xxxx-110-PVM-Y-xxx	GA DRAWING OF SERVICE VESSEL	CPU	WS	AA

PART-B

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
2838	xxxx-110-PVM-Y-xxx	GA DRAWING MISCELLANEOUS ITEMS SUCH AS CO2 ABOSORBERS, FUME	CPU	WS	AA
2839	xxxx-110-PVM-Y-xxx	GA DRAWING OF RESIN TRAP	CPU	WS	AA
2840	xxxx-110-PVM-Y-xxx	GA DRAWING OF EJECTOR	CPU	WS	AA
2841	xxxx-110-PVM-H-xxx	VALVE SCHEDULE - CPU	CPU	WS	AA
2842	xxxx-110-PVM-H-xxx	PAINTING SCHEDULE-CPU	CPU	WS	AA
2843	xxxx-110-PVM-P-xxx	PIPING LAYOUT AROUND SERVICE VESSELS	CPU	WS	AA
2844	xxxx-110-PVM-L-xxx	External Piping layout from Regeneration building to Auxiliary pump house	CPU	WS	AA
2845	xxxx-110-PVM-Y-xxx	GA DRAWING OF ACID STORAGE TANK	CPU	WS	AA
2846	xxxx-110-PVM-Y-xxx	GA DRAWING OF ALKALI STORAGE TANK	CPU	WS	AA
2847	xxxx-110-PVM-Y-xxx	GA DRAWING AF ACID MEASURING TANK	CPU	WS	AA
2848	xxxx-110-PVM-Y-xxx	GA DRAWING OF ALKALI PREPARATION TANK	CPU	WS	AA
2849	xxxx-110-PVM-Y-xxx	GA DRAWING OF ALKALI DAY TANK	CPU	WS	AA
2850	xxxx-110-PVM-Y-xxx	GA DRAWING OF AC FILTER FOR ALKALI	CPU	WS	AA
2851	xxxx-110-PVM-L-xxx	INTERNAL PIPING LAYOUT IN REGENERATION BUILDING	CPU	WS	AA
2852	xxxx-110-PVM-Y-xxx	ELECTRIC ACTUATOR FOR DIAPHRAGM VALVE - CPU	CPU	WS	AA
2853	xxxx-110-PVM-Y-xxx	GA DRAWING OF HOT WATER TANK	CPU	WS	AA
2854	xxxx-110-PVM-Y-xxx	GA DRAWING OF PRIMING TANK OF NEUTRALISATION PIT (IF APPLICABLE)	CPU	WS	AA
2855	xxxx-110-PVM-Y-xxx	GA DRAWING OF LIME TANK OF NEUTRALISATION PIT (IF APPLICABLE)	CPU	WS	AA
2856	xxxx-110-PVM-Y-xxx	GA DRAWING OF NEUTRALISATION PIT	CPU	WS	AA
2857	xxxx-110-PVM-L-xxx	EXTERNAL PIPING LAYOUT FROM CPP SERVICE VESSELS TO REGENERATION AREA	CPU	WS	AA
2858	xxxx-110-PVM-L-xxx	EXTERNAL PIPING LAYOUT IN REGENERATION AREA	CPU	WS	AA
2859	xxxx-110-PVM-Y-xxx	DATA SHEET ALONGWITH GA OF BALL VALVE (AUTO)	CPU	WS	AA
2860	xxxx-110-PVM-Y-xxx	DATA SHEET ALONGWITH GA. C/S OF REGENERATION PUMPS	CPU	WS	AA
2861	xxxx-110-PVM-N-xxx	Performance curve & TDS of REGENERATION PUMPS	CPU	WS	A
2862	xxxx-110-PVM-Y-xxx	DATA SHEET ALONGWITH GA. C/S OF RESIN TRANSFER PUMPS	CPU	WS	AA
2863	xxxx-110-PVM-N-xxx	Performance curve & TDS of RESIN TRANSFER PUMPS	CPU	WS	A
2864	xxxx-110-PVM-Y-xxx	DATA SHEET OF SAFETY SHOWERS	CPU	WS	AA
2865	xxxx-110-PVM-Y-xxx	DATA SHEET OF AGITATORS FOR ALKALI PREPARATION AND ALKALI DAY TANK	CPU	WS	AA
2866	xxxx-110-PVM-P-xxx	CPU PIPING SCHEDULE	CPU	WS	AA
2867	xxxx-110-PVM-W-xxx	CONTROL WRITE UP / PHILOSOPHY FOR CONDENSATE POLISHING PLANT	CPU	WS	A
2868	xxxx-110-PVM-Y-xxx	DATA SHEET ALONGWITH GA OF DIAPHRAM TYPE VALVES (MANUAL TYPE)	CPU	WS	AA
2869	xxxx-110-PVM-Y-xxx	DATA SHEET ALONG WITH GA OF BUTTERFLY TYPE VALVES (MANUAL TYPE)	CPU	WS	AA
2870	xxxx-110-PVM-Y-xxx	DATA SHEET AFONG WITH GA OF BUTTERFLY TYPE VALVES (AUTO - DOUBLE ACTING)	CPU	WS	AA
2871	xxxx-110-PVM-Y-xxx	DATA SHEET AFONGWITH GA OF NON- RETURN VALVE	CPU	WS	AA
2872	xxxx-110-PVM-Y-xxx	DATA SHEET AIONGWILG G A OF BALL VALVE (MANUAL)	CPU	WS	AA
2873	xxxx-110-PVM-Y-xxx	DATA SHEET ALONGWILH GA OF ISOLATION GATES (N.PIT)	CPU	WS	AA
2874	xxxx-110-PVM-Y-xxx	GA, cross-section, ch curve & datasheet of ACID UNLOADING PUMPS	CPU	WS	AA
2875	xxxx-110-PVM-Y-xxx	GA, cross-section, ch curve & datasheet of ALKALI UNLOADING PUMPS	CPU	WS	AA
2876	xxxx-110-PVM-Y-xxx	GA, cross-section, ch curve & datasheet of ALKALI TRANSFER CUM RECIRCULATION PUMPS	CPU	WS	AA
2877	xxxx-110-PVM-Y-xxx	DATA SHEET AJONGWITH GA. C/S OF BLOWERS OF SERVICE AREA	CPU	WS	AA
2878	xxxx-110-PVM-Y-xxx	DATA SHEET ALONGWITH GA, C/S OF BLOWERS OF REGENERATION AREA	CPU	WS	AA
2879	xxxx-110-PVM-Y-xxx	GA, cross-section, ch curve & datasheet of EFFLUENT DISPOSAL PUMPS (IF APPLICABLE)	CPU	WS	AA
2880	xxxx-110-PVM-Y-xxx	GA, cross-section, ch curve & datasheet of RESIN WASTE WATER RECIRCULATION PUMPS	CPU	WS	AA
2881	xxxx-110-PVM-Y-xxx	GA, cross-section, ch curve & datasheet of METERING PUMPS (ALKALI)	CPU	WS	AA
2882	xxxx-110-PVM-Y-xxx	GA, cross-section, ch curve & datasheet of METERING PUMPS (ACID)	CPU	WS	AA
2883	xxxx-110-PVM-X-xxx	PERFORMANCE & GUARANTEE TEST PROCEDURE FOR CONDENSATE POLISHING PLANT	CPU	WS	AA
2884	xxxx-110-PVM-W-xxx	OPERATION AND MAINTENANCE MANUAL FOR CONDENSATE POLISHING PLANT	CPU	WS	A
2885	xxxx-110-PVM-R-001	Sub QR data for Condensate Polishing Plant	CPU	WS	AA
2886	XXXX-001-130-PVM-L-001	P&IDs OF FOHS (LDO & DAY TANK SYSTEM)		MH	A
2887	XXXX-001-130-PVM-U-003	DESIGN CALCULATION OF TANKS FOR FOHS (LDO & LDO DAY TANK)		MH	A
2888	XXXX-001-130-PVM-U-006	Design Calculation of Oil Water Separator		MH	A
2889	XXXX-001-130-PVM-U-007A	LDO Line Pressure Drop Calculation along with NPSH and PUMP HEAD CALULATION OF PUMPS FOR LDO		MH	A
2890	XXXX-001-130-PVM-U-010	DESIGN CALCULATION & GAD OF MISCELLANEOUS TANKS FOR FOHS (DRAIN OIL)		MH	AA
2891	XXXX-001-130-PVM-B-004	GA/Nozzle Orientation of LDO Storage Tank & LDO DAY OIL TANK		MH	A
2892	XXXX-001-130-PVM-B-040	Fabrication Details of LDO Storage Tank		MH	AA
2893	XXXX-001-130-PVM-P-022	GA of roof Structure for LDO Storage Tank & LDO DAY TANK		MH	AA
2894	XXXX-001-130-PVM-B-023	Staircase drawing for LDO Storage Tank & LDO DAY TANK		MH	AA
2895	XXXX-001-130-PVM-B-024	GA of Oil Water Separator		MH	AA
2896	XXXX-001-130-PVM-P-033	Piping Layout in & around Pump House		MH	A
2897	XXXX-001-130-PVM-P-034	Piping Layout in & around Storage Tank Farm Area		MH	A
2898	XXXX-001-130-PVM-P-035	Composite Layout of Fuel Oil Area		MH	A
2899	XXXX-001-130-PVM-B-025	GAD OF FOHS FOR CCOE APPROVAL		MH	AA
2900	XXXX-001-130-PVM-H-038	Valve Schedule of FOHS		MH	AA
2901	XXXX-001-130-PVM-H-039	Pipe Schedule of FOHS		MH	AA
2902	XXXX-001-130-PVM-W-002	Operation and Control Philosophy of fuel oil Unloading System		MH	AA
2903	XXXX-001-130-PVM-Y-026	GAD and TDS of Screw Pumps of FOHS		MH	AA
2904	XXXX-001-130-PVM-Y-027	DS of Pipes, Fittings, Flanges, Gasket etc for FO System		MH	AA
2905	XXXX-001-130-PVM-Y-028	TDS & GA for CS Gate / Globe / Check Valves - FO System		MH	AA
2906	XXXX-001-130-PVM-Y-029	TDS & GA for Ball / Plug Valves - FO System		MH	AA
2907	XXXX-001-130-PVM-Y-031	Data Sheet for painting on pipes and valves (Painting procedure at site) for FO System		MH	AA
2908	XXXX-001-130-PVM-B-020	GA of Strainer for LDO unloading Pumps		MH	AA
2909	XXXX-001-130-PVM-P-021	GA of Oil Hose for LDO		MH	AA
2910	XXXX-001-130-PVM-W-057	PG Test Procedure for FOHS		MH	A
2911	XXXX-001-130-PVM-X-058	O&M Manual for Fuel Oil System		MH	A
2912	XXXX-370-162-PVM-B-017	BOTTOM ASH OVERFLOW TANK & PUMPS - GA		MH	AA
2913	XXXX-370-162-PVM-B-021	BOTTOM ASH HOPPER GA DRAWING		MH	A
2914	XXXX-370-162-PVM-U-001	WATER AND SLURRY BALANCE CALCULATION		MH	A
2915	XXXX-370-162-PVM-U-002	BOTTOM ASH HOPPER VOLUME CALCULATION		MH	A
2916	XXXX-370-162-PVM-U-004	ASH SLURRY DISPOSAL PUMP SIZING CALCULATION		MH	A
2917	XXXX-370-162-PVM-U-005	SIZING CALCULATION OF BAHF, BALP, FAHP, ECO ASH , FLUSHING WATER PUMP		MH	A

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 39 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
2918	XXXX-370-162-PVM-U-014	CAPACITY CALCULATION OF BUFFER HOPPER		MH	A
2919	XXXX-370-162-PVM-U-015	SIZING CALCULATION OF PRESSURE SYSTEM		MH	A
2920	XXXX-370-162-PVM-U-020	SIZING OF BOTTOM ASH OVERFLOW TANK & PUMPS		MH	A
2921	XXXX-370-162-PVM-U-022	VOLUME CALCULATION OF ASH SLURRY SUMP		MH	A
2922	XXXX-370-162-PVM-U-023	CALCULATION FOR COOLING WATER REQUIREMENT FOR BOTTOM ASH HOPPER		MH	A
2923	XXXX-370-162-PVM-U-027	SIZING CALCULATION OF BA SEAL WATER PUMP		MH	A
2924	XXXX-370-162-PVM-U-031	SIZING CALCULATION OF APH SLURRY PUMP		MH	A
2925	XXXX-370-162-PVM-U-039	SIZING CALCULATION OF COARSE ASH TANK		MH	A
2926	XXXX-370-162-PVM-B-007	BOTTOM ASH SLURRY TRANSPORTATION PIPING LAYOUT		MH	A
2927	XXXX-370-162-PVM-B-018	FLY ASH BUFFER HOPPER TOWER - GA		MH	A
2928	XXXX-370-162-PVM-B-019	ASH SLURRY PUMP HOUSE GA		MH	A
2929	XXXX-370-162-PVM-B-020	ASH WATER PUMP HOUSE GA WITH SIZING CALCULATION OF ASH WATER SUMP/TANK		MH	A
2930	XXXX-370-162-PVM-B-025	SETTLING & SURGE TANK GA ALONG WITH SIZING CALCULATION		MH	A
2931	XXXX-370-162-PVM-B-030	TRANSPORT AIR COMPRESSOR HOUSE GA		MH	A
2932	XXXX-370-162-PVM-B-119	GA OF COARSE ASH EQUIPMENT BELOW APH DUCT & SCR HOPPER		MH	AA
2933	XXXX-370-162-PVM-B-120	GA OF COARSE ASH SLURRY TANK		MH	AA
2934	XXXX-370-162-PVM-L-001	BOTTOM & ECONOMISER ASH HANDLING SYSTEM-SINGLE LINE FLOW DIAGRAM		MH	A
2935	XXXX-370-162-PVM-L-002	FLY ASH VACUUM CONVEYING SYSTEM-SINGLE LINE FLOW DIAGRAM		MH	A
2936	XXXX-370-162-PVM-L-003	FLY ASH PRESSURE CONVEYING SYSTEM-SINGLE LINE FLOW DIAGRAM		MH	A
2937	XXXX-370-162-PVM-L-004	ASH WATER & ASH SLURRY DISPOSAL SYSTEM - SINGLE LINE FLOW DIAGRAM		MH	A
2938	XXXX-370-162-PVM-L-007	INSTRUMENT AIR SYSTEM - SINGLE LINE FLOW DIAGRAM		MH	A
2939	XXXX-370-162-PVM-U-003	JET PUMP SIZING CALCULATION		MH	A
2940	XXXX-370-162-PVM-U-017	SIZING CALCULATION OF IAC		MH	AA
2941	XXXX-370-162-PVM-U-021	VOLUME CALCULATION OF FA SILO		MH	A
2942	XXXX-370-162-PVM-B-001	ASH HANDLING SYSTEM-KEY PLAN		MH	A
2943	XXXX-370-162-PVM-B-004	PIPING LAYOUT FOR DRY FLY ASH TRANSPORTATION PIPING ON DRY FA PIPE RACK		MH	A
2944	XXXX-370-162-PVM-B-005	IN PLANT PIPING LAYOUT (AWPH TO BAH AREA)		MH	AA
2945	XXXX-370-162-PVM-B-009	ASH SLURRY DISPOSAL AREA PIPING LAYOUTS (INSIDE PLANT)		MH	A
2946	XXXX-370-162-PVM-B-014	FA SILO AREA LAYOUT		MH	A
2947	XXXX-370-162-PVM-B-026	FLY ASH SILO GA		MH	A
2948	XXXX-370-162-PVM-B-027	FLY ASH SILO UTILITY BUILDING GA		MH	AA
2949	XXXX-370-162-PVM-B-042	BUFFER HOPPER GA		MH	AA
2950	XXXX-370-162-PVM-B-113	GA OF BA SEAL WATER PUMP & PERFORMANCE CURVE		MH	AA
2951	XXXX-370-162-PVM-U-018	PIPE SIZING CALCULATION - WATER & AIR		MH	AA
2952	XXXX-370-162-PVM-U-019	SIZING & THICKNESS CALCULATION OF AIR LOCK VESSEL		MH	A
2953	XXXX-370-162-PVM-U-029	SIZING CALCULATION OF BAG FILTER OVER BUFFER HOPPER		MH	A
2954	XXXX-370-162-PVM-U-030	SIZING CALCULATION OF SLUDGE PUMP		MH	AA
2955	XXXX-370-162-PVM-U-032	SIZING CALCULATION OF DRAIN PUMP (BA SLURRY PH AREA, VACUUM PUMP AREA, FA SILO AREA)		MH	AA
2956	XXXX-370-162-PVM-U-033	SIZING CALCULATION OF ASH CONDITIONER PUMP		MH	AA
2957	XXXX-370-162-PVM-U-034	SIZING CALCULATION OF WASH WATER PUMP		MH	AA
2958	XXXX-370-162-PVM-U-036	SIZING CALCULATION OF ASH WATER RECIRCULATION PUMP		MH	A
2959	XXXX-370-162-PVM-B-002	ECONOMISER HOPPER, APH, SCR HOPPER AREA - EQUIPMENT & PIPING LAYOUT		MH	A
2960	XXXX-370-162-PVM-B-010	ASH SLURRY DISPOSAL AREA PIPING LAYOUTS (OUTSIDE PLANT)		MH	A
2961	XXXX-370-162-PVM-B-011	GARLANDING OF ASH SLURRY DISPOSAL PIPES AROUND MINE VOID		MH	A
2962	XXXX-370-162-PVM-B-013	RECIRCULATION AREA LAYOUT		MH	A
2963	XXXX-370-162-PVM-B-022	ASH SLURRY PUMP HOUSE AREA DRAIN PUMP & SUMP GENERAL ARRANGEMENT		MH	AA
2964	XXXX-370-162-PVM-B-023	FLY ASH SILO AREA DRAIN PUMP & SUMP GENERAL ARRANGEMENT		MH	AA
2965	XXXX-370-162-PVM-B-031	ASH WATER RECIRCULATION PUMP HOUSE GA		MH	A
2966	XXXX-370-162-PVM-B-033	JET PUMP GA		MH	AA
2967	XXXX-370-162-PVM-B-036	CLINKER GRINDER GENERAL ARRANGEMENT		MH	AA
2968	XXXX-370-162-PVM-B-037	CLINKER GRINDER DRIVE ARRANGEMENT		MH	AA
2969	XXXX-370-162-PVM-B-089	GA AND C/S DRG. OF BA OVERFLOW PUMPS		MH	AA
2970	XXXX-370-162-PVM-B-108	GA OF FLUID COUPLING FOR CLINKER GRINDER		MH	AA
2971	XXXX-370-162-PVM-B-109	GA OF FLUID COUPLING FOR SLURRY PUMP		MH	AA
2972	XXXX-370-162-PVM-B-114	GA OF BA SEAL WATER TANK AND PUMP FOUNDATION DETAIL		MH	AA
2973	XXXX-370-162-PVM-B-117	GA OF SEAL WATER TANK AND PUMP FOUNDATION DETAIL		MH	AA
2974	XXXX-370-162-PVM-L-006	ASH WATER RECIRCULATION SYSTEM-SINGLE LINE FLOW DIAGRAM		MH	A
2975	XXXX-370-162-PVM-U-016	SIZING & THICKNESS CALCULATION AND GA OF AIR RECEIVER OF TAC, IAC		MH	A
2976	XXXX-370-162-PVM-U-028	SIZING CALCULATION OF VENT FILTER & VENT FAN OVER FA SILO		MH	AA
2977	XXXX-370-162-PVM-U-040	Sizing calculation of FA silo area make up water pump		MH	AA
2978	XXXX-370-162-PVM-Y-001	REFRACTORY DATASHEET		MH	AA
2979	XXXX-370-162-PVM-Y-019	DATASHEET & PERFORMANCE CURVE OF BOTTOM ASH OVERFLOW PUMP		MH	AA
2980	XXXX-370-162-PVM-Y-029	DATASHEET & PERFORMANCE CURVE OF COARSE ASH SLURRY PUMP		MH	AA
2981	XXXX-370-162-PVM-B-047	AIR OIL CONVERTER TANK GA		MH	AA
2982	XXXX-370-162-PVM-B-050	FLUSHING APPARATUS BELOW ECONOMISER HOPPER- GA		MH	AA
2983	XXXX-370-162-PVM-B-051	AIR LOCK VESSEL GENERAL ARRANGEMENT		MH	AA
2984	XXXX-370-162-PVM-B-080	GA AND C/S DRG. OF FAHP WATER PUMP		MH	AA
2985	XXXX-370-162-PVM-B-081	GA AND C/S DRG. OF BAHF WATER PUMP		MH	AA
2986	XXXX-370-162-PVM-B-082	GA AND C/S DRG. OF BALP WATER PUMP		MH	AA
2987	XXXX-370-162-PVM-B-083	GA AND C/S DRG. OF FLUSHING WATER PUMP		MH	AA
2988	XXXX-370-162-PVM-B-084	GA AND C/S DRG. OF SEAL WATER PUMP		MH	AA
2989	XXXX-370-162-PVM-B-086	GA AND C/S DRG. OF ECO ASH WATER PUMP		MH	AA
2990	XXXX-370-162-PVM-B-087	GA AND C/S DRG. OF ASH SLURRY PUMP-2nd STAGE		MH	AA
2991	XXXX-370-162-PVM-B-088	GA AND C/S DRG. OF ASH SLURRY PUMP- 1ST STAGE		MH	AA
2992	XXXX-370-162-PVM-B-099	GA OF VACUUM PUMP		MH	AA
2993	XXXX-370-162-PVM-B-100	GA OF TAC		MH	AA
2994	XXXX-370-162-PVM-B-101	GA OF IA COMPRESSOR		MH	AA
2995	XXXX-370-162-PVM-B-124	GA & CROSS SECTION OF COARSE ASH SLURRY PUMP		MH	AA
2996	XXXX-370-162-PVM-F-001	P&I DIAGRAM & CONTROL WRITE UP OF INSTRUMENT AIR COMPRESSOR		MH	A
2997	XXXX-370-162-PVM-F-002	P&I DIAGRAM & CONTROL WRITE UP OF TRANSPORT AIR COMPRESSOR		MH	A
2998	XXXX-370-162-PVM-F-003	P&I DIAGRAM & CONTROL WRITE UP FOR IAC AIR DRIER		MH	AA

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
2999	XXXX-370-162-PVM-Y-002	GA, C/S DRAWING & TECHNICAL DATA SHEET OF GEAR BOX FOR ASH SLURRY PUMP		MH	AA
3000	XXXX-370-162-PVM-Y-007	TECHNICAL DATA SHEET & GA DRAWING OF GEAR BOX FOR CLINKER GRINDER DRIVE UNIT		MH	AA
3001	XXXX-370-162-PVM-Y-011	DATASHEET & PERFORMANCE CURVE OF FAHP WATER PUMP		MH	AA
3002	XXXX-370-162-PVM-Y-012	DATASHEET & PERFORMANCE CURVE OF BAHF WATER PUMP		MH	AA
3003	XXXX-370-162-PVM-Y-013	DATASHEET & PERFORMANCE CURVE OF BALP WATER PUMP		MH	AA
3004	XXXX-370-162-PVM-Y-014	DATASHEET & PERFORMANCE CURVE OF FLUSHING WATER PUMP		MH	AA
3005	XXXX-370-162-PVM-Y-015	DATASHEET & PERFORMANCE CURVE OF SEAL WATER PUMP		MH	AA
3006	XXXX-370-162-PVM-Y-016	DATASHEET & PERFORMANCE CURVE OF ECO ASH WATER PUMP		MH	AA
3007	XXXX-370-162-PVM-Y-018	DATASHEET & PERFORMANCE CURVE OF ASH SLURRY PUMP		MH	AA
3008	XXXX-370-162-PVM-Y-023	DATASHEET & PERFORMANCE CURVE OF VACUUM PUMP		MH	AA
3009	XXXX-370-162-PVM-Y-024	DATASHEET OF TAC		MH	A
3010	XXXX-370-162-PVM-Y-025	DATASHEET OF IAC		MH	AA
3011	XXXX-370-162-PVM-B-003	BUFFER HOPPER TOWER - PIPING LAYOUT & EQUIPMENT ARRANGEMENT		MH	AA
3012	XXXX-370-162-PVM-B-006	ESP AREA PIPING LAYOUT - (PLAN & SECTION)		MH	AA
3013	XXXX-370-162-PVM-B-008	BOTTOM ASH HOPPER WATER PIPING LAYOUT		MH	AA
3014	XXXX-370-162-PVM-B-016	ESP FLUIDISING & INSTRUMENT AIR PIPING LAYOUT		MH	AA
3015	XXXX-370-162-PVM-B-038	FEED SUMP GA		MH	AA
3016	XXXX-370-162-PVM-B-052	ASH SLURRY SUMP LINER		MH	AA
3017	XXXX-370-162-PVM-B-053	SLURRY SUMP PLUG GATE		MH	AA
3018	XXXX-370-162-PVM-B-062	GENERAL ARRANGEMENT OF AIR RECEIVER (IAC)		MH	AA
3019	XXXX-370-162-PVM-B-063	GENERAL ARRANGEMENT OF AIR RECEIVER (TAC)		MH	AA
3020	XXXX-370-162-PVM-B-067	MISC. CB. LINED FITTINGS FOR APH & BA SLURRY DISPOSAL LINE		MH	AA
3021	XXXX-370-162-PVM-B-069	SLURRY SUMP JETTING NOZZLE GA		MH	AA
3022	XXXX-370-162-PVM-B-090	GA AND C/S DRG. OF SLUDGE PUMP - SETTLING TANK AREA		MH	AA
3023	XXXX-370-162-PVM-B-091	GA AND C/S DRG. OF DRAIN PUMP - ASPH AREA		MH	AA
3024	XXXX-370-162-PVM-B-094	GA AND C/S DRG. OF ASH CONDITIONER WATER PUMP		MH	AA
3025	XXXX-370-162-PVM-B-102	GA OF IAC AIR DRYING PLANT		MH	AA
3026	XXXX-370-162-PVM-B-112	GA DRAWING OF SLURRY DUTY KNIFE GATE VALVE		MH	AA
3027	XXXX-370-162-PVM-B-115	GA AND C/S DRG. OF ASH WATER RECIRCULATION PUMP		MH	AA
3028	XXXX-370-162-PVM-B-121	GA OF EXPANSION JOINT		MH	AA
3029	XXXX-370-162-PVM-B-122	GA & CROSS SECTION OF DRAIN PUMP AT VACUUM PUMP AREA UNIT #1		MH	AA
3030	XXXX-370-162-PVM-B-123	GA & CROSS SECTION OF DRAIN PUMP AT VACUUM PUMP AREA UNIT #2		MH	AA
3031	XXXX-370-162-PVM-B-134	FLUIDIZER ARRGT. FOR ESP HOPPER		MH	AA
3032	XXXX-370-162-PVM-F-005	CONTROL WRITE-UP OF COMPLETE ASH HANDLING SYSTEM		MH	AA
3033	XXXX-370-162-PVM-H-001	VALVE SCHEDULE		MH	AA
3034	XXXX-370-162-PVM-Y-006	DATA SHEET & GA DRAWING OF ASH SLURRY PUMP DISCHARGE VALVE		MH	AA
3035	XXXX-370-162-PVM-Y-009	DATASHEET FOR EOT CRANES		MH	AA
3036	XXXX-370-162-PVM-Y-017	DATASHEET & PERFORMANCE CURVE OF WASH WATER PUMP		MH	AA
3037	XXXX-370-162-PVM-Y-020	DATASHEET & PERFORMANCE CURVE OF SLUDGE PUMP		MH	AA
3038	XXXX-370-162-PVM-Y-026	DATASHEET OF IAC DRIER		MH	AA
3039	XXXX-370-162-PVM-Y-035	PIPE DATA SHEET		MH	AA
3040	XXXX-370-162-PVM-B-034	FEED GATE ASSEMBLY		MH	AA
3041	XXXX-370-162-PVM-B-035	PNEUMATIC CYLINDER FOR FEED GATE GA		MH	AA
3042	XXXX-370-162-PVM-B-039	ASH INTAKE VALVE BELOW ESP GA		MH	AA
3043	XXXX-370-162-PVM-B-040	AIR INTAKE VALVE GA		MH	AA
3044	XXXX-370-162-PVM-B-043	ROTARY FEEDER GA		MH	AA
3045	XXXX-370-162-PVM-B-048	VACUUM BREAKER GA		MH	AA
3046	XXXX-370-162-PVM-B-054	TEE IN FLY ASH LINE (VACUUM)		MH	AA
3047	XXXX-370-162-PVM-B-055	FLY ASH FITTINGS (VACUUM LINE)		MH	AA
3048	XXXX-370-162-PVM-B-056	CAST BASALT FITTINGS FOR BA SLURRY DISPOSAL LINE		MH	AA
3049	XXXX-370-162-PVM-B-057	SLEEVE COUPLING GA		MH	AA
3050	XXXX-370-162-PVM-B-058	ALLOY CI SPOOL PIECE FOR VACUUM/PRESSURE CONVEYING LINE		MH	AA
3051	XXXX-370-162-PVM-B-059	SPLIT COUPLING FOR JET PUMP SUCTION		MH	AA
3052	XXXX-370-162-PVM-B-060	SPLIT COUPLING FOR JET PUMP DISCHARGE		MH	AA
3053	XXXX-370-162-PVM-B-061	TOTALLY ENCLOSED ROTARY SIDE GATE (BRANCH ISOLATION VALVE)		MH	AA
3054	XXXX-370-162-PVM-B-064	SPOOL PIECE (BASALT LINED) FA SYSTEM		MH	AA
3055	XXXX-370-162-PVM-B-065	FITTINGS-(BASALT LINED) FOR DRY SYSTEM		MH	AA
3056	XXXX-370-162-PVM-B-066	SPOOL FOR FOR BA SYSTEM		MH	AA
3057	XXXX-370-162-PVM-B-068	SPLIT FLANGE FOR CONNECTING ASH INTAKE VALVE		MH	AA
3058	XXXX-370-162-PVM-B-070	AIRLOCK VESSEL DISCHARGE VALVE GA		MH	AA
3059	XXXX-370-162-PVM-B-071	INTERCONNECTION VALVE GA		MH	AA
3060	XXXX-370-162-PVM-B-072	SILO (FA) INTAKE VALVE GA		MH	AA
3061	XXXX-370-162-PVM-B-073	GA OF SLEEVE COUPLING (TYPE-A-A) [PLAIN END PIPE TO PLAIN END PIPE GA OF SLEEVE COUPLING		MH	AA
3062	XXXX-370-162-PVM-B-074	FITTINGS FOR FA CONVEYING LINE		MH	AA
3063	XXXX-370-162-PVM-B-075	FITTINGS FOR VACUUM LINE		MH	AA
3064	XXXX-370-162-PVM-B-076	GA DRAWING OF ALLOY CI EXPANDER FOR FLY ASH PR. CONVEYING LINE		MH	AA
3065	XXXX-370-162-PVM-B-077	EQUALIZING (VENT VALVE) VALVE GA FOR ALV		MH	AA
3066	XXXX-370-162-PVM-B-105	GA AND C/S DRG. OF BLOWER FOR BUFFER HOPPER		MH	AA
3067	XXXX-370-162-PVM-B-106	GA OF HEATER FOR BLOWER OF BUFFER HOPPER		MH	AA
3068	XXXX-370-162-PVM-B-110	GA OF PIPE COUPLINGS FOR FLY ASH CONVEYING PIPE LINE		MH	AA
3069	XXXX-370-162-PVM-B-111	CAST BASALT LINED FITTING INSIDE SLURRY PUMP HOUSE		MH	AA
3070	XXXX-370-162-PVM-B-118	GA OF PRESSURE-VACUUM RELIEF VALVE		MH	AA
3071	XXXX-370-162-PVM-Y-004	DATA SHEET OF CAST IRON PIPE FOR FLY ASH CONVEYING (AIRLOCK VESSEL TO SILO)		MH	AA
3072	XXXX-370-162-PVM-Y-027	DATASHEET & PERFORMANCE CURVE OF BLOWER FOR BUFFER HOPPER		MH	AA
3073	XXXX-370-162-PVM-Y-031	GA AND DATA SHEET FOR TRUCK WEIGHING BRIDGE		MH	AA
3074	XXXX-370-162-PVM-Y-032	GA AND DATA SHEET FOR RAIL WAGON WEIGHING BRIDGE		MH	AA
3075	XXXX-370-162-PVM-B-041	FLUIDISING PAD FOR BUFFER HOPPER & FA SILO - GA		MH	AA
3076	XXXX-370-162-PVM-B-045	GA & DATA SHEET OF TELESCOPIC SPOUT		MH	AA
3077	XXXX-370-162-PVM-B-085	GA AND C/S DRG. OF WASH WATER PUMP		MH	AA
3078	XXXX-370-162-PVM-B-092	GA AND C/S DRG. OF DRAIN PUMP - FA SILO AREA		MH	AA
3079	XXXX-370-162-PVM-B-103	GA AND C/S DRG. OF BLOWER FOR FA SILO AREA		MH	AA
3080	XXXX-370-162-PVM-B-107	GA OF HEATERS FOR BLOWERS OF SILO AREA		MH	AA
3081	XXXX-370-162-PVM-B-130	GA OF PNEUMAITC CYLINDERS FOR ASH HANDLING VALVES		MH	AA
3082	XXXX-370-162-PVM-B-131	AIR CYLINDER FOR FLY ASH LINE KGV		MH	AA
3083	XXXX-370-162-PVM-B-137	GA and data sheet of FA silo area make up water pump		MH	AA
3084	XXXX-370-162-PVM-U-037	CALCULATION OF FLY ASH SILO AREA DUST SUPPRESSION SYSTEM		MH	AA

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 41 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
3085	XXXX-370-162-PVM-Y-010	DATASHEET & PERFORMANCE CURVE FOR SILO FLUIDISING BLOWERS		MH	AA
3086	XXXX-370-162-PVM-Y-021	DATASHEET & PERFORMANCE CURVE OF ASH CONDITINER WATER PUMP		MH	AA
3087	XXXX-370-162-PVM-Y-028	DATASHEET OF HEATERS FOR SILO AND BUFFER HOPPER		MH	AA
3088	XXXX-370-162-PVM-B-049	GA of Vent Filter for FA Silo		MH	AA
3089	XXXX-370-162-PVM-B-078	GA OF PLUG VALVE (MANUAL)		MH	AA
3090	XXXX-370-162-PVM-B-079	GA OF BUTTERFLY VALVE (PNEUMATIC)		MH	AA
3091	XXXX-370-162-PVM-B-096	GA OF CAST IRON GATE VALVE		MH	AA
3092	XXXX-370-162-PVM-B-097	GA OF CAST IRON GLOBE VALVE		MH	AA
3093	XXXX-370-162-PVM-B-098	GA OF CAST IRON CHECK VALVE		MH	AA
3094	XXXX-370-162-PVM-B-116	GA AND C/S DRG. OF DUST SUPPRESSION PUMP		MH	AA
3095	XXXX-370-162-PVM-B-129	GA DRAWING OF BALL VALVE		MH	AA
3096	XXXX-370-162-PVM-B-136	GA AND C/S DRG. OF OF PORTABLE SUBMERSIBLE PUMP		MH	AA
3097	XXXX-370-162-PVM-Y-003	GA & TECHNICAL DATA SHEET OF GUN METAL VALVE		MH	AA
3098	XXXX-370-162-PVM-Y-005	DATA SHEET & GA DRAWING AND PERFORMANCE CURVE OF FA SILO VENT FAN		MH	AA
3099	XXXX-370-162-PVM-Y-008	GA & TECHNICAL DATA SHEET OF FORGED AND CARBON CAST STEEL VALVE		MH	AA
3100	XXXX-370-162-PVM-Y-030	DATA SHEET FOR ELECTRIC HOIST		MH	AA
3101	XXXX-370-162-PVM-Y-034	GA AND DATA SHEET FOR FA SILO AREA DS PUMP		MH	AA
3102	XXXX-370-162-PVM-W-001	PG TEST PROCEDURE		MH	AA
3103	XXXX-370-162-PVM-W-002	O & M MANUAL		MH	AA
3104	XXXX-102-102-PVM-L-050	P & I Diagram of Mill Rejects Handling System		MH	A
3105		DESIGN PHILOSOPHY AND SYSTEM SIZING CALCULATION OF MILL REJECT SYSTEM		MH	A
3106		EQPT AND PIPING LAYOUT OF MILL REJECT SYSTEM AND PIPING LAYOUT FROM COMPRESSOR HOUSE		MH	A
3107		PG TEST PROCEDURE OF MILL REJECT SYSTEM		MH	A
3108	XXXX-001-155-PVM-B-001	TYPICAL C. S. OF CONVEYOR GALLERY & TUNNEL FOR CHP,BHP, LHP, GHP		MH	A
3109	XXXX-001-155-PVM-B-002	CONVEYOR PROFILES FOR CHP, BHP,LHP, GHP		MH	A
3110	XXXX-001-155-PVM-B-003	GA & LOAD DATA OF BELT CONVEYOR -1A/B		MH	A
3111	XXXX-001-155-PVM-B-004	GA & LOAD DATA OF BELT CONVEYOR -2A/B,3A/B		MH	A
3112	XXXX-001-155-PVM-B-005	GA & LOAD DATA OF BELT CONVEYOR -7A/B		MH	A
3113	XXXX-001-155-PVM-B-006	GA & LOAD DATA OF BELT CONVEYOR -3A/B		MH	A
3114	XXXX-001-155-PVM-B-007	GA & LOAD DATA OF BELT CONVEYOR -4A/B		MH	A
3115	XXXX-001-155-PVM-B-008	GA & LOAD DATA OF BELT CONVEYOR -5A/B, 6A/B		MH	A
3116	XXXX-001-155-PVM-B-009	GA & LOAD DATA OF BELT CONVEYOR -7A/B, 8A/B		MH	A
3117	XXXX-001-155-PVM-B-010	GA & LOAD DATA OF BELT CONVEYOR -10A/B,11A/B		MH	A
3118	XXXX-001-155-PVM-B-014	GA & LOAD DATA BELT FEEDER 1,2,3 & 4 FOR COAL CRH		MH	AA
3119	XXXX-001-155-PVM-B-015	GA & LOAD DATA OF LIMESTONE & GYPSUM BELT CONVEYOR		MH	A
3120	XXXX-001-155-PVM-B-022	GA OF TP -1 WITH LOAD DATA		MH	A
3121	XXXX-001-155-PVM-B-023	GA OF TP -2 WITH LOAD DATA		MH	A
3122	XXXX-001-155-PVM-B-025	GA OF TP -3,4,5,6,7 WITH LOAD DATA		MH	A
3123	XXXX-001-155-PVM-B-026	GA OF TP -8,9 WITH LOAD DATA		MH	A
3124	XXXX-001-155-PVM-B-032	LOAD DATA FOR BUNKER FLOORS OF UNIT#1,2		MH	AA
3125	XXXX-001-155-PVM-B-033	GA OF TRACK HOPPER-1 WITH LOAD DATA		MH	A
3126	XXXX-001-155-PVM-B-035	GA OF COAL - CRUSHER HOUSE WITH LOAD DATA		MH	A
3127	XXXX-001-155-PVM-B-036	GA OF LHP-GHP JT/TP WITH LOAD DATA		MH	A
3128	XXXX-001-155-PVM-B-039	GA OF LIMESTONE-CRUSHER HOUSE WITH LOAD DATA		MH	A
3129	XXXX-001-155-PVM-B-041	GA OF GYPSUM STORAGE SHED WITH LOAD DATA		MH	A
3130	XXXX-001-155-PVM-B-042	GA OF PADDLE FEEDER FOR COAL		MH	A
3131	XXXX-001-155-PVM-B-043	GA OF HYDRAULIC SYSTEMS FOR PADDLE FEEDER FOR COAL		MH	AA
3132	XXXX-001-155-PVM-B-044	GA OF GEARED MOTOR FOR PADDLE FEEDER FOR COAL		MH	AA
3133	XXXX-001-155-PVM-B-045	GA,DBR & P&ID OF MM-DS SYSTEM FOR PADDLE FEEDER FOR COAL		MH	AA
3134	XXXX-001-155-PVM-B-046	GA OF PADDLE FEEDER/BRU FOR LIMESTONE		MH	AA
3135	XXXX-001-155-PVM-B-047	GA OF HYDRAULIC SYSTEMS FOR PADDLE FEEDER/BRU FOR LIMESTONE		MH	AA
3136	XXXX-001-155-PVM-B-048	GA OF GEARED MOTOR FOR PADDLE FEEDER FOR LIMESTONE		MH	AA
3137	XXXX-001-155-PVM-B-049	GA OF TRUCK TIPPLER FOR LIMESTONE		MH	AA
3138	XXXX-001-155-PVM-B-060	GA OF RING GRANULATOR CRUSHER FOR COAL		MH	A
3139	XXXX-001-155-PVM-B-061	GA & TDS OF VIBRATION ISOLATION SYSTEM IN CRH		MH	AA
3140	XXXX-001-155-PVM-B-062	GA OF SCOOP COUPLING & ITS OIL COOLER FOR RING GRANULATOR CRUSHER FOR COAL		MH	AA
3141	XXXX-001-155-PVM-B-063	GA OF HYDRAULIC POWER PACK AND CIRCUIT FOR DOOR OPENING OF COAL CRUSHER		MH	AA
3142	XXXX-001-155-PVM-B-064	GA OF HAMMER MILL CRUSHER FOR LIMESTONE		MH	AA
3143	XXXX-001-155-PVM-B-065	GA & TDS OF VIBRATION ISOLATION SYSTEM IN LCH		MH	AA
3144	XXXX-001-155-PVM-B-066	GA OF SCOOP COUPLING & ITS OIL COOLER FOR HAMMER MILL CRUSHER FOR LIMESTONE		MH	AA
3145	XXXX-001-155-PVM-B-067	GA OF HYDRAULIC POWER PACK AND CIRCUIT FOR HAMMER MILL CRUSHER FOR LIMESTONE		MH	AA
3146	XXXX-001-155-PVM-B-068	GA & TDS OF VIBRATING FEEDER FOR COAL IN CRH		MH	AA
3147	XXXX-001-155-PVM-B-069	GA & TDS OF VIBRATING FEEDER FOR LIMESTONE IN LCH		MH	AA
3148	XXXX-001-155-PVM-B-070	WHEEL LOAD DIAGRAM FOR STACKER CUM RECLAIMER MACHINE		MH	AA
3149	XXXX-001-155-PVM-B-071	G.A. OF STACKER CUM RECLAIMER MACHINE WITH TECHNICAL DATA SHEET		MH	A
3150	XXXX-001-155-PVM-B-072	SIZING & POWER CALCULATIONS FOR BOOM, LUFF, SLEW, BUCKET WHEEL & TRAVEL DRIVES FOR STACKER CUM RECLAIMER MACHINE		MH	A
3151	XXXX-001-155-PVM-B-073	STABILITY & WHEEL LOAD CALCULATIONS FOR STACKER CUM RECLAIMER MACHINE		MH	A
3152	XXXX-001-155-PVM-B-074	GA of Sub- assemblies for stacker reclaimer machine		MH	AA
3153	XXXX-001-155-PVM-B-075	GA OF STORM LOCK FOR STACKER CUM RECLAIMER MACHINE		MH	AA
3154	XXXX-001-155-PVM-B-076	TDS FOR BELTING OF BOOM CONVEYOR FOR STACKER CUM RECLAIMER MACHINE		MH	AA
3155	XXXX-001-155-PVM-B-077	GA OF ALL PULLEYS INCLUDING CLACULATIONS FOR STACKER CUM RECLAIMER MACHINE		MH	AA
3156	XXXX-001-155-PVM-B-078	GA OF ALL IDLERS FOR STACKER CUM RECLAIMER MACHINE		MH	AA
3157	XXXX-001-155-PVM-B-079	GA, TDS & P&ID FOR HYDRAULIC SYSTEMS (HYD. POWER PACK, HYD. DRIVE/HYD. CYLINDER) FOR BUCKET WHEEL, SLEWING, LUFFING & OPERATER CABIN FOR STACKER CUM RECLAIMER MACHINE		MH	A
3158	XXXX-001-155-PVM-B-080	SELECTION & GA OF ROLLER BEARING SLEW RING FOR STACKER CUM RECLAIMER MACHINE		MH	A
3159	XXXX-001-155-PVM-B-081	LUBRICATION SYSTEM DIAGRAM FOR STACKER CUM RECLAIMER MACHINE TRIPPER ,TRAVEL & SLEWING MECHANISM		MH	AA

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 42 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
3160	XXXX-001-155-PVM-B-082	SELECTION OF DRIVE COMPONENTS FOR STACKER CUM RECLAIMER MACHINE		MH	A
3161	XXXX-001-155-PVM-B-083	GA OF GEAR BOXES USED IN STACKER CUM RECLAIMER MACHINE		MH	AA
3162	XXXX-001-155-PVM-B-084	GA OF FLUID COUPLING USED IN STACKER CUM RECLAIMER MACHINE		MH	AA
3163	XXXX-001-155-PVM-B-085	GA OF GEARED COUPLING USED IN STACKER CUM RECLAIMER MACHINE		MH	AA
3164	XXXX-001-155-PVM-B-086	GA OF BRAKES FOR STACKER CUM RECLAIMER MACHINE		MH	AA
3165	XXXX-001-155-PVM-B-087	GA & TDS OF BELT WEIGHER FOR STACKER CUM RECLAIMER MACHINE		MH	AA
3166	XXXX-001-155-PVM-B-088	GA & TDS OF RAIL CLAMPS FOR STACKER CUM RECLAIMER MACHINE		MH	AA
3167	XXXX-001-155-PVM-B-089	GA & TDS OF EXTERNAL SCRAPER FOR STACKER CUM RECLAIMER MACHINE		MH	AA
3168	XXXX-001-155-PVM-B-090	LUFFING CYLINDER ASSEMBLY FOR STACKER CUM RECLAIMER MACHINE		MH	AA
3169	XXXX-001-155-PVM-B-091	GA & TDS OF BUCKET WHEEL DRIVE ASSEMBLY FOR STACKER CUM RECLAIMER MACHINE		MH	A
3170	XXXX-001-155-PVM-B-092	GA & TDS OF PUMPS FOR DS SYSTEM FOR STACKER CUM RECLAIMER MACHINE		MH	AA
3171	XXXX-001-155-PVM-B-093	GA & TDS FOR NOZZLES FOR DS SYSTEM FOR STACKER CUM RECLAIMER MACHINE		MH	AA
3172	XXXX-001-155-PVM-B-094	GA OF ALL TYPES OF IDLERS FOR CHP, BHP, LHP, GHP CONVEYORS		MH	AA
3173	XXXX-001-155-PVM-B-095	GA OF ALL TYPES OF PULLEYS FOR CHP, BHP CONVEYORS		MH	A
3174	XXXX-001-155-PVM-B-096	GA OF ALL TYPES OF PULLEYS FOR LHP, GHP CONVEYORS		MH	AA
3175	XXXX-001-155-PVM-B-097	GA OF SKIRT BOARD & SKIRT SEALING FOR CHP, LHP, GHP & AHP CONVEYORS		MH	AA
3176	XXXX-001-155-PVM-B-098	GA OF GEAR BOX FOR CHP, BHP CONVEYORS		MH	AA
3177	XXXX-001-155-PVM-B-099	GA OF GEAR BOX FOR LHP & GHP CONVEYORS		MH	AA
3178	XXXX-001-155-PVM-B-100	GA OF EXTERNAL (PRIMARY & SECONDARY) SCRAPER FOR CHP, BHP, LHP, GHP CONVEYORS		MH	AA
3179	XXXX-001-155-PVM-B-101	GA OF INTERNAL SCRAPER FOR CHP, BHP, LHP, GHP CONVEYORS		MH	AA
3180	XXXX-001-155-PVM-B-102	GA OF TRACTION TYPE FLUID COUPLING FOR CHP, LHP, GHP & AHP CONVEYORS		MH	AA
3181	XXXX-001-155-PVM-B-103	GA OF SCOOP TYPE FLUID COUPLING & OIL COOLER FOR CHP, BHP, LHP, GHP		MH	AA
3182	XXXX-001-155-PVM-B-104	GA OF GEARED COUPLING FOR CHP, BHP CONVEYORS		MH	AA
3183	XXXX-001-155-PVM-B-105	GA OF GEARED COUPLING FOR LHP & GHP CONVEYORS		MH	AA
3184	XXXX-001-155-PVM-B-106	GA OF ELECTRO-HYDRAULIC THRUSTOR BRAKES FOR CHP, LHP, GHP & AHP CONVEYORS		MH	AA
3185	XXXX-001-155-PVM-B-107	GA OF BELT VULCANIZING MACHINE (INCLUDING TECH. DATA SHEET) FOR CHP, LHP, GHP & AHP CONVEYORS		MH	AA
3186	XXXX-001-155-PVM-B-108	GA OF BELT WEIGHER FOR CHP, LHP & AHP CONVEYORS (INCLUDING TECHNICAL DATA SHEET & SCHEDULE)		MH	AA
3187	XXXX-001-155-PVM-B-109	GA & TDS OF ELEVATOR AT CHP, BHP		MH	AA
3188	XXXX-001-155-PVM-B-110	GA OF MOTORIZED FLAP GATES FOR CHP, LHP, GHP & AHP CONVEYORS (INCLUDING TYPICAL SELECTION CRITERIA, TECHNICAL DATA SHEET & SCHEDULE)		MH	AA
3189	XXXX-001-155-PVM-B-111	GA OF LINEAR ACTUATOR FOR FLAP GATES FOR CHP, LHP, GHP CONVEYORS		MH	AA
3190	XXXX-001-155-PVM-B-112	GA OF IN-LINE MAGNETIC SEPARATOR (INCLUDING TECHNICAL DATA SHEET & SCHEDULE) FOR CHP & LHP		MH	AA
3191	XXXX-001-155-PVM-B-113	GA OF METAL DETECTOR (INCLUDING TECHNICAL DATA SHEET & SCHEDULE) FOR CHP, BHP & LHP		MH	AA
3192	XXXX-001-155-PVM-B-114	GA OF METAL DETECTOR (INCLUDING TECHNICAL DATA SHEET & SCHEDULE FOR STEEL CORD BELT)		MH	AA
3193	XXXX-001-155-PVM-B-115	GA OF MANUAL HOISTS/CHAIN PULLEY BLOCK (INCLUDING TECHNICAL DATA SHEET) FOR CHP, LHP, GHP & AHP CONVEYORS		MH	AA
3194	XXXX-001-155-PVM-B-116	GA OF ELECTRICAL HOISTS (INCLUDING TECHNICAL DATA SHEET) FOR CHP, LHP & GHP CONVEYORS		MH	AA
3195	XXXX-001-155-PVM-B-117	GA OF ELECTRIC WINCH		MH	AA
3196	XXXX-001-155-PVM-B-118	GA OF EOT CRANE (INCLUDING TECHNICAL DATA SHEET) FOR CHP WORKSHOP BUILDING		MH	AA
3197	XXXX-001-155-PVM-B-119	GA OF RACK AND PINION GATE FOR CHP & LHP		MH	AA
3198	XXXX-001-155-PVM-B-120	GA OF ROTARY ACTUATOR FOR R&P GATE FOR CHP & LHP		MH	AA
3199	XXXX-001-155-PVM-B-121	GA OF ROD GATE ASSEMBLY FOR CHP & LHP		MH	AA
3200	XXXX-001-155-PVM-B-122	GA OF SUSPENDED MAGNET WITH TECHNICAL DATA SHEET FOR CHP & LHP		MH	A
3201	XXXX-001-155-PVM-B-123	GA OF SUMP PUMP WITH TECHNICAL DATA SHEET FOR CHP, LHP & GHP		MH	AA
3202	XXXX-001-155-PVM-B-124	GA OF TRAVELLING TRIPPER FOR CHP CONVEYORS		MH	A
3203	XXXX-001-155-PVM-B-126	GA OF TRAVELLING TRIPPER FOR GHP CONVEYORS		MH	AA
3204	XXXX-001-155-PVM-B-127	GA OF GEAR box FOR TRAVELLING TRIPPER FOR CHP, LHP, GHP & AHP CONVEYORS		MH	AA
3205	XXXX-001-155-PVM-B-128	GA OF GEAR BOX & COUPLING FOR TRAVELLING TRIPPER FOR CHP, LHP, GHP & AHP CONVEYORS		MH	AA
3206	XXXX-001-155-PVM-B-129	GA OF HYDRAULIC THRUSTER OPERATED RAIL CLAMP FOR TRAVELLING TRIPPER FOR CHP, LHP, GHP & AHP CONVEYORS		MH	AA
3207	XXXX-001-155-PVM-B-130	GA OF COAL SAMPLING UNIT FOR T.P. - 3 (INCLUDING TECHNICAL DATA SHEET)		MH	AA
3208	XXXX-001-155-PVM-B-131	GA OF COAL SAMPLING UNIT FOR MAIN PLANT TP-5 (INCLUDING TECHNICAL DATA SHEET)		MH	AA
3209	XXXX-001-155-PVM-B-132	GA OF LIMESTONE SAMPLING UNIT FOR LIMESTONE CRUSHER HOUSE (INCLUDING TECHNICAL DATA SHEET)		MH	AA
3210	XXXX-001-155-PVM-B-135	GA AND FOUNDATION DETAILS OF VENTURI SCRUBBER FOR COAL CRH		MH	AA
3211	XXXX-001-155-PVM-B-136	GA OF DUST EXTRACTION WATER SYSTEM PUMPS FOR COAL CRH		MH	AA
3212	XXXX-001-155-PVM-B-137	GA OF CENTRIFUGAL FAN FOR DE SYSTEM FOR COAL CRH		MH	AA
3213	XXXX-001-155-PVM-B-138	GA OF DAMPERS (BOTH MANUAL & MOTORISED) FOR DE SYSTEM FOR COAL CRH		MH	AA
3214	XXXX-001-155-PVM-B-139	GA/DATA SHEET OF STRAINER FOR DE SYSTEM FOR COAL CRH		MH	AA
3215	XXXX-001-155-PVM-B-140	GA OF VALVES FOR DE SYSTEM FOR COAL CRH		MH	AA
3216	XXXX-001-155-PVM-B-141	GA OF BAG FILTER FOR DE SYSTEM FOR LIMESTONE		MH	AA
3217	XXXX-001-155-PVM-B-142	GA OF CENTRIFUGAL FAN FOR DE SYSTEM		MH	AA
3218	XXXX-001-155-PVM-B-143	GA OF DAMPERS (BOTH MANUAL & MOTORISED) FOR DE SYSTEM		MH	AA
3219	XXXX-001-155-PVM-B-144	GA OF AIR RECEIVER FOR SCREW COMPRESSORS FOR DE SYSTEM		MH	AA
3220	XXXX-001-155-PVM-B-145	GA OF SCREW COMPRESSOR FOR DE SYSTEM		MH	AA
3221	XXXX-001-155-PVM-B-146	GA & LOAD DATA OF PUMP HOUSE		MH	A
3222	XXXX-001-155-PVM-B-148	GA/DATA SHEET OF DS & WATER SYSTEM PUMPS		MH	AA
3223	XXXX-001-155-PVM-B-149	GA/DATASHEET OF DUPLEX STRAINER FOR WATER/DS SYSTEM		MH	AA

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 43 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
3224	XXXX-001-155-PVM-B-150	GA/DATASHEET OF WATER SYSTEM COMPONENT - CI GLOBE VALVES, CI CHECK VALVES, CI GATE VALVES, CI PRV		MH	AA
3225	XXXX-001-155-PVM-B-151	GA/DATASHEET OF WATER SYSTEM COMPONENT - GM GLOBE VALVES, GM GATE VALVES, GM CHECK VALVES, GM BALL VALVES, GM PRV		MH	AA
3226	XXXX-001-155-PVM-B-152	GA/DATASHEET OF WATER SYSTEM COMPONENT - FLOAT VALVES		MH	AA
3227	XXXX-001-155-PVM-B-153	GA/DATASHEET OF WATER SYSTEM COMPONENT - SOLENOID VALVES		MH	AA
3228	XXXX-001-155-PVM-B-154	GA OF SS BALL VALVES		MH	AA
3229	XXXX-001-155-PVM-B-155	GA OF CS BALL VALVES		MH	AA
3230	XXXX-001-155-PVM-B-156	GA/DATASHEET OF DUST SUPPRESSION SYSTEM COMPONENT - HEADERS FOR DFDSS		MH	AA
3231	XXXX-001-155-PVM-B-157	GA/DATASHEET OF DUST SUPPRESSION SYSTEM COMPONENT - NOZZLES FOR DFDSS		MH	AA
3232	XXXX-001-155-PVM-B-158	GA/DATASHEET OF DUST SUPPRESSION SYSTEM COMPONENT - FCU FOR DFDSS		MH	AA
3233	XXXX-001-155-PVM-B-159	GA/DATASHEET OF DUST SUPPRESSION SYSTEM COMPONENT - SOLENOID BOX FOR DFDSS		MH	AA
3234	XXXX-001-155-PVM-B-160	GA/DATASHEET OF DUST SUPPRESSION SYSTEM COMPONENT - SPRINKLERS		MH	AA
3235	XXXX-001-155-PVM-B-161	GA OF AIR RECEIVER FOR DFDSS SYSTEM		MH	AA
3236	XXXX-001-155-PVM-B-162	GA OF SCREW COMPRESSOR FOR DFDSS SYSTEM		MH	AA
3237	XXXX-001-155-PVM-B-165	GA OF CENTRIFUGAL FANS		MH	AA
3238	XXXX-001-155-PVM-B-166	GA OF AXIAL FLOW EXHAUST FANS		MH	AA
3239	XXXX-001-155-PVM-B-167	GA OF EXHAUST FAN FOR BUNKER BAY, TOILETS ETC.		MH	AA
3240	XXXX-001-155-PVM-B-168	GA OF CHP WORKSHOP BUILDING CUM OFFICE		MH	A
3241	XXXX-001-155-PVM-B-170	GA OF BRU/BOX FEEDER FOR LHP/BHP		MH	A
3242	XXXX-001-155-PVM-B-171	CIVIL INPUTS FOR BRU/BOX FEEDER FOR LHP		MH	AA
3243	XXXX-001-155-PVM-B-172	GA OF TRUCK TIPPLER FOR LHP/BHP		MH	A
3244	XXXX-001-155-PVM-B-173	GA & DATASHEET OF PLOUGH DIVERTOR FOR BHP		MH	AA
3245	XXXX-001-155-PVM-B-174	GA & DATA SHEET FOR PLOUGH DIVERTOR FOR LHP		MH	AA
3246	XXXX-001-155-PVM-B-175	CIVIL INPUTS FOR TRUCK TIPPLER FOR LHP		MH	AA
3247	XXXX-001-155-PVM-B-176	CONTROL WRITE-UP FOR DUST SUPPRESSION & WATER SYSTEM		MH	AA
3248	XXXX-001-155-PVM-B-177	STOCKPILE LAYOUT & CIVIL INPUTS FOR STACKER CUM RECLAIMER MACHINE		MH	A
3249	XXXX-001-155-PVM-B-178	DUCT LAYOUT OF VENTURI SCRUBBER TYPE WET DE SYSTEM FOR COAL CRH		MH	AA
3250	XXXX-001-155-PVM-B-179	DUCT LAYOUT & GA OF DE SYSTEM FOR LIMESTONE HANDLING SYSTEM		MH	AA
3251	XXXX-001-155-PVM-B-186	P&ID FOR SERVICE WATER, POTABLE WATER SYSTEMS OF CHP LHP, BHP		MH	A
3252	XXXX-001-155-PVM-B-188	P&ID FOR CHP/BHP/GHP DUST SUPPRESSION SYSTEM		MH	A
3253	XXXX-001-155-PVM-B-190	PIPING LAYOUT OF DFDSS, SW, DW, DS		MH	AA
3254	XXXX-001-155-PVM-B-191	DUCT LAYOUT & GA OF PRESSURIZED VENTILATION FOR MCC ROOMS		MH	AA
3255	XXXX-001-155-PVM-B-193	DUCT LAYOUT & GA OF MECHANICAL VENTILATION FOR TRACK HOPPER COMPLEX AND UNDERGROUND TUNNELS		MH	AA
3256	XXXX-001-155-PVM-B-196	SCHEMATIC DIAGRAM and P&ID FOR VENTILATION SYSTEM		MH	A
3257	XXXX-001-155-PVM-B-197	SCHEMATIC DIAGRAM & DUCTING LAYOUT FOR AIR CONDITIONING		MH	AA
3258	XXXX-001-155-PVM-B-198	ELECTRIC & MANUAL HOIST SCHEDULE FOR CHP, LHP, GHP CONVEYORS		MH	AA
3259	XXXX-001-155-PVM-B-199	IDLER SCHEDULE FOR CHP, LHP, GHP & AHP CONVEYORS		MH	AA
3260	XXXX-001-155-PVM-B-200	DRIVE SCHEDULE FOR CHP, LHP, GHP & AHP CONVEYORS		MH	AA
3261	XXXX-001-155-PVM-B-201	BELT SCHEDULE FOR CHP, LHP, GHP & AHP CONVEYORS		MH	AA
3262	XXXX-001-155-PVM-B-202	PAINTING SCHEDULE/SPECIFICATIONS FOR CHP, LHP, GHP (MECHANICAL)		MH	AA
3263	XXXX-001-155-PVM-B-204	VALVE SCHEDULE		MH	AA
3264	XXXX-001-155-PVM-B-205	COAL FLOW DIAGRAM		MH	A
3265	XXXX-001-155-PVM-B-206	LIMESTONE & GYPSUM FLOW DIAGRAM		MH	A
3266	XXXX-001-155-PVM-B-208	DBR & P&ID OF MACHINE MOUNTED DS SYSTEM & TDS OF PIPES & FITTINGS FOR DS SYSTEM STACKER CUM RECLAIMER MACHINE		MH	A
3267	XXXX-001-155-PVM-B-209	DBR & P&ID OF WET TYPE DUST EXTRACTION SYSTEM FOR COAL CRH		MH	A
3268	XXXX-001-155-PVM-B-210	DBR & P&ID OF DRY TYPE DUST EXTRACTION SYSTEM FOR LCH		MH	AA
3269	XXXX-001-155-PVM-B-211	DESIGN BASIS REPORT OF DFDSS/CFDS SYSTEMS		MH	AA
3270	XXXX-001-155-PVM-B-213	DESIGN BASIS REPORT OF SERVICE WATER AND POTABLE WATER SYSTEMS		MH	A
3271	XXXX-001-155-PVM-B-214	DESIGN BASIS REPORT OF DUST SUPPRESSION SYSTEMS		MH	A
3272	XXXX-001-155-PVM-B-215	DBR AND P&ID OF DE MAKE-UP WATER SYSTEM FOR COAL CRH		MH	AA
3273	XXXX-001-155-PVM-B-216	DESIGN BASIS REPORT OF VENTILATION SYSTEM		MH	AA
3274	XXXX-001-155-PVM-B-217	DESIGN BASIS REPORT OF PRESSURIZED VENTILATION SYSTEM FOR MCC BUILDINGS		MH	AA
3275	XXXX-001-155-PVM-B-218	POWER & BELT TENSION CALCULATION FOR ALL CONVEYORS FOR CHP, BHP		MH	A
3276	XXXX-001-155-PVM-B-219	POWER & BELT TENSION CALCULATION FOR ALL CONVEYORS FOR LHP, GHP		MH	A
3277	XXXX-001-155-PVM-B-220	SELECTION OF DRIVE COMPONENTS FOR CONVEYORS FOR CHP, LHP, GHP		MH	A
3278	XXXX-001-155-PVM-B-221	COASTING TIME CALCULATIONS FOR CHP, LHP, GHP		MH	AA
3279	XXXX-001-155-PVM-B-222	TRACK HOPPER SIZING CALCULATIONS		MH	A
3280	XXXX-001-155-PVM-B-225	SIZING CALCULATION FOR PADDLE WHEEL FOR COAL & LT DRIVE AND DRIVE SELECTION		MH	A
3281	XXXX-001-155-PVM-B-228	DRIVE SIZING CALCULATION FOR WAGON TIPPLER AND SIDE ARM CHARGER		MH	A
3282	XXXX-001-155-PVM-B-229	DESIGN CALCULATION FOR RING GRANULATOR CRUSHER FOR COAL		MH	A
3283	XXXX-001-155-PVM-B-230	DESIGN CALCULATION FOR HAMMER MILL CRUSHER FOR LIMESTONE		MH	A
3284	XXXX-001-155-PVM-B-231	DESIGN CALCULATION/SELECTION FOR PULLEYS FOR CHP LHP GHP CONVEYORS		MH	A
3285	XXXX-001-155-PVM-B-232	DESIGN CALCULATION/SELECTION FOR PULLEYS FOR LHP GHP CONVEYORS		MH	A
3286	XXXX-001-155-PVM-B-233	DESIGN CALCULATION FOR COAL SAMPLING UNIT		MH	A
3287	XXXX-001-155-PVM-B-234	DESIGN CALCULATION FOR LIMESTONE SAMPLING UNIT		MH	A
3288	XXXX-001-155-PVM-B-235	SIZING CALCULATION FOR AIR CONDITIONING SYSTEM		MH	A
3289	XXXX-001-155-PVM-B-236	O&M MANUALS FOR CHP, LHP, GHP & AHP (CONVEYORS & RELATED EQPT.)		MH	A
3290	XXXX-001-155-PVM-B-237	TECHNICAL DATA SHEET - CONVEYOR BELT & BUNKER SEALING BELT		MH	A
3291	xxxx-001-TR-102-QVE-Q-001	Quality plan for passenger cum goods elevator	EPC	QA-ELECTRICAL	A
3292	xxxx-001-IS-162-QVE-B-277	VFD PANELS	EPC	QA-ELECTRICAL	A

PART-B

SINGARENI TPP-II (1X800MW)

SUB-SECTION-G-07

MDL

EPC PACKAGE

BID DOC NO.:CW-CM-11159-C-O-M-001

PAGE 44 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
3293	xxxx-001-BP-110-QVE-Q-001	MQP for HT Motors (TG)	EPC	QA-ELECTRICAL	A
3294	xxxx-001-HW-110-QVE-Q-101	MQP for STATOR FRAME FABRICATION	EPC	QA-ELECTRICAL	E
3295	xxxx-001-HW-110-QVE-Q-102	MQP for STATOR FRAME MACHINING WITH MANHOLE COVER	EPC	QA-ELECTRICAL	E
3296	xxxx-001-HW-110-QVE-Q-103	MQP for SPRINGS	EPC	QA-ELECTRICAL	E
3297	xxxx-001-HW-110-QVE-Q-104	MQP for SPRING & SPRING BASKET ASSEMBLY	EPC	QA-ELECTRICAL	E
3298	xxxx-001-HW-110-QVE-Q-105	MQP for CORE BAR FOR STATOR	EPC	QA-ELECTRICAL	E
3299	xxxx-001-HW-110-QVE-Q-106	MQP for TENSION BOLT FOR STATOR CORE (INSULATED)	EPC	QA-ELECTRICAL	E
3300	xxxx-001-HW-110-QVE-Q-107	MQP for CORE PRESS RING & FINGERS	EPC	QA-ELECTRICAL	E
3301	xxxx-001-HW-110-QVE-Q-108	MQP for STATOR CORE ASSEMBLY	EPC	QA-ELECTRICAL	E
3302	xxxx-001-HW-110-QVE-Q-109	MQP for HEADERS FOR STATOR	EPC	QA-ELECTRICAL	E
3303	xxxx-001-HW-110-QVE-Q-110	MQP for STATOR WINDING BARS	EPC	QA-ELECTRICAL	E
3304	xxxx-001-HW-110-QVE-Q-111	MQP for STATOR WINDING ASSEMBLY	EPC	QA-ELECTRICAL	E
3305	xxxx-001-HW-110-QVE-Q-112	MQP for BAFFLE RING & BAFFLE RING CARRIER MACHINING	EPC	QA-ELECTRICAL	E
3306	xxxx-001-HW-110-QVE-Q-113	MQP for END SHIELD (FABRICATION & MACHINING)	EPC	QA-ELECTRICAL	E
3307	xxxx-001-HW-110-QVE-Q-114	MQP for SHAFT SEAL ASSEMBLY (SEAL RING & SEAL BODY)	EPC	QA-ELECTRICAL	E
3308	xxxx-001-HW-110-QVE-Q-115	MQP for BEARING SHELL MACHINING (GENERATOR)	EPC	QA-ELECTRICAL	E
3309	xxxx-001-HW-110-QVE-Q-116	MQP for HYDROGEN COOLERS	EPC	QA-ELECTRICAL	E
3310	xxxx-001-HW-110-QVE-Q-117	MQP for TERMINAL BUSHING BOX (FABRICATION & MACHINING)	EPC	QA-ELECTRICAL	E
3311	xxxx-001-HW-110-QVE-Q-118	MQP for PRIMARY WATER TANK	EPC	QA-ELECTRICAL	E
3312	xxxx-001-HW-110-QVE-Q-119	MQP for PRIMARY WATER PUMP & FILTER UNIT ASSEMBLY	EPC	QA-ELECTRICAL	E
3313	xxxx-001-HW-110-QVE-Q-120	MQP for ALKALYSER UNIT	EPC	QA-ELECTRICAL	E
3314	xxxx-001-HW-110-QVE-Q-121	MQP for SEAL OIL UNIT & PIPING	EPC	QA-ELECTRICAL	E
3315	xxxx-001-HW-110-QVE-Q-122	MQP for GAS UNIT & PIPING	EPC	QA-ELECTRICAL	E
3316	xxxx-001-HW-110-QVE-Q-123	MQP for SEAL OIL STORAGE TANK	EPC	QA-ELECTRICAL	E
3317	xxxx-001-HW-110-QVE-Q-124	MQP for CO2 VAPOURISER	EPC	QA-ELECTRICAL	E
3318	xxxx-001-HW-110-QVE-Q-125	MQP for GENERATOR ASSEMBLY AT WORKS	EPC	QA-ELECTRICAL	E
3319	xxxx-001-HW-110-QVE-Q-126	MQP for GENERATOR WORKS RUN TEST	EPC	QA-ELECTRICAL	E
3320	xxxx-001-HW-110-QVE-Q-127	MQP for EXCITER SHAFT MACHINING	EPC	QA-ELECTRICAL	E
3321	xxxx-001-HW-110-QVE-Q-128	MQP for EXCITER FRAME (MAIN & PILOT)	EPC	QA-ELECTRICAL	E
3322	xxxx-001-HW-110-QVE-Q-129	MQP for EXCITER STATOR MAIN	EPC	QA-ELECTRICAL	E
3323	xxxx-001-HW-110-QVE-Q-130	MQP for EXCITER STATOR PILOT	EPC	QA-ELECTRICAL	E
3324	xxxx-001-HW-110-QVE-Q-131	MQP for MAIN EXCITER ARMATURE WINDING	EPC	QA-ELECTRICAL	E
3325	xxxx-001-HW-110-QVE-Q-132	MQP for RECTIFIER WHEEL ASSEMBLY	EPC	QA-ELECTRICAL	E
3326	xxxx-001-HW-110-QVE-Q-133	MQP for DC LEAD ASSEMBLY FOR EXCITER	EPC	QA-ELECTRICAL	E
3327	xxxx-001-HW-110-QVE-Q-134	MQP for PERMANENT MAGNET & SHOE ASSEMBLY	EPC	QA-ELECTRICAL	E
3328	xxxx-001-HW-110-QVE-Q-135	MQP for EXCITER ROTOR BALANCING	EPC	QA-ELECTRICAL	E
3329	xxxx-001-HW-110-QVE-Q-136	MQP for EXCITER ASSEMBLY (MAIN & PMG)	EPC	QA-ELECTRICAL	E
3330	xxxx-001-HW-110-QVE-Q-137	MQP for EXCITER AIR COOLER	EPC	QA-ELECTRICAL	E
3331	xxxx-001-HW-110-QVE-Q-138	MQP for EXCITER TESTING	EPC	QA-ELECTRICAL	E
3332	xxxx-001-HW-110-QVE-Q-139	MQP for GENERATOR SHAFT MACHINING	EPC	QA-ELECTRICAL	E
3333	xxxx-001-HW-110-QVE-Q-140	MQP for ROTOR WINDING COPPER	EPC	QA-ELECTRICAL	E
3334	xxxx-001-HW-110-QVE-Q-141	MQP for ROTOR RETAINING RINGS	EPC	QA-ELECTRICAL	E
3335	xxxx-001-HW-110-QVE-Q-142	MQP for ROTATING BLADES	EPC	QA-ELECTRICAL	E
3336	xxxx-001-HW-110-QVE-Q-143	MQP for INSERT RINGS	EPC	QA-ELECTRICAL	E
3337	xxxx-001-HW-110-QVE-Q-144	MQP for ROTOR WEDGES	EPC	QA-ELECTRICAL	E
3338	xxxx-001-HW-110-QVE-Q-145	MQP for FAN BLOWER HUB	EPC	QA-ELECTRICAL	E
3339	xxxx-001-HW-110-QVE-Q-146	MQP for ROTOR COMPLETE	EPC	QA-ELECTRICAL	E
3340	xxxx-001-HW-110-QVE-Q-302	MQP FOR HYDROGEN COOLER	EPC	QA-ELECTRICAL	E
3341	xxxx-001-HW-110-QVE-Q-303	MQP FOR EXCITER COOLER	EPC	QA-ELECTRICAL	E
3342	xxxx-001-HW-110-QVE-Q-304	MQP FOR FINNING OF COOLER TUBES	EPC	QA-ELECTRICAL	E
3343	xxxx-001-HW-110-QVE-Q-305	MQP FOR PW COOLER FOR STATOR	EPC	QA-ELECTRICAL	E
3344	xxxx-001-HW-110-QVE-Q-306	MQP FOR SEAL OIL COOLER	EPC	QA-ELECTRICAL	E
3345	xxxx-001-HW-110-QVE-Q-307	MQP FOR GENERATOR INTEGRAL PIPING	EPC	QA-ELECTRICAL	E
3346	xxxx-001-HW-110-QVE-Q-308	MQP for stator Lamination	EPC	QA-ELECTRICAL	E
3347	xxxx-001-HW-110-QVE-Q-309	MQP FOR SOLID COPPER CONDUCTOR (FOR STATOR BAR)	EPC	QA-ELECTRICAL	A
3348	xxxx-001-HW-110-QVE-Q-310	MQP FOR HOLLOW COPPER INSULATED CONDUCTOR(STATOR BAR)	EPC	QA-ELECTRICAL	A
3349	xxxx-001-HW-110-QVE-Q-311	MQP FOR WATER SUPPLY HOSE (INSULATED)	EPC	QA-ELECTRICAL	A
3350	xxxx-001-HW-110-QVE-Q-312	MQP FOR WATER BOX FOR STATOR BARS	EPC	QA-ELECTRICAL	A
3351	xxxx-001-HW-110-QVE-Q-313	MQP FOR BEARING COMPLETE EXCITER	EPC	QA-ELECTRICAL	A
3352	xxxx-001-HW-110-QVE-Q-314	MQP FOR FINNING OF COOLER TUBES	EPC	QA-ELECTRICAL	A
3353	xxxx-001-HW-110-QVE-Q-315	MQP FOR VAPOUR EXHAUSTER	EPC	QA-ELECTRICAL	A
3354	xxxx-001-HW-110-QVE-Q-316	MQP FOR ION EXCHANGER	EPC	QA-ELECTRICAL	A
3355	xxxx-001-HW-110-QVE-Q-317	MQP FOR REFRIGERANT TYPE GAS DRIER	EPC	QA-ELECTRICAL	A
3356	xxxx-001-HW-110-QVE-Q-318	MQP FOR SEAL OIL PUMP	EPC	QA-ELECTRICAL	A
3357	xxxx-001-HW-110-QVE-Q-319	MQP FOR PW PUMP	EPC	QA-ELECTRICAL	A
3358	xxxx-001-HW-110-QVE-Q-320	MQP FOR RC BLOCK	EPC	QA-ELECTRICAL	A
3359	xxxx-001-HW-110-QVE-Q-321	MQP FOR GAS ANALYSER CABINET	EPC	QA-ELECTRICAL	A
3360	xxxx-001-HW-110-QVE-Q-322	Routine Test procedure of Exciter Testing	EPC	QA-ELECTRICAL	A
3361	xxxx-001-HW-110-QVE-Q-323	LT Motor of more than 50 KW for Primary water Pump	EPC	QA-ELECTRICAL	A
3362	xxxx-001-HW-110-QVE-Q-324	MQP OF MOTOR OF VACUUM PUMP	EPC	QA-ELECTRICAL	A
3363	xxxx-001-HY-110-QVE-Q-001	MQP LT AC MOTOR FOR BFPDT LOS	EPC	QA-ELECTRICAL	A
3364	xxxx-001-NR-110-QVE-Q-546	FIELD QUALITY PLAN FOR GENERATOR & AUX	EPC	QA-ELECTRICAL	A
3365	xxxx-001-PE-110-QVE-Q-414	MANUFACTURING QUALITY PLAN OF MOTORS (ABOVE 50 KW) FOR TG	EPC	QA-ELECTRICAL	A
3366	xxxx-001-PE-110-QVE-Q-429	QP. MOTORS	EPC	QA-ELECTRICAL	A
3367	xxxx-001-PE-110-QVE-Q-600	MQP- RECTIFIER for HGP	EPC	QA-ELECTRICAL	A
3368	xxxx-001-NR-207-QVE-Q-001	FIELD QUALITY PLAN FOR HV BUS DUCT (15.75 KV/ 21 KV)	GENBD_sys	QA-ELECTRICAL	A
3369	xxxx-001-RU-207-QVE-Q-143	MQP for Isolated Phase Busduct & Accessories	GENBD_sys	QA-ELECTRICAL	A
3370	xxxx-001-RU-207-QVE-Q-144	MQP for Segregated Phase Busduct & Accessories	GENBD_sys	QA-ELECTRICAL	A
3371	xxxx-001-BP-205-QVE-Q-001	MQP FOR SWITCHGEAR PANEL (11KV & 3.3KV)	HTSWGR_sys	QA-ELECTRICAL	A
3372	xxxx-001-BP-205-QVE-Q-002	MQP FOR DATA CONCENTRATOR PANEL & INTEGRATION	HTSWGR_sys	QA-ELECTRICAL	A
3373	xxxx-001-BP-205-QVE-Q-003	MQP FOR Protection Panel (GRP/STRP)	HTSWGR_sys	QA-ELECTRICAL	A
3374	xxxx-001-BP-205-QVE-Q-004	FAT of Numerical Relay	HTSWGR_sys	QA-ELECTRICAL	A
3375	xxxx-001-BP-205-QVE-Q-005	MQP for Bus Transfer Panel	HTSWGR_sys	QA-ELECTRICAL	A
3376	xxxx-001-NR-205-QVE-Q-001	FIELD QUALITY PLAN FOR HT SWITCHGEARS	HTSWGR_sys	QA-ELECTRICAL	A
3377	xxxx-001-NR-206-QVE-Q-001	FIELD QUALITY PLAN FOR LT BUS DUCT	LTWGR	QA-ELECTRICAL	A
3378	xxxx-001-NR-206-QVE-Q-002	FIELD QUALITY PLAN FOR LT SWITCHGEARS	LTWGR	QA-ELECTRICAL	A
3379	xxxx-001-EP-206-PVE-Q-001	MQP FOR LT SWITCHGEAR	LTWGR	QA-ELECTRICAL	A
3380	xxxx-001-EP-206-PVE-Q-002	MQP FOR LT BUSDUCT	LTWGR	QA-ELECTRICAL	A
3381	xxxx-001-PE-215-QVE-Q-003	220V BATTERY BANK - FQP	ELESUP_sys	QA-ELECTRICAL	A
3382	xxxx-001-PE-215-QVE-Q-128	AUX. SERVICE TRANSFORMER FIELD QUALITY PLAN	ELESUP_sys	QA-ELECTRICAL	A
3383	xxxx-001-PE-215-QVE-Q-218	Field quality plan for station lighting system	ELESUP_sys	QA-ELECTRICAL	A
3384	xxxx-001-PE-215-QVE-Q-005	220V BATTERY BANK - MQP	ELESUP_sys	QA-ELECTRICAL	A
3385	xxxx-001-PE-215-QVE-Q-013	MQP OF POLES	ELESUP_sys	QA-ELECTRICAL	A
3386	xxxx-001-PE-215-QVE-Q-015	MQP OF LPs	ELESUP_sys	QA-ELECTRICAL	A
3387	xxxx-001-PE-215-QVE-Q-108	QUALITY PLAN FOR CABLE TRAY SUPPORT STRUCTURE	ELESUP	QA-ELECTRICAL	A
3388	xxxx-001-PE-215-QVE-Q-109	MQP-HT Cable	ELESUP_sys	QA-ELECTRICAL	A

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 45 OF 66

Si No	NTPC Drg No	DRG_TITLE	SUB-SYSTEM	Dept	CATEGORY
3389	xxxx-001-PE-215-QVE-Q-110	QUALITY PLAN -LT XLPE Power Cable	ELESUP sys	QA-ELECTRICAL	A
3390	xxxx-001-PE-215-QVE-Q-111	QUALITY PLAN-LT HRPVC Control Cable	ELESUP sys	QA-ELECTRICAL	A
3391	xxxx-001-PE-215-QVE-Q-112	QUALITY PLAN for Cable Tray	ELESUP sys	QA-ELECTRICAL	A
3392	xxxx-001-PE-215-QVE-Q-115	QUALITY PLAN - CABLE JOINTING & TERMINATIONS KIT	ELESUP sys	QA-ELECTRICAL	A
3393	xxxx-001-PE-215-QVE-Q-116	QUALITY PLAN - CABLE TREFOIL CLAMPS	ELESUP sys	QA-ELECTRICAL	A
3394	xxxx-001-PE-215-QVE-Q-120	QUALITY PLAN-LT FS POWER Cable	ELESUP sys	QA-ELECTRICAL	A
3395	xxxx-001-PE-215-QVE-Q-126	FIELD QUALITY PLAN FOR CABLE FIRE SEALING SYSTEM TYPE|EPC E	ELESUP sys	QA-ELECTRICAL	A
3396	xxxx-001-PE-215-QVE-Q-127	QUALITY PLAN FOR CABLE FIRE SEALING SYSTEM,EPC ELECTRICAL E	ELESUP sys	QA-ELECTRICAL	A
3397	xxxx-001-PE-215-QVE-Q-128	QUALITY PLAN FOR AUX. SERVICE TRANSFORMERS	ELESUP sys	QA-ELECTRICAL	A
3398	xxxx-001-PE-215-QVE-Q-210	MQP FOR LUMINARIES	ELESUP sys	QA-ELECTRICAL	A
3399	xxxx-001-PE-215-QVE-Q-211	MQP FOR LDBS	ELESUP sys	QA-ELECTRICAL	A
3400	xxxx-001-PE-215-QVE-Q-212	MQP FOR TRANSFORMERS	ELESUP sys	QA-ELECTRICAL	A
3401	xxxx-001-PE-215-QVE-Q-213	MQP FOR WIRES	ELESUP sys	QA-ELECTRICAL	A
3402	xxxx-001-PE-215-QVE-Q-214	MQP FOR MISCELLANEOUS ITEMS	ELESUP sys	QA-ELECTRICAL	A
3403	xxxx-001-PE-215-QVE-Q-215	Manufacturing quality plan for High Mast	ELESUP sys	QA-ELECTRICAL	A
3404	xxxx-001-PE-215-QVE-Q-216	Manufacturing quality plan for FRP Junction Boxes	ELESUP sys	QA-ELECTRICAL	A
3405	xxxx-001-PE-215-QVE-Q-217	Manufacturing quality plan for Lighting Transformers	ELESUP sys	QA-ELECTRICAL	A
3406	xxxx-001-NR-200-QVE-G-007	FIELD QUALITY PLAN FOR STATION LIGHTING SYSTEM	ELEC.MIS sys	QA-ELECTRICAL	A
3407	xxxx-001-BP-501-QVE-Q-001	Generator Transformer - MANUFACTURING QUALITY PLAN	POWTRA sys	QA-ELECTRICAL	A
3408	xxxx-001-BP-501-QVE-Q-002	MANUFACTURING QUALITY PLAN---OFAP COOLER	POWTRA sys	QA-ELECTRICAL	A
3409	xxxx-001-BP-501-QVE-Q-003	MANUFACTURING QUALITY PLAN---Shunt Reactor	POWTRA sys	QA-ELECTRICAL	A
3410	xxxx-001-BP-501-QVE-Q-004	Quality Plan of Current Transformer	POWTRA sys	QA-ELECTRICAL	A
3411	xxxx-001-BP-501-QVE-Q-005	Quality Plan of Capacitor Voltage transformer	POWTRA sys	QA-ELECTRICAL	A
3412	xxxx-001-BP-501-QVE-Q-006	WPS and PQR for POWER TRANSFORMER	POWTRA sys	QA-ELECTRICAL	A
3413	xxxx-001-JH-501-QVE-G-001	FQP FOR BUS REACTOR	POWTRA sys	QA-ELECTRICAL	A
3414	xxxx-001-JH-501-QVE-G-002	FQP FOR NGT	POWTRA sys	QA-ELECTRICAL	A
3415	xxxx-001-JH-501-QVE-G-003	FQP FOR DRY TYPE TRF	POWTRA sys	QA-ELECTRICAL	A
3416	xxxx-001-JH-501-QVE-G-004	FQP FOR MV BUSDUCT	POWTRA sys	QA-ELECTRICAL	A
3417	xxxx-001-JH-501-QVE-Q-001	MQP for Dry Type Transformer	POWTRA sys	QA-ELECTRICAL	A
3418	xxxx-001-JH-501-QVE-Q-002	MQP for UT	POWTRA sys	QA-ELECTRICAL	A
3419	xxxx-001-JH-501-QVE-Q-002A	MQP for UAT	POWTRA sys	QA-ELECTRICAL	A
3420	xxxx-001-JH-501-QVE-Q-003	MQP for MV Busduct (IPBD/SPBD)	POWTRA sys	QA-ELECTRICAL	A
3421	xxxx-001-JH-501-QVE-Q-004	MQP for NEUTRAL GROUNDING TRANSFORMER	POWTRA sys	QA-ELECTRICAL	A
3422	xxxx-001-JH-501-QVE-Q-005	MQP for Oil Purifying Equipment	POWTRA sys	QA-ELECTRICAL	A
3423	xxxx-001-JH-501-QVE-Q-006	MQP for Composite Monitoring System	POWTRA sys	QA-ELECTRICAL	A
3424	xxxx-001-JH-501-QVE-W-01	WPS FOR TRF TANK	POWTRA sys	QA-ELECTRICAL	A
3425	xxxx-001-JH-501-QVE-W-02	WPS FOR BUSDUCT	POWTRA sys	QA-ELECTRICAL	A
3426	xxxx-001-NR-501-QVE-G-002	FIELD QUALITY PLAN FOR POWER TRANSFORMERS (GT, ST & UAT)	POWTRA sys	QA-ELECTRICAL	A
3427	xxxx-001-PE-501-QVE-Q-001	QP OF 11 & 3.3 KV NGR	POWTRA sys	QA-ELECTRICAL	A
3428	xxxx-001-BP-155-QVE-Q-001	MQP for HT MOTOR	QA-ELECTRICAL	QA-ELECTRICAL	A
3429	xxxx-001-IS-155-QVE-Q-003	QAP OF HT POWER CABLE	CHP sys	QA-ELECTRICAL	A
3430	xxxx-001-IS-155-QVE-Q-005	QAP OF LT POWER CABLE	CHP sys	QA-ELECTRICAL	A
3431	xxxx-001-IS-155-QVE-Q-007	QAP OF LT CONTROL CABLE	CHP sys	QA-ELECTRICAL	A
3432	xxxx-001-IS-155-QVE-Q-013	QAP OF BATTERY	CHP sys	QA-ELECTRICAL	A
3433	xxxx-001-IS-155-QVE-Q-014	QAP OF BATTERY CHARGER	CHP sys	QA-ELECTRICAL	A
3434	xxxx-001-IS-155-QVE-Q-016	QAP OF CONTROL JUNCTION BOXES	CHP sys	QA-ELECTRICAL	A
3435	xxxx-001-IS-155-QVE-Q-018	QAP OF CABLE TRAY	CHP sys	QA-ELECTRICAL	A
3436	xxxx-001-IS-155-QVE-Q-021	QAP OF EARTHING MATERIAL	CHP sys	QA-ELECTRICAL	A
3437	xxxx-001-IS-155-QVE-Q-025	QAP OF MLDB/LDB/ LIGHTING PANEL	CHP sys	QA-ELECTRICAL	A
3438	xxxx-001-IS-155-QVE-Q-027	QAP OF LIGHTING TRANSFORMER	CHP sys	QA-ELECTRICAL	A
3439	xxxx-001-IS-155-QVE-Q-030	QAP OF LIGHTING FIXTURE (LUMINAIRES)	CHP sys	QA-ELECTRICAL	A
3440	xxxx-001-IS-155-QVE-Q-033	QAP OF ACDB/DCFB/WDB	CHP sys	QA-ELECTRICAL	A
3441	xxxx-001-IS-155-QVE-Q-045	QAP OF LPBS FOR CONVEYOR PACKAGE	CHP sys	QA-ELECTRICAL	A
3442	xxxx-001-IS-155-QVE-Q-048	QAP OF BELT MONITORING SYSTEM PANEL	CHP sys	QA-ELECTRICAL	A
3443	xxxx-001-IS-155-QVE-Q-050	QAP OF DUST EXTRACTION SYSTEM PANEL	CHP sys	QA-ELECTRICAL	A
3444	xxxx-001-IS-155-QVE-Q-052	QAP OF TRAVELLING TRIPPER PANEL	CHP sys	QA-ELECTRICAL	A
3445	xxxx-001-IS-155-QVE-Q-057	QAP OF COAL SAMPLING UNIT CONTROL PANEL	CHP sys	QA-ELECTRICAL	A
3446	xxxx-001-IS-155-QVE-Q-060	QAP OF ZSS, PCS, CBS & BSS FOR CONVEYORS	CHP sys	QA-ELECTRICAL	A
3447	xxxx-001-IS-155-QVE-Q-062	QAP OF LT MOTORS FOR CONVEYORS	CHP sys	QA-ELECTRICAL	A
3448	xxxx-001-IS-155-QVE-Q-147	QAP OF LT TRANSFORMER FOR SCR MACHINE	CHP sys	QA-ELECTRICAL	A
3449	xxxx-001-IS-155-QVE-Q-154	QAP OF LT MOTORS FOR SCR MACHINE	CHP sys	QA-ELECTRICAL	A
3450	xxxx-001-IS-155-QVE-Q-172	QAP OF LPBS FOR MACHINE PACKAGE	CHP sys	QA-ELECTRICAL	A
3451	xxxx-001-IS-155-QVE-Q-189	QAP OF LT MOTORS FOR WT & SAC MACHINE	CHP sys	QA-ELECTRICAL	A
3452	xxxx-001-IS-155-QVE-Q-192	QAP OF DUST SUPPRESSION SYSTEM PANEL	CHP sys	QA-ELECTRICAL	A
3453	xxxx-001-IS-155-QVE-Q-194	QAP OF LT MOTORS FOR DS SYSTEM	CHP sys	QA-ELECTRICAL	A
3454	xxxx-001-IS-155-QVE-Q-196	QAP OF LPBS FOR WATER SYSTEM	CHP sys	QA-ELECTRICAL	A
3455	xxxx-001-IS-155-QVE-Q-290	QAP OF HT TRAILING CABLE FOR SCR MACHINE	CHP sys	QA-ELECTRICAL	A
3456	xxxx-001-IS-155-QVE-Q-292	QAP OF CONTROL TRAILING CABLE FOR SCR MACHINE	CHP sys	QA-ELECTRICAL	A
3457	xxxx-001-BP-133-QVE-Q-001	MQP for HT Motors	CWSYS	QA-ELECTRICAL	A
3458	xxxx-001-ES-151-QVE-Q-001	QAP-CONTROL CABLES	FDPS sys	QA-ELECTRICAL	A
3459	xxxx-001-ES-151-QVE-Q-004	QAP-HT motor for Hydrant and Spray pumps	FDPS sys	QA-ELECTRICAL	A
3460	xxxx-001-ES-151-QVE-Q-009	QP-Local Control Panel (Electrical)	FDPS sys	QA-ELECTRICAL	A
3461	xxxx-001-PE-148-QVE-Q-003	MQP FOR LT MOTOR >50KW	VENTILATION sys	QA-ELECTRICAL	A
3462	xxxx-001-BP-102-QVE-Q-001	MQP for HT Motors (SG)	SG	QA-ELECTRICAL	A
3463	xxxx-001-PE-102-QVE-Q-001	QAP for Motors (LT) MRS	SG	QA-ELECTRICAL	A
3464	xxxx-001-PE-102-QVE-Q-002	QAP for Control Cables MRS	SG	QA-ELECTRICAL	A
3465	xxxx-001-PE-102-QVE-Q-003	QAP of Local Panel for Drain Sump Pump of MRS	SG	QA-ELECTRICAL	A
3466	xxxx-001-PE-102-QVE-Q-004	MQP for Cable Tray	SG	QA-ELECTRICAL	A
3467	xxxx-001-RP-102-QVE-Q-001	MQP FOR SEAL AIR FAN MOTOR	SG	QA-ELECTRICAL	A
3468	xxxx-001-TR-102-QVE-Q-001	Quality plan for passenger cum goods elevator	SG	QA-ELECTRICAL	A
3469	xxxx-001-JH-104-QVE-Q-001	QAP for HVR Transformer-95KVp, 800mA, JHANSI WO-72085A10200	ESP	QA-ELECTRICAL	A
3470	xxxx-001-JH-104-QVE-Q-002	QP for ESP Electronic Controller	ESP	QA-ELECTRICAL	A
3471	xxxx-001-NR-104-QVE-G-001	FQP FOR ESP ELECTRICAL ERECTION	ESP	QA-ELECTRICAL	A
3472	xxxx-001-RP-104-QVE-Q-001	MQP for ESP Switch Gear Panel	ESP	QA-ELECTRICAL	A
3473	xxxx-001-RP-104-QVE-Q-002	MQP Endorsement sheet for Power Cable	ESP	QA-ELECTRICAL	A
3474	xxxx-001-RP-104-QVE-Q-005	MQP for Control Cable	ESP	QA-ELECTRICAL	A
3475	xxxx-001-RP-104-QVE-Q-007	MQP for Support and Wall through Insulator	ESP	QA-ELECTRICAL	A
3476	xxxx-001-RP-104-QVE-Q-008	MQP for Shaft Insulator	ESP	QA-ELECTRICAL	A
3477	xxxx-001-RP-104-QVE-Q-009	MQP for Flexible cable tray support System	ESP	QA-ELECTRICAL	A
3478	xxxx-001-RP-104-QVE-Q-010	MQP for Panel Type Hopper Heater	ESP	QA-ELECTRICAL	A
3479	xxxx-001-RP-104-QVE-Q-011	SQP Endorsement sheet for Galvanized Cable Trays and Accessories	ESP	QA-ELECTRICAL	A
3480	xxxx-001-BP-162-QVE-Q-001	MQP for AHP HT MOTOR	QA-ELECTRICAL	QA-ELECTRICAL	A
3481	xxxx-001-IS-162-QVE-B-277	VFD PANELS FOR HCSD SYSTEM - OGA, SCHEMATIC AND BOM	AHP sys sys	QA-ELECTRICAL	A
3482	xxxx-001-IS-162-QVE-Q-198	QAP OF LT MOTORS FOR AHP	AHP sys sys	QA-ELECTRICAL	A
3483	xxxx-001-IS-162-QVE-Q-199	MQP of Weigh Bridge	AHP sys sys	QA-ELECTRICAL	A
3484	xxxx-001-IS-162-QVE-Q-207	QAP OF CONTROL PANELS FOR AHP	AHP sys sys	QA-ELECTRICAL	A

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 46 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
3485	xxxx-001-IS-162-QVE-Q-227	QAP OF LPBS FOR AHP	AHP_sys_sys	QA-ELECTRICAL	A
3486	xxxx-001-IS-162-QVE-Q-259	QAP OF HT MOTORS-TAC	AHP_sys_sys	QA-ELECTRICAL	A
3487	xxxx-001-IS-162-QVE-Q-261	QAP OF LT MOTORS-IAC	AHP_sys_sys	QA-ELECTRICAL	A
3488	xxxx-001-IS-162-QVE-Q-263	QAP OF MOTORS-WATER PUMPS	AHP_sys_sys	QA-ELECTRICAL	A
3489	xxxx-001-IS-162-QVE-Q-278	QAP FOR HCSD SYSTEM MOTORS	AHP_sys_sys	QA-ELECTRICAL	A
3490	xxxx-001-IS-162-QVE-Q-285	QAP OF POWER JUNCTION BOXES	AHP_sys_sys	QA-ELECTRICAL	A
3491	xxxx-001-BP-109-QVE-Q-001	MQP for HT Motors	FGD	QA-ELECTRICAL	A
3492	xxxx-001-IS-109-QVE-P-043	QAP OF LT MOTORS FOR LHP-GHP	FGD	QA-ELECTRICAL	A
3493	xxxx-001-RP-109-QVE-Q-001	QP for LT Motors used in Water Pumps	FGD	QA-ELECTRICAL	A
3494	xxxx-001-PE-317-QVE-Q-002	CHIMNEY- FQP FOR ELECTRICAL WORK	CHIMNEY_sys	QA-ELECTRICAL	A
3495	xxxx-001-PE-317-QVE-Q-003	CHIMNEY-MQP FOR AVIATION LIGHTING	CHIMNEY_sys	QA-ELECTRICAL	A
3496	xxxx-001-PE-317-QVE-Q-004	CHIMNEY-MQP FOR ELECTRICAL PANELS	CHIMNEY_sys	QA-ELECTRICAL	A
3497	xxxx-001-PE-317-QVE-Q-005	CHIMNEY-MQP FOR LIGHTING TRANSFORMER	CHIMNEY_sys	QA-ELECTRICAL	A
3498	xxxx-001-QVI-Q-001	MQP FOR AAQMS	EPC	QA-C&I	A
3499	xxxx-001-QVI-Q-002	MQP FOR AMMONIA LEAK DETECTOR	EPC	QA-C&I	A
3500	xxxx-001-QVI-Q-003	MQP FOR BATTERY for UPS & 24V Battery Charger	EPC	QA-C&I	A
3501	xxxx-001-QVI-Q-004	MQP FOR DDCMIS	EPC	QA-C&I	A
3502	xxxx-001-QVI-Q-005	MQP FLOW NOZZLE ASSEMBLY	EPC	QA-C&I	A
3503	xxxx-001-QVI-Q-006	MQP FOR FLUE GAS ANALYSER-CO	EPC	QA-C&I	A
3504	xxxx-001-QVI-Q-007	MQP FOR FLUE GAS ANALYSER-O2 HT	EPC	QA-C&I	A
3505	xxxx-001-QVI-Q-008	MQP FOR CEMS	EPC	QA-C&I	A
3506	xxxx-001-QVI-Q-009	MQP FOR Intelligent Battery charger 24V DC / DCDB/BHMS	EPC	QA-C&I	A
3507	xxxx-001-QVI-Q-010	MQP FOR MERCURY ANALSER	EPC	QA-C&I	A
3508	xxxx-001-QVI-Q-011	MQP FOR PH ANALYSER (Self Retractable & self-cleaning type type)	EPC	QA-C&I	A
3509	xxxx-001-QVI-Q-012	MQP FOR SWAS (Sampling Handling System and Dry Panel)	EPC	QA-C&I	A
3510	xxxx-001-QVI-Q-013	MQP FOR VMS	EPC	QA-C&I	A
3511	xxxx-001-QVI-Q-014	MQP FOR Acoustic pyrometer System	EPC	QA-C&I	A
3512	xxxx-001-QVI-Q-015	MQP FOR ADDRESSABLE DETECTORS (MULTI SENSOR, PHOTO & HEAT DETECTORS TYPE), INTERFACE UNITS & MANNUAL CALL POINTS	EPC	QA-C&I	A
3513	xxxx-001-QVI-Q-016	MQP FOR CCTV-IP BASED	EPC	QA-C&I	A
3514	xxxx-001-QVI-Q-017	MQP FOR CONTROL DESK	EPC	QA-C&I	A
3515	xxxx-001-QVI-Q-018	MQP FOR CONTROL VALVES FOR AUX PRDS SYSTEM	EPC	QA-C&I	A
3516	xxxx-001-QVI-Q-019	MQP FOR CONTROL VALVE FOR START UP SYSTEM	EPC	QA-C&I	A
3517	xxxx-001-QVI-Q-020	MQP FOR CONTROL VALVE FOR BFP RECIRCULATION	EPC	QA-C&I	A
3518	xxxx-001-QVI-Q-021	MQO FOR CONTROL VALVE FOR FEEDWATER FLOW CONTROL	EPC	QA-C&I	A
3519	xxxx-001-QVI-Q-022	MQP FOR Control valves for Soot blower pressure reducing, SH/ RH Attenuation.	EPC	QA-C&I	A
3520	xxxx-001-QVI-Q-023	MQP FOR Control valve(Other than BFP RC, FW flow Control)	EPC	QA-C&I	A
3521	xxxx-001-QVI-Q-024	MQP FOR Control valve(Other than Start up Contorl, SH/RH/SB Control.)- up to 2500 class, Pneumatic operated	EPC	QA-C&I	A
3522	xxxx-001-QVI-Q-025	MQP FOR Control Valve (Ceramic lined)	EPC	QA-C&I	A
3523	xxxx-001-QVI-Q-026	MQP FOR Electrical Actuator (With gear box if applicable)	EPC	QA-C&I	A
3524	xxxx-001-QVI-Q-027	MQP FOR Electronics Transmitter -Field Bus Based (Pressure , DP and DP based Flow/Level)	EPC	QA-C&I	A
3525	xxxx-001-QVI-Q-028	MQP FOR Fiber optic cable	EPC	QA-C&I	A
3526	xxxx-001-QVI-Q-029	MQP FOR FIRE ALARM PANEL -MICROPROCESSOR BASED	EPC	QA-C&I	A
3527	xxxx-001-QVI-Q-030	MQP FOR Flame Monitoring System (Scanner)	EPC	QA-C&I	A
3528	xxxx-001-QVI-Q-031	MQP FOR H2 Gas Analyser	EPC	QA-C&I	A
3529	xxxx-001-QVI-Q-032	MQP FOR HEA IGNITOR	EPC	QA-C&I	A
3530	xxxx-001-QVI-Q-033	MQP FOR High Temp. cable (PTFE/FEP)	EPC	QA-C&I	A
3531	xxxx-001-QVI-Q-034	MQP FOR Impulse Pipes/Tubes	EPC	QA-C&I	A
3532	xxxx-001-QVI-Q-035	MQP FOR INSTRUMENT CABLES	EPC	QA-C&I	A
3533	xxxx-001-QVI-Q-036	MQP FOR INSTRUMENT VALVES	EPC	QA-C&I	A
3534	xxxx-001-QVI-Q-037	MQP FOR LVS	EPC	QA-C&I	A
3535	xxxx-001-QVI-Q-038	MQP FOR Level switch- cond type	EPC	QA-C&I	A
3536	xxxx-001-QVI-Q-039	MQP FOR Local Instrument Enclosure/Rack	EPC	QA-C&I	A
3537	xxxx-001-QVI-Q-040	MQP FOR Master Slave Clock System	EPC	QA-C&I	A
3538	xxxx-001-QVI-Q-041	MQP FOR PA System (IP Based)	EPC	QA-C&I	A
3539	xxxx-001-QVI-Q-042	MQP FOR PLC System	EPC	QA-C&I	A
3540	xxxx-001-QVI-Q-043	MQP FOR Pneumatic Actuator Regulating (Power Cylinder HAD,CAD SADC & Burner Tilt)	EPC	QA-C&I	A
3541	xxxx-001-QVI-Q-044	MQP FOR Temp Transmitter -Field Bus based Single/Dual Input	EPC	QA-C&I	A
3542	xxxx-001-QVI-Q-045	MQP FOR Turbine supervisory Instruments along with vibration analysis system.	EPC	QA-C&I	A
3543	xxxx-001-QVI-Q-046	MQP FOR Wireless Solution (Microwave Tower Communication)	EPC	QA-C&I	A
3544	xxxx-001-QVI-Q-047	MQP of Field Bus Cable	EPC	QA-C&I	A
3545	xxxx-001-QVI-Q-048	MQP of Stockyard Management System(Including 3D profiling scanner ,Thermal Imaging Camera, RTK GPS)	EPC	QA-C&I	A
3546	xxxx-001-QVI-Q-049	MQP OF UPS	EPC	QA-C&I	A
3547	xxxx-001-QVI-Q-001	FQP of material receipt, Storage and erection of C&I Items	EPC	QA-C&I	A
3548	xxxx-001-QVM-G-001	FIELD QUALITY PLAN FOR ERECTION OF BOILER STRUCTURE	EPC	QA-SG	A
3549	xxxx-001-QVM-G-002	FIELD QUALITY PLAN FOR ERECTION OF BOILER PRESSURE PARTS	EPC	QA-SG	A
3550	xxxx-001-QVM-G-003	FIELD QUALITY PLAN FOR ERECTION OF AIR PRE-HEATER	EPC	QA-SG	A
3551	xxxx-001-QVM-G-004	FIELD QUALITY PLAN FOR ERECTION OF COAL MILLS	EPC	QA-SG	A
3552	xxxx-001-QVM-G-005	FIELD QUALITY PLAN FOR ERECTION OF PULVERIZED COAL PIPING	EPC	QA-SG	A
3553	xxxx-001-QVM-G-006	FIELD QUALITY PLAN FOR ERECTION OF COAL FEEDER	EPC	QA-SG	A
3554	xxxx-001-QVM-G-007	FIELD QUALITY PLAN FOR ERECTION OF ID FAN	EPC	QA-SG	A
3555	xxxx-001-QVM-G-008	FIELD QUALITY PLAN FOR ERECTION OF PA FAN	EPC	QA-SG	A
3556	xxxx-001-QVM-G-009	FIELD QUALITY PLAN FOR ERECTION OF FD FAN	EPC	QA-SG	A
3557	xxxx-001-QVM-G-010	FIELD QUALITY PLAN FOR ERECTION OF SEAL AIR FAN	EPC	QA-SG	A
3558	xxxx-001-QVM-G-011	FIELD QUALITY PLAN FOR ERECTION OF DUCT, DAMPER & GATES	EPC	QA-SG	A
3559	xxxx-001-QVM-G-012	FIELD QUALITY PLAN FOR ERECTION OF LINING & INSULATION	EPC	QA-SG	A
3560	xxxx-001-QVM-G-013	FIELD QUALITY PLAN FOR ERECTION OF AUX. BOILER	EPC	QA-SG	A
3561	xxxx-001-QVM-G-014	FIELD QUALITY PLAN FOR ERECTION OF FUEL FIRING SYSTEM	EPC	QA-SG	A
3562	xxxx-001-QVM-G-015	FIELD QUALITY PLAN FOR ERECTION OF SOOT BLOWERS & FINE FITT	EPC	QA-SG	A
3563	xxxx-001-QVM-G-016	FIELD QUALITY PLAN FOR ERECTION OF BOILER WATER CIRCULATION	EPC	QA-SG	A
3564	xxxx-001-QVM-G-017	FIELD QUALITY PLAN FOR ERECTION OF POWER CYCLE PIPING (HP P	EPC	QA-SG	A
3565	xxxx-001-QVM-G-018	FIELD QUALITY PLAN FOR BOILER (RECEIPT & STORAGE)	EPC	QA-SG	A
3566	xxxx-001-QVM-G-019	FIELD QUALITY PLAN FOR ERECTION OF COAL BUNKER & RING GIRDE	EPC	QA-SG	A
3567	xxxx-001-QVM-G-020	FIELD QUALITY PLAN FOR ERECTION OF FIELD WELDING SHEDULE.	EPC	QA-SG	A
3568	xxxx-001-QVM-Q-001	PGMA Categorisation List for Manufacturing Items	EPC	QA-SG	A
3569	xxxx-001-QVM-Q-002	MQP for Pipe Fittings special class- Grade 91/92	EPC	QA-SG	A
3570	xxxx-001-QVM-Q-003	MQP for Boiler piping	EPC	QA-SG	A
3571	xxxx-001-QVM-Q-004	MQP FOR SPIRAL WALL, WINDBOX AND SOFA PANELS	EPC	QA-SG	A
3572	xxxx-001-QVM-Q-005	MQP for Boiler Pressure parts - Separator, storage tank for supercritical boiler	EPC	QA-SG	A

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 47 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
3573	xxxx-001-QVM-Q-006	MQP for Headers	EPC	QA-SG	A
3574	xxxx-001-QVM-Q-007	MQP for Boiler Pressure Parts and Piping -GE Scope	EPC	QA-SG	A
3575	xxxx-001-QVM-Q-008	MQP for Tubular products (Coils, panels including spiral wall)	EPC	QA-SG	A
3576	xxxx-001-QVM-Q-009	MQP for Safety valves ? Spring loaded	EPC	QA-SG	A
3577	xxxx-001-QVM-Q-010	MQP for SRV	EPC	QA-SG	A
3578	xxxx-001-QVM-Q-011	MQP for Plug valves	EPC	QA-SG	A
3579	xxxx-001-QVM-Q-012	Quality Plan -Endorsement sheet for Connecting plate assy	EPC	QA-SG	E
3580	xxxx-001-QVM-Q-013	Quality Plan -Endorsement sheet for Guide bearing Assy	EPC	QA-SG	E
3581	xxxx-001-QVM-Q-014	Quality Plan -Endorsement sheet for Module Assy	EPC	QA-SG	E
3582	xxxx-001-QVM-Q-015	Quality Plan -Endorsement sheet for Rotor drive Assy	EPC	QA-SG	E
3583	xxxx-001-QVM-Q-016	Quality Plan -Endorsement sheet for Rotor post Assy	EPC	QA-SG	E
3584	xxxx-001-QVM-Q-017	Quality Plan -Endorsement sheet for Support bearing Assy	EPC	QA-SG	E
3585	xxxx-001-QVM-Q-018	MQP for Grinding Rolls	EPC	QA-SG	A
3586	xxxx-001-QVM-Q-019	MQP for Bull Ring Segments	EPC	QA-SG	A
3587	xxxx-001-QVM-Q-020	Quality Plan -Endorsement sheet for PA Fan (Static Parts)	EPC	QA-SG	E
3588	xxxx-001-QVM-Q-021	Quality Plan -Endorsement sheet for PA Fan (Rotating Parts)	EPC	QA-SG	E
3589	xxxx-001-QVM-Q-022	Quality Plan -Endorsement sheet for FD Fan (Static Parts)	EPC	QA-SG	E
3590	xxxx-001-QVM-Q-023	Quality Plan -Endorsement sheet for FD Fan (Rotating Parts)	EPC	QA-SG	E
3591	xxxx-001-QVM-Q-024	Quality Plan -Endorsement sheet for ID Fan (Static Parts)	EPC	QA-SG	E
3592	xxxx-001-QVM-Q-025	Quality Plan -Endorsement sheet for ID Fan (Rotating Parts)	EPC	QA-SG	E
3593	xxxx-001-QVM-Q-026	Quality Plan -Endorsement sheet for Lub oil system	EPC	QA-SG	E
3594	xxxx-001-QVM-Q-027	Quality Plan -Endorsement sheet for Seal air fan	EPC	QA-SG	E
3595	xxxx-001-QVM-Q-028	Endorsement sheet for Scanner Air Fans	EPC	QA-SG	E
3596	xxxx-001-QVM-Q-029	Quality Plan -MQP for Chimney for Aux. Boiler	EPC	QA-SG	A
3597	xxxx-001-QVM-Q-030	MQP for Hangers and supports (CLH & VLH)	EPC	QA-SG	A
3598	xxxx-001-QVM-Q-031	MQP for Soot blowers (LRSB, wall De slaggar, Rotary Blower, Temperature F	EPC	QA-SG	A
3599	xxxx-001-QVM-Q-032	Endorsement sheet for HFO/LFO Pumps	EPC	QA-SG	E
3600	xxxx-001-QVM-Q-033	MQP for Boiler recirculation pump-for supercritical boiler	EPC	QA-SG	A
3601	xxxx-001-QVM-Q-034	Endorsement sheet for LRB Wool Mattress	EPC	QA-SG	E
3602	xxxx-001-QVM-Q-035	MQP for Furnace maintenance platforms	EPC	QA-SG	A
3603	xxxx-001-QVM-Q-036	MQP for Quick erection furnace scaffolding	EPC	QA-SG	A
3604	xxxx-001-QVM-Q-037	MQP for Electrical Handling Equipment (Electric hoist >= 5T Capacity)	EPC	QA-SG	A
3605	xxxx-001-QVM-Q-038	MQP for Metallic expansion joint	EPC	QA-SG	A
3606	xxxx-001-QVM-Q-039	MQP for Primary structure (Ceiling Girders, Main Columns, Aux. Columns, Built up Beams, Boxes, Buckstay, Bracings, Mill Bay structure, APH support structure).	EPC	QA-SG	A
3607	xxxx-001-QVM-Q-040	MQP for Ceramic lined coal pipe/bends	EPC	QA-SG	A
3608	xxxx-001-QVM-Q-041	MQP for Ceramic Lined Items-Pulverised Coal Pipes/Bends	EPC	QA-SG	A
3609	xxxx-001-QVM-Q-042	MQP for Gravimetric feeder	EPC	QA-SG	A
3610	xxxx-001-QVM-Q-043	Quality Plan -Endorsement sheet for Gates and Dampers	EPC	QA-SG	E
3611	xxxx-001-QVM-Q-044	Quality Plan - Endorsement sheet for UPPER Rotor Post Pin	EPC	QA-SG	E
3612	xxxx-001-QVM-Q-045	Quality Plan - Endorsement sheet for Rotor Housing Assy	EPC	QA-SG	E
3613	xxxx-001-QVM-Q-046	MQP for Acoustic Steam Leak Detection System	EPC	QA-SG	A
3614	xxxx-001-QVM-Q-047	MQP for Pulveriser Gear Box	EPC	QA-SG	A
3615	xxxx-001-QVM-Q-048	MQP for Lubrication Oil System (Pulveriser Gear Box)	EPC	QA-SG	A
3616	xxxx-001-QVM-Q-049	MQP for wind box TT burner Assy. & AA port	EPC	QA-SG	A
3617	xxxx-001-QVM-Q-050	MQP for Knife Gate Valve	EPC	QA-SG	A
3618	xxxx-001-QVM-Q-051	MQP for Mill Side Housing	EPC	QA-SG	A
3619	xxxx-001-QVM-Q-052	MQP for Separator Body	EPC	QA-SG	A
3620	xxxx-001-QVM-Q-053	MQP for Separator Top	EPC	QA-SG	A
3621	xxxx-001-QVM-Q-054	MQP for Bowl, Bowl Hub & Vane Wheel Assembly	EPC	QA-SG	A
3622	xxxx-001-QVM-Q-055	MQP for Journal Shaft Assembly	EPC	QA-SG	A
3623	xxxx-001-QVM-Q-056	MQP for Journal Opening Cover Assembly	EPC	QA-SG	A
3624	xxxx-001-QVM-Q-057	MQP for Journal Head Assembly	EPC	QA-SG	A
3625	xxxx-001-QVM-Q-058	MQP for Boiler Pressure parts -Spheres	EPC	QA-SG	A
3626	xxxx-001-QVM-Q-059	MQP FOR SINGLE GIRDER CRANE WITH SUB VENDOR LIST	EPC	QA-SG	A
3627	xxxx-001-QVM-Q-060	QP FOR PIPING FABRICATION (IBR) & FITTINGS	EPC	QA-SG	A
3628	xxxx-001-QVM-Q-061	QP FOR PIPING FABRICATION (NON-IBR) & FITTINGS	EPC	QA-SG	A
3629	xxxx-001-QVM-Q-062	QP FOR A) FORMED FITTINGS MANUFACTURED AT SHOPS, B) FORGED FITTINGS OUTSOURCED FROM OTHER NTPC APPROVED VENDORS	EPC	QA-SG	A
3630	xxxx-001-QVM-Q-063	QP FOR HANGERS & SUPPORTS	EPC	QA-SG	A
3631	xxxx-001-QVM-Q-064	QP FOR BUILT UP BEAMS, FABRICATED BEAMS - AUTO WELDING	EPC	QA-SG	A
3632	xxxx-001-QVM-Q-065	QP FOR TANKS & VESSELS	EPC	QA-SG	A
3633	xxxx-001-QVM-Q-066	QP FOR LIGHTLY BONDED WOOL MATTRESS	EPC	QA-SG	A
3634	xxxx-001-QVM-Q-067	QP FOR IBR PIPING -WITH VENDOR MATERIAL	EPC	QA-SG	A
3635	xxxx-001-QVM-Q-068	QP FOR NON -IBR PIPING -WITH VENDOR MATERIAL	EPC	QA-SG	A
3636	xxxx-001-QVM-Q-069	PGMA-QP CORRELATION	EPC	QA-SG	A
3637	xxxx-001-QVM-Q-070	PGMA-QP CORRELATION-WITH VENDOR MATERIAL	EPC	QA-SG	A
3638	xxxx-001-QVM-Q-071	QP FOR DEAEERATOR FOR AUXILIARY BOILER	EPC	QA-SG	A
3639	xxxx-001-QVM-Q-072	QP FOR FABRICATED TEE'S AND Y-PIECES (BOUGHT OUT ITEM)	EPC	QA-SG	A
3640	xxxx-001-QVM-Q-073	QP FOR FABRICATED TRUNNION (BOUGHT OUT ITEM)	EPC	QA-SG	A
3641	xxxx-001-QVM-Q-074	QP FOR Gr91 CLAMPS	EPC	QA-SG	A
3642	xxxx-001-QVM-Q-075	QP FOR PLATE FORMED PIPES	EPC	QA-SG	A
3643	xxxx-001-QVM-Q-076	QP FOR Gr-91/92 FITTINGS (BOUGHT OUT ITEM)	EPC	QA-SG	A
3644	xxxx-001-QVM-Q-077	VENDOR QP FOR CONDENSATE PUMP	EPC	QA-SG	A
3645	xxxx-001-QVM-Q-078	Endorsement Sheet for Alloy Steel Tubes - T11 & T12 (M/s Changzhou Chany	EPC	QA-SG	E
3646	xxxx-001-QVM-Q-079	Endorsement Sheet for Fittings (M/s Flash Forge,	EPC	QA-SG	E
3647	xxxx-001-QVM-Q-080	Endorsement Sheet for Fittings (M/s Dee	EPC	QA-SG	E
3648	xxxx-001-QVM-Q-081	Endorsement Sheet for Stainless Steel Tubes (M/s Zhejiang Jiuli, China)	EPC	QA-SG	E
3649	xxxx-001-QVM-Q-082	Endorsement Sheet for Stainless Steel Tubes (M/s Huadi, China)	EPC	QA-SG	E
3650	xxxx-001-QVM-Q-083	Endorsement Sheet for F92 Forgings & Forged	EPC	QA-SG	E
3651	xxxx-001-QVM-Q-084	Endorsement Sheet for F92 Forgings & Forged	EPC	QA-SG	E
3652	xxxx-001-QVM-Q-087	MQP of Coal Bunker Silo and Ring Beam Fabrication	EPC	QA-SG	A
3653	xxxx-001-QVM-Q-090	Erection Welding Schedule for Boiler Pressure Parts	EPC	QA-SG	A
3654	xxxx-001-QVM-Q-091	FQP FOR ESP MECHANICAL ERECTION	EPC	QA-SG	A
3655	xxxx-001-QVM-Q-092	Categorization list for boiler auxiliary items like Fans, ESP, Gates & Dampers	EPC	QA-SG	A
3656	xxxx-001-QVM-Q-093	Quality Plan - Endorsement sheet for Emitting Electrode	EPC	QA-SG	E
3657	xxxx-001-QVM-Q-094	Quality Plan -Endorsement sheet for Collecting Electrode	EPC	QA-SG	E
3658	xxxx-001-QVM-Q-095	Quality Plan - Endorsement sheet for ESP Columns of ESP supporting structu	EPC	QA-SG	E
3659	xxxx-001-QVM-Q-096	Quality Plan -Endorsement sheet for LRB wool mattress	EPC	QA-SG	E
3660	xxxx-001-QVM-Q-097	HP OUTER CASING CASTING	EPC	QA-TG-Mech	E
3661	xxxx-001-QVM-Q-098	HP OUTER CASING M/C	EPC	QA-TG-Mech	E
3662	xxxx-001-QVM-Q-099	HP OUTER CASING M/C	EPC	QA-TG-Mech	E
3663	xxxx-001-QVM-Q-100	HP INNER CASING CASTING	EPC	QA-TG-Mech	E
3664	xxxx-001-QVM-Q-101	HP INNER CASING M/C	EPC	QA-TG-Mech	E

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 48 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
3665	xxxx-001-QVM-Q-102	HP TURBINE SHAFT FORGING	EPC	QA-TG-Mech	E
3666	xxxx-001-QVM-Q-103	HP TURBINE ROTOR	EPC	QA-TG-Mech	E
3667	xxxx-001-QVM-Q-104	Turbine rotor, type HP	EPC	QA-TG-Mech	E
3668	xxxx-001-QVM-Q-105	Turbine rotor, overlay welding for type HP	EPC	QA-TG-Mech	E
3669	xxxx-001-QVM-Q-106	HP STATIONARY BLADES BAR STOCK	EPC	QA-TG-Mech	E
3670	xxxx-001-QVM-Q-107	HP STATIONARY BLADES (M/C)	EPC	QA-TG-Mech	E
3671	xxxx-001-QVM-Q-108	HP MOVING BLADES BAR	EPC	QA-TG-Mech	E
3672	xxxx-001-QVM-Q-109	HP MOVING BLADES M/C	EPC	QA-TG-Mech	E
3673	xxxx-001-QVM-Q-110	ESV & CV CASING (HP VALVES)	EPC	QA-TG-Mech	E
3674	xxxx-001-QVM-Q-111	ESV & CV CASING (HP VALVES) M/C	EPC	QA-TG-Mech	E
3675	xxxx-001-QVM-Q-112	HP VALVE ASSEMBLY	EPC	QA-TG-Mech	E
3676	xxxx-001-QVM-Q-113	HP JOINT BOLTS	EPC	QA-TG-Mech	E
3677	xxxx-001-QVM-Q-114	IP OUTER CASING CASTING	EPC	QA-TG-Mech	E
3678	xxxx-001-QVM-Q-115	IP OUTER CASING M/C	EPC	QA-TG-Mech	E
3679	xxxx-001-QVM-Q-116	IP INNER CASING CASTING	EPC	QA-TG-Mech	E
3680	xxxx-001-QVM-Q-117	IP INNER CASING M/C	EPC	QA-TG-Mech	E
3681	xxxx-001-QVM-Q-118	IP ROTOR FORGING	EPC	QA-TG-Mech	E
3682	xxxx-001-QVM-Q-119	Weld Overlay of IP Shaft	EPC	QA-TG-Mech	E
3683	xxxx-001-QVM-Q-120	IP TURBINE SHAFT M/C	EPC	QA-TG-Mech	E
3684	xxxx-001-QVM-Q-121	IP TURBINE ROTOR	EPC	QA-TG-Mech	E
3685	xxxx-001-QVM-Q-122	IP STATIONARY BLADES BAR STOCK	EPC	QA-TG-Mech	E
3686	xxxx-001-QVM-Q-123	IP STATIONARY BLADES M/C	EPC	QA-TG-Mech	E
3687	xxxx-001-QVM-Q-124	IP MOVING BLADES	EPC	QA-TG-Mech	E
3688	xxxx-001-QVM-Q-125	IP MOVING BLADES M/C	EPC	QA-TG-Mech	E
3689	xxxx-001-QVM-Q-126	IV & CV VALVE CASING (MAT)	EPC	QA-TG-Mech	E
3690	xxxx-001-QVM-Q-127	IV & CV VALVE CASING (M/C)	EPC	QA-TG-Mech	E
3691	xxxx-001-QVM-Q-128	IV & CV VALVE ASSEMBLY	EPC	QA-TG-Mech	E
3692	xxxx-001-QVM-Q-129	IP JOINT BOLTS	EPC	QA-TG-Mech	E
3693	xxxx-001-QVM-Q-130	LP TURBINE SHAFT FORGING	EPC	QA-TG-Mech	E
3694	xxxx-001-QVM-Q-131	LP TURBINE SHAFT M/C	EPC	QA-TG-Mech	E
3695	xxxx-001-QVM-Q-132	LP TURBINE ROTOR	EPC	QA-TG-Mech	E
3696	xxxx-001-QVM-Q-133	LP INNER CASING	EPC	QA-TG-Mech	E
3697	xxxx-001-QVM-Q-134	LP OUTER CASING	EPC	QA-TG-Mech	E
3698	xxxx-001-QVM-Q-135	EXPANSION JOINT IN EXTRACTION LINE	EPC	QA-TG-Mech	A
3699	xxxx-001-QVM-Q-136	LP CROSS OVER PIPE	EPC	QA-TG-Mech	E
3700	xxxx-001-QVM-Q-137	LP STATIONARY BLADES FROM BAR	EPC	QA-TG-Mech	E
3701	xxxx-001-QVM-Q-138	LP STATIONARY BLADES FROM BAR (M/C)	EPC	QA-TG-Mech	E
3702	xxxx-001-QVM-Q-139	LP CAST BLADES (CASTED)	EPC	QA-TG-Mech	E
3703	xxxx-001-QVM-Q-140	LP MOVING BLADES FROM BARS	EPC	QA-TG-Mech	E
3704	xxxx-001-QVM-Q-141	LP FORGED BLADES	EPC	QA-TG-Mech	E
3705	xxxx-001-QVM-Q-142	COUPLING BOLTS & NUTS (HP/IP/LP)	EPC	QA-TG-Mech	E
3706	xxxx-001-QVM-Q-143	BEARING SHELL & METAL OF BEARING LINING	EPC	QA-TG-Mech	E
3707	xxxx-001-QVM-Q-144	BEARING PEDESTAL WITH COVER	EPC	QA-TG-Mech	E
3708	xxxx-001-QVM-Q-145	ELECTRO HYDRAULIC ACTUATOR (STEAM VALVES)	EPC	QA-TG-Mech	A
3709	xxxx-001-QVM-Q-146	SERVOMOTOR & VALVE FOR CRH-NRV	EPC	QA-TG-Mech	A
3710	xxxx-001-QVM-Q-147	SELF CLEANING STRAINER	EPC	QA-TG-Mech	A
3711	xxxx-001-QVM-Q-148	ENDORSEMENT SHEET FOR VIS OF TURBOGENERATOR	EPC	QA-TG-Mech	E
3712	xxxx-001-QVM-Q-149	FQP LIST FOR TG AND AUX PKG	EPC	QA-TG-Mech	E
3713	xxxx-001-QVM-Q-150	HP TURBINE ASSLY	EPC	QA-TG-Mech	E
3714	xxxx-001-QVM-Q-151	IP TURBINE ASSLY	EPC	QA-TG-Mech	E
3715	xxxx-001-QVM-Q-152	LP STATIONARY BLADES	EPC	QA-TG-Mech	E
3716	xxxx-001-QVM-Q-153	HP VALVE SPINDLE/ VALVE CONE WITH SPINDLE	EPC	QA-TG-Mech	E
3717	xxxx-001-QVM-Q-154	VALVE CASING, MAIN STEAM, MANUFACTURING (OVERLOAD VALVE)	EPC	QA-TG-Mech	E
3718	xxxx-001-QVM-Q-155	FITTINGS (NON RETURN VALVE CASING/ WELDED)	EPC	QA-TG-Mech	A
3719	xxxx-001-QVM-Q-156	FITTINGS (REHEATER VALVE)	EPC	QA-TG-Mech	A
3720	xxxx-001-QVM-Q-157	Valve Type-HP (ESV & CV)	EPC	QA-TG-Mech	E
3721	xxxx-001-QVM-Q-158	Valve Type-I (IVCV)	EPC	QA-TG-Mech	E
3722	xxxx-001-QVM-Q-159	LP hollow stationary blades	EPC	QA-TG-Mech	E
3723	xxxx-001-QVM-Q-160	*Rotor blades LP (forged) edge hardening	EPC	QA-TG-Mech	E
3724	xxxx-001-QVM-Q-161	Fittings	EPC	QA-TG-Mech	A
3725	xxxx-001-QVM-Q-162	MANUFACTURING QUALITY PLAN FOR Casing Upper Part, Casing Side Wall (L&R), Front Wall (TS&GS)	EPC	QA-TG-Mech	E
3726	xxxx-001-QVM-Q-163	ANGLE VALVES	EPC	QA-TG-Mech	A
3727	xxxx-001-QVM-Q-164	MQP FOR HYDRAULIC POWER SUPPLY UNIT	EPC	QA-TG-Mech	A
3728	xxxx-001-QVM-Q-165	MQP FOR HP Spray Water Control Valves	EPC	QA-TG-Mech	A
3729	xxxx-001-QVM-Q-166	MQP FOR HP Spray Water Isolation Valves	EPC	QA-TG-Mech	A
3730	xxxx-001-QVM-Q-167	MQP FOR HP Steam Control Valves	EPC	QA-TG-Mech	A
3731	xxxx-001-QVM-Q-168	Condenser Spring	EPC	QA-TG-Mech	A
3732	xxxx-001-QVM-Q-169	Vacuum Pump	EPC	QA-TG-Mech	A
3733	xxxx-001-QVM-Q-170	Oil Purification System	EPC	QA-TG-Mech	A
3734	xxxx-001-QVM-Q-171	Oil Vapour Exhauster	EPC	QA-TG-Mech	A
3735	xxxx-001-QVM-Q-172	Turning Gear	EPC	QA-TG-Mech	A
3736	xxxx-001-QVM-Q-173	Boiler feed pump	EPC	QA-TG-Mech	A
3737	xxxx-001-QVM-Q-174	Boiler feed booster pump	EPC	QA-TG-Mech	A
3738	xxxx-001-QVM-Q-175	Hydraulic coupling (Voith)	EPC	QA-TG-Mech	A
3739	xxxx-001-QVM-Q-176	Connecting Coupling FOR Motor with Pumps	EPC	QA-TG-Mech	A
3740	xxxx-001-QVM-Q-177	BFP Suction Strainer (Conical)	EPC	QA-TG-Mech	A
3741	xxxx-001-QVM-Q-178	Centrifugal emergency lube oil pump	EPC	QA-TG-Mech	A
3742	xxxx-001-QVM-Q-179	Screw pump L.O Pump	EPC	QA-TG-Mech	A
3743	xxxx-001-QVM-Q-180	CS Gate,globe & check valves unto # 800 & size 1½"to 8"	EPC	QA-TG-Mech	A
3744	xxxx-001-QVM-Q-181	Jacking Oil Pump	EPC	QA-TG-Mech	A
3745	xxxx-001-QVM-Q-182	Lub oil system	EPC	QA-TG-Mech	A
3746	xxxx-001-QVM-Q-183	Twin oil cooler	EPC	QA-TG-Mech	A
3747	xxxx-001-QVM-Q-184	HP Heater	EPC	QA-TG-Mech	A
3748	xxxx-001-QVM-Q-185	Dearator Header & storage tank	EPC	QA-TG-Mech	A
3749	xxxx-001-QVM-Q-186	LP Heater	EPC	QA-TG-Mech	A
3750	xxxx-001-QVM-Q-187	Drain cooler	EPC	QA-TG-Mech	A
3751	xxxx-001-QVM-Q-188	CS gate, Globe & check valve 800-2500 CL 1½ to 10?	EPC	QA-TG-Mech	A
3752	xxxx-001-QVM-Q-189	CS gate, Globe & Check valve upto 800 CL (1½ to 10½)-SH1	EPC	QA-TG-Mech	A
3753	xxxx-001-QVM-Q-190	CCS Globe valve upto 300 NB and 150 Class	EPC	QA-TG-Mech	A
3754	xxxx-001-QVM-Q-191	Safety relief valve	EPC	QA-TG-Mech	A
3755	xxxx-001-QVM-Q-192	Foundation frame for BFP,BP,Hyd.cplng,gear box, motor including grillages & stools	EPC	QA-TG-Mech	A
3756	xxxx-001-QVM-Q-193	BFP drive turbine	EPC	QA-TG-Mech	E
3757	xxxx-001-QVM-Q-194	BFP drive turbine-MECH RUN TEST PROCEDURE	EPC	QA-TG-Mech	E
3758	xxxx-001-QVM-Q-195	LP INNER CASING-1&2 ASSLY	EPC	QA-TG-Mech	E

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 49 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
3759	xxxx-001-QVM-Q-196	LP ASSEMBLY	EPC	QA-TG-Mech	E
3760	xxxx-001-QVM-Q-197	CONDENSER TUBES	EPC	QA-TG-Mech	A
3761	xxxx-001-QVM-Q-198	LP HEATER TUBES	EPC	QA-TG-Mech	A
3762	xxxx-001-QVM-Q-199	GSC TUBES	EPC	QA-TG-Mech	A
3763	xxxx-001-QVM-Q-200	CONDENSER SUB- ASSLY	EPC	QA-TG-Mech	E
3764	xxxx-001-QVM-Q-201	CONDENSER TUBE PLATES	EPC	QA-TG-Mech	E
3765	xxxx-001-QVM-Q-202	GLAND STEAM CONDENSER	EPC	QA-TG-Mech	A
3766	xxxx-001-QVM-Q-203	TURBINE OIL COOLER	EPC	QA-TG-Mech	A
3767	xxxx-001-QVM-Q-204	TURBINE INTEGRAL PIPING	EPC	QA-TG-Mech	A
3768	xxxx-001-QVM-Q-205	OIL PURIFICATION SYSTEM	EPC	QA-TG-Mech	A
3769	xxxx-001-QVM-Q-206	OIL COOLER	EPC	QA-TG-Mech	A
3770	xxxx-001-QVM-Q-207	3 WAY TEMPERATURE CONTROL	EPC	QA-TG-Mech	A
3771	xxxx-001-QVM-Q-208	ANGLE DRAIN VALVE	EPC	QA-TG-Mech	A
3772	xxxx-001-QVM-Q-209	LP BYPASS SYSTEM	EPC	QA-TG-Mech	A
3773	xxxx-001-QVM-Q-210	FWS-CONDENSER	EPC	QA-TG-Mech	E
3774	xxxx-001-QVM-Q-211	Spring Loaded Bypass Valves	EPC	QA-TG-Mech	A
3775	xxxx-001-QVM-Q-212	Power Cycle Valves	EPC	QA-TG-Mech	A
3776	xxxx-001-QVM-Q-213	MQP for Strainer	EPC	QA-TG-Mech	A
3777	xxxx-001-QVM-Q-214	METALLIC BELLOWS	EPC	QA-TG-Mech	A
3778	xxxx-001-QVM-Q-215	THERMAL INSULATION PACKAGE	EPC	QA-TG-Mech	A
3779	xxxx-001-QVM-Q-216	BUTTER FLY VALVES CI/CCS/CSS CONST.(STEAM SERVICE)	EPC	QA-TG-Mech	A
3780	xxxx-001-QVM-Q-217	BUTTER FLY VALVES CI/CCS/CSS CONST.(WATER SERVICE)	EPC	QA-TG-Mech	A
3781	xxxx-001-QVM-Q-218	COMPENSATORS	EPC	QA-TG-Mech	A
3782	xxxx-001-QVM-Q-219	Seal Steam & Leak Steam Valve	EPC	QA-TG-Mech	A
3783	xxxx-001-QVM-Q-220	TANKS & VESSELS	EPC	QA-TG-Mech	A
3784	xxxx-001-QVM-G-021	FQP-STEAM TURBINE & AUX. (Storage & Preservation)	EPC	QA-TG-Mech	E
3785	xxxx-001-QVM-G-022	FQP-STEAM TURBINE & AUX.-ERECTION	EPC	QA-TG-Mech	E
3786	xxxx-001-QVM-G-023	FQP-CONDENSER	EPC	QA-TG-Mech	E
3787	xxxx-001-QVM-G-024	FQP-BOILER FEED PUMP	EPC	QA-TG-Mech	E
3788	xxxx-001-QVM-G-025	FQP-THERMAL INSULATION FOR FQP-STEAM TURBINE	EPC	QA-TG-Mech	E
3789	xxxx-001-QVM-G-026	FQP FOR BFP(MD&TD)	EPC	QA-TG-Mech	E
3790	xxxx-001-QVM-Q-220	MQP Axial fan	AC SYSTEM	QA-MECH/BOP-WS	E
3791	xxxx-001-QVM-Q-221	MQP Balancing Valves	AC SYSTEM	QA-MECH/BOP-WS	A
3792	xxxx-001-QVM-Q-222	MQP Butterfly Valves	AC SYSTEM	QA-MECH/BOP-WS	A
3793	xxxx-001-QVM-Q-223	MQP Centrifugal fan	AC SYSTEM	QA-MECH/BOP-WS	E
3794	xxxx-001-QVM-Q-224	MQP Conventional Gate/Globe Valve/ Check Valve (Size >600 NB or Rating Pr Class > 300	AC SYSTEM	QA-MECH/BOP-WS	E
3795	xxxx-001-QVM-Q-225	MQP Horizontal Centrifugal Pumps	AC SYSTEM	QA-MECH/BOP-WS	E
3796	xxxx-001-QVM-Q-226	MQP MS ERW Pipe (Black/GI)	AC SYSTEM	QA-MECH/BOP-WS	E
3797	xxxx-001-QVM-Q-227	MQP Pipe-CS/SS seamless	AC SYSTEM	QA-MECH/BOP-WS	A
3798	xxxx-001-QVM-Q-228	MQP Screw Chiller	AC SYSTEM	QA-MECH/BOP-WS	A
3799	xxxx-001-QVM-Q-229	MQP VRF	AC SYSTEM	QA-MECH/BOP-WS	A
3800	xxxx-001-QVM-G-027	FQP - RECEIPT & STORAGE	AC SYSTEM	QA-MECH/BOP-WS	E
3801	xxxx-001-QVM-G-028	FQP - ERECTION	AC SYSTEM	QA-MECH/BOP-WS	E
3802	xxxx-001-QVM-Q-230	MQP Axial/RE fan	ENTILATION SYSTE	QA-MECH/BOP-WS	E
3803	xxxx-001-QVM-Q-231	MQP Butterfly Valves	ENTILATION SYSTE	QA-MECH/BOP-WS	A
3804	xxxx-001-QVM-Q-232	MQP Centrifugal fan	ENTILATION SYSTE	QA-MECH/BOP-WS	E
3805	xxxx-001-QVM-Q-233	MQP Conventional Gate/Globe Valve/ Check Valve (Size >600 NB or Rating	ENTILATION SYSTE	QA-MECH/BOP-WS	E
3806	xxxx-001-QVM-Q-234	MQP Horizontal Centrifugal Pumps	ENTILATION SYSTE	QA-MECH/BOP-WS	E
3807	xxxx-001-QVM-Q-235	MQP MS ERW Pipe (Black/GI)	ENTILATION SYSTE	QA-MECH/BOP-WS	E
3808	xxxx-001-QVM-G-029	FQP - RECEIPT & STORAGE	ENTILATION SYSTE	QA-MECH/BOP-WS	E
3809	xxxx-001-QVM-G-030	FQP - ERECTION	ENTILATION SYSTE	QA-MECH/BOP-WS	E
3810	xxxx-001-QVM-Q-236	MQP Air Dryer	ompressed Air Syste	QA-MECH/BOP-WS	A
3811	xxxx-001-QVM-Q-237	MQP Air receiver(≥10 bar pressure)	ompressed Air Syste	QA-MECH/BOP-WS	A
3812	xxxx-001-QVM-Q-238	MQP Ball valve/Plug valve	ompressed Air Syste	QA-MECH/BOP-WS	E
3813	xxxx-001-QVM-Q-239	MQP Conventional Gate/Globe Valve/ Check Valve (Size >600 NB or Rating	ompressed Air Syste	QA-MECH/BOP-WS	E
3814	xxxx-001-QVM-Q-240	MQP MS ERW Pipe (Black/GI)	ompressed Air Syste	QA-MECH/BOP-WS	E
3815	xxxx-001-QVM-Q-241	MQP Pipe-CS/SS seamless	ompressed Air Syste	QA-MECH/BOP-WS	A
3816	xxxx-001-QVM-Q-242	MQP Electric Hoist/EOT Crane/Chain pulley block (> 10 Ton)	ompressed Air Syste	QA-MECH/BOP-WS	A
3817	xxxx-001-QVM-Q-243	MQP Air Compressor	ompressed Air Syste	QA-MECH/BOP-WS	A
3818	xxxx-001-QVM-Q-244	MQP PIPE-CS/SS seamless	ompressed Air Syste	QA-MECH/BOP-WS	A
3819	xxxx-001-QVM-G-031	FQP - RECEIPT, STORAGE AND ERECTION	ompressed Air Syste	QA-MECH/BOP-WS	A
3820	xxxx-001-QVM-Q-245	MQP Butterfly Valves	essure Piping/Statio	QA-MECH/BOP-WS	A
3821	xxxx-001-QVM-Q-246	MQP Conventional Gate/Globe Valve/ Check Valve (Size >600 NB or Rating	essure Piping/Statio	QA-MECH/BOP-WS	E
3822	xxxx-001-QVM-Q-247	MQP MS ERW Pipe (Black/GI)	essure Piping/Statio	QA-MECH/BOP-WS	E
3823	xxxx-001-QVM-Q-248	MQP Pipe-CS/SS seamless	essure Piping/Statio	QA-MECH/BOP-WS	A
3824	xxxx-001-QVM-Q-249	MQP Dual Plate check valve	essure Piping/Statio	QA-MECH/BOP-WS	A
3825	xxxx-001-QVM-Q-250	MQP Submersible/Sump Pump	essure Piping/Statio	QA-MECH/BOP-WS	A
3826	xxxx-001-QVM-Q-251	MQP Wrapping & coating materials	essure Piping/Statio	QA-MECH/BOP-WS	A
3827	xxxx-001-QVM-Q-252	MQP Pipes & Fittings-CI and DI	essure Piping/Statio	QA-MECH/BOP-WS	A
3828	xxxx-001-QVM-G-032	FQP - RECEIPT AND STORAGE	essure Piping/Statio	QA-MECH/BOP-WS	E
3829	xxxx-001-QVM-G-033	FQP - ERECTION	essure Piping/Statio	QA-MECH/BOP-WS	E
3830	xxxx-001-QVM-Q-253	MQP Ball valve/Plug valve	Handling & Storage	QA-MECH/BOP-WS	E
3831	xxxx-001-QVM-Q-254	MQP Conventional Gate/Globe Valve/ Check Valve (Size >600 NB or Rating Pr Class > 300)	Handling & Storage	QA-MECH/BOP-WS	E
3832	xxxx-001-QVM-Q-255	MQP Butterfly Valves	Handling & Storage	QA-MECH/BOP-WS	A
3833	xxxx-001-QVM-Q-256	MQP Drain Oil Tank/ Misc Shop fabricated Tank	Handling & Storage	QA-MECH/BOP-WS	A
3834	xxxx-001-QVM-Q-257	MQP MS Pipe(Black/GI)	Handling & Storage	QA-MECH/BOP-WS	E
3835	xxxx-001-QVM-Q-258	MQP PIPE-CS/SS seamless	Handling & Storage	QA-MECH/BOP-WS	A
3836	xxxx-001-QVM-Q-259	MQP Pipe-SS ERW ASTM A 312	Handling & Storage	QA-MECH/BOP-WS	A
3837	xxxx-001-QVM-Q-260	MQP Pipes & Fittings-CI	Handling & Storage	QA-MECH/BOP-WS	A
3838	xxxx-001-QVM-Q-261	MQP Screw Pump (Single & twin)	Handling & Storage	QA-MECH/BOP-WS	A
3839	xxxx-001-QVM-Q-262	MQP Submersible/Sump Pump	Handling & Storage	QA-MECH/BOP-WS	A
3840	xxxx-001-QVM-Q-263	MQP Wrapping & coating materials	Handling & Storage	QA-MECH/BOP-WS	A
3841	xxxx-001-QVM-Q-264	MQP Electric Hoist/EOT Crane/Chain pulley block (> 10 Ton)	Handling & Storage	QA-MECH/BOP-WS	A
3842	xxxx-001-QVM-G-034	FQP - RECEIPT AND STORAGE	Handling & Storage	QA-MECH/BOP-WS	A
3843	xxxx-001-QVM-G-035	FQP - ERECTION	Handling & Storage	QA-MECH/BOP-WS	A
3844	xxxx-001-QVM-Q-265	MQP Butterfly Valves	up water Piping sy	QA-MECH/BOP-WS	A
3845	xxxx-001-QVM-Q-266	MQP Conventional Gate/Globe Valve/ Check Valve >600 NB or Rating	up water Piping sy	QA-MECH/BOP-WS	E
3846	xxxx-001-QVM-Q-267	MQP MS ERW Pipe (Black/GI)	up water Piping sy	QA-MECH/BOP-WS	E
3847	xxxx-001-QVM-Q-268	MQP Pipe-CS/SS seamless	up water Piping sy	QA-MECH/BOP-WS	A
3848	xxxx-001-QVM-Q-269	MQP ERW Pipes (API 5L)	up water Piping sy	QA-MECH/BOP-WS	A
3849	xxxx-001-QVM-Q-270	MQP GRP Pipes & Fittings	up water Piping sy	QA-MECH/BOP-WS	A
3850	xxxx-001-QVM-Q-271	MQP Joint /fitting coating material for 3 LPE pipes	up water Piping sy	QA-MECH/BOP-WS	A
3851	xxxx-001-QVM-Q-272	MQP Pipe-3 LPE coated pipes	up water Piping sy	QA-MECH/BOP-WS	A
3852	xxxx-001-QVM-Q-273	MQP Metallic Expansion Joint	up water Piping sy	QA-MECH/BOP-WS	A

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 50 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
3853	xxxx-001-QVM-Q-274	MQP Rubber Expansion Joint	Water Piping sy	QA-MECH/BOP-WS	A
3854	xxxx-001-QVM-Q-275	MQP Pipes & Fittings-CI and DI	Water Piping sy	QA-MECH/BOP-WS	A
3855	xxxx-001-QVM-Q-276	MQP Submersible/Sump Pump	Water Piping sy	QA-MECH/BOP-WS	A
3856	xxxx-001-QVM-Q-277	MQP Vertical/Horizontal Centrifugal Pumps	Water Piping sy	QA-MECH/BOP-WS	A
3857	xxxx-001-QVM-Q-278	MQP Wrapping & coating materials	Water Piping sy	QA-MECH/BOP-WS	A
3858	xxxx-001-QVM-Q-036	FQP - RECEIPT AND STORAGE	Water Piping sy	QA-MECH/BOP-WS	A
3859	xxxx-001-QVM-G-037	FQP - ERECTION	Water Piping sy	QA-MECH/BOP-WS	A
3860	xxxx-001-QVM-Q-279	MQP Plate Heat Exchanger	nt Cooling Water sy	QA-MECH/BOP-WS	A
3861	xxxx-001-QVM-Q-280	MQP ACW/DMCW Pumps	nt Cooling Water sy	QA-MECH/BOP-WS	A
3862	xxxx-001-QVM-Q-281	MQP Butterfly Valves	nt Cooling Water sy	QA-MECH/BOP-WS	A
3863	xxxx-001-QVM-Q-282	MQP Conventional Gate/Globe Valve/ Check Valve (Size >600 NB or Rating)	nt Cooling Water sy	QA-MECH/BOP-WS	E
3864	xxxx-001-QVM-Q-283	MQP MS ERW Pipe (Black/GI)	nt Cooling Water sy	QA-MECH/BOP-WS	E
3865	xxxx-001-QVM-Q-284	MQP Metallic Expansion Joint	nt Cooling Water sy	QA-MECH/BOP-WS	A
3866	xxxx-001-QVM-Q-285	MQP Rubber Expansion Joint	nt Cooling Water sy	QA-MECH/BOP-WS	A
3867	xxxx-001-QVM-Q-038	FQP - RECEIPT, STORAGE AND ERECTION	nt Cooling Water sy	QA-MECH/BOP-WS	A
3868	xxxx-001-QVM-Q-286	MQP FOR AIR BLOWERS -LOBE TYPE	TG-CPU	QA-BOP	A
3869	xxxx-001-QVM-Q-287	MQP FOR CPU SERVICE VESSEL	TG-CPU	QA-BOP	A
3870	xxxx-001-QVM-Q-288	MQP FOR PUMP -SUBMERSIBLE / SUMP	TG-CPU	QA-BOP	A
3871	xxxx-001-QVM-Q-289	MQP FOR VALVE- DIAPHRAGM TYPE	TG-CPU	QA-BOP	A
3872	xxxx-001-QVM-Q-290	MQP FOR VALVE-PLUG	TG-CPU	QA-BOP	A
3873	xxxx-001-QVM-Q-291	MQP FOR VALVE-BUTTERFLY	TG-CPU	QA-BOP	A
3874	xxxx-001-QVM-Q-292	MQP FOR VALVE-BALL	TG-CPU	QA-BOP	A
3875	xxxx-001-QVM-Q-293	VALVE-DUAL PLATE CHECK	TG-CPU	QA-BOP	A
3876	xxxx-001-QVM-Q-294	MQP FOR PIPE-MS (BLACK/GI)	TG-CPU	QA-BOP	A
3877	xxxx-001-QVM-Q-295	MQP FOR PIPE-SS ASTM A 312	TG-CPU	QA-BOP	A
3878	xxxx-001-QVM-Q-296	MQP FOR PIPE- CS SEAMLESS PIPE	TG-CPU	QA-BOP	A
3879	xxxx-001-QVM-Q-297	MQP FOR PIPING FABRICATION -HP>300PSI	TG-CPU	QA-BOP	A
3880	xxxx-001-QVM-Q-298	MQP FOR PUMPS- HORIZONTAL & VERTICAL CENTRIFUGAL	TG-CPU	QA-BOP	A
3881	xxxx-001-QVM-Q-299	MQP FOR PUMP-METERING/DOSING	TG-CPU	QA-BOP	A
3882	xxxx-001-QVM-Q-300	MQP FOR PUMP - PP- ACID/ ALKALI UNLOADING	TG-CPU	QA-BOP	A
3883	xxxx-001-QVM-Q-301	MQP FOR RUBBER LINING OF TANKS/ VESSELS/ PIPES/ VALVES/FITTING	TG-CPU	QA-BOP	A
3884	xxxx-001-QVM-G-039	FQP FOR ERECTION -CPU	TG-CPU	QA-BOP	A
3885	xxxx-001-QVM-Q-302	MQP FOR CW PUMP	SYSTEM EQUIPM	QA-BOP	A
3886	xxxx-001-QVM-Q-303	MQP FOR EOT CRANE /GANTRY CRANE	SYSTEM EQUIPM	QA-BOP	A
3887	xxxx-001-QVM-Q-304	MQP FOR ELECTRO HYDRAULIC ACTUATOR FOR CW PUMP DISCHARGE	SYSTEM EQUIPM	QA-BOP	A
3888	xxxx-001-QVM-Q-305	MQP PUMP -SUBMERSIBLE / SUMP	SYSTEM EQUIPM	QA-BOP	A
3889	xxxx-001-QVM-Q-306	MQP FOR PUMPS- HORIZONTAL & VERTICAL CENTRIFUGAL	SYSTEM EQUIPM	QA-BOP	A
3890	xxxx-001-QVM-Q-307	MQP FOR PUMPS -VT	SYSTEM EQUIPM	QA-BOP	A
3891	xxxx-001-QVM-Q-308	MQP FOR RUBBER EXPANSION JOINT	SYSTEM EQUIPM	QA-BOP	A
3892	xxxx-001-QVM-Q-309	MQP FOR VALVE- BUTTERFLY VALVES	SYSTEM EQUIPM	QA-BOP	A
3893	xxxx-001-QVM-Q-310	MQP FOR PIPE-MS (BLACK/GI)(IS 1239 / IS 3589)	SYSTEM EQUIPM	QA-BOP	A
3894	xxxx-001-QVM-Q-311	MQP FOR ROLLED AND WELDED PIPE	SYSTEM EQUIPM	QA-BOP	A
3895	xxxx-001-QVM-Q-312	MQP FOR THRUST BEARING	SYSTEM EQUIPM	QA-BOP	A
3896	xxxx-001-QVM-Q-313	MQP FOR VALVE- DUAL PLATE CHECK	SYSTEM EQUIPM	QA-BOP	A
3897	xxxx-001-QVM-Q-314	MQP FOR WRAPPING & COATING MATERIAL (ANTI CORROSIVE TAPE)	SYSTEM EQUIPM	QA-BOP	A
3898	xxxx-001-QVM-G-040	FQP FOR ERECTION -CW SYSTEM EQUIPMENTS	SYSTEM EQUIPM	QA-BOP	A
3899	xxxx-001-QVM-Q-315	MQP for AIR BLOWERS -LOBE TYPE > = 5KW	WTP	QA-BOP	E
3900	xxxx-001-QVM-Q-316	MQP for AIR BLOWERS -CENTRIFUGAL > = 5KW	WTP	QA-BOP	E
3901	xxxx-001-QVM-Q-317	MQP for ELECTRIC HOIST /EOT CRANE /CHAIN PULLEY BLOCK > 10T	WTP	QA-BOP	E
3902	xxxx-001-QVM-Q-318	MQP for FAN-AXIAL TYPE > = 5KW	WTP	QA-BOP	E
3903	xxxx-001-QVM-Q-319	MQP for PIPE-MS (BLACK/GI)(IS 1239 / IS 3589)(> 1000 NB)	WTP	QA-BOP	E
3904	xxxx-001-QVM-Q-320	MQP for PIPES & FITTINGS-GRP	WTP	QA-BOP	A
3905	xxxx-001-QVM-Q-321	MQP for PR VESSELS >= 10 BAR	WTP	QA-BOP	A
3906	xxxx-001-QVM-Q-322	MQP for PUMP -SUBMERSIBLE / SUMP >=30KW	WTP	QA-BOP	E
3907	xxxx-001-QVM-Q-323	MQP for VALVE- DIAPHRAGM TYPE	WTP	QA-BOP	A
3908	xxxx-001-QVM-Q-324	MQP for VALVE- BUTTERFLY > 600MM OR CLASS>150	WTP	QA-BOP	A
3909	xxxx-001-QVM-Q-325	MQP forAIR BLOWERS -LOBE TYPE < 5KW	WTP	QA-BOP	E
3910	xxxx-001-QVM-Q-326	MQP for IR BLOWERS -CENTRIFUGAL < 5KW	WTP	QA-BOP	E
3911	xxxx-001-QVM-Q-327	MQP for CHLORINE TONNER	WTP	QA-BOP	A
3912	xxxx-001-QVM-Q-328	MQP for CHLORINATOR WITH ACCESSORIES	WTP	QA-BOP	A
3913	xxxx-001-QVM-Q-329	MQP for CHLORINE EVAPORATOR WITH ACCESSORIES	WTP	QA-BOP	A
3914	xxxx-001-QVM-Q-330	MQP for CHLORINE GAS FILTER	WTP	QA-BOP	A
3915	xxxx-001-QVM-Q-331	MQP for FAN-AXIAL TYPE < 5KW	WTP	QA-BOP	E
3916	xxxx-001-QVM-Q-332	MQP forGATE- SLUICE /ISOLATION GATE	WTP	QA-BOP	E
3917	xxxx-001-QVM-Q-333	MQP for PIPE-MS (BLACK/GI)(IS 1239 / IS 3589)(UP TO 1000 NB)	WTP	QA-BOP	E
3918	xxxx-001-QVM-Q-334	MQP for PIPE-SS ASTM A 312	WTP	QA-BOP	E
3919	xxxx-001-QVM-Q-335	MQP for PIPE-CS SEAMLESS PIPE	WTP	QA-BOP	E
3920	xxxx-001-QVM-Q-336	MQP for PIPES & FITTINGS-CI	WTP	QA-BOP	A
3921	xxxx-001-QVM-Q-337	MQP for PIPING FABRICATION -HP>300PSI	WTP	QA-BOP	A
3922	xxxx-001-QVM-Q-338	MQP for PUMPS- HORIZONTAL & VERTICAL CENTRIFUGAL	WTP	QA-BOP	E
3923	xxxx-001-QVM-Q-339	MQP for PUMPS -VT	WTP	QA-BOP	E
3924	xxxx-001-QVM-Q-340	MQP for PUMP -SUBMERSIBLE / SUMP < 30KW	WTP	QA-BOP	E
3925	xxxx-001-QVM-Q-341	MQP for PUMP-METERING/DOSING	WTP	QA-BOP	E
3926	xxxx-001-QVM-Q-342	MQP for PUMP - PP- ACID/ ALKALI UNLOADING	WTP	QA-BOP	A
3927	xxxx-001-QVM-Q-343	MQP for PUMPS-SCREW TYPE	WTP	QA-BOP	A
3928	xxxx-001-QVM-Q-344	MQP for RUBBER LINING OF TANKS/ VESSELS/ PIPES/ VALVES/FITTING	WTP	QA-BOP	E
3929	xxxx-001-QVM-Q-345	MQP for RO PRESSURE TUBE	WTP	QA-BOP	A
3930	xxxx-001-QVM-Q-346	MQP for TUBE SETTLER MEDIA	WTP	QA-BOP	A
3931	xxxx-001-QVM-Q-347	MQP for VALVE- PLUG UP TO 100 MM & CLASS 800	WTP	QA-BOP	A
3932	xxxx-001-QVM-Q-348	MQP for VALVE- BUTTERFLY UP TO 600MM & CLASS 150	WTP	QA-BOP	A
3933	xxxx-001-QVM-Q-349	MQP for VALVE- BALL UP TO 100 MM & CLASS 800	WTP	QA-BOP	E
3934	xxxx-001-QVM-Q-350	MQP for VALVE- DUAL PLATE CHECK UP TO 600MM & CLASS 300	WTP	QA-BOP	E
3935	xxxx-001-QVM-G-041	FQP for WTP(MECHANICAL)	WTP	QA-BOP	A
3936	xxxx-001-QVM-Q-351	MQP for DRIFT ELIMINATOR-PVC	NDCT	QA-BOP	E
3937	xxxx-001-QVM-Q-352	MQP for FAN-AXIAL TYPE < 5KW	NDCT	QA-BOP	E
3938	xxxx-001-QVM-Q-353	MQP for FAN- AXIAL TYPE > = 5KW	NDCT	QA-BOP	E
3939	xxxx-001-QVM-Q-354	MQP for FILLS	NDCT	QA-BOP	E
3940	xxxx-001-QVM-Q-355	MQP for PIPES-MS- (BLACK/ GI) AS PER IS:1239 & IS:3589 UPTO 1000 NB	NDCT	QA-BOP	E
3941	xxxx-001-QVM-Q-356	MQP for PIPES-MS- (BLACK/ GI) AS PER IS IS:3589 >1000NB	NDCT	QA-BOP	E
3942	xxxx-001-QVM-Q-357	MQP for PIPES & FITTINGS-GRP	NDCT	QA-BOP	A
3943	xxxx-001-QVM-Q-358	MQP for PIPES & FITTINGS-CI	NDCT	QA-BOP	A
3944	xxxx-001-QVM-Q-359	MQP for PUMP -SUBMERSIBLE / SUMP< 30KW	NDCT	QA-BOP	E
3945	xxxx-001-QVM-Q-360	MQP for PUMP -SUBMERSIBLE>= 30KW	NDCT	QA-BOP	E
3946	xxxx-001-QVM-Q-361	MQP for ROLLED AND WELDED PIPE	NDCT	QA-BOP	E
3947	xxxx-001-QVM-Q-362	MQP for RUBBER EXPANSION JOINT < 1600NB	NDCT	QA-BOP	E
3948	xxxx-001-QVM-Q-363	MQP for RUBBER EXPANSION JOINT>=1600NB	NDCT	QA-BOP	E

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 51 OF 66

Si No	NTPC Drg No	DRG_TITLE	SUB-SYSTEM	Dept	CATEGORY
3949	xxxx-001-QVM-Q-364	MQP for VALVE-BUTTERFLY UP TO 600MM & CLASS 150	NDCT	QA-BOP	A
3950	xxxx-001-QVM-Q-365	MQP for VALVE-BUTTERFLY > 600MM OR CLASS>150	NDCT	QA-BOP	A
3951	xxxx-001-QVM-Q-366	MQP for WRAPPING & COATING MATERIAL -ANTI CORROSIVE TAPE	NDCT	QA-BOP	E
3952	xxxx-001-QVM-G-042	FQP for IDCT (MECHANICAL)	IDCT	QA-BOP	A
3953	xxxx-001-QVM-Q-367	MQP for HORIZONTAL / VERTICAL CENTRIFUGAL PUMPS(MOTOR RATIO)	FDPs	QA-BOP	E
3954	xxxx-001-QVM-Q-368	MQP for DIESEL ENGINE	FDPs	QA-BOP	A
3955	xxxx-001-QVM-Q-369	MQP for HYDRANT VALVE	FDPs	QA-BOP	A
3956	xxxx-001-QVM-Q-370	MQP for CI / CS/SS BUTTERFLY VALVE (MANUAL/ PNEU/ ELECT)UP TO 600NB	FDPs	QA-BOP	A
3957	xxxx-001-QVM-Q-371	MQP for GATE / GLOBE / CHECK VALVES(UPTO 600 NB & UP TO CLASS 150)	FDPs	QA-BOP	E
3958	xxxx-001-QVM-Q-372	MQP for SEAMLESS PIPE (FOR INERT GAS SYSTEM)	FDPs	QA-BOP	E
3959	xxxx-001-QVM-Q-373	MQP for MS PIPE (IS:1239 / IS:3589 UPTO 150 NB/ 900 NB)	FDPs	QA-BOP	E
3960	xxxx-001-QVM-Q-374	MQP for FIRE HOSE	FDPs	QA-BOP	E
3961	xxxx-001-QVM-Q-375	MQP for WATER MONITOR	FDPs	QA-BOP	A
3962	xxxx-001-QVM-Q-376	MQP for BRANCH PIPE , COUPLING & NOZZLE (SS & GM)	FDPs	QA-BOP	E
3963	xxxx-001-QVM-Q-377	MQP for DELUGE VALVE WITH TRIMS	FDPs	QA-BOP	A
3964	xxxx-001-QVM-Q-378	MQP for HV/ MV SPRAY NOZZLE	FDPs	QA-BOP	E
3965	xxxx-001-QVM-Q-379	MQP for INERT GAS EXTINGUISHING SYSTEM	FDPs	QA-BOP	A
3966	xxxx-001-QVM-Q-380	MQP for FIRE EXTINGUISHER	FDPs	QA-BOP	A
3967	xxxx-001-QVM-Q-381	MQP for SS ERW/SEAMLESS PIPES	FDPs	QA-BOP	E
3968	xxxx-001-QVM-Q-382	MQP for ALARM VALVE WITH TRIMS	FDPs	QA-BOP	A
3969	xxxx-001-QVM-G-043	FQP for FDPs (MECHANICAL)	FDPs	QA-BOP	A
3970	xxxx-001-QVM-Q-383	QAP for Steel Cord Conveyor Belt	CHP/LHP/GHP	QA-BOP	E
3971	xxxx-001-QVM-Q-384	QAP for Textile Conveyor Belt	CHP/LHP/GHP	QA-BOP	E
3972	xxxx-001-QVM-Q-385	QAP for Belt Weigher	CHP/LHP/GHP	QA-BOP	E
3973	xxxx-001-QVM-Q-386	QAP for Belt Cleaner	CHP/LHP/GHP	QA-BOP	E
3974	xxxx-001-QVM-Q-387	QAP for Skirt Sealing System	CHP/LHP/GHP	QA-BOP	E
3975	xxxx-001-QVM-Q-388	QAP for Traction type Fluid Coupling	CHP/LHP/GHP	QA-BOP	E
3976	xxxx-001-QVM-Q-389	QAP for Scoop type Fluid Coupling	CHP/LHP/GHP	QA-BOP	E
3977	xxxx-001-QVM-Q-390	QAP for Gearbox	CHP/LHP/GHP	QA-BOP	E
3978	xxxx-001-QVM-Q-391	QAP for Electric Hoist	CHP/LHP/GHP	QA-BOP	E
3979	xxxx-001-QVM-Q-392	QAP for Manual Hoist	CHP/LHP/GHP	QA-BOP	E
3980	xxxx-001-QVM-Q-393	QAP for Motorized Trolley	CHP/LHP/GHP	QA-BOP	E
3981	xxxx-001-QVM-Q-394	QAP for Suspended Magnet	CHP/LHP/GHP	QA-BOP	E
3982	xxxx-001-QVM-Q-395	QAP for ILMs	CHP/LHP/GHP	QA-BOP	E
3983	xxxx-001-QVM-Q-396	QAP for Metal Detector	CHP/LHP/GHP	QA-BOP	E
3984	xxxx-001-QVM-Q-397	QAP for Coal Sampling System	CHP/LHP/GHP	QA-BOP	A
3985	xxxx-001-QVM-Q-398	QAP for Limestone Sampling System	CHP/LHP/GHP	QA-BOP	A
3986	xxxx-001-QVM-Q-399	QAP for Elevator	CHP/LHP/GHP	QA-BOP	A
3987	xxxx-001-QVM-Q-400	QAP for Belt Vulcanising Machine	CHP/LHP/GHP	QA-BOP	E
3988	xxxx-001-QVM-Q-401	QAP for Flap Gate	CHP/LHP/GHP	QA-BOP	E
3989	xxxx-001-QVM-Q-402	QAP for Rod Gate	CHP/LHP/GHP	QA-BOP	E
3990	xxxx-001-QVM-Q-403	QAP for Rack & Pinion Gate	CHP/LHP/GHP	QA-BOP	E
3991	xxxx-001-QVM-Q-404	QAP for Actuators for Flap Gates & R&P Gate	CHP/LHP/GHP	QA-BOP	E
3992	xxxx-001-QVM-Q-405	QAP for Vibrating Feeder	CHP/LHP/GHP	QA-BOP	A
3993	xxxx-001-QVM-Q-406	QAP for Vibration Isolation System	CHP/LHP/GHP	QA-BOP	A
3994	xxxx-001-QVM-Q-407	QAP for Bulk Reception Unit	CHP/LHP/GHP	QA-BOP	A
3995	xxxx-001-QVM-Q-408	QAP for Truck Tippling Unit	CHP/LHP/GHP	QA-BOP	A
3996	xxxx-001-QVM-Q-409	QAP for Pitter Type Weigh Bridge	CHP/LHP/GHP	QA-BOP	A
3997	xxxx-001-QVM-Q-410	QAP for Telescopic Chute	CHP/LHP/GHP	QA-BOP	E
3998	xxxx-001-QVM-Q-411	QAP for EOT Crane	CHP/LHP/GHP	QA-BOP	A
3999	xxxx-001-QVM-Q-412	QAP for Hydraulic Cylinder for SR Package	CHP/LHP/GHP	QA-BOP	A
4000	xxxx-001-QVM-Q-413	QAP for Hydraulic Cylinder for WT Package	CHP/LHP/GHP	QA-BOP	A
4001	xxxx-001-QVM-Q-414	QAP for Hydraulic Power Pack for SR Package	CHP/LHP/GHP	QA-BOP	A
4002	xxxx-001-QVM-Q-415	QAP for Hydraulic Power Pack for WT Package	CHP/LHP/GHP	QA-BOP	A
4003	xxxx-001-QVM-Q-416	QAP for Hydraulic Motor for SR Package	CHP/LHP/GHP	QA-BOP	E
4004	xxxx-001-QVM-Q-417	QAP for Hydraulic Motor for WT Package	CHP/LHP/GHP	QA-BOP	E
4005	xxxx-001-QVM-Q-418	QAP for DS / DFDS / SW System	CHP/LHP/GHP	QA-BOP	E
4006	xxxx-001-QVM-Q-419	QAP for Centrifugal Pump	CHP/LHP/GHP	QA-BOP	E
4007	xxxx-001-QVM-Q-420	QAP for CI Valve	CHP/LHP/GHP	QA-BOP	E
4008	xxxx-001-QVM-Q-421	QAP for Ball Valve	CHP/LHP/GHP	QA-BOP	E
4009	xxxx-001-QVM-Q-422	QAP for Duplex Strainer	CHP/LHP/GHP	QA-BOP	E
4010	xxxx-001-QVM-Q-423	QAP for MS Black Pipes	CHP/LHP/GHP	QA-BOP	E
4011	xxxx-001-QVM-Q-424	QAP for GI Pipes	CHP/LHP/GHP	QA-BOP	E
4012	xxxx-001-QVM-Q-425	QAP for Sump Pump	CHP/LHP/GHP	QA-BOP	E
4013	xxxx-001-QVM-Q-426	QAP for DE System Components	CHP/LHP/GHP	QA-BOP	E
4014	xxxx-001-QVM-Q-427	QAP for Screw Compressor	CHP/LHP/GHP	QA-BOP	E
4015	xxxx-001-QVM-Q-428	QAP for Centrifugal Fan for DE System	CHP/LHP/GHP	QA-BOP	A
4016	xxxx-001-QVM-Q-429	QAP for Axial Fan for DE System	CHP/LHP/GHP	QA-BOP	A
4017	xxxx-001-QVM-Q-430	QAP for Air Receiver for DE System	CHP/LHP/GHP	QA-BOP	A
4018	xxxx-001-QVM-Q-431	QAP for Motorized CI Valves	CHP/LHP/GHP	QA-BOP	A
4019	xxxx-001-QVM-Q-432	QAP of Venturi Scrubbers for Dust Extraction System	CHP/LHP/GHP	QA-BOP	E
4020	xxxx-001-QVM-Q-433	QAP for Truck Loading System Components	CHP/LHP/GHP	QA-BOP	E
4021	xxxx-001-QVM-Q-434	QAP for Train Loading System Components	CHP/LHP/GHP	QA-BOP	E
4022	xxxx-001-QVM-Q-435	QAP for Ventilation System Components	CHP/LHP/GHP	QA-BOP	E
4023	xxxx-001-QVM-Q-436	QAP for Centrifugal Fans for Ventilation System	CHP/LHP/GHP	QA-BOP	E
4024	xxxx-001-QVM-Q-437	QAP for Axial Fans for Ventilation System	CHP/LHP/GHP	QA-BOP	E
4025	xxxx-001-QVM-Q-438	QAP for V-PLOUGH	CHP/LHP/GHP	QA-BOP	A
4026	xxxx-001-QVM-Q-439	QAP FOR WAGON TIPPLER	CHP/LHP/GHP	QA-BOP	A
4027	xxxx-001-QVM-Q-440	QAP FOR SIDE ARM CHARGER	CHP/LHP/GHP	QA-BOP	A
4028	xxxx-001-QVM-Q-441	QAP FOR APRON FEEDER Dribble Conveyor	CHP/LHP/GHP	QA-BOP	A
4029	xxxx-001-QVM-Q-442	QAP OF TRAVELLING TRIPPER	CHP/LHP/GHP	QA-BOP	A
4030	xxxx-001-QVM-Q-443	QAP- RING GRANULATOR CRUSHER	CHP/LHP/GHP	QA-BOP	A
4031	xxxx-001-QVM-Q-444	QAP-VIBRATING GRIZZLY FEEDER & VIBRATING SCREEN	CHP/LHP/GHP	QA-BOP	A
4032	xxxx-001-QVM-Q-445	QAP OF STACKER RECLAIMER	CHP/LHP/GHP	QA-BOP	A
4033	xxxx-001-QVM-Q-446	QAP FOR HAMMER MILL CRUSHER-Limestone	CHP/LHP/GHP	QA-BOP	E
4034	xxxx-001-QVM-Q-447	QAP OF IDLERS	CHP/LHP/GHP	QA-BOP	E
4035	xxxx-001-QVM-Q-448	QAP OF PULLEY	CHP/LHP/GHP	QA-BOP	E
4036	xxxx-001-QVM-Q-449	SHOP FABRICATED STRUCTURE(CAT-I ITEMS)	CHP/LHP/GHP	QA-BOP	A
4037	xxxx-001-QVM-Q-450	SHOP FABRICATED STRUCTURE(CAT-II ITEMS)	CHP/LHP/GHP	QA-BOP	E
4038	xxxx-001-QVM-Q-451	QAP OF TECHNOLOGICAL STRUCTURE	CHP/LHP/GHP	QA-BOP	E
4039	xxxx-001-QVM-Q-452	QAP for Decking sheet	CHP/LHP/GHP	QA-BOP	A
4040	xxxx-001-QVM-Q-453	QAP for ELECTROFORGED GRATINGS	CHP/LHP/GHP	QA-BOP	A
4041	xxxx-001-QVM-G-044	FIELD QUALITY PLAN FOR CHP / LHP/ GHP MECHANICAL	CHP/LHP/GHP	QA-BOP	E
4042	xxxx-001-QVM-Q-454	MQP Axial fan	AHS	QA-MECH/BOP-AHS	E
4043	xxxx-001-QVM-Q-455	PUMPS- HORIZONTAL & VERTICAL CENTRIFUGAL, PUMPS -VT	AHS	QA-MECH/BOP-AHS	A
4044	xxxx-001-QVM-Q-456	PUMP -SUBMERSIBLE/SUMP>= 30KW	AHS	QA-MECH/BOP-AHS	E

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 52 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
4045	xxxx-001-QVM-Q-457	RUBBER EXPANSION JOINT >=1600NB	AHS	QA-MECH/BOP-AHS	E
4046	xxxx-001-QVM-Q-458	VALVE-BALL/PLUG > 100 MM OR CLASS > 800	AHS	QA-MECH/BOP-AHS	E
4047	xxxx-001-QVM-Q-459	VALVE-BUTTERFLY > 600MM OR CLASS>150	AHS	QA-MECH/BOP-AHS	A
4048	xxxx-001-QVM-Q-460	COMPRESSOR	AHS	QA-MECH/BOP-AHS	E
4049	xxxx-001-QVM-Q-461	AIR DRYER	AHS	QA-MECH/BOP-AHS	E
4050	xxxx-001-QVM-Q-462	CENTRIFUGAL FAN	AHS	QA-MECH/BOP-AHS	A
4051	xxxx-001-QVM-Q-463	PR VESSEL/AIR RECEIVER(≥ 10 BAR)	AHS	QA-MECH/BOP-AHS	A
4052	xxxx-001-QVM-Q-464	ASH SLURRY PUMP	AHS	QA-MECH/BOP-AHS	A
4053	xxxx-001-QVM-Q-465	BA HOPPER GATE ASSLY	AHS	QA-MECH/BOP-AHS	A
4054	xxxx-001-QVM-Q-466	BASALT LINER PIPES & FITTINGS	AHS	QA-MECH/BOP-AHS	A
4055	xxxx-001-QVM-Q-467	HOPPER(BA/BUFFER)	AHS	QA-MECH/BOP-AHS	A
4056	xxxx-001-QVM-Q-468	Electric Hoist/EOT Crane/Gantry Crane/Chain pulley block (> 10 Ton)	AHS	QA-MECH/BOP-AHS	A
4057	xxxx-001-QVM-Q-469	CHARGE PUMP(BOOSTER PUMP)	AHS	QA-MECH/BOP-AHS	A
4058	xxxx-001-QVM-Q-470	CLINCKER GRINDER & ITS DRIVE ARRANGEMENT	AHS	QA-MECH/BOP-AHS	A
4059	xxxx-001-QVM-Q-471	DRY ASH UNLOADING TELESCOPIC CHUTE	AHS	QA-MECH/BOP-AHS	A
4060	xxxx-001-QVM-Q-472	EQUALISING VALVE	AHS	QA-MECH/BOP-AHS	A
4061	xxxx-001-QVM-Q-473	FEEDER EJECTOR, HYDRO EJECTOR	AHS	QA-MECH/BOP-AHS	A
4062	xxxx-001-QVM-Q-474	FLUID COUPLING(SCOOP & TRACTION TYPE)	AHS	QA-MECH/BOP-AHS	A
4063	xxxx-001-QVM-Q-475	SILO & ITS SUPPORTING STRUCTURE	AHS	QA-MECH/BOP-AHS	A
4064	xxxx-001-QVM-Q-476	GEAR BOX	AHS	QA-MECH/BOP-AHS	A
4065	xxxx-001-QVM-Q-477	HCSD PUMP WITH SUCTION VESSEL, PULSATION DAMPEER AND PUMP CONTROLLER	AHS	QA-MECH/BOP-AHS	A
4066	xxxx-001-QVM-Q-478	SEAMLESS PIPE	AHS	QA-MECH/BOP-AHS	A
4067	xxxx-001-QVM-Q-479	HYDROMIX DUST CONDITIONER	AHS	QA-MECH/BOP-AHS	A
4068	xxxx-001-QVM-Q-480	VALVE: PLATE, PLUG GATE FOR SUMP ISOLATION, KNIFE GATE, MATERIAL HANDLING	AHS	QA-MECH/BOP-AHS	A
4069	xxxx-001-QVM-Q-481	MS Pipe (Black/GI) (IS 1239 / IS 3589) (>1000 NB)	AHS	QA-MECH/BOP-AHS	E
4070	xxxx-001-QVM-Q-482	METALLIC EXPANSION BELLOW/JOINT	AHS	QA-MECH/BOP-AHS	A
4071	xxxx-001-QVM-Q-483	PNEUMATIC/HYDRAULIC CYLINDER	AHS	QA-MECH/BOP-AHS	A
4072	xxxx-001-QVM-Q-484	ROTARY FEEDER & ROTARY SEGREGATING VALVE, SEGREGATING SLIDE VALVE	AHS	QA-MECH/BOP-AHS	A
4073	xxxx-001-QVM-Q-485	VACUUM BREAKER	AHS	QA-MECH/BOP-AHS	A
4074	xxxx-001-QVM-Q-486	VACUUM PUMP, MECHANICAL EXHAUSTER	AHS	QA-MECH/BOP-AHS	A
4075	xxxx-001-QVM-Q-487	PULLEYS	AHS	QA-MECH/BOP-AHS	A
4076	xxxx-001-QVM-Q-488	WRAPPING & COATING MATERIAL -ANTI CORROSIVE TAPE	AHS	QA-MECH/BOP-AHS	A
4077	xxxx-001-QVM-Q-489	ACI FITTINGS & LINER/CI PIPES & FITTINGS	AHS	QA-MECH/BOP-AHS	A
4078	xxxx-001-QVM-Q-490	AIR LOCK VESSEL/ AIR VESSEL IN CONTROL LOOP (DAMPENER)/BA OVERFLOW TANK/COARSE ASH TANK/COLLECTOR TANK/AIR WASHER	AHS	QA-MECH/BOP-AHS	A
4079	xxxx-001-QVM-Q-491	AIR OIL CONVERTOR TANK	AHS	QA-MECH/BOP-AHS	A
4080	xxxx-001-QVM-Q-492	BAG FILTER/SILO VENT FILTER	AHS	QA-MECH/BOP-AHS	A
4081	xxxx-001-QVM-Q-493	CASTABLE REFRACTORY	AHS	QA-MECH/BOP-AHS	A
4082	xxxx-001-QVM-Q-494	ROLLED /WELDED PIPE	AHS	QA-MECH/BOP-AHS	A
4083	xxxx-001-QVM-Q-495	SUPPORTING STRUCTURE: BA HOPPER, BUFFER HOPPER, BA OVERFLOW TANK, SETTLING/SURGE TANK ETC	AHS	QA-MECH/BOP-AHS	A
4084	xxxx-001-QVM-Q-496	ACI BENDS	MRHS	QA-MECH/BOP-MRHS	A
4085	xxxx-001-QVM-Q-497	MQP Air receiver(≥10 bar pressure)	MRHS	QA-MECH/BOP-MRHS	A
4086	xxxx-001-QVM-Q-498	MQP Ball valve/Plug valve	MRHS	QA-MECH/BOP-MRHS	E
4087	xxxx-001-QVM-Q-499	MQP Conventional Gate/Globe Valve/ Check Valve (Size >600 NB or Rating Pr Class > 300)	MRHS	QA-MECH/BOP-MRHS	E
4088	xxxx-001-QVM-Q-500	MQP Butterfly Valves	MRHS	QA-MECH/BOP-MRHS	E
4089	xxxx-001-QVM-Q-501	MQP MS Pipe(Black/GI)	MRHS	QA-MECH/BOP-MRHS	E
4090	xxxx-001-QVM-Q-502	MQP Bag/Vent Filters	MRHS	QA-MECH/BOP-MRHS	A
4091	xxxx-001-QVM-Q-503	MQP Belt conveyors	MRHS	QA-MECH/BOP-MRHS	A
4092	xxxx-001-QVM-Q-504	MQP Chain Bucket Elevator/Chain Elevator	MRHS	QA-MECH/BOP-MRHS	A
4093	xxxx-001-QVM-Q-505	MQP Conveying Compressor	MRHS	QA-MECH/BOP-MRHS	A
4094	xxxx-001-QVM-Q-506	MQP Denseveyor	MRHS	QA-MECH/BOP-MRHS	A
4095	xxxx-001-QVM-Q-507	MQP Electric Hoist/EOT Crane/Chain pulley block (> 10 Ton)	MRHS	QA-MECH/BOP-MRHS	A
4096	xxxx-001-QVM-Q-508	MQP Fabric Expansion/ non-metallic belows	MRHS	QA-MECH/BOP-MRHS	A
4097	xxxx-001-QVM-Q-509	MQP Gear Box	MRHS	QA-MECH/BOP-MRHS	A
4098	xxxx-001-QVM-Q-510	MQP Pulleys	MRHS	QA-MECH/BOP-MRHS	A
4099	xxxx-001-QVM-Q-511	MQP Fluid Coupling(Scoop & Traction type)	MRHS	QA-MECH/BOP-MRHS	A
4100	xxxx-001-QVM-Q-512	MQP Submersible/Sump Pump	MRHS	QA-MECH/BOP-MRHS	A
4101	xxxx-001-QVM-Q-513	MQP Silo	MRHS	QA-MECH/BOP-MRHS	A
4102	xxxx-001-QVM-Q-514	MQP Plate Valve/Knife Gate Valve	MRHS	QA-MECH/BOP-MRHS	A
4103	xxxx-001-QVM-Q-515	MQP IDLERS	MRHS	QA-MECH/BOP-MRHS	E
4104	xxxx-001-QVM-Q-516	FQP - RECEIPT, STORAGE AND ERECTION	MRHS	QA-MECH/BOP-MRHS	A
4105	xxxx-001-QVM-Q-516	Diesel Engine	DG Set	QA-MECH/BOP-MRHS	A
4106	xxxx-001-QVM-Q-516	FQP - ASH HANDLING SYSTEM	AHS	QA-MECH/BOP-AHS	A
4107	xxxx-001-QVM-Q-516	FQP - RECEIPT, STORAGE AND ERECTION	AHS	QA-MECH/BOP-AHS	A
4108	xxxx-001-QVC-G-001	FQP for Civil works	Civil	QA Civil	A
4109	xxxx-001-QVC-Q-001	MQP for GALVANISED STEEL STRUCTURES (LATTICE & PIPE) FOR SWITCHYARD AND TRANSMISSION LINE.	Civil	QA Civil	E
4110	xxxx-001-QVC-Q-002	MQP for COLOUR COATED METAL DECK & CLADDING/ROOFING SHEET	Civil	QA Civil	A
4111	xxxx-001-QVC-Q-003	MQP for CHIMNEY ELEVATOR (RACK AND PINION).	Civil	QA Civil	A
4112	xxxx-001-QVC-Q-004	MQP for FABRIC EXPANSION COMPENSATOR (FOR CHIMNEY).	Civil	QA Civil	A
4113	xxxx-001-QVC-Q-005	MQP for MINERAL WOOL FOR THERMAL INSULATION (FOR CHIMNEY)	Civil	QA Civil	E
4114	xxxx-001-QVC-Q-006	MQP for STOP LOG GATES, TRASH RACK AND LIFTING BEAM	Civil	QA Civil	A
4115	xxxx-001-QVC-Q-007	MQP for HDPE LINER (GEOMEMBRANE)	Civil	QA Civil	A
4116	xxxx-001-QVC-Q-008	MQP for ELECTROFORGED GRATING	Civil	QA Civil	E
4117	0000-136-PVM-F-023	P & I Diagram of CW Chlorination System	Chlorination	WS	A
4118	0000-136-PVM-F-024	P & I Diagram of PT Chlorination System	Chlorination	WS	A
4119	0000-136-PVM-F-026	Equipment Layout of CW Chlorination system	Chlorination	WS	A
4120	0000-136-PVM-F-027	Equipment Layout of PT Chlorination system	Chlorination	WS	A
4121	0000-136-PVM-H-029	Valve Schedule for chlorination system	Chlorination	WS	A
4122	0000-136-PVM-L-034	Outdoor piping layout for PT & CW Chlorination system	Chlorination	WS	A
4123	0000-136-PVM-L-035	Indoor piping layout for PT & CW Chlorination system	Chlorination	WS	A
4124	0000-136-PVM-L-036	Ducting layout for PT & CW Chlorination system	Chlorination	WS	A
4125	0000-136-PVM-Y-057	Datasheet and GA of Non Return Valve for Chlorination	Chlorination	WS	A
4126	0000-136-PVM-Y-059	Datasheet and GA of Manual Operated Gate Valve for Chlorination	Chlorination	WS	A
4127	0000-136-PVM-Y-060	Datasheet and GA of Globe Valve for Chlorination	Chlorination	WS	A
4128	0000-136-PVM-Y-061	Datasheet and GA of Manual and Motor Operated Butterfly Valve	Chlorination	WS	A

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 53 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
4129	0000-136-PVM-Y-062	Datasheet and GA of Manual and Motor Operated Butterfly Valve for Chlorination	Chlorination	WS	A
4130	0000-136-PVM-Y-063	Datasheet and G. A of Non Return Valve	Chlorination	WS	A
4131	0000-136-PVM-Y-064	Datasheet and GA of Plug Valve	Chlorination	WS	A
4132	0000-136-PVM-Y-065	Datasheet and GA of Diaphragm Valve	Chlorination	WS	A
4133	0000-136-PVM-Y-066	Datasheet and GA of Diaphragm Valve for Chlorination	Chlorination	WS	A
4134	0000-136-PVM-Y-067	Datasheet & GA of Air Blower For Chlorination	Chlorination	WS	A
4135	0000-136-PVM-Y-068	Datasheet and G.A of Air Blower with Motor (Sludge Pit)	Chlorination	WS	A
4136	0000-136-PVM-Y-069	Datasheet for CW & PT Chlorinator, Vaporiser, chlorine gas filter and FRP H	Chlorination	WS	A
4137	0000-136-PVM-Y-070	Datasheet for Ball valve for chlorine gas/liquid service CW & PT	Chlorination	WS	A
4138	0000-136-PVM-Y-071	Datasheet for header isolation valve (CW & PT)	Chlorination	WS	A
4139	0000-136-PVM-Y-072	Datasheet for Safety shower and Emergency KIT B	Chlorination	WS	A
4140	0000-136-PVM-Y-073	Datasheet & G. A of Globe Valve	Chlorination	WS	A
4141	0000-001-315-PVC-C-XXXX	TG Area-Design Philosophy/Basis including materials, loading, founding level/bearing capacity, analysis method, finishing/painting details etc. for all facilities in the area		Civil	A
4142	0000-001-315-PVC-C-0003A	MPH BUILDING - LAYOUT & DETAILS OF BASE PLATE UNIT-1		Civil	AA
4143	0000-001-315-PVC-C-0004	MPH BUILDING - STRUCTURAL FRAMING & COLUMN DETAILS ALONG A ROW INCLUDING CONDUCTOR ANCHORAGE & BUS DUCT SUPPORTING STRUCTURE BRACKETS UNIT-1		Civil	AA
4144	0000-001-315-PVC-C-0007	MPH BUILDING - STRUCTURAL FRAMING & COLUMN DETAILS ALONG B ROW UNIT-1		Civil	AA
4145	0000-001-315-PVC-C-0010	MPH BUILDING - STRUCTURAL FRAMING & COLUMN DETAILS ALONG C ROW UNIT-1		Civil	AA
4146	0000-001-315-PVC-C-0014A	MPH BUILDING - DETAILS OF ROOF PURLIN (AB BAY) UNIT - 1		Civil	AA
4147	0000-001-315-PVC-C-0014B	MPH BUILDING - DETAILS OF ROOF PURLIN (AB BAY) UNIT - 1		Civil	AA
4148	0000-001-315-PVC-C-0016A	MPH BUILDING - GA AND DETAIL OF GANTRY GIRDERS UNIT - 1 SHT 1		Civil	AA
4149	0000-001-315-PVC-C-0016B	MPH BUILDING - GA AND DETAIL OF GANTRY GIRDERS UNIT - 1 SHT 2		Civil	AA
4150	0000-001-315-PVC-C-0018A	MPH BUILDING - DETAILS OF ROOF GIRDER / TRUSS (AB BAY) UNIT - 1		Civil	AA
4151	0000-001-315-PVC-C-0018B	MPH BUILDING - DETAILS OF ROOF GIRDER / TRUSS (AB BAY) UNIT - 1		Civil	AA
4152	0000-001-315-PVC-C-0019A	MPH BUILDING - LAYOUT AND DETAILS OF B-C BAY GIRDERS UNIT-1		Civil	AA
4153	0000-001-315-PVC-C-0068A	MPH BUILDING - DETAIL OF GABLE END COLUMNS ALONG GRID-1		Civil	AA
4154	0000-001-315-PVC-C-0068B	MPH BUILDING - DETAIL OF GABLE END COLUMNS ALONG GRID-39		Civil	AA
4155	0000-001-315-PVC-C-0089A	GENERAL NOTES FOR STRUCTURAL STEEL WORKS		Civil	A
4156	0000-001-315-PVC-C-0151A	STANDARD DETAILS OF ARCH WORKS- SHEET-1		Civil	A
4157	0000-001-315-PVC-C-0151B	STANDARD DETAILS OF ARCH WORKS - SHEET-2		Civil	A
4158	0000-001-315-PVC-C-0151C	STANDARD DETAILS OF DOORS		Civil	A
4159	0000-001-315-PVC-C-0151E	STANDARD DETAILS OF WINDOWS		Civil	A
4160	0000-001-315-PVC-C-0152A	MPH BUILDING - A-ROW ELEVATION & SECTIONS		Civil	A
4161	0000-001-315-PVC-C-0172	MPH BUILDING - ARCH PLAN, FINISHING SCHEDULE & FLOOR PATTERN @ +EL 18.00M UNIT-1		Civil	A
4162	0000-001-315-PVC-C-XXXX	SG Area-Design Philosophy/Basis including materials, loading, founding level/bearing capacity, analysis method, finishing/painting details etc. for all facilities in the area		Civil	A
4163	0000-001-315-PVC-C-0281A	BUNKER BAY - FRAMING PLAN OF FEEDER FLOOR (SECONDARY BEAMS)		Civil	AA
4164	0000-001-315-PVC-C-0281B	BUNKER'S BAY - R.C.C. DETAILS OF FEEDER FLOOR		Civil	AA
4165	0000-001-315-PVC-C-0282A	BUNKER BAY - FRAMING PLAN OF TRIPPER FLOOR (SECONDARY BEAMS)		Civil	AA
4166	0000-001-315-PVC-C-0282B	BUNKER'S BAY - R.C.C. DETAILS OF TRIPPER FLOOR		Civil	AA
4167	0000-001-315-PVC-C-0283A	BUNKER BAY - FRAMING PLAN OF ROOF (SECONDARY BEAMS)		Civil	AA
4168	0000-001-315-PVC-C-0284A	BUNKER BAY - G.A. OF BUNKERS & SUPPORTING DETAILS SHT-1		Civil	AA
4169	0000-001-315-PVC-C-0284B	BUNKER BAY - G.A. OF BUNKERS & SUPPORTING DETAILS SHT-2		Civil	AA
4170	0000-001-315-PVC-C-0301	T.G. FDN -GA OF RAFT		Civil	A
4171	0000-001-315-PVC-C-0302	R/F DETAIL OF TG RAFT AND COLUMNS		Civil	A
4172	0000-001-315-PVC-C-0303A	T.G FDN -DETAILS OF PLATFORM /FLOORS BELOW TG DECK PART 1/4 TO 4/4		Civil	A
4173	0000-001-315-PVC-C-0306	T.G. FDN TOP DECK-RC DET OF LONGITUDINAL BEAM 11, 12, 13 & 14		Civil	A
4174	0000-001-315-PVC-C-0308	T.G FDN -GA OF DECK: TOP PLAN		Civil	A
4175	0000-001-315-PVC-C-0309A	T.G FDN -GA OF DECK: BOTTOM PLAN		Civil	A
4176	0000-001-315-PVC-C-0309B	T.G FDN -GA OF DECK: SECTIONS		Civil	A
4177	0000-001-315-PVC-C-0312A	T.G FDN -GA OF DECK: LIST OF EMBEDMENT		Civil	A
4178	0000-001-315-PVC-C-0312B	T.G. FDN TOP DECK-RC DET OF CROSS BEAM 5 (PART 1 OF 2 & 2 OF 2)		Civil	A
4179	0000-001-315-PVC-C-0313	T.G. FDN TOP DECK-RC DET OF LONGITUDINAL BEAM 7 (PART 1 OF 6 TO 6 OF 6)		Civil	A
4180	0000-001-315-PVC-C-0314	T.G. FDN TOP DECK-RC DET OF LONGITUDINAL BEAM 8 (PART 1 OF 6 TO 6 OF 6)		Civil	A
4181	0000-001-315-PVC-C-0315A	T.G. FDN TOP DECK-RC DET OF LONGITUDINAL BEAM 9 (PART 1 OF 6 TO 6 OF 6)		Civil	A
4182	0000-001-315-PVC-C-0316	T.G. FDN TOP DECK-RC DET OF LONGITUDINAL BEAM 10 (PART 1 OF 6 TO 6 OF 6)		Civil	A
4183	0000-001-315-PVC-C-0317	T.G. FDN TOP DECK - RC DET OF CROSS BEAM 1 ()		Civil	A
4184	0000-001-315-PVC-C-0318	T.G. FDN TOP DECK-RC DET OF CROSS BEAM 2 (PART 1 OF 3 TO 3 OF 3)		Civil	A
4185	0000-001-315-PVC-C-0319	T.G. FDN TOP DECK - RC DET OF CROSS BEAM 3 (PART 1 OF 2 & 2 OF 2)		Civil	A
4186	0000-001-315-PVC-C-0320	T.G. FDN TOP DECK-RC DET OF CROSS BEAM 4 (PART 1 OF 2 & 2 OF 2)		Civil	A
4187	0000-001-315-PVC-C-0335A	GA OF TDBFP DECK		Civil	AA
4188	0000-001-315-PVC-C-0335B	RC OF TDBFP DECK (PART 1 OF 6 TO 6 OF 6)		Civil	AA
4189	0000-001-315-PVC-C-0339A	GA OF MDBFP FOUNDATION		Civil	AA
4190	0000-001-315-PVC-C-0339B	RC OF MDBFP FOUNDATION		Civil	AA
4191	0000-001-315-PVC-C-0405	ID FAN-GA OF FOUNDATION-UNIT 1		Civil	AA
4192	0000-001-315-PVC-C-0406	I.D. FAN - R.C. DETAILS OF FOUNDATION-UNIT 1		Civil	AA
4193	0000-001-315-PVC-C-0410	F.D. FAN - G.A. OF FOUNDATION -UNIT 1		Civil	AA
4194	0000-001-315-PVC-C-0411	F.D. FAN - RC DETAILS OF FOUNDATION -UNIT 1		Civil	AA
4195	0000-001-315-PVC-C-0414	P.A. FAN - G.A. OF FOUNDATION-UNIT 1		Civil	AA
4196	0000-001-315-PVC-C-0415	P.A. FAN - R.C. DETAILS OF FOUNDATION-UNIT 1		Civil	AA
4197	0000-001-315-PVC-C-0451B	GENERAL NOTES & STD. DETAILS FOR CIVIL WORKS		Civil	A
4198	0000-001-315-PVC-C-0452A	G.A. OF BOILER FOUNDATIONS AND PEDESTALS - UNIT-1		Civil	AA
4199	0000-001-315-PVC-C-0452B	R.C. DETAILS OF BOILER FOUNDATIONS AND PEDESTALS - UNIT-1		Civil	AA
4200	0000-001-315-PVC-C-0454A	MPH BUILDING - G.A. & R.C. OF COLS FDN ON ROW A to F UNIT-1		Civil	AA
4201	0000-001-315-PVC-C-1601	GA AND RC DETAIL OF ABSORBER FOUNDATION		Civil	AA
4202	0000-001-315-PVC-U-0003B	MPH BLDG. - UNIT-1 ANALYSIS AND DESIGN OF MAIN FRAME		Civil	AA

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 54 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
4203	0000-001-315-PVC-U-0335	DESIGN OF TDBFP FOUNDATION		Civil	AA
4204	0000-001-315-PVC-U-0339	DESIGN OF MDBFP FOUNDATION		Civil	AA
4205	0000-001-315-PVC-U-0402	MILL & BUNKER BAY - DESIGN OF BUNKER & SUPPORTING GIRDERS		Civil	AA
4206	0000-001-315-PVC-U-0403	MILL & BUNKER BAY - DESIGN OF FEEDER FLOOR BEAMS & SLAB		Civil	AA
4207	0000-001-315-PVC-U-0403A	DESIGN OF I.D. FAN FOUNDATION		Civil	AA
4208	0000-001-315-PVC-U-0404	MILL & BUNKER BAY - DESIGN OF TRIPPER FLOOR & SLAB		Civil	AA
4209	0000-001-315-PVC-U-0405	MILL & BUNKER BAY - DESIGN OF ROOF BEAMS & SLAB		Civil	AA
4210	0000-001-315-PVC-U-0406	MILL & BUNKER BAY - DESIGN OF CLADDING RUNNERS		Civil	AA
4211	0000-001-315-PVC-U-0408	DESIGN OF F.D. FAN FOUNDATION		Civil	AA
4212	0000-001-315-PVC-U-0412	DESIGN OF P.A. FAN FOUNDATION		Civil	AA
4213	0000-001-315-PVC-U-0452A	DESIGN OF INTEGRATED BOILER FOUNDATION - UNIT 1		Civil	AA
4214	0000-001-315-PVC-U-0452B	DESIGN OF INTEGRATED BOILER FOUNDATION - UNIT 2		Civil	AA
4215	0000-001-315-PVC-U-059	MPH BLDG. - DESIGN OF GANTRY GIRDERS - UNIT 1		Civil	AA
4216	0000-001-315-PVC-U-0687	DESIGN CRITERIA DOCUMENT FOR CIVIL , STRUCTURAL AND ARCHITECTURAL WORKS.		Civil	A
4217	0000-001-315-PVC-U-161	DESIGN OF ABSORBER FOUNDATION		Civil	AA
4218	0000-001-315-PVC-U-1680	T.G. FOUNDATION : STATIC ANALYSIS		Civil	A
4219	0000-001-315-PVC-U-1681	T.G. FOUNDATION : DESIGN OF T.G. DECK GIRDERS		Civil	A
4220	0000-109-PVC-B-101	FGD Wet Stack-General Arrangement of Wet Stack		Civil	AA
4221	0000-109-PVC-B-102	FGD Wet Stack- Foundation Details including shell dowels & duct pedestals		Civil	AA
4222	0000-109-PVC-B-103	FGD Wet Stack- Shell Profile and Details of Main Reinforcement		Civil	AA
4223	0000-109-PVC-B-106	FGD Wet Stack- Details of Platform & Restraint scheme ,Details of Hangar		Civil	AA
4224	0000-109-PVC-B-142	GA OF LINERS AND DETAILS OF FLUE LINERS-AII CANS		Civil	AA
4225	0000-109-PVC-B-143	GA OF ELEVATOR - FGD Wet Stack		Civil	AA
4226	0000-109-PVC-B-144	DATASHEET OF ELEVATOR - FGD Wet Stack		Civil	AA
4227	0000-109-PVC-U-102	FGD Wet Stack-Analysis and design of foundation		Civil	A
4228	0000-109-PVC-U-103	FGD Wet Stack-Analysis & design of RCC shell,platforms and extra reinforcement around platform beam recess and other miscellaneous openings		Civil	A
4229	0000-109-PVC-W-001	FGD Wet Stack-Wind Tunnel Procedure and Wind tunnel test report		Civil	A
4230	0000-001-PE-318-PVC-C-046	RAW WATER RESERVOIR LAYOUT		Civil	AA
4231	0000-001-PE-318-PVC-C-047	RAW WATER RESERVOIR SECTIONS		Civil	AA
4232	0000-001-PE-318-PVC-C-048	RAW WATER RESERVOIR SPILLWAY DETAILS		Civil	AA
4233	0000-301C-PVC-C-133	Rain Water Harvesting - Layout		Civil	A
4234	0000-301C-PVC-C-134	Rain Water Harvesting Details		Civil	A
4235	0000-001-315-PVC-C-0022A	MPH BUILDING (A-C BAY) - FRAMING PLAN AT EL +9.00M FFL UNIT - 1		Civil	AA
4236	0000-001-315-PVC-C-0022B	MPH BUILDING (A-C BAY) - FRAMING PLAN AT EL +9.00M FFL UNIT - 1		Civil	AA
4237	0000-001-315-PVC-C-0025A	MPH BUILDING (A-C BAY) - FRAMING PLAN AT EL +18.00M FFL UNIT - 1		Civil	AA
4238	0000-001-315-PVC-C-0025B	MPH BUILDING (A-C BAY) - FRAMING PLAN AT EL +18.00M FFL UNIT - 1		Civil	AA
4239	0000-001-315-PVC-C-0027A	MPH BUILDING CONTROL TOWER (C-F BAY) - FRAMING PLAN AT EL +25.00M FFL UNIT - 1		Civil	AA
4240	0000-001-315-PVC-C-0027B	MPH BUILDING CONTROL TOWER (C-F BAY) - FRAMING PLAN AT EL +25.00M FFL UNIT - 1		Civil	AA
4241	0000-001-315-PVC-C-0029A	MPH BUILDING (B-F BAY)- FRAMING PLAN AT EL +28.00M FFL UNIT - 1		Civil	AA
4242	0000-001-315-PVC-C-0029B	MPH BUILDING (B-F BAY)- FRAMING PLAN AT EL +28.00M FFL UNIT - 1		Civil	AA
4243	0000-001-315-PVC-C-0030A	MPH BUILDING CONTROL TOWER (C-F BAY) - FRAMING PLAN AT EL +34.50M FFL UNIT - 1		Civil	AA
4244	0000-001-315-PVC-C-0030B	MPH BUILDING CONTROL TOWER (C-H BAY) - FRAMING PLAN AT EL +34.50M FFL UNIT - 1		Civil	AA
4245	0000-001-315-PVC-C-0032	PH BLDG.- STRUCTURAL FRAMING ALONG D, E & F ROW INCLUDING LONGITUDINAL & TRANSVERSE GIRDER DETAILS UNIT - 1		Civil	AA
4246	0000-001-315-PVC-C-0033A	MPH BUILDING - DETAIL OF AUXILIARY COLUMNS UNIT - 1		Civil	AA
4247	0000-001-315-PVC-C-0033B	MPH BUILDING - DETAIL OF AUXILIARY COLUMNS UNIT - 1		Civil	AA
4248	0000-001-315-PVC-C-0035A	MPH BUILDING CONTROL TOWER - WALL BEAM & CLADDING FRAMING ALONG AND ACROSS D, E & F ROW - UNIT-1		Civil	AA
4249	0000-001-315-PVC-C-0035C	MPH BUILDING - FRAMING PLAN AT EL +4.0M FFL - UNIT-1		Civil	AA
4250	0000-001-315-PVC-C-0037A	MPH BUILDING (A-F BAY) - FRAMING PLAN AT EL +12.750M/13.750M FFL UNIT-1		Civil	AA
4251	0000-001-315-PVC-C-0043A	MPH BUILDING CONTROL TOWER (C-F BAY) - FRAMING PLAN AT EL +18.00M FFL - UNIT - 1		Civil	AA
4252	0000-001-315-PVC-C-0043B	MPH BUILDING CONTROL TOWER (C-F BAY) - FRAMING PLAN AT EL +18.00M FFL - UNIT - 1		Civil	AA
4253	0000-001-315-PVC-C-0044A	MPH BUILDING CONTROL TOWER (C-F BAY) - FRAMING PLAN AT EL 9.0M FFL - UNIT - 1		Civil	AA
4254	0000-001-315-PVC-C-0044B	MPH BUILDING CONTROL TOWER (C-F BAY) - FRAMING PLAN AT EL 9.0M FFL - UNIT - 1		Civil	AA
4255	0000-001-315-PVC-C-0046	MPH BUILDING - OIL CANAL FRAMING PLAN-UNIT-1		Civil	AA
4256	0000-001-315-PVC-C-0047	MPH BUILDING - FRAMING PLAN- TDBFP HANDLING AT EL 5.00M FFL - UNIT - 1		Civil	AA
4257	0000-001-315-PVC-C-0050	MPH BUILDING - WALL BEAM & CLADDING FRAMING ALONG A ROW UNIT - 1		Civil	AA
4258	0000-001-315-PVC-C-0057	MPH BUILDING - WALL BEAM & CLADDING FRAMING ALONG B ROW UNIT - 1		Civil	AA
4259	0000-001-315-PVC-C-0058	MPH BUILDING - WALL BEAM & CLADDING FRAMING ALONG C ROW UNIT - 1		Civil	AA
4260	0000-001-315-PVC-C-0059	MPH BUILDING - CABLE GALLERY ALONG C-ROW STRUCTURAL DETAILS - UNIT - 1, & 3		Civil	AA
4261	0000-001-315-PVC-C-0060	MPH BUILDING - CABLE GALLERY ALONG C-ROW STRUCTURAL DETAILS - UNIT - 1		Civil	AA
4262	0000-001-315-PVC-C-0062	MPH BUILDING - DETAILS OF STAIRCASE A-B BAY, MKD. SC-01 & SC-02		Civil	AA
4263	0000-001-315-PVC-C-0064	MPH BUILDING - DETAILS OF STAIRCASE MKD. SC-03		Civil	AA
4264	0000-001-315-PVC-C-0066	MPH BUILDING - DETAILS OF STAIRCASE MKD. SC-04		Civil	AA
4265	0000-001-315-PVC-C-0069A	MPH BUILDING - CLADDING FRAMING OF GABLE END ALONG GRID-1		Civil	AA
4266	0000-001-315-PVC-C-0069B	MPH BUILDING - CLADDING FRAMING OF GABLE END ALONG GRID-39		Civil	AA
4267	0000-001-315-PVC-C-0070	MPH BUILDING - DETAILS OF STAIRCASE MKD. SC-05		Civil	AA
4268	0000-001-315-PVC-C-0076	MPH BUILDING - (AT F-ROW)DETAIL OF STAIRCASE MKD. SC-06		Civil	AA
4269	0000-001-315-PVC-C-0083A	MPH BUILDING - CAT WALK ABOVE FALSE CEILING UNIT-1		Civil	AA
4270	0000-001-315-PVC-C-0091	MPH BUILDING - G.A. & R.C. DTLS OF METAL DECK ROOF (AB BAY) UNIT-1		Civil	AA
4271	0000-001-315-PVC-C-0093A	MPH BUILDING (A-C BAY) - GA & R.C. DTLS OF FL @ EL +9.0M (FFL) UNIT-1		Civil	AA
4272	0000-001-315-PVC-C-0093D	MPH BUILDING CONTROL TOWER (C-F BAY) - GA & R.C. DTLS OF FL @ EL +9.0M - UNIT - 1		Civil	AA

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
4273	0000-001-315-PVC-C-0098A	MPH BUILDING CONTROL TOWER (C-F BAY) - GA & R.C. DTLS OF FL @ EL +25.0M UNIT-1		Civil	AA
4274	0000-001-315-PVC-C-0100A	MPH BUILDING (B-F BAY) - GA & R.C. DTLS OF FL @ EL 28.00M UNIT-1		Civil	AA
4275	0000-001-315-PVC-C-0103A	MPH BUILDING CONTROL TOWER (C-F BAY) - GA & R.C. DTLS OF FL @ EL 33.00M UNIT - 1		Civil	AA
4276	0000-001-315-PVC-C-0105A	MPH BUILDING - GA & R.C. DTLS OF FL @ EL +4.0M - UNIT-1		Civil	AA
4277	0000-001-315-PVC-C-0109A	MPH BUILDING (A-F BAY) - GA & R.C. DTLS OF FL @ EL +13.00/14.00M UNIT-1		Civil	AA
4278	0000-001-315-PVC-C-0111A	MPH BUILDING (A-C BAY) - GA & R.C. DTLS OF FL @ EL +18.00M UNIT-1		Civil	AA
4279	0000-001-315-PVC-C-0111D	MPH BUILDING CONTROL TOWER (C-F BAY) - GA & R.C. DTLS OF FL @ EL +18.00M UNIT - 1		Civil	AA
4280	0000-001-315-PVC-C-0113	MPH BUILDING - GA & RC DETAILS OF OIL CANAL-UNIT-1		Civil	AA
4281	0000-001-315-PVC-C-0119A	MPH BUILDING - (AB & BC BAY) MISC. PLATFORMS		Civil	AA
4282	0000-001-315-PVC-C-0152B	MPH BUILDING - PERSPECTIVE VIEW		Civil	AA
4283	0000-001-315-PVC-C-0154	MPH BUILDING CONTROL ROOM & CER ROOM - GLAZED PARTITION DETAILS		Civil	AA
4284	0000-001-315-PVC-C-0156	MPH BUILDING - C-ROW ELEVATION & SECTIONS		Civil	AA
4285	0000-001-315-PVC-C-0160	MPH BUILDING - ELEVATION OF GABLE END GRID-1		Civil	AA
4286	0000-001-315-PVC-C-0161	MPH BUILDING - ELEVATION OF GABLE END GRID-38		Civil	AA
4287	0000-001-315-PVC-C-0162	MPH BUILDING - ARCH PLAN OF A-B BAY ROOF (UNIT - 1)		Civil	AA
4288	0000-001-315-PVC-C-0164	MPH BUILDING - ARCH PLAN & FINISHING SCHEDULE @ EL + 0.0M UNIT-1		Civil	AA
4289	0000-001-315-PVC-C-0167	MPH BUILDING - ARCH PLAN & FINISHING SCHEDULE @ EL +4.00M UNIT - 1		Civil	AA
4290	0000-001-315-PVC-C-0168	MPH BUILDING - ARCH PLAN & FINISHING SCHEDULE @ EL +9.00M UNIT-1		Civil	AA
4291	0000-001-315-PVC-C-016A	DEGASSER AREA: DESIGN OF EQUIPMENT FOUNDATION		Civil	AA
4292	0000-001-315-PVC-C-0171	MPH BUILDING - ARCH PLAN & FINISHING SCHEDULE @ EL +13.00M/14.00M UNIT-1		Civil	AA
4293	0000-001-315-PVC-C-0175	MPH BUILDING CONTROL TOWER - ARCH PLAN & FINISHING SCHEDULE @ EL 25.0M, 28.50M & 34.50M UNIT-1		Civil	AA
4294	0000-001-315-PVC-C-0178	MPH BUILDING - CONTROL ROOM - FALSE CEILING PLAN & DETAILS		Civil	AA
4295	0000-001-315-PVC-C-0180	MPH BUILDING - OPERATING FLOOR FLOORING PATTERN & FINSHING SCHEDULE (UNIT 1)		Civil	AA
4296	0000-001-315-PVC-C-0181A	MPH BUILDING - TOILET DETAILS - UNIT-1		Civil	AA
4297	0000-001-315-PVC-C-0182A	MPH BUILDING - DOOR & WINDOW SCHEDULE - UNIT-1		Civil	AA
4298	0000-001-315-PVC-C-0182B	MPH BUILDING - DOOR & WINDOW SCHEDULE - UNIT-2		Civil	AA
4299	0000-001-315-PVC-C-0182C	MPH BUILDING - DOOR & WINDOW SCHEDULE - UNIT-3		Civil	AA
4300	0000-001-315-PVC-C-0240	MPH BUILDING - INTERCONNECTING GALLERY- PH BLDG. TO SERVICE BLDG.		Civil	AA
4301	0000-001-315-PVC-C-0271	AIR COMPRESSOOR BLDG. - ARCHITECTURAL PLANS & FINISHING SCHEDULE		Civil	AA
4302	0000-001-315-PVC-C-0272	AIR COMPRESSOOR BLDG. - ARCHITECTURAL ELEVATIONS & SECTIONS		Civil	AA
4303	0000-001-315-PVC-C-0273	AIR COMPRESSOOR BLDG. - TOILET DETAILS		Civil	AA
4304	0000-001-315-PVC-C-0274	AIR COMPRESSOOR BLDG. - GA & RC DETAIL OF FOUNDATION & PEDESTALS		Civil	AA
4305	0000-001-315-PVC-C-0275	AIR COMPRESSOOR BLDG. - GA & R/F DETAIL OF PLINTH BEAMS		Civil	AA
4306	0000-001-315-PVC-C-0276A	AIR COMPRESSOOR BLDG. - LAYOUT & DETAILS OF BASE PLATE		Civil	AA
4307	0000-001-315-PVC-C-0276B	AIR COMPRESSOOR BLDG. - FRAMING ELEVATION		Civil	AA
4308	0000-001-315-PVC-C-0276C	AIR COMPRESSOOR BLDG. - DETAILS OF GANTRY GIRDER		Civil	AA
4309	0000-001-315-PVC-C-0277	AIR COMPRESSOOR BLDG. - ROOF FRAMING DETAILS		Civil	AA
4310	0000-001-315-PVC-C-0278	AIR COMPRESSOOR BLDG. - DETAILS OF WALL BEAM & CLADDING		Civil	AA
4311	0000-001-315-PVC-C-0279	AIR COMPRESSOOR BLDG. - G.A & R.C. DTLS OF GRADE SLAB, COMPRESSORS & AIR RECIEVERS		Civil	AA
4312	0000-001-315-PVC-C-0280	AIR COMPRESSOOR BLDG. - GA & RC DETAIL OF ROOF SLAB		Civil	AA
4313	0000-001-315-PVC-C-0280A	ACW PH: GA & RC DETAILS OF MISC PUMP FOUNDATION		Civil	AA
4314	0000-001-315-PVC-C-0281	ACW PH: GA & RC ACW AREA GRADE SLAB		Civil	AA
4315	0000-001-315-PVC-C-0285	BUNKER'S BAY - CLADDING AND MIS DETAILS		Civil	AA
4316	0000-001-315-PVC-C-0315	MPH BUILDING CONTROL ROOM - SECTIONAL ELEVATION & DETAILS		Civil	AA
4317	0000-001-315-PVC-C-0333	MPH BUILDING - GA & R.C. DETAILS OF CEP PIT-UNIT-1		Civil	AA
4318	0000-001-315-PVC-C-0355	MPH BUILDING - GA & R.C. DTLS OF FL @ EL + 0.0M UNIT-1		Civil	AA
4319	0000-001-315-PVC-C-0364A	MPH BUILDING - MISC. STAIRS		Civil	AA
4320	0000-001-315-PVC-C-0365	BUS DUCT SUPPORTING STRUCTURAL FRAMING DETAILS		Civil	AA
4321	0000-001-315-PVC-C-0366	MPH BUILDING - CRITICAL PIPE SUPPORTING STRUCTURES		Civil	AA
4322	0000-001-315-PVC-C-0401	Ball MILL FOUNDATION - GA DETAILS		Civil	AA
4323	0000-001-315-PVC-C-0402	Ball MILL FOUNDATION - RC DETAILS		Civil	AA
4324	0000-001-315-PVC-C-0417A	SEAL AIR FAN -GA OF FOUNDATION-UNIT 1		Civil	AA
4325	0000-001-315-PVC-C-0417B	SEAL AIR FAN -RC DETAILS OF FOUNDATION-UNIT 1		Civil	AA
4326	0000-001-315-PVC-C-0420	AREA PAVING - SECTIONAL DETAILS OF CD BAY PASSAGE		Civil	AA
4327	0000-001-315-PVC-C-0421A	BOILER AREA G.A. & R.C. DETAILS OF GRADE SLAB @ (-) 0.200M UNIT-1		Civil	AA
4328	0000-001-315-PVC-C-0422	BOILER AREA GA AND RC DETAILS OF MISC. MRS TRENCH & BUNKER BAY GROUND FLOOR - UNIT-1		Civil	AA
4329	0000-001-315-PVC-C-0423	BOILER AREA - GA & RC DETAILS OF LIFT PIT - UNIT 1		Civil	AA
4330	0000-001-315-PVC-C-0424	BOILER AREA - GA & RC DETAILS OF MISC. FOUNDATIONS & IBD TANK		Civil	AA
4331	0000-001-315-PVC-C-0425	BOILER AREA - GA & RC DETAILS OF MRS FOUNDATION		Civil	AA
4332	0000-001-315-PVC-C-0428	ESP AREA G.A. & R.C. DETAILS OF GRADE SLAB @(-) 0.200M UNIT-1 PART 1		Civil	AA
4333	0000-001-315-PVC-C-0429	CHIMNEY AREA G.A. & R.C. DETAILS OF GRADE SLAB @ (-) 0.200M UNIT-1 PART 1		Civil	AA
4334	0000-001-315-PVC-C-0453A	G.A. OF ESP FOUNDATIONS - UNIT-1		Civil	AA
4335	0000-001-315-PVC-C-0453B	R.C. DETAILS OF ESP FOUNDATIONS - UNIT-1		Civil	AA
4336	0000-001-315-PVC-C-0454D	MPH BUILDING - G.A. & R.C. DTLS OF INTERMEDIATE COLS. (AB BAY) FDN UNIT-1		Civil	AA
4337	0000-001-315-PVC-C-0463	G.A. & R.C. DETAILS OF ID DUCT FOUNDATIONS (ESP TO CHIMNEY) - UNIT-1 PART 1		Civil	AA
4338	0000-001-315-PVC-C-0464	G.A. & R.C. DETAILS OF ID DUCT FOUNDATIONS (BOILER TO ESP) UNIT-1		Civil	AA
4339	0000-001-315-PVC-C-0481A	G.A. OF AUXILIARY BOILER FOUNDATION		Civil	AA
4340	0000-001-315-PVC-C-0481B	R.C. DETAILS OF AUXILIARY BOILER FOUNDATION		Civil	AA
4341	0000-001-315-PVC-C-0482	AUXILIARY BOILER - ARCH DETAILS AND G.A. & R.C. DETAILS OF FOUNDATIONS, COLUMNS & BEAMS OF CONTROL ROOM & M.C.C.		Civil	AA
4342	0000-001-315-PVC-C-0483A	AUX. BOILER-RC OF FD FAN FOUNDATION		Civil	AA
4343	0000-001-315-PVC-C-0483B	AUXILIARY BOILER - G.A. & R.C. DETAILS OF GRADE SLAB OF CONTROL ROOM & M.C.C.		Civil	AA

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 56 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
4344	0000-001-315-PVC-C-0486	AUX. BOILER- GA OF FD FAN FOUNDATION		Civil	AA
4345	0000-001-315-PVC-C-0486A	G.A. OF AUXILIARY BOILER CHIMNEY FOUNDATION		Civil	AA
4346	0000-001-315-PVC-C-0486B	R.C. DETAILS OF AUXILIARY BOILER CHIMNEY FOUNDATION		Civil	AA
4347	0000-001-315-PVC-C-0501A	TRANSFORMER YARD - GA DETAILS OF GENERATOR TRANSFORMER (GT) - UNIT 1		Civil	AA
4348	0000-001-315-PVC-C-0501B	TRANSFORMER YARD - R.C. DETAILS OF GENERATOR TRANSFORMER (GT) - UNIT 1		Civil	AA
4349	0000-001-315-PVC-C-0502A	TRANSFORMER YARD - GA DETAILS OF STATION TRANSFORMER (ST) - UNIT 1		Civil	AA
4350	0000-001-315-PVC-C-0502B	TRANSFORMER YARD - R.C. DETAILS OF STATION TRANSFORMER (ST) - UNIT 1		Civil	AA
4351	0000-001-315-PVC-C-0503A	TRANSFORMER YARD - GA DETAILS OF UNIT TRANSFORMER (UT) - UNIT 1		Civil	AA
4352	0000-001-315-PVC-C-0503B	TRANSFORMER YARD - R.C. DETAILS OF UNIT TRANSFORMER (UT) - UNIT 1		Civil	AA
4353	0000-001-315-PVC-C-0504A	TRANSFORMER YARD - GA DETAILS OF UNIT AUX. TRANSFORMER (UAT) - UNIT 1		Civil	AA
4354	0000-001-315-PVC-C-0504B	TRANSFORMER YARD - R.C. DETAILS OF UNIT AUX. TRANSFORMER (UAT) - UNIT 1		Civil	AA
4355	0000-001-315-PVC-C-0505	TRANSFORMER YARD - OIL WATER PIT GA AND RC DETAILS - UNIT 1		Civil	AA
4356	0000-001-315-PVC-C-0506A	TRANSFORMER YARD - BUS DUCT FOUNDATION GA AND RC DETAIL- UNIT-1 SHT-1		Civil	AA
4357	0000-001-315-PVC-C-0506B	TRANSFORMER YARD - BUS DUCT FOUNDATION GA AND RC DETAIL- UNIT-1 SHT-2		Civil	AA
4358	0000-001-315-PVC-C-0507A	TRANSFORMER YARD - GA OF UNIT 1		Civil	AA
4359	0000-001-315-PVC-C-0507B	TRANSFORMER YARD - RC DETAIL OF UNIT 1		Civil	AA
4360	0000-001-315-PVC-C-0508A	TRANSFORMER YARD - GA OF UNIT 2		Civil	AA
4361	0000-001-315-PVC-C-0508B	TRANSFORMER YARD - RC DETAIL OF UNIT 2		Civil	AA
4362	0000-001-315-PVC-C-0509A	TRANSFORMER YARD - GA OF UNIT 3		Civil	AA
4363	0000-001-315-PVC-C-0509B	TRANSFORMER YARD - RC DETAIL OF UNIT 3		Civil	AA
4364	0000-001-315-PVC-C-0510	COND TRANSFER PH: GA & RC DETAIL OF CST TANK FOUNDATION		Civil	AA
4365	0000-001-315-PVC-C-0511	TRANSFORMER YARD - GA AND RC DETAILS OF SPARE GENERATOR TRANSFORMER		Civil	AA
4366	0000-001-315-PVC-C-0512A	TRANSFORMER YARD - FENCING DETAILS - UNIT 1-SHT-1		Civil	AA
4367	0000-001-315-PVC-C-0512B	TRANSFORMER YARD - FENCING DETAILS - UNIT 1-SHT-2		Civil	AA
4368	0000-001-315-PVC-C-0515A	D.G. SET BLDG. - GA OF DG SET FOUNDATION		Civil	AA
4369	0000-001-315-PVC-C-0516	D.G. SET BLDG. - RC DETAIL OF DG SET FOUNDATION		Civil	AA
4370	0000-001-315-PVC-C-0535	TRANSFORMER YARD - GA AND RC DETAIL OF RAIL SIDING		Civil	AA
4371	0000-001-315-PVC-C-0789	GATES ALONG BOUNDARY WALL - GA & RC DETAILS OF SECURITY OFFICE		Civil	AA
4372	0000-001-315-PVC-C-0790	GATES ALONG BOUNDARY WALL - STRUCTURAL DETAILS		Civil	AA
4373	0000-001-315-PVC-C-1121	ESP CONTROL BLDG. - GA & RC DETAILS OF FOUNDATIONS & PEDESTALS & PLINTH BEAMS - UNIT - 1		Civil	AA
4374	0000-001-315-PVC-C-1122	ESP CONTROL BLDG. - BASE PLATE LAYOUT & DETAILS - UNIT 1		Civil	AA
4375	0000-001-315-PVC-C-1123	ESP CONTROL BLDG. - STRUCTURAL FRAMING ELEVATION - UNIT - 1		Civil	AA
4376	0000-001-315-PVC-C-1124	ESP CONTROL BLDG. - FLOOR MAIN BEAM DETAILS - UNIT - 1		Civil	AA
4377	0000-001-315-PVC-C-1126	ESP CONTROL BLDG. - WALL BEAM DETAILS - UNIT - 1		Civil	AA
4378	0000-001-315-PVC-C-1130A	ESP CONTROL BLDG. - FIRST FLOOR FRAMING DETAILS - UNIT - 1		Civil	AA
4379	0000-001-315-PVC-C-1130B	ESP CONTROL BLDG. - G.A & R.C. DETAILS OF FIRST FLOOR SLAB - UNIT - 1		Civil	AA
4380	0000-001-315-PVC-C-1131A	ESP CONTROL BLDG. - SECOND FLOOR FLOOR FRAMING DETAILS - UNIT - 1		Civil	AA
4381	0000-001-315-PVC-C-1131B	ESP CONTROL BLDG. - G.A & R.C. DETAILS OF SECOND FLOOR SLAB - UNIT - 1		Civil	AA
4382	0000-001-315-PVC-C-1133	ESP CONTROL BLDG. - LAYOUT & DETAILS OF STAIRCASE		Civil	AA
4383	0000-001-315-PVC-C-1134	ESP CONTROL BLDG. - LAYOUT & DETAILS OF STAIRCASE		Civil	AA
4384	0000-001-315-PVC-C-1135	ESP CONT ROOM- G.A. & RC DETAIL OF 0.0 M FLOOR - UNIT - 1		Civil	AA
4385	0000-001-315-PVC-C-1137	ESP CONTROL BLDG.-ARCHITECTURAL PLANS - UNIT 1 - SHT 1		Civil	AA
4386	0000-001-315-PVC-C-1138	ESP CONTROL BLDG.-ARCHITECTURAL PLANS - UNIT 1 - SHT 2		Civil	AA
4387	0000-001-315-PVC-C-1139	ESP CONTROL BLDG.-ARCHITECTURAL ELEVATIONS & SECTIONS UNIT 1 - SHT 1		Civil	AA
4388	0000-001-315-PVC-C-1140	ESP CONTROL BLDG.-ARCHITECTURAL ELEVATIONS & SECTIONS UNIT 1 - SHT 2		Civil	AA
4389	0000-001-315-PVC-C-1141	ESP CONTROL BLDG. - TOILET DETAILS UNIT 1		Civil	AA
4390	0000-001-315-PVC-C-1142	ESP CONTROL BLDG. - FALSE CEILING DETAILS - UNIT 1		Civil	AA
4391	0000-001-315-PVC-C-1226	COND TRANSFER PH: GA & RC DETAIL OF GRADE SLAB		Civil	AA
4392	0000-001-315-PVC-C-1251A	FUEL OIL AREA : G.A. & RC DETAILS OF DYKE		Civil	AA
4393	0000-001-315-PVC-C-1251B	FUEL OIL AREA : GA & RC DETAILS OF PAVING AND PIPE SUPPORT PEDESTALS		Civil	AA
4394	0000-001-315-PVC-C-1252	H.F.O. TENCH: LAYOUT & DETAILS OF OF HFO TRENCH & PEDESTAL		Civil	AA
4395	0000-001-315-PVC-C-1253	FUEL OIL DYKE - FENCING DETAILS		Civil	AA
4396	0000-001-315-PVC-C-1261	F.O.P.H. - ARCHITECTURAL FLOOR PLANS		Civil	AA
4397	0000-001-315-PVC-C-1262	F.O.P.H. - ARCHITECTURAL ELVATIONS		Civil	AA
4398	0000-001-315-PVC-C-1263	F.O.P.H. - ARCHITECTURAL SECTIONS & DETAILS		Civil	AA
4399	0000-001-315-PVC-C-1264	F.O.P.H. - G.A. & R.C. DETAILS OF FOUNDATIONS & COLUMNS		Civil	AA
4400	0000-001-315-PVC-C-1265	F.O.P.H. - G.A. & R.C. DETAILS OF PLINTH BEAMS & TIE BEAMS		Civil	AA
4401	0000-001-315-PVC-C-1266	F.O.P.H. - GA & RC DETAILS OF OIL WATER SEPERATOR PIT		Civil	AA
4402	0000-001-315-PVC-C-1267	H.F.O. & L.D.O. TANKS - G.A. & R.C. DETAILS OF FOUNDATION		Civil	AA
4403	0000-001-315-PVC-C-1269	F.O.P.H. - G.A. & R.C. DETAILS OF GRADE SLAB		Civil	AA
4404	0000-001-315-PVC-C-1273	F.O.P.H. - G.A. & R.C. DETAILS OF ROOF BEAMS & ROOF SLAB		Civil	AA
4405	0000-001-315-PVC-C-1315	ESP CONT ROOM - G.A. & RC DETAILS OF TRANSFORMER FOUNDATIONS UNIT - 1		Civil	AA
4406	0000-001-315-PVC-C-1315A	ESP CONTROL BLDG. - ROOF FRAMING DETAILS - UNIT - 1		Civil	AA
4407	0000-001-315-PVC-C-1315B	ESP CONTROL BLDG. - G.A & R.C. DETAILS OF ROOF SLAB - UNIT - 1		Civil	AA
4408	0000-001-315-PVC-C-133A	RAIN WATER HARVESTING-LAYOUT-SHT-1,3 4		Civil	AA
4409	0000-001-315-PVC-C-134A	RAIN WATER HARVESTING-DETAILS OF RECHARGE PITS ETC.		Civil	AA
4410	0000-001-315-PVC-C-1450	PIPE RACK MILL BUNKER U-1-STR LAYOUT & DET		Civil	AA
4411	0000-001-315-PVC-C-1451	SAFETY PARK - ARCHITECTURAL PLANS & FINISH SCHEDULE		Civil	AA
4412	0000-001-315-PVC-C-1451A	PIPE RACK MILL BUNKER U-1-STR LAYOUT, COLS & DET		Civil	AA
4413	0000-001-315-PVC-C-1452	SAFETY PARK - ARCHITECTURAL DETAIL		Civil	AA
4414	0000-001-315-PVC-C-1452A	PIPE RACK MILL BUNKER U-1-FND LAYOUT & DET		Civil	AA
4415	0000-001-315-PVC-C-1453	SAFETY PARK - TOILET DETAILS		Civil	AA
4416	0000-001-315-PVC-C-1453A	PIPE RACK MILL BUNKER U-2-STR LAYOUT & DET		Civil	AA
4417	0000-001-315-PVC-C-1454	SAFETY PARK - GA & RC DETAILS OF FOUNDATION		Civil	AA
4418	0000-001-315-PVC-C-1454A	PIPE RACK MILL BUNKER U-2-STR LAYOUT, COLS & DET		Civil	AA
4419	0000-001-315-PVC-C-1455	SAFETY PARK - STRUCTURAL DETAIL OF MAIN FRAME		Civil	AA

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 57 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
4420	0000-001-315-PVC-C-1455A	PIPE RACK MILL BUNKER U-2-FND LAYOUT & DET		Civil	AA
4421	0000-001-315-PVC-C-1456	SAFETY PARK - STRUCTURAL DETAIL OF ROOF AND SIDE CLADDING		Civil	AA
4422	0000-001-315-PVC-C-1456A	PIPE RACK MILL BUNKER U-3-STR LAYOUT & DET		Civil	AA
4423	0000-001-315-PVC-C-1457	SAFETY PARK - GA & RC DETAIL OF GRADE SLAB		Civil	AA
4424	0000-001-315-PVC-C-1457A	PIPE RACK MILL BUNKER U-3-STR LAYOUT, COLS & DET		Civil	AA
4425	0000-001-315-PVC-C-1458	SAFETY PARK - DETAILS OF PACKAGE TYPE STP		Civil	AA
4426	0000-001-315-PVC-C-1458A	PIPE RACK MILL BUNKER U-3-FND LAYOUT & DET		Civil	AA
4427	0000-001-315-PVC-C-1459	PIPE RACK PR-1/ BOP AREA - GA & RC DETAILS		Civil	AA
4428	0000-001-315-PVC-C-1460	PIPE RACK PR-1/ BOP AREA - STRUCTURAL LAYOUT & Details		Civil	AA
4429	0000-001-315-PVC-C-1461	PIPE RACK PR-1/ BOP AREA - STRUCTURAL elevation & DETAILS		Civil	AA
4430	0000-001-315-PVC-C-1462	PIPE RACK PR-2/ BOP AREA - GA & RC DETAILS		Civil	AA
4431	0000-001-315-PVC-C-1463	PIPE RACK PR-2/ BOP AREA - STRUCTURAL LAYOUT & Details		Civil	AA
4432	0000-001-315-PVC-C-1464	PIPE RACK PR-2/ BOP AREA - STRUCTURAL elevation & DETAILS		Civil	AA
4433	0000-001-315-PVC-C-1465	PIPE RACK PR-3/ BOP AREA - GA & RC DETAILS		Civil	AA
4434	0000-001-315-PVC-C-1466	PIPE RACK PR-3/ BOP AREA - STRUCTURAL LAYOUT & Details		Civil	AA
4435	0000-001-315-PVC-C-1467	PIPE RACK PR-3/ BOP AREA - STRUCTURAL elevation & DETAILS		Civil	AA
4436	0000-001-315-PVC-C-1468	PIPE RACK PR-4/ BOP AREA - GA & RC DETAILS		Civil	AA
4437	0000-001-315-PVC-C-1469	PIPE RACK PR-4/ BOP AREA - STRUCTURAL LAYOUT & Details		Civil	AA
4438	0000-001-315-PVC-C-1470	PIPE RACK PR-4/ BOP AREA - STRUCTURAL elevation & DETAILS		Civil	AA
4439	0000-001-315-PVC-C-1471	PIPE RACK ALONG ESP UNIT-1-1- STRUCTURAL LAYOUT		Civil	AA
4440	0000-001-315-PVC-C-1472	PIPE RACK ALONG ESP UNIT-1 - STRUCTURAL DETAILS		Civil	AA
4441	0000-001-315-PVC-C-1477	INTERPLANT CABLE TRENCH LAYOUT-BTG AREA		Civil	AA
4442	0000-001-315-PVC-C-1478	INTERPLANT CABLE TRENCH LAYOUT-DM PLANT AREA		Civil	AA
4443	0000-001-315-PVC-C-1479	INTERPLANT CABLE TRENCH LAYOUT-OTHER BOP AREA		Civil	AA
4444	0000-001-315-PVC-C-1480	INTER-PLANT PIPE / CABLE TRESTLE FROM TRANSFORMER YARD TO SWITCHYARD - LAYOUT & DETAILS OF FOUNDATIONS		Civil	AA
4445	0000-001-315-PVC-C-1616	Ball MILL BLDG. - ARCHITECTURAL PLANS & FINISHING SCHEDULE		Civil	AA
4446	0000-001-315-PVC-C-1617	Ball MILL BLDG. - ARCHITECTURAL ELEVATIONS		Civil	AA
4447	0000-001-315-PVC-C-1618	Ball MILL BLDG. - ARCHITECTURAL SECTIONS		Civil	AA
4448	0000-001-315-PVC-C-1620	Ball MILL BLDG. - GA & RC DETAILS OF FOUNDATION		Civil	AA
4449	0000-001-315-PVC-C-1621	Ball MILL BLDG. - MAIN FRAME DETAIL		Civil	AA
4450	0000-001-315-PVC-C-1622	Ball MILL BLDG. - BASE PLATE LAYOUT AND DETAILS		Civil	AA
4451	0000-001-315-PVC-C-1623	Ball MILL BLDG. - DETAILS OF CLADDING RUNNER		Civil	AA
4452	0000-001-315-PVC-C-1624	Ball MILL BLDG. - FLOOR FRAMING AT ROOF LEVEL		Civil	AA
4453	0000-001-315-PVC-C-1625	Ball MILL BLDG. - DETAIL OF MISC PLATFORM		Civil	AA
4454	0000-001-315-PVC-C-1628	Ball MILL BLDG. - GA & RC DETAIL AT ROOF LEVEL		Civil	AA
4455	0000-001-315-PVC-C-1629	Ball MILL BLDG. - GA & RC DETAIL AT GROUND FLOOR		Civil	AA
4456	0000-001-315-PVC-C-1630	G.A. & R.C. DETAILS OF Ball MILLS		Civil	AA
4457	0000-001-315-PVC-C-1631	GA & RC DETAIL OF LIME STONE SILO FOUNDATION		Civil	AA
4458	0000-001-315-PVC-C-1655	OXIDATION PH - ARCHITECTURAL PLANS 7 FINISHING SCHEDULE - UNIT 1		Civil	AA
4459	0000-001-315-PVC-C-1656	OXIDATION PH - ARCHITECTURAL DETAILS (ELEVATIONS & SECTIONS) -UNIT 1		Civil	AA
4460	0000-001-315-PVC-C-1658	OXIDATION PH - GA & RC DETAILS OF FOUNDATION -UNIT-1 & 3		Civil	AA
4461	0000-001-315-PVC-C-1659	OXIDATION PH - LAYOUT AND DETAIL OF BASE PLATE -UNIT-1		Civil	AA
4462	0000-001-315-PVC-C-1660	OXIDATION PH - MAIN FRAME DETAILS		Civil	AA
4463	0000-001-315-PVC-C-1661	OXIDATION PH - DETAIL OF ROOF AND SIDE CLAD		Civil	AA
4464	0000-001-315-PVC-C-1662	OXIDATION PH - GA & RC DETAIL OF 0.0 M FLOOR		Civil	AA
4465	0000-001-315-PVC-C-1664	MISC TANKS -GA & RC DETAILS OF FOUNDATION - SHT-1		Civil	AA
4466	0000-001-315-PVC-C-1665	MISC TANKS -GA & RC DETAILS OF FOUNDATION - SHT-2		Civil	AA
4467	0000-001-315-PVC-C-1666	MISC TANKS -GA & RC DETAILS OF FOUNDATION - SHT-3		Civil	AA
4468	0000-001-315-PVC-C-1667	SO2 ANALYSER ROOM - ARCH PLAN AND SECTIONS		Civil	AA
4469	0000-001-315-PVC-C-1668	SO2 ANALYSER ROOM -GA AND RC DETAIL OF FOUNDATION, PLINTH BEAM, ROOF BEAM & SLAB		Civil	AA
4470	0000-001-315-PVC-C-1669	DUCT SUPPORTING - GA AND RC DETAIL OF FOUNDATION		Civil	AA
4471	0000-001-315-PVC-C-1670A	FGD PIPE RACK- LAYOUT AND STRUCTURAL DETAILS-PART-1-SHT-1		Civil	AA
4472	0000-001-315-PVC-C-1670B	FGD PIPE RACK- LAYOUT AND STRUCTURAL DETAILS-PART-1-SHT-2		Civil	AA
4473	0000-001-315-PVC-C-1670C	FGD PIPE RACK- GA AND RC DETAIL OF FOUNDATION -PART-1		Civil	AA
4474	0000-001-315-PVC-C-1670D	FGD PIPE RACK- LAYOUT AND STRUCTURAL DETAILS-PART-2-SHT-1		Civil	AA
4475	0000-001-315-PVC-C-1670E	FGD PIPE RACK- LAYOUT AND STRUCTURAL DETAILS-PART-2-SHT-2		Civil	AA
4476	0000-001-315-PVC-C-1670F	FGD PIPE RACK- GA AND RC DETAIL OF FOUNDATION -PART-2		Civil	AA
4477	0000-001-315-PVC-C-1670G	FGD PIPE RACK- LAYOUT AND STRUCTURAL DETAILS-PART-3-SHT-1		Civil	AA
4478	0000-001-315-PVC-C-1670H	FGD PIPE RACK- LAYOUT AND STRUCTURAL DETAILS-PART-3-SHT-2		Civil	AA
4479	0000-001-315-PVC-C-1670I	FGD PIPE RACK- GA AND RC DETAIL OF FOUNDATION -PART-3		Civil	AA
4480	0000-001-315-PVC-C-1670J	FGD PIPE RACK- LAYOUT AND STRUCTURAL DETAILS-PART-4-SHT-1		Civil	AA
4481	0000-001-315-PVC-C-1670K	FGD PIPE RACK- LAYOUT AND STRUCTURAL DETAILS-PART-4-SHT-2		Civil	AA
4482	0000-001-315-PVC-C-1670L	FGD PIPE RACK- GA AND RC DETAIL OF FOUNDATION -PART-4		Civil	AA
4483	0000-001-315-PVC-C-1671	AMMONIA STORAGE SHED - ARCHITECTURAL PLANS		Civil	AA
4484	0000-001-315-PVC-C-1672	AMMONIA STORAGE SHED - ARCHITECTURAL DETAILS (ELEVATIONS)		Civil	AA
4485	0000-001-315-PVC-C-1673	AMMONIA STORAGE SHED - GA & RC DETAILS OF FOUNDATION		Civil	AA
4486	0000-001-315-PVC-C-1674	AMMONIA STORAGE SHED - MAIN FRAME DETAIL		Civil	AA
4487	0000-001-315-PVC-C-1675	AMMONIA STORAGE SHED - FLOOR FRAMING AT ROOF LEVEL		Civil	AA
4488	0000-001-315-PVC-C-1676	AMMONIA STORAGE SHED - DETAIL OF SIDE CLADDING RUNNER		Civil	AA
4489	0000-001-315-PVC-C-1677	AMMONIA STORAGE SHED - GA & RC DETAIL AT ROOF LEVEL		Civil	AA
4490	0000-001-315-PVC-C-1678	AMMONIA STORAGE SHED - GA & RC DETAIL AT GROUND FLOOR		Civil	AA
4491	0000-001-315-PVC-C-309	CHEMICAL STORAGE SHED : GA of Superstructure		Civil	AA
4492	0000-001-315-PVC-C-311	CHEMICAL STORAGE SHED : GA & RC Details of Foundation		Civil	AA
4493	0000-001-315-PVC-U-0333A	MPH BLDG. - DESIGN OF CEP PIT		Civil	AA
4494	0000-001-315-PVC-U-040	MPH BLDG. - UNIT-1 - DESIGN OF AUX. COLUMN FOUNDATION		Civil	AA
4495	0000-001-315-PVC-U-0401	Ball MILL : DESIGN OF FOUNDATION		Civil	AA
4496	0000-001-315-PVC-U-043	MPH BLDG (AB BAY) - DESIGN OF ROOF SLAB & METAL DECK		Civil	AA
4497	0000-001-315-PVC-U-044	MPH BLDG. - DESIGN OF MISC FOUNDATIONS @ EL + 0.0M		Civil	AA
4498	0000-001-315-PVC-U-045	MPH BLDG. - DESIGN OF OIL CANAL		Civil	AA
4499	0000-001-315-PVC-U-0453	DESIGN OF E.S.P. FOUNDATION -UNIT-1		Civil	AA
4500	0000-001-315-PVC-U-0454	MPH BLDG. - UNIT-1 - DESIGN OF MAIN COLUMN FOUNDATION		Civil	AA
4501	0000-001-315-PVC-U-0454A	DESIGN OF ID DUCT FOUNDATION (BOILER TO ESP)		Civil	AA
4502	0000-001-315-PVC-U-0455A	DESIGN OF ID DUCT FOUNDATION (ESP TO CHIMNEY)		Civil	AA
4503	0000-001-315-PVC-U-0481	DESIGN OF AUXILIARY BOILER FOUNDATION		Civil	AA
4504	0000-001-315-PVC-U-0488	ESP CONTROL BLDG. - DESIGN OF FOUNDATIONS, PEDESTALS & PLINTH BEAMS		Civil	AA
4505	0000-001-315-PVC-U-0490	TRANSFORMER YARD - DESIGN OF GENERATOR TRANSFORMER FOUNDATION		Civil	AA
4506	0000-001-315-PVC-U-0491	TRANSFORMER YARD - DESIGN OF MISCELLANEOUS FOUNDATION		Civil	AA
4507	0000-001-315-PVC-U-0492	TRANSFORMER YARD - DESIGN OF U.T. & S.T. FOUNDATION		Civil	AA
4508	0000-001-315-PVC-U-0493	TRANSFORMER YARD - DESIGN U.A.T. FOUNDATION		Civil	AA

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 58 OF 66

Si No	NTPC Drg No	DRG_TITLE	SUB-SYSTEM	Dept	CATEGORY
4509	0000-001-315-PVC-U-0495	F.O.P.H. : ANALYSIS AND DESIGN OF FOUNDATIONS & COLUMNS		Civil	AA
4510	0000-001-315-PVC-U-0496	HFO TRENCH : DESIGN OF TRENCH AND MISC FOUNDATION		Civil	AA
4511	0000-001-315-PVC-U-0497	DESIGN OF SEAL AIR FAN FOUNDATION		Civil	AA
4512	0000-001-315-PVC-U-0498	IT BLDG. - ANALYSIS AND DESIGN OF FOUNDATIONS, COLUMNS & PLINTH BEAMS		Civil	AA
4513	0000-001-315-PVC-U-053	PMCC BLDG- DESIGN OF FOUNDATION ND COLUMN		Civil	AA
4514	0000-001-315-PVC-U-054	PMCC BLDG- DESIGN OF BEAMS AND SLAB		Civil	AA
4515	0000-001-315-PVC-U-0540	BOILER AREA : DESIGN OF MISCELLANEOUS FOUNDATIONS		Civil	AA
4516	0000-001-315-PVC-U-058	MPH BLDG. - UNIT - 1 - DESIGN OF AUXILIARY COLUMNS		Civil	AA
4517	0000-001-315-PVC-U-060	MPH BLDG. (A-C BAY) - DESIGN OF FLOOR SLAB AND BEAM @ EL +4.0M UNIT - 1		Civil	AA
4518	0000-001-315-PVC-U-061	MPH BLDG. (A-C BAY) - DESIGN OF FLOOR SLAB AND BEAM @ EL +9.0M UNIT - 1		Civil	AA
4519	0000-001-315-PVC-U-062	MPH BLDG. CONTROL TOWER (C-F BAY) - DESIGN OF FLOOR SLAB AND BEAM @ EL +9.0M UNIT - 1		Civil	AA
4520	0000-001-315-PVC-U-063	MPH BLDG. (A-F BAY) - DESIGN OF FLOOR SLAB AND BEAM @ EL +13.0M /14.0M UNIT - 1		Civil	AA
4521	0000-001-315-PVC-U-064	MPH BLDG. (A-C BAY) - DESIGN OF FLOOR SLAB AND D BEAM @ EL +18.0M UNIT - 1		Civil	AA
4522	0000-001-315-PVC-U-065	MPH BLDG. CONTROL TOWER (C-F BAY) - DESIGN OF FLOOR SLAB AND BEAM @ EL +18.0M UNIT - 1		Civil	AA
4523	0000-001-315-PVC-U-066	MPH BLDG. (BC BAY) - DESIGN OF BEAMS AT EL +5.10 M		Civil	AA
4524	0000-001-315-PVC-U-067	MPH BLDG. CONTROL TOWER (C-F BAY) - DESIGN OF FLOOR SLAB AND BEAM @ EL +24.5M UNIT 1		Civil	AA
4525	0000-001-315-PVC-U-068	MPH BLDG. (BC BAY) - DESIGN OF FLOOR SLAB AND BEAM @ EL + 28.0M		Civil	AA
4526	0000-001-315-PVC-U-0687A	O & M PERMANENT STORE- LIGHT MATERIAL STORE - ANALYSIS AND DESIGN OF FOUNDATIONS, COLUMNS , BEAMS AND ROOF SLAB		Civil	AA
4527	0000-001-315-PVC-U-069	MPH BLDG. CONTROL TOWER (C-F BAY) - DESIGN OF FLOOR SLAB AND BEAM @ AT EL 34.50M UNIT-1		Civil	AA
4528	0000-001-315-PVC-U-070	MPH BLDG. (BC BAY) - DESIGN OF CRITICAL PIPE SUPPORT BEAMS @ EL + 40.0M		Civil	AA
4529	0000-001-315-PVC-U-071	MPH BLDG. - DESIGN OF PURLINS - UNIT 1		Civil	AA
4530	0000-001-315-PVC-U-072	MPH BLDG - DESIGN OF CLADDING RUNNERS ALONG A ROW UNIT-1		Civil	AA
4531	0000-001-315-PVC-U-073	MPH BLDG (Unit -1) - DESIGN OF CLADDING RUNNERS ALONG B ROW		Civil	AA
4532	0000-001-315-PVC-U-074	MPH BLDG - DESIGN OF CLADDING RUNNERS ALONG C TO F ROW		Civil	AA
4533	0000-001-315-PVC-U-075	MPH BLDG. - DESIGN OF MISC. PLATFORMS		Civil	AA
4534	0000-001-315-PVC-U-076	MPH BLDG. - DESIGN OF STAIRCASE A-C BAY.		Civil	AA
4535	0000-001-315-PVC-U-077	MPH BLDG. - DESIGN OF STAIRCASE C-F BAY.		Civil	AA
4536	0000-001-315-PVC-U-078	MPH BLDG. - DESIGN OF BUS DUCT SUPPORTING STRUCTURE		Civil	AA
4537	0000-001-315-PVC-U-079	MPH BLDG. - DESIGN OF CABLE GALLERY ALONG C-ROW		Civil	AA
4538	0000-001-315-PVC-U-080	ESP CONTROL BLDG. - DESIGN OF MAIN FRAME COLUMNS & BEAMS		Civil	AA
4539	0000-001-315-PVC-U-081	ESP CONTROL BLDG. - DESIGN OF FLOOR BEAMS AND FLOOR SLAB		Civil	AA
4540	0000-001-315-PVC-U-082	ESP CONTROL BLDG. - DESIGN OF ROOF BEAMS & ROOF SLABS		Civil	AA
4541	0000-001-315-PVC-U-083	ESP CONTROL BLDG. - DESIGN OF STAIRCASE		Civil	AA
4542	0000-001-315-PVC-U-084	ESP CONTROL BLDG. - DESIGN OF WALL BEAMS		Civil	AA
4543	0000-001-315-PVC-U-085	ESP CONTROL BLDG. - DESIGN OF TRANSFORMER FOUNDATIONS		Civil	AA
4544	0000-001-315-PVC-U-086	DESIGN OF AUXILIARY BOILER CHIMNEY FOUNDATION.		Civil	AA
4545	0000-001-315-PVC-U-087	DESIGN OF AUXILIARY BOILER BFP FOUNDATION.		Civil	AA
4546	0000-001-315-PVC-U-088	DESIGN OF AUXILIARY BOILER FD FOUNDATION.		Civil	AA
4547	0000-001-315-PVC-U-089	DESIGN OF AUXILIARY BOILER MISC FOUNDATION.		Civil	AA
4548	0000-001-315-PVC-U-090	SAFETY PARK - DESIGN OF FOUNDATIONS & PEDESTALS		Civil	AA
4549	0000-001-315-PVC-U-091	SAFETY PARK- DESIGN OF MAIN FRAME , BASE PLATE.		Civil	AA
4550	0000-001-315-PVC-U-092	SAFETY PARK- DESIGN OF ROOF TRUSS AND SIDE CLADDING RUNNER.		Civil	AA
4551	0000-001-315-PVC-U-093	DESIGN OF H.F.O. & L.D.O. TANK FOUNDATIONS		Civil	AA
4552	0000-001-315-PVC-U-094	DYKE AREA : DESIGN OF MISCELLANEOUS FOUNDATIONS		Civil	AA
4553	0000-001-315-PVC-U-095	F.O.P.H. : DESIGN OF PLINTH BEAMS, TIE BEAMS, ROOF BEAMS, ROOF SLAB & MONO RAIL		Civil	AA
4554	0000-001-315-PVC-U-096	F.O.P.H. : DESIGN OF MISC EQUIPMENT FOUNDATIONS		Civil	AA
4555	0000-001-315-PVC-U-098	ACW TREATMENT-DESIGN OF MISC EQUIPMENT FOUNDATION		Civil	AA
4556	0000-001-315-PVC-U-099	CHLORINE DI OXIDE AREA - DESIGN OF MISC EQUIPMENT FOUNDATION		Civil	AA
4557	0000-001-315-PVC-U-100	DESIGN OF CLARIFIED WATER TANK		Civil	AA
4558	0000-001-315-PVC-U-101	COND STORAGE TANK - DESIGN OF TANK FOUNDATION		Civil	AA
4559	0000-001-315-PVC-U-108	IT BLDG. - DESIGN OF TIE BEAMS, FLOOR BEAMS, FLOOR SLAB, ROOF BEAMS & ROOF SLAB		Civil	AA
4560	0000-001-315-PVC-U-109	D.G. SET - DESIGN OF FOUNDATION		Civil	AA
4561	0000-001-315-PVC-U-118	COMPRESSOR BLDG. - ANALYSIS AND DESIGN OF FOUNDATIONS & PEDESTALS		Civil	AA
4562	0000-001-315-PVC-U-119	COMPRESSOR BLDG. - DESIGN OF PLINTH BEAMS, ROOF BEAMS, ROOF SLAB & CRANE GIRDER		Civil	AA
4563	0000-001-315-PVC-U-120	COMPRESSOR BLDG. - DESIGN OF EQUIPMENT FOUNDATIONS AT EL(±)0.00M		Civil	AA
4564	0000-001-315-PVC-U-121	ACW PH AREA - DESIGN OF EQUIPMENT FOUNDATION		Civil	AA
4565	0000-001-315-PVC-U-141	PIPE RACK MILL BUNKER AREA UNIT-1- ANALYSIS AND DESIGN		Civil	AA
4566	0000-001-315-PVC-U-142	PIPE RACK MILL BUNKER AREA UNIT-1- DESIGN OF FOUNDATION & PEDESTALS		Civil	AA
4567	0000-001-315-PVC-U-145	DM PLANT CONTROL ROOM - ANALYSIS AND DESIGN OF BUILDING		Civil	AA
4568	0000-001-315-PVC-U-147	PIPE RACK PR-1/ BOP AREA - ANALYSIS AND DESIGN		Civil	AA
4569	0000-001-315-PVC-U-148	PIPE RACK PR-1/ BOP AREA- DESIGN OF FOUNDATION & PEDESTALS		Civil	AA
4570	0000-001-315-PVC-U-149	PIPE RACK PR-2/ BOP AREA- ANALYSIS AND DESIGN		Civil	AA
4571	0000-001-315-PVC-U-150	PIPE RACK PR-2/ BOP AREA- DESIGN OF FOUNDATION & PEDESTALS		Civil	AA
4572	0000-001-315-PVC-U-151	PIPE RACK PR-3/ BOP AREA - ANALYSIS AND DESIGN		Civil	AA
4573	0000-001-315-PVC-U-152	PIPE RACK PR-3/ BOP AREA- DESIGN OF FOUNDATION & PEDESTALS		Civil	AA
4574	0000-001-315-PVC-U-153	PIPE RACK PR-4/ BOP AREA- ANALYSIS AND DESIGN		Civil	AA
4575	0000-001-315-PVC-U-154	PIPE RACK PR-4/ BOP AREA - DESIGN OF FOUNDATION & PEDESTALS		Civil	AA
4576	0000-001-315-PVC-U-155	PIPE RACK ALONG ESP UNIT-1- ANALYSIS AND DESIGN		Civil	AA
4577	0000-001-315-PVC-U-158	DESIGN OF INTERPLANT CABLE TRENCH- BTG AREA		Civil	AA
4578	0000-001-315-PVC-U-159	DESIGN OF INTERPLANT CABLE TRENCH -BOP AREA		Civil	AA
4579	0000-001-315-PVC-U-160	DESIGN OF RAIN WATER HARVESTING STRUCTURES		Civil	AA
4580	0000-001-315-PVC-U-165	ANALYSIS AND DESIGN OF Ball MILL BUILDG.		Civil	AA
4581	0000-001-315-PVC-U-166	Ball MILL BUILDG: DESIGN OF ROOF SLAB AND SIDE CLAD		Civil	AA
4582	0000-001-315-PVC-U-167	Ball MILL BUILDG: DESIGN OF MISC EQUIP FOUNDATION		Civil	AA

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 59 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
4583	0000-001-315-PVC-U-1679	T.G. FOUNDATION : DYNAMIC ANALYSIS		Civil	AA
4584	0000-001-315-PVC-U-168	DESIGN OF LIME STONE SILO FOUNDATION		Civil	AA
4585	0000-001-315-PVC-U-1681A	DESIGN OF Ball MILL FOUNDATION		Civil	AA
4586	0000-001-315-PVC-U-1682	T.G. FOUNDATION : DESIGN OF MISC PLATFORMS		Civil	AA
4587	0000-001-315-PVC-U-172	OXIDATION PH: DESIGN OF FOUNDATION AND PEDESTAL		Civil	AA
4588	0000-001-315-PVC-U-173	OXIDATION PH: DESIGN OF BASE PLATE AND SUPER STRUCTURE		Civil	AA
4589	0000-001-315-PVC-U-174	OXIDATION PH: DESIGN OF MISC EQUIP FOUNDATION		Civil	AA
4590	0000-001-315-PVC-U-175	DESIGN OF MISC TANKS -OF FGD AREA		Civil	AA
4591	0000-001-315-PVC-U-176	ANALYSIS AND DESIGN OF SO2 ANALYSER ROOM		Civil	AA
4592	0000-001-315-PVC-U-177	DESIGN OF DUCT SUPPORTING FOUNDATION OF FGD AREA		Civil	AA
4593	0000-001-315-PVC-U-178A	DESIGN OF PIPE SUPPORTING STRUCTURE OF FGD AREA-PART-1		Civil	AA
4594	0000-001-315-PVC-U-178B	DESIGN OF PIPE SUPPORTING STRUCTURE FOUNDATION OF FGD AREA-PART-1		Civil	AA
4595	0000-001-315-PVC-U-178C	DESIGN OF PIPE SUPPORTING STRUCTURE OF FGD AREA-PART-2		Civil	AA
4596	0000-001-315-PVC-U-178D	DESIGN OF PIPE SUPPORTING STRUCTURE FOUNDATION OF FGD AREA-PART-2		Civil	AA
4597	0000-001-315-PVC-U-178E	DESIGN OF PIPE SUPPORTING STRUCTURE OF FGD AREA-PART-3		Civil	AA
4598	0000-001-315-PVC-U-178F	DESIGN OF PIPE SUPPORTING STRUCTURE FOUNDATION OF FGD AREA-PART-3		Civil	AA
4599	0000-001-315-PVC-U-178G	DESIGN OF PIPE SUPPORTING STRUCTURE OF FGD AREA-PART-4		Civil	AA
4600	0000-001-315-PVC-U-178H	DESIGN OF PIPE SUPPORTING STRUCTURE FOUNDATION OF FGD AREA-PART-4		Civil	AA
4601	0000-001-315-PVC-U-179	ANALYSIS AND DESIGN OF AMMONIA STORAGE SHED.		Civil	AA
4602	0000-001-315-PVC-U-180	AMMONIA STORAGE SHED: DESIGN OF FOUNDATION		Civil	AA
4603	0000-001-315-PVC-U-181	AMMONIA STORAGE SHED: DESIGN OF ROOF SLAB AND SIDE CLAD		Civil	AA
4604	0000-001-315-PVC-U-182	AMMONIA STORAGE SHED: DESIGN OF MISC EQUIP FOUNDATION		Civil	AA
4605	0000-001-315-PVC-U-308	CHEMICAL STORAGE SHED : Design of Superstructure		Civil	AA
4606	0000-001-315-PVC-U-310	CHEMICAL STORAGE SHED : Design of Foundation		Civil	AA
4607	0000-109-PVC-B-110	FGD Wet Stack- Layout & Details of Staircase		Civil	AA
4608	0000-109-PVC-B-111	FGD Wet Stack- Details of Ladders, Hatches and other Miscellaneous Items		Civil	AA
4609	0000-109-PVC-B-112	FGD Wet Stack- Details of Roof Slab		Civil	AA
4610	0000-109-PVC-B-113	FGD Wet Stack- Details of Grade Level Slab		Civil	AA
4611	0000-109-PVC-B-114	FGD Wet Stack- Scheme for Aviation Obstruction Markings		Civil	AA
4612	0000-109-PVC-B-115	FGD Wet Stack- Details of Sampling Ports in Flue Liner		Civil	AA
4613	0000-109-PVC-B-116	FGD Wet Stack-Details of Rain Water Downtake pipe		Civil	AA
4614	0000-109-PVC-B-117	FGD Wet Stack-Details of Louvers For Air inlet opening		Civil	AA
4615	0000-109-PVC-B-118	FGD Wet Stack-Details of Door For Aviation warning lights & Relief opening		Civil	AA
4616	0000-109-PVC-B-119	FGD Wet Stack-Details of Access Door		Civil	AA
4617	0000-109-PVC-B-120	FGD Wet Stack-Details of Rolling Shutter		Civil	AA
4618	0000-109-PVC-U-106	FGD Wet Stack-DESIGN OF STAIRCASE		Civil	AA
4619	0000-001-PE-318-PVC-B-101	RAW WATER PH- STOP LOG GATE GA		Civil	AA
4620	0000-001-PE-318-PVC-B-102	RAW WATER PH- EMBEDDED PARTS		Civil	AA
4621	0000-001-PE-318-PVC-B-103	RAW WATER PH- TRAS RACK GA		Civil	AA
4622	0000-001-PE-318-PVC-B-104	RAW WATER PH- STRUCTURAL DETAILS OF LIFTING BEAM ASSEMBLY FOR GATE		Civil	AA
4623	0000-001-PE-318-PVC-B-105	RAW WATER PH- DETAIL OF LIFTING BEAM		Civil	AA
4624	0000-001-PE-318-PVC-B-106	RAW WATER PH- SLUICE GATE EMBEDDED PARTS		Civil	AA
4625	0000-001-PE-318-PVC-B-107	RAW WATER PH- SLUICE GATE GA		Civil	AA
4626	0000-001-PE-318-PVC-C-016	CW SYSTEM - LAYOUT OF CW CHANNEL FROM COOLING TOWER TO FOREBAY		Civil	AA
4627	0000-001-PE-318-PVC-C-017	CW DUCTS - RC DETAIL OF DUCT FROM COOLING TOWER TO FOREBAY		Civil	AA
4628	0000-001-PE-318-PVC-C-020	CW PH - ARCHITECTURAL PLANS		Civil	AA
4629	0000-001-PE-318-PVC-C-021	CW PH - ARCHITECTURAL ELEVATIONS		Civil	AA
4630	0000-001-PE-318-PVC-C-022	CW PH - ARCHITECTURAL SECTIONS		Civil	AA
4631	0000-001-PE-318-PVC-C-025	CW PH - GA DETAIL AT MEZANINE FLOOR		Civil	AA
4632	0000-001-PE-318-PVC-C-026	CW PH - GA DETAIL AT OPERATING FLOOR		Civil	AA
4633	0000-001-PE-318-PVC-C-027	CW PH - GA & RC DETAILS OF GROUND FLOOR		Civil	AA
4634	0000-001-PE-318-PVC-C-028	CW PH - GA & RC SHEET DETAIL OF ROOF		Civil	AA
4635	0000-001-PE-318-PVC-C-030	CW PH - RC DETAIL AT OPERATING FLOOR		Civil	AA
4636	0000-001-PE-318-PVC-C-031	CW PH - GA DETAILS OF SUMP (PLANS)		Civil	AA
4637	0000-001-PE-318-PVC-C-032	CW PH - GA DETAILS OF SUMP (SECTION)		Civil	AA
4638	0000-001-PE-318-PVC-C-033	CW PH - RC DETAIL OF SUMP SHEET-1		Civil	AA
4639	0000-001-PE-318-PVC-C-034	CW PH - RC DETAILS OF SUMP SHEET-2		Civil	AA
4640	0000-001-PE-318-PVC-C-035	CW PH - SUPERSTRUCTURE FRAMING ELEVATION		Civil	AA
4641	0000-001-PE-318-PVC-C-036	CW PH - DETAILS OF PARKING		Civil	AA
4642	0000-001-PE-318-PVC-C-037	CW PIPE - LAYOUT OF PIPE FROM MAIN POWER HOUSE TO CWPB AND CWPB TO COOLING TOWER		Civil	AA
4643	0000-001-PE-318-PVC-C-038	FOREBAY -GENERAL ARRANGEMENT		Civil	AA
4644	0000-001-PE-318-PVC-C-039	CW PUMP HOUSE-FOREBAY - RC DETAIL		Civil	AA
4645	0000-001-PE-318-PVC-C-040	CW PH - GANTRY GIRDER		Civil	AA
4646	0000-001-PE-318-PVC-C-041	ELECTRICAL ANNEXE - GA & RC DETAILS OF FOUNDATION, COLUMN & PLINTH BEAMS		Civil	AA
4647	0000-001-PE-318-PVC-C-042	CWPB ELECTRICAL ANNEXE - GA & RC DETAILS OF BEAMS AND SLAB		Civil	AA
4648	0000-001-PE-318-PVC-C-044	ELECTRICAL ANNEXE - GA & RC DETAILS OF GROUND FLOOR		Civil	AA
4649	0000-001-PE-318-PVC-C-049	RAW WATER RESERVOIR TOE DRAIN DETAILS		Civil	AA
4650	0000-001-PE-318-PVC-C-050	RAW WATER RESERVOIR INLET PIPE DETAILS		Civil	AA
4651	0000-001-PE-318-PVC-C-051	RAW WATER RESERVOIR MISCELLANEOUS DETAILS		Civil	AA
4652	0000-001-PE-318-PVC-C-052	RAW WATER PH- ARCHITECTURAL PLAN & ELEV.N.		Civil	AA
4653	0000-001-PE-318-PVC-C-053	RAW WATER PH - ARCHITECTURAL SECTIONS & DETAILS		Civil	AA
4654	0000-001-PE-318-PVC-C-054	RAW WATER PH-GA & RC DETAILS OF Sump		Civil	AA
4655	0000-001-PE-318-PVC-C-055	RAW WATER PH-GA & R.C. DETAILS OF PLINTH BEAMS & LINTEL BEAMS		Civil	AA
4656	0000-001-PE-318-PVC-C-056	RAW WATER PH -GA & R.C. DETAILS OF OPERATING FLOOR		Civil	AA
4657	0000-001-PE-318-PVC-C-057	RAW WATER PH-GA & R.C. DTLS OF GROUND FLOOR SLABS		Civil	AA
4658	0000-001-PE-318-PVC-C-058	RAW WATER PH Elect Annexe Bldg -GA & RC detail of foundation and column schedule		Civil	AA
4659	0000-001-PE-318-PVC-C-059	RAW WATER PH Elect Annexe Bldg-GA & R.C. DETAILS OF PLINTH BEAMS & LINTEL BEAMS		Civil	AA
4660	0000-001-PE-318-PVC-U-003	CW SYSTEM - DESIGN OF CHANNEL		Civil	AA
4661	0000-001-PE-318-PVC-U-004	CW PUMP HOUSE - LOAD CALCULATION & DESIGN OF SUPERSTRUCTURE		Civil	AA
4662	0000-001-PE-318-PVC-U-006	CW PUMP HOUSE - DESIGN OF SUMP		Civil	AA
4663	0000-001-PE-318-PVC-U-007	CW PUMP HOUSE-DESIGN OF FOREBAY		Civil	AA
4664	0000-001-PE-318-PVC-U-008	CW PUMP HOUSE - DESIGN OF FLOORS		Civil	AA

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 60 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
4665	0000-001-PE-318-PVC-U-009	DESILTING CHAMBER - DESIGN CALCULATIONS		Civil	AA
4666	0000-001-PE-318-PVC-U-011	ELECTRICAL ANNEXE - DESIGN OF FOUNDATIONS AND SUPERSTRUCTURE		Civil	AA
4667	0000-001-PE-318-PVC-U-012	RAW WATER PH - DESIGN OF FOUNDATIONS		Civil	AA
4668	0000-001-PE-318-PVC-U-013	RAW WATER PH - LOAD CALCULATION & DESIGN OF SUPERSTRUCTURE		Civil	AA
4669	0000-001-PE-318-PVC-U-015	RAW WATER RESERVOIR- DESIGN OF WALL & RAFT		Civil	AA
4670	0000-001-PE-318-PVC-U-017	CWPH & Design of Gantry Girder		Civil	AA
4671	0000-001-PE-318-PVC-U-018	RAW WATER PH- DESIGN OF STOP LOG GATE & TRASH RACK		Civil	AA
4672	0000-001-PE-318-PVC-U-019	RAW WATER PH & DESIGN OF BEAM & SLAB AT FLOOR LEVEL		Civil	AA
4673	0000-001-PE-318-PVC-U-021	CLARIFIED WATER PH & DESIGN OF BEAM & SLAB AT FLOOR		Civil	AA
4674	0000-155-PVC-C-XXXX	Material Handling Area-Design Philosophy/Basis including materials, loading, founding level/bearing capacity, analysis method, finishing/painting details etc. for all facilities in the area		Civil	A
4675	000-155-PVC-C-0101	Design basis Structural and Architectural for CHP, LHP, BHP and GHP structures and facilities.		Civil	A
4676	000-155-PVC-C-0102	Design Basis Report for Civil Works for CHP, LHP, BHP and GHP		Civil	A
4677	000-155-PVC-C-0103	GA of Vibration Isolation system for Coal Crushers with foundation design		Civil	AA
4678	000-155-PVC-C-0104	GA of Vibration Isolation system for Lime stone Crushers with foundation design		Civil	AA
4679	000-155-PVC-C-0107	Structural GA of Elevations for Lime Stone Crusher House LCH		Civil	AA
4680	000-155-PVC-C-0112	GA & Reinforcement details of Lime stone Crusher Deck Slab		Civil	AA
4681	000-155-PVC-C-0114	Strl Design Calculation of Coal Crusher House		Civil	A
4682	000-155-PVC-C-0115	Structural GA of plans for Coal Crusher House		Civil	AA
4683	000-155-PVC-C-0116	Structural GA of Elevations for Coal Crusher House		Civil	A
4684	000-155-PVC-C-0117	Structural GA of Side Runner & purlins for Coal Crusher House		Civil	AA
4685	000-155-PVC-C-0118	Structural GA of Stair for Coal Crusher House		Civil	AA
4686	000-155-PVC-C-0119	Design calculations for Coal Crusher House CH Sub structure		Civil	AA
4687	000-155-PVC-C-0120	Foundation layout and RCC detail for Coal Crusher House CH structure		Civil	AA
4688	000-155-PVC-C-0121	GA & Reinforcement details of slabs for Coal Crusher House CH		Civil	AA
4689	000-155-PVC-C-0122	GA & Reinforcement details of Coal Crusher Deck Slab		Civil	AA
4690	000-155-PVC-C-0123	Strl Design Calculation of Lime Bulk Silo Building		Civil	AA
4691	000-155-PVC-C-0124	Structural GA for Lime Bulk Silo Building		Civil	AA
4692	000-155-PVC-C-0125	Design Calculations for Lime Bulk Silo Building Substructure		Civil	AA
4693	000-155-PVC-C-0126	GA & Reinforcement details of Lime Bulk Silo Building foundation		Civil	AA
4694	000-155-PVC-C-0127	GA & Reinforcement details of slabs for Lime Bulk Silo Building		Civil	AA
4695	000-155-PVC-C-0128	Strl Design Calculation of Biomass Bulk Silo Building		Civil	AA
4696	000-155-PVC-C-0129	Structural GA for Biomass Bulk Silo Building		Civil	AA
4697	000-155-PVC-C-0130	Design Calculations for Biomass Bulk Silo Building Substructure		Civil	AA
4698	000-155-PVC-C-0132	GA & Reinforcement details of slabs for Biomass Bulk Silo Building		Civil	AA
4699	000-155-PVC-C-0133	GA & Reinforcement details of Biomass Bulk Silo Building foundation		Civil	AA
4700	000-155-PVC-C-0134	Architectural drawing for Track hopper		Civil	AA
4701	000-155-PVC-C-0135	Architectural drawing for Transfer Point TP-3,TP-2,TP-1		Civil	AA
4702	000-155-PVC-C-0136	Architectural drawing for Coal Crusher House CH		Civil	AA
4703	000-155-PVC-C-0137	Architectural drawing for Transfer Point TP-8		Civil	AA
4704	000-155-PVC-C-0138	Architectural drawing for Transfer Point TP-9		Civil	AA
4705	000-155-PVC-C-0140	Architectural drawing for Lime Silo Buildings		Civil	AA
4706	000-155-PVC-C-0141	Architectural drawing for Biomass Silo Building		Civil	AA
4707	000-155-PVC-C-0142	Architectural drawing for MCC A		Civil	AA
4708	000-155-PVC-C-0143	Architectural drawing for MCC B		Civil	AA
4709	000-155-PVC-C-0144	Architectural drawing for MCC C		Civil	AA
4710	000-155-PVC-C-0145	Architectural drawing for Pump houses		Civil	AA
4711	000-155-PVC-C-0146	Data sheet for cladding sheet		Civil	AA
4712	000-155-PVC-C-0147	General Notes and Standard Details		Civil	AA
4713	000-155-PVC-C-0148	Geotechnical Investigation Report		Civil	AA
4714	000-155-PVC-C-0149	Dewatering and Excavation scheme for Track hopper		Civil	AA
4715	000-155-PVC-C-0150	Design Calculations for Track Hopper Substructure		Civil	A
4716	000-155-PVC-C-0151	Track hopper Complex-GA Drawings		Civil	AA
4717	000-155-PVC-C-0152	Track hopper Complex-RCC Drawings		Civil	AA
4718	000-155-PVC-C-0153	Track hopper Complex-Super structure Design		Civil	AA
4719	000-155-PVC-C-0154	Track hopper Complex-Super structure GA and structural details		Civil	AA
4720	000-155-PVC-C-0155	Design Calculations for Machinery hatch(MH) Track Hopper Substructure		Civil	AA
4721	000-155-PVC-C-0156	MH area-GA Drawings		Civil	AA
4722	000-155-PVC-C-0157	MH Complex-RCC Drawings		Civil	AA
4723	000-155-PVC-C-0158	MH Complex-Super structure Design		Civil	AA
4724	000-155-PVC-C-0159	MH Complex-Super structure GA and structural details		Civil	AA
4725	000-155-PVC-C-0160	Design Calculations for Bucket elevator		Civil	AA
4726	000-155-PVC-C-0161	GA and RCC detail for Bucket elevator		Civil	AA
4727	000-155-PVC-C-0162	Design of Tunnel for Conveyor 1A/B- RCC Raft, Wall and Slab		Civil	AA
4728	000-155-PVC-C-0163	Tunnel Conveyor 1A/B- General Arrangement Detail		Civil	AA
4729	000-155-PVC-C-0164	Tunnel Conveyor 1A/B -Reinforcement Detail		Civil	AA
4730	000-155-PVC-C-0165	GA & R/f details of ventilation duct & fan foundation for Tunnel Conveyor 1A/B		Civil	AA
4731	000-155-PVC-C-0166	Penthouse Foundation GA and RCC detail		Civil	AA
4732	000-155-PVC-C-0167	Penthouse Super Structure GA and RCC detail		Civil	AA
4733	000-155-PVC-C-0168	Design Calculations for Belt Conveyor BC 1A/B Superstructure		Civil	AA
4734	000-155-PVC-C-0169	Design Calculations for Belt Conveyor BC 1A/B Sub-structure		Civil	AA
4735	000-155-PVC-C-0170	GA & Reinforcement details of Belt Conveyor BC 1A/B foundation		Civil	AA
4736	000-155-PVC-C-0171	Structural details of Belt Conveyor BC 1A/B super structure		Civil	AA
4737	000-155-PVC-C-0172	Design Calculations for Belt Conveyor BC 2A/B Superstructure		Civil	AA
4738	000-155-PVC-C-0173	Design Calculations for Belt Conveyor BC 2A/B Sub-structure		Civil	AA
4739	000-155-PVC-C-0174	GA & Reinforcement details of Belt Conveyor BC 2A/B foundation		Civil	AA
4740	000-155-PVC-C-0175	Structural details of Belt Conveyor BC 2A/B super structure		Civil	AA
4741	000-155-PVC-C-0176	Design Calculations for Belt Conveyor BC 3A/B Superstructure		Civil	AA
4742	000-155-PVC-C-0177	Design Calculations for Belt Conveyor BC 3A/B Sub-structure		Civil	AA
4743	000-155-PVC-C-0178	GA & Reinforcement details of Belt Conveyor BC 3A/B foundation		Civil	AA
4744	000-155-PVC-C-0179	Structural details of Belt Conveyor BC 3A/B super structure		Civil	AA
4745	000-155-PVC-C-0180	Design Calculations for Belt Conveyor BC 4A/B Superstructure		Civil	A
4746	000-155-PVC-C-0181	Design Calculations for Belt Conveyor BC 4A/B Sub-structure		Civil	AA
4747	000-155-PVC-C-0182	GA & Reinforcement details of Belt Conveyor BC 4A/B foundation		Civil	AA
4748	000-155-PVC-C-0183	Structural details of Belt Conveyor BC 4A/B super structure		Civil	AA
4749	000-155-PVC-C-0184	Design Calculations for Belt Conveyor BC 10A/B Superstructure		Civil	AA
4750	000-155-PVC-C-0185	Design Calculations for Belt Conveyor BC 10A/B Sub-structure		Civil	AA
4751	000-155-PVC-C-0186	GA & Reinforcement details of Belt Conveyor BC 10A/B foundation		Civil	AA
4752	000-155-PVC-C-0187	Structural details of Belt Conveyor BC 10A/B super structure		Civil	AA
4753	000-155-PVC-C-0188	Design Calculations for Belt Conveyor BC 11A/B Superstructure		Civil	AA
4754	000-155-PVC-C-0189	Design Calculations for Belt Conveyor BC 11A/B Sub-structure		Civil	AA

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 61 OF 66

Si No	NTPC Drg No	DRG_TITLE	SUB-SYSTEM	Dept	CATEGORY
4755	000-155-PVC-C-0190	GA & Reinforcement details of Belt Conveyor BC 11A/B foundation		Civil	AA
4756	000-155-PVC-C-0191	Structural details of Belt Conveyor BC 11A/B super structure		Civil	AA
4757	000-155-PVC-C-0196	Design Calculations for Biomass Belt Conveyor Superstructure		Civil	AA
4758	000-155-PVC-C-0197	Design Calculations for Biomass Belt Conveyor Sub-structure		Civil	AA
4759	000-155-PVC-C-0198	GA & Reinforcement details of Biomass Belt Conveyor foundation		Civil	AA
4760	000-155-PVC-C-0199	Structural details of Biomass Belt Conveyor super structure		Civil	AA
4761	000-155-PVC-C-0200	Design calculations for Transfer Point TP-1 super structure		Civil	AA
4762	000-155-PVC-C-0201	Design calculations for Transfer Point TP-1 substructure		Civil	AA
4763	000-155-PVC-C-0202	Foundation layout and RCC details for Transfer Point TP-1		Civil	AA
4764	000-155-PVC-C-0203	Structural GA of Transfer Point TP-1		Civil	AA
4765	000-155-PVC-C-0204	Design calculations for Lime stone Transfer Point TP-1 super structure		Civil	AA
4766	000-155-PVC-C-0205	Design calculations for Lime stone Transfer Point TP-1 substructure		Civil	AA
4767	000-155-PVC-C-0206	Foundation layout and RCC details for Lime stone Transfer Point TP-1		Civil	AA
4768	000-155-PVC-C-0207	Structural GA of Lime stone Transfer Point TP-1		Civil	AA
4769	000-155-PVC-C-0208	Design calculations for Transfer Point TP-2 super structure		Civil	AA
4770	000-155-PVC-C-0209	Design calculations for Transfer Point TP-2 substructure		Civil	AA
4771	000-155-PVC-C-0210	Foundation layout and RCC details for Transfer Point TP-2		Civil	AA
4772	000-155-PVC-C-0211	Structural GA of Transfer Point TP-2		Civil	AA
4773	000-155-PVC-C-0212	Design calculations for Transfer Point TP-3 super structure		Civil	AA
4774	000-155-PVC-C-0213	Design calculations for Transfer Point TP-3 substructure		Civil	AA
4775	000-155-PVC-C-0214	Foundation layout and RCC details for Transfer Point TP-3		Civil	AA
4776	000-155-PVC-C-0215	Structural GA of Transfer Point TP-3		Civil	AA
4777	000-155-PVC-C-0216	Design calculations for Transfer Point TP-8 super structure		Civil	AA
4778	000-155-PVC-C-0217	Design calculations for Transfer Point TP-8 substructure		Civil	AA
4779	000-155-PVC-C-0218	Foundation layout and RCC details for Transfer Point TP-8		Civil	AA
4780	000-155-PVC-C-0219	Structural GA of Transfer Point TP-8		Civil	AA
4781	000-155-PVC-C-0220	Design calculations for Transfer Point TP-9 super structure		Civil	AA
4782	000-155-PVC-C-0221	Design calculations for Transfer Point TP-9 substructure		Civil	AA
4783	0000-155-PVC-C-XXXX	Misc Buildings-Design Philosophy/Basis including materials, loading, founding level/bearing capacity, analysis method, finishing/painting details etc. for all facilities in the area		Civil	A
4784	0000-001-PE-PVC-C-0271	AIR COMPRESSOR BLDG. - ARCHITECTURAL PLANS & FINISHING SCHEDULE		Civil	AA
4785	0000-001-PE-PVC-C-0272	AIR COMPRESSOR BLDG. - ARCHITECTURAL ELEVATIONS & SECTIONS		Civil	AA
4786	0000-001-PE-PVC-C-0273	AIR COMPRESSOR BLDG. - TOILET DETAILS		Civil	AA
4787	0000-001-315-PVC-C-1315	ESP CONT ROOM - G.A. & RC DETAILS OF TRANSFORMER FOUNDATIONS UNIT - 1		Civil	AA
4788	0000-001-315-PVC-C-1315A	ESP CONTROL BLDG. - ROOF FRAMING DETAILS - UNIT - 1		Civil	AA
4789	0000-001-315-PVC-C-1315B	ESP CONTROL BLDG. - G.A & R.C. DETAILS OF ROOF SLAB - UNIT - 1		Civil	AA
4790	0000-001-315-PVC-C-1451	SAFETY PARK - ARCHITECTURAL PLANS & FINISH SCHEDULE		Civil	AA
4791	0000-001-315-PVC-C-1452	SAFETY PARK - ARCHITECTURAL DETAIL		Civil	AA
4792	0000-001-315-PVC-C-1453	SAFETY PARK - TOILET DETAILS		Civil	AA
4793	0000-001-315-PVC-C-1454	SAFETY PARK - GA & RC DETAILS OF FOUNDATION		Civil	AA
4794	0000-001-315-PVC-C-1455	SAFETY PARK - STRUCTURAL DETAIL OF MAIN FRAME		Civil	AA
4795	0000-001-315-PVC-C-1456	SAFETY PARK - STRUCTURAL DETAIL OF ROOF AND SIDE CLADDING		Civil	AA
4796	0000-001-315-PVC-C-1457	SAFETY PARK - GA & RC DETAIL OF GRADE SLAB		Civil	AA
4797	0000-001-315-PVC-C-1458	SAFETY PARK - DETAILS OF PACKAGE TYPE STP		Civil	AA
4798	0000-001-315-PVC-U-090	SAFETY PARK - DESIGN OF FOUNDATIONS & PEDESTALS		Civil	AA
4799	0000-001-315-PVC-U-091	SAFETY PARK- DESIGN OF MAIN FRAME , BASE PLATE		Civil	AA
4800	0000-001-315-PVC-U-092	SAFETY PARK- DESIGN OF ROOF TRUSS AND SIDE CLADDING RUNNER		Civil	AA
4801	0000-155-PVC-C-XXXX	CW System-Design Philosophy/Basis including materials, loading, founding level/bearing capacity, analysis method, finishing/painting details etc. for all facilities in the area		Civil	A
4802	0000-155-PVC-C-XXXX	WTP-Design Philosophy/Basis including materials, loading, founding level/bearing capacity, analysis method, finishing/painting details etc. for all facilities in the area		Civil	A
4803	9562-135-PVC-B-001	Layout and details of foundation		Civil	AA
4804	9562-135-PVC-B-002	GA of foundation, pond wall and pedestal		Civil	A
4805	9562-135-PVC-B-003	Shell Profile And thickness.		Civil	A
4806	9562-135-PVC-B-005	Details of Staircase		Civil	AA
4807	9562-135-PVC-B-006	Details of Diagonal Columns For Cooling Tower		Civil	AA
4808	9562-135-PVC-B-007	GA of Fill Supporting Structure		Civil	AA
4809	9562-135-PVC-B-009	Details of C.W. Outlet, Hoist support structure and embedment dets.		Civil	AA
4810	9562-135-PVC-B-010	Layout and details of pile/foundation of internal fill support structure		Civil	AA
4811	9562-135-PVC-B-011	Details of Access Door		Civil	AA
4812	9562-135-PVC-B-012-SH1	Layout and Details of Pond floor and Grillage column footings		Civil	AA
4813	9562-135-PVC-B-012-SH2	Layout and Details of Pond floor and Grillage column footings		Civil	AA
4814	9562-135-PVC-C-001	R.C. Details of foundation, Pond Wall And Pedestal		Civil	AA
4815	9562-135-PVC-C-002	Details Of External M.S. Ladder		Civil	AA
4816	9562-135-PVC-C-003	RCC Details of Tower Shell from EL+8m to EL+30m		Civil	AA
4817	9562-135-PVC-C-005	Details of all around pavement		Civil	AA
4818	9562-135-PVC-C-006	RCC Details of Tower Shell from EL+60 to EL+90m		Civil	AA
4819	9562-135-PVC-C-007	RCC Details of Tower Shell from EL+90 to EL+120		Civil	AA
4820	9562-135-PVC-C-008	RCC Details of Tower Shell from EL+120 to TOP OF SHELL		Civil	AA
4821	9562-135-PVC-C-009	RCC Details of Grillage Columns and Bracings		Civil	AA
4822	9562-135-PVC-C-010	RC Details of Lower Tier Beams (precast main beams)		Civil	AA
4823	9562-135-PVC-C-011	Details of precast fill supporting beams		Civil	AA
4824	9562-135-PVC-C-012	RC details of Upper Tier Beams		Civil	AA
4825	9562-135-PVC-C-013	R.C.C.Details of Basin Floor and Grillage Column Footings		Civil	AA
4826	9562-135-PVC-C-014	R. C. Details of CW Outlet, embedment dets of gates & trash racks		Civil	AA
4827	9562-135-PVC-C-015	R.C. Details of Drain Sump and Drain Box		Civil	AA
4828	9562-135-PVC-C-016	R.C. Details of Main Hot Water Duct		Civil	AA
4829	9562-135-PVC-C-019	Details of Intermediate Access/changeover Platform		Civil	AA
4830	9562-135-PVC-C-020	Details of Screen Trash Rack at Outlet		Civil	AA
4831	9562-135-PVC-C-022	Details of external Trestles for Hot water piping		Civil	AA
4832	9562-135-PVC-C-023	RC Details of intermediate tier beams		Civil	AA
4833	9562-135-PVC-C-024	Details of Precast Beam at Drift Eliminator level		Civil	AA
4834	9562-135-PVC-C-025	Numeration and RC details of Column Brackets supporting Precast Grid Beams		Civil	AA
4835	9562-135-PVC-U-007	Analysis & design of fill supporting structure		Civil	AA
4836	9562-135-PVC-U-010	Analysis & design of Hot water duct & Supporting structure		Civil	AA
4837	9562-135-PVC-U-011	Analysis & Design of pond wall, pond floor		Civil	AA
4838	9562-135-PVC-U-012	Analysis & design of desludge chamber		Civil	AA
4839	9562-135-PVC-U-013	Analysis & design of cold water outlet & Monorail lifting arrangement		Civil	AA

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 62 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
4840	9562-135-PVC-U-014	Analysis & design of staircase		Civil	AA
4841	9562-135-PVC-U-015	Analysis & design of platform		Civil	AA
4842	9562-135-PVC-U-016	Analysis & design of Miscellaneous items (Stop log gates, trash racks, etc)		Civil	AA
4843	9562-135-PVC-U-017	Analysis & design of Precast Beams		Civil	AA
4844	9562-135-PVC-U-019	Wind Tunnel Testing : Methodology and Report		Civil	AA
4845	9562-135-PVC-U-021	Analysis and design of columns for internal fill supporting structure		Civil	AA
4846	9562-135-PVC-U-022	Design of Lower Tier and Tie Beams		Civil	AA
4847	9562-135-PVC-U-023	Design of Upper Tier Beams		Civil	AA
4848	9562-135-PVC-U-024	Design of pedestals for hot water piping		Civil	AA
4849	9562-135-PVC-U-026	Design of intermediate tier beams		Civil	AA
4850	9562-135-PVC-U-028	Wind Tunnel Test Report		Civil	AA
4851	9562-135-PVC-U-029	Design of Column Brackets		Civil	AA
4852	9578-001-136-PVC-B-003A	Water Treatment Plant - Layout and Details of Aerator, Stilling Chamber, Parshall Flume and Inlet chamber (For PT - CW)		Civil	AA
4853	9578-001-136-PVC-B-006A	Water Treatment Plant - Layout and Details of Aerator, Stilling Chamber, Parshall Flume and Inlet chamber (For DM)		Civil	AA
4854	9578-001-136-PVC-B-009A	Water Treatment Plant - GA and Sectional Details of Non-DM Clarifier		Civil	AA
4855	9578-001-136-PVC-B-010A	Water Treatment Plant - RC Details of Non-DM Clarifier		Civil	AA
4856	9578-001-136-PVC-B-012B	Water Treatment Plant - Sectional Details of Interconnecting Channels and Walkways		Civil	AA
4857	9578-001-136-PVC-B-016	Water Treatment Plant - RC Details of DM Clarifier		Civil	AA
4858	9578-001-136-PVC-B-021A	Water Treatment Plant -Gravity Filter house - Architectural Floor Plan at Ground Floor, Channel cum Walkway and Roof		Civil	AA
4859	9578-001-136-PVC-B-022	Water Treatment Plant -Gravity Filter house - Layout and Sections- Sheet 1		Civil	AA
4860	9578-001-136-PVC-B-023	Water Treatment Plant -Gravity Filter house - Layout and Sections- Sheet 2		Civil	AA
4861	9578-001-136-PVC-B-024	Water Treatment Plant -Gravity Filter house - Layout and Sections		Civil	AA
4862	9578-001-136-PVC-B-025	Water Treatment Plant -PIPING CORRIDOR -LAYOUT AND RC Details		Civil	AA
4863	9578-001-136-PVC-B-030A	Chemical House - Ground Floor Plan / Roof Plan		Civil	AA
4864	9578-001-136-PVC-B-030B	Chemical House - Elevation / Sections		Civil	AA
4865	9578-001-136-PVC-B-030C	Chemical House - Door / Window Details, Toilet Details, and Finishes Schedule		Civil	AA
4866	9578-001-136-PVC-B-031A	Chemical House - Layout and RC Details of Foundations and Columns		Civil	AA
4867	9578-001-136-PVC-B-032A	Chemical House - Layout and RC Details of Plinth Beams and Lintel Beams		Civil	AA
4868	9578-001-136-PVC-B-032B	Chemical House - Layout and RC Details of First Floor Beams and Slab		Civil	AA
4869	9578-001-136-PVC-B-033	Chemical House - Layout and RC Details of Grade slab		Civil	AA
4870	9578-001-136-PVC-B-034A	Chemical House - Layout and RC Details of Tanks and Pedestals at first floor - Sheet 1		Civil	AA
4871	9578-001-136-PVC-B-035A	Chemical House - Layout and RC Details of Lintel Beams and Tie Beams		Civil	AA
4872	9578-001-136-PVC-B-035B	Chemical House - Layout and RC Details of Roof Beams and Slab		Civil	AA
4873	9578-001-136-PVC-B-036A	Chemical House - Layout and RC Details of Staircase		Civil	AA
4874	9578-001-136-PVC-B-038	Chemical House - Layout and RC Details of Tanks above Roof		Civil	AA
4875	9578-001-136-PVC-B-041	Water Treatment Plant - Layout and RC Details Backwash Waste Collection Pit		Civil	AA
4876	9578-001-136-PVC-B-046A	Effluent Treatment Plant - PT Switchgear Room - Architectural Floor Plan at Ground Floor and Roof, Door, Window and Finishing Schedule		Civil	AA
4877	9578-001-136-PVC-B-047	Effluent Treatment Plant- PT Switchgear Room- Layout and RC Details of Foundations, Columns and Plinth Beams		Civil	AA
4878	9578-001-136-PVC-B-048	Effluent Treatment Plant- PT Switchgear Room- Layout and RC Details of Roof Beams and slab		Civil	AA
4879	9578-001-136-PVC-B-049	Effluent Treatment Plant- PT Switchgear Room- Layout and RC Details of Grade slab		Civil	AA
4880	9578-001-136-PVC-B-058	Effluent Treatment Plant area:: Layout and RC Details of waste service water collection Sump and Pump sump		Civil	AA
4881	9578-001-136-PVC-B-063	Water Treatment Plant - Layout and RC Details of Sludge Sump and Pump area		Civil	AA
4882	9578-001-136-PVC-B-068A	PT Chlorination Building - Arch Ground Floor & Roof Plan, Elevation, Sections Finish Schedule and D/W schedule		Civil	AA
4883	9578-001-136-PVC-B-068B	CW Chlorination Building - Plan,Elevation/Sections,Finish Schedule,D/W Schedule		Civil	AA
4884	9578-001-136-PVC-B-068C	CW Chlorination Building -Roof Framing details		Civil	AA
4885	9578-001-136-PVC-B-068D	PT Chlorination Building -Layout and RC detail foundation and Columns		Civil	AA
4886	9578-001-136-PVC-B-068F	PT Chlorination Building - Layout and RC Details of Roof Beams and Slab		Civil	AA
4887	9578-001-136-PVC-B-068G	PT Chlorination Building - Layout and RC Details of Grade Slab		Civil	AA
4888	9578-001-136-PVC-B-068H	PT Chlorination Building - Roof Framing Details		Civil	AA
4889	9578-001-136-PVC-B-069A	CW Chlorination Building - Layout of Foundations, Columns		Civil	AA
4890	9578-001-136-PVC-B-069C	Chlorination Building - Layout and RC Details of Plinth Beams and Lintel Beams		Civil	AA
4891	9578-001-136-PVC-B-070	Chlorination Building - Layout and RC Details of Roof Beams and Slab		Civil	AA
4892	9578-001-136-PVC-B-072	CW Chlorination Building - Layout and RC Details of Grade Slab		Civil	AA
4893	9578-001-136-PVC-B-082A	Effluent Treatment Plant area: Layout and RC Details of Lamella clarifier		Civil	AA
4894	9578-001-136-PVC-B-087A	Effluent Treatment Plant - Central Monitoring Basin - Layout and R C details		Civil	AA
4895	9578-001-136-PVC-B-092	Clarified Water Storage Tank - Layout, Sections and Details		Civil	AA
4896	9578-001-136-PVC-B-093A	Clarified Water Storage Tank - RC Details of Wall, Column and Counterfort		Civil	AA
4897	9578-001-136-PVC-B-093B	Clarified Water Storage Tank - Layout of Roof Slab		Civil	AA
4898	9578-001-136-PVC-B-095	Clarified Water Storage Tank and Pump House-Layout and RC Details of Equipment Foundation		Civil	AA
4899	9578-001-136-PVC-B-110	CW Chemical House- Ground Floor Plan / Roof Plan,ELEVATION AND SECTION		Civil	AA
4900	9578-001-136-PVC-B-118	Filtered Water Storage Tank - Layout of Base Slab & Walls		Civil	AA
4901	9578-001-136-PVC-B-135	Effluent Treatment Plant - Effluent Holding Tank Area Oil water separator Pit - Layout		Civil	AA
4902	9578-001-136-PVC-C-004A	Water Treatment Plant - Neutralization Pit & Backwash Pit - Layout and RC Details		Civil	AA
4903	9578-001-136-PVC-C-016A	DM Plant Area - Degassed Water Storage Tank Foundation - Analysis and Design		Civil	AA
4904	9578-001-136-PVC-C-021A	DM Plant Area - Bulk Acid and Alkali Storage Area - Analysis and Design		Civil	AA
4905	9578-001-136-PVC-C-022A	DM Plant Area - Bulk Acid and Alkali Storage Area - Layout		Civil	AA
4906	9578-001-136-PVC-C-025A	DM Plant Building-Analysis and Design of Substructure		Civil	AA
4907	9578-001-136-PVC-C-025B	DM Plant Building-Analysis and Design of Superstructure		Civil	AA
4908	9578-001-136-PVC-C-027A	DM Plant Building-Layout and RC details of foundations and Pedestals		Civil	AA
4909	9578-001-136-PVC-C-027B	DM Plant Building- Layout and RC details of grade slab		Civil	AA
4910	9578-001-136-PVC-C-028	DM Plant Building- Architectural Floor and Roof Plan		Civil	AA
4911	9578-001-136-PVC-C-029	DM Plant Building- Girt Elevations and details		Civil	AA
4912	9578-001-136-PVC-C-031A	Laboratory Building - Layout and RC Details of Plinth Beams and Lintel Beams		Civil	AA
4913	9578-001-136-PVC-C-031B	Laboratory Building - Layout and RC Details of First Floor Beams and Slab		Civil	AA

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 63 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
4914	9578-001-136-PVC-C-031C	DM Chemical Laboratory Building - Layout and RC Details of Roof Beams and Slab		Civil	AA
4915	9578-001-136-PVC-C-033A	Laboratory Building - Layout and RC Details of Staircase		Civil	AA
4916	9578-001-136-PVC-C-035A	CW Chemical Laboratory Building - Layout and RC Details of Grade slab		Civil	AA
4917	9578-001-136-PVC-C-036A	Laboratory Building - Ground Floor Plan / Roof Plan		Civil	AA
4918	9578-001-136-PVC-C-036B	Laboratory Building - Elevation / Sections		Civil	AA
4919	9578-001-136-PVC-C-036C	Laboratory Building - Toilet Details		Civil	AA
4920	9578-001-136-PVC-C-043A	Water Treatment Plant -Layouts and details of interconnecting pathways and paving details for all facilities		Civil	AA
4921	9578-001-136-PVC-C-113	CW Chemical House- Layout and RC Details of Foundations and Columns		Civil	AA
4922	9578-001-136-PVC-C-114	CW Chemical House-layout and details of base plates, steel framing plans and elevation		Civil	AA
4923	9578-001-136-PVC-C-116	CW Chemical House- Layout and RC Details of Tanks and Grade Slab		Civil	AA
4924	9578-001-136-PVC-C-119	Filtered Water Storage Tank -Layout and RC Details of Top Slab and Beams		Civil	AA
4925	9578-001-136-PVC-C-119	Filtered Water Storage Tank -Layout and RC Details of Top Slab and Beams		Civil	AA
4926	9578-001-136-PVC-C-123	Water Treatment Plant-Layout & RC detail of CPU Sump Pit		Civil	AA
4927	9578-001-136-PVC-C-124	Miscellaneous Sumps and Pits Layout and RC Details of Pit		Civil	AA
4928	9578-001-136-PVC-C-133	Effluent Treatment Plant - Layout and RC Details of Grade Slab- Sheet 1		Civil	AA
4929	9578-001-136-PVC-U-002A	Water Treatment Plant - Analysis and Design of Neutralization Pit		Civil	AA
4930	9578-001-136-PVC-U-002B	Water Treatment Plant - Analysis and Design of Stilling Chamber, Parshall Flume and Flash Mixer (For Main Service)		Civil	AA
4931	9578-001-136-PVC-U-005B	Water Treatment Plant - Analysis and Design of Aerator (For DM)		Civil	AA
4932	9578-001-136-PVC-U-008	Water Treatment Plant - Analysis and Design of Non-DM Clarifiers		Civil	AA
4933	9578-001-136-PVC-U-014	Water Treatment Plant - Analysis and Design of DM Clarifiers		Civil	AA
4934	9578-001-136-PVC-U-017	Water Treatment Plant - Analysis and Design of Interconnecting Channel		Civil	AA
4935	9578-001-136-PVC-U-020B	Water Treatment Plant -Gravity Filter house - Analysis and Design of Superstructure		Civil	AA
4936	9578-001-136-PVC-U-020C	Filtered Water Storage Tank - Analysis and Design		Civil	AA
4937	9578-001-136-PVC-U-023A	DM Tank Foundation - Analysis and Design of Ring Wall Foundation		Civil	AA
4938	9578-001-136-PVC-U-023B	DM Tank Area - Analysis and Design of Misc. foundations and Pipe Sleepers		Civil	AA
4939	9578-001-136-PVC-U-023C	Analysis and design of pipe sleepers		Civil	AA
4940	9578-001-136-PVC-U-026A	DM Plant Building- Base plate Layout and details		Civil	AA
4941	9578-001-136-PVC-U-026B	DM Plant Building- Framing elevation		Civil	AA
4942	9578-001-136-PVC-U-026C	DM Plant Building- Details of Roof Framing		Civil	AA
4943	9578-001-136-PVC-U-026D	DM Plant Building- Purlin plan and details		Civil	AA
4944	9578-001-136-PVC-U-029A	Chemical House - Analysis and Design of Substructure		Civil	AA
4945	9578-001-136-PVC-U-029B	Chemical Hous - Analysis and Design of Superstructure		Civil	AA
4946	9578-001-136-PVC-U-030A	DM Chemical Laboratory Building - Layout and RC Details of Foundations and Columns		Civil	AA
4947	9578-001-136-PVC-U-031	LAB BUILDING - Analysis and Design		Civil	AA
4948	9578-001-136-PVC-U-037	Chemical House - Analysis and Design of Water Storage tank		Civil	AA
4949	9578-001-136-PVC-U-040	Water Treatment Plant - Analysis and Design of Backwash collection pit		Civil	AA
4950	9578-001-136-PVC-U-045	Effluent Treatment Plant - Central Monitoring Basin Switchgear room - Analysis and Design		Civil	AA
4951	9578-001-136-PVC-U-046A	Pipe pedestals DM Plant Area- RC Details		Civil	AA
4952	9578-001-136-PVC-U-081	Effluent Treatment Plant area- Analysis and design of lamella clarifier		Civil	AA
4953	9578-001-136-PVC-U-086A	Effluent Treatment Plant - Central Monitoring Basin - Analysis and Design		Civil	AA
4954	9578-001-136-PVC-U-091A	Clarified Water Storage Tank - Analysis and Design		Civil	AA
4955	9578-001-136-PVC-U-091B	Clarified Water Pump Area - Analysis and Design of Equipment Foundations		Civil	AA
4956	9578-001-136-PVC-U-091C	Clarified Water Storage Tank - Analysis and Design of super structure		Civil	AA
4957	9578-001-136-PVC-U-124	Miscellaneous Sumps and Pits , Analysis and Design		Civil	AA
4958	9578-001-136-PVC-U-142	Chlorination Building - Analysis and Design		Civil	AA
4959	9578-001-136-PVC-U-143	CW Chemical House- Analysis and Design of Substructure		Civil	AA
4960	9578-001-136-PVC-U-144	CW Chemical House- Analysis and Design of Superstructure and Foundation		Civil	AA
4961	9578-001-136-PVC-U-145	DM , WTP & CPU MCC Building - Analysis and Design of Substructure		Civil	AA
4962	9578-001-136-PVC-U-146	DM , WTP & CPU MCC Building - Analysis and Design of Superstructure		Civil	AA
4963	9578-001-136-PVC-U-150	Water Treatment Plant - Analysis and Design of Sludge Sump		Civil	AA
4964	9578-001-136-PVC-U-153	DM,WTP & CPU MCC Bldg ,RWPH Switchgear Room and FWPH- Analysis and Design of Transformer Foundation		Civil	AA
4965	9578-001-136-PVC-U-155	Effluent Treatment Plant Area ?Analysis & Design oil water separator		Civil	AA
4966	9578-001-136-PVC-U-156	Effluent Treatment Plant Area ?Analysis and Design of Miscellaneous Tank		Civil	AA
4967	XXXX-001-110-HWR-PVC-C-001	Foundation Design-Description of loads and design criteria for foundation of super critical sets	TG Pkg. Elect	Electrical	AA
4968	XXXX-001-110-HJS-PVC-V-247	UNIT TRANSFORMER - FOUNDATION PLAN	TG Pkg. Elect	Electrical	AA
4969	0000-001-102-PVC-K-015	Erection Strategy for Boiler	EPC-SG_sys	SG	AA
4970	XXXX-001-XXX-PVC-X-001	IDCT-Design Philosophy/Basis including materials, loading, founding level/bearing capacity, analysis method, finishing/painting details etc. for all facilities in the area	CIVIL	CIVIL	A
4971	XXXX-001-XXX-PVC-X-002	Civil Design Basis of IDCT	CIVIL	CIVIL	A
4972	XXXX-001-XXX-PVC-X-003	DESIGN CALCULATION OF SUB STRUCTURE FOR CT	CIVIL	CIVIL	A
4973	XXXX-001-XXX-PVC-X-004	DESIGN CALCULATION FOR OUTLET, SLUDGE PIT & PIPE SUPPORT FOR IDCT	CIVIL	CIVIL	A
4974	XXXX-001-XXX-PVC-X-005	DESIGN CALCULATION FORDESIGN CALCULATION FOR STAIRCASE FOR CT	CIVIL	CIVIL	A
4975	XXXX-001-XXX-PVC-X-006	DESIGN CALCULATION FOR SUPER STRUCTURE OF CT	CIVIL	CIVIL	A
4976	XXXX-001-XXX-PVC-X-007	DESIGN CALCULATION FOR STOP LOG GATE/SLIDE GATE	CIVIL	CIVIL	A
4977	XXXX-001-XXX-PVC-X-008	GA AND DETAIL OF BOTTOM ASH HOPPER AND STAIR	CIVIL	CIVIL	A
4978	XXXX-001-XXX-PVC-X-009	BUFFER HOPPER- GA AND DETAIL	CIVIL	CIVIL	A
4979	XXXX-001-XXX-PVC-X-010	SURGE TANK- GA AND DETAIL	CIVIL	CIVIL	A
4980	XXXX-001-XXX-PVC-X-011	SETTLING TANK- GA AND DETAIL	CIVIL	CIVIL	A
4981	XXXX-001-XXX-PVC-X-012	MIXING TANK -GA AND DETAIL	CIVIL	CIVIL	A
4982	XXXX-001-XXX-PVC-X-013	FA SILO- SUPER STRUCTURE	CIVIL	CIVIL	A
4983	XXXX-001-XXX-PVC-X-014	HSCD SILO- SUPER STRUCTURE	CIVIL	CIVIL	A
4984	XXXX-001-XXX-PVC-X-015	BOTTOM ASH OVERFLOW TANK- SUPER STRUCTURE	CIVIL	CIVIL	A
4985	XXXX-001-XXX-PVC-X-016	GA AND DETAIL OF BOTTOM SEAL WATER TANK	CIVIL	CIVIL	A
4986	XXXX-001-XXX-PVC-X-017	Ash slurry pump house building structural design	CIVIL	CIVIL	A
4987	XXXX-001-XXX-PVC-X-018	Ash slurry pump house building structural load data	CIVIL	CIVIL	A
4988	XXXX-001-XXX-PVC-X-019	HSCD Pump house shed super structure design calculation	CIVIL	CIVIL	A
4989	XXXX-001-XXX-PVC-X-020	HSCD Pump house shed super structure general arrangement	CIVIL	CIVIL	A
4990	XXXX-001-XXX-PVC-X-021	Structural calculation for TAC building	CIVIL	CIVIL	A
4991	XXXX-001-XXX-PVC-X-022	Structural GA of APH Slurry Tank	CIVIL	CIVIL	A
4992	XXXX-001-XXX-PVC-X-023	Structural calculation for APH Slurry Tank	CIVIL	CIVIL	A
4993	XXXX-001-XXX-PVC-X-024	DESIGN OF BOTTOM ASH HOPPER INCLUDING STAIRCASE	CIVIL	CIVIL	A

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 64 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
4994	XXXX-001-XXX-PVC-X-025	DESIGN OF BUFFER HOPPER INCLUDING STAIRCASE	CIVIL	CIVIL	A
4995	XXXX-001-XXX-PVC-X-026	DESIGN OF SURGE TANK	CIVIL	CIVIL	A
4996	XXXX-001-XXX-PVC-X-027	DESIGN OF SETTLING TANK	CIVIL	CIVIL	A
4997	XXXX-001-XXX-PVC-X-028	DESIGN OF MIXING TANK	CIVIL	CIVIL	A
4998	XXXX-001-XXX-PVC-X-029	DESIGN OF FA SILO INCLUDING STAIRCASE	CIVIL	CIVIL	A
4999	XXXX-001-XXX-PVC-X-030	DESIGN OF HSCD SILO INCLUDING STAIRCASE	CIVIL	CIVIL	A
5000	XXXX-001-XXX-PVC-X-031	DESIGN OF BOTTOM ASH OVERFLOW TANK	CIVIL	CIVIL	A
5001	XXXX-001-XXX-PVC-X-032	DESIGN OF BOTTOM SEAL WATER TANK	CIVIL	CIVIL	A
5002	XXXX-001-XXX-PVC-X-033	BOTTOM ASH HOPPER - GA & LOAD DATA AT BASE PLATE LEVEL ALONGWITH STAIRCASE & MISC. SUPPORT NEAR BAH AREA	CIVIL	CIVIL	A
5003	XXXX-001-XXX-PVC-X-034	BUFFER HOPPER TOWER - GA & LOAD DATA AT BASE PLATE LEVEL ALONG WITH STAIRCASE	CIVIL	CIVIL	A
5004	XXXX-001-XXX-PVC-X-035	HSCD P/P HOUSE SHED - FOUNDATION LOAD DATA AT BASE PLATE LEVEL ALONG WITH STAIRCASE	CIVIL	CIVIL	A
5005	XXXX-001-XXX-PVC-X-036	Load data for mixing tank	CIVIL	CIVIL	A
5006	XXXX-001-XXX-PVC-X-037	Foundation load data for TAC building	CIVIL	CIVIL	A
5007	XXXX-001-XXX-PVC-X-038	Silo Utility Building Complex : Floor plans/roof plan	CIVIL	CIVIL	A
5008	XXXX-001-XXX-PVC-X-039	Silo Utility Building Complex : Elevation And Sections	CIVIL	CIVIL	A
5009	XXXX-001-XXX-PVC-X-040	Silo Utility Building Complex: Layout & RCC Details Of Foundations, plinth beam & Columns	CIVIL	CIVIL	A
5010	XXXX-001-XXX-PVC-X-041	Silo Utility Building Complex: Layout & RCC Details Of Lintel Beams, Crane Girder, Etc.	CIVIL	CIVIL	A
5011	XXXX-001-XXX-PVC-X-042	Silo Utility Building Complex: Layout & RCC Details Of Roof	CIVIL	CIVIL	A
5012	XXXX-001-XXX-PVC-X-043	Silo Utility Building Complex: Structural- Details of crane Girder	CIVIL	CIVIL	A
5013	XXXX-001-XXX-PVC-X-044	Silo Utility Building Complex: Layout & RCC Details Of Ground Floor & Equipment Foundations	CIVIL	CIVIL	A
5014	XXXX-001-XXX-PVC-X-045	Silo Area Complex : Layout & RCC Details Of Paving Including Drains, Sump, Etc.	CIVIL	CIVIL	A
5015	XXXX-001-XXX-PVC-X-046	Transport Air Compressor Room : Floor plans/roof plan	CIVIL	CIVIL	A
5016	XXXX-001-XXX-PVC-X-047	Transport Air Compressor Room : Elevation And Sections	CIVIL	CIVIL	A
5017	XXXX-001-XXX-PVC-X-048	Transport Air Compressor Room : Door/window/ Ventilator/ finish schedule and Details	CIVIL	CIVIL	A
5018	XXXX-001-XXX-PVC-X-049	Transport Air Compressor Room : Layout & RCC Details Of Foundations & Pedestals	CIVIL	CIVIL	A
5019	XXXX-001-XXX-PVC-X-050	Transport Air Compressor Room :Structural GA of Shed	CIVIL	CIVIL	A
5020	XXXX-001-XXX-PVC-X-051	Transport Air Compressor Room : Layout & RCC Details Of Ground Floor & Equipment Foundations	CIVIL	CIVIL	A
5021	XXXX-001-XXX-PVC-X-052	Ash Slurry Pump House : Structural GA of PH Shed	CIVIL	CIVIL	A
5022	XXXX-001-XXX-PVC-X-053	Bottom Ash Slurry Pump House : Elevation And Sections	CIVIL	CIVIL	A
5023	XXXX-001-XXX-PVC-X-054	Ash Slurry Pump House :Floor and Roof Plan	CIVIL	CIVIL	A
5024	XXXX-001-XXX-PVC-X-055	Ash Slurry Pump House : Layout & RCC Details Of Sump	CIVIL	CIVIL	A
5025	XXXX-001-XXX-PVC-X-056	Bottom Ash Slurry Pump House : Layout & RCC Details Of Foundations & Pedestals	CIVIL	CIVIL	A
5026	XXXX-001-XXX-PVC-X-057	Ash Slurry Pump House : Layout & RCC Details Of Ground Floor & Equipment Foundations	CIVIL	CIVIL	A
5027	XXXX-001-XXX-PVC-X-058	Ash Water Pump House : Layout & RCC Details Of Sump	CIVIL	CIVIL	A
5028	XXXX-001-XXX-PVC-X-059	Ash Water Pump House : Layout & RCC Details Of Ground Floor & Equipment Foundations	CIVIL	CIVIL	A
5029	XXXX-001-XXX-PVC-X-060	HSCD Pump House: Floor plans/roof plan	CIVIL	CIVIL	A
5030	XXXX-001-XXX-PVC-X-061	HSCD Pump House: Elevations And Sections	CIVIL	CIVIL	A
5031	XXXX-001-XXX-PVC-X-062	HSCD Pump House : Layout & RCC Details Of Foundations, plinth beam & Pedestals	CIVIL	CIVIL	A
5032	XXXX-001-XXX-PVC-X-063	HSCD Pump House : Layout & RCC Details Of Ground Floor & Equipment Foundations	CIVIL	CIVIL	A
5033	XXXX-001-XXX-PVC-X-064	Ash Handling Control Building : Floor plans/roof plan	CIVIL	CIVIL	A
5034	XXXX-001-XXX-PVC-X-065	Ash Handling Control Building : Elevations And Sections	CIVIL	CIVIL	A
5035	XXXX-001-XXX-PVC-X-066	Ash Handling Control Building : Door/window/ Ventilator/ finish schedule and Details	CIVIL	CIVIL	A
5036	XXXX-001-XXX-PVC-X-067	AHP Switchgear cum Control room building: Layout & RC Details Of Foundations & Columns	CIVIL	CIVIL	A
5037	XXXX-001-XXX-PVC-X-068	AHP Switchgear cum Control room building: Layout & RC Details Of plinth beams & Lintel Beams	CIVIL	CIVIL	A
5038	XXXX-001-XXX-PVC-X-069	Ash Handling Switchgear cum Control Building : Layout & RCC Details Of Floor beam, Roof Beam and Slab	CIVIL	CIVIL	A
5039	XXXX-001-XXX-PVC-X-070	Ash Handling Control Building : Layout & RCC Details Of Ground Floor & Equipment Foundations	CIVIL	CIVIL	A
5040	XXXX-001-XXX-PVC-X-071	Ash Handling Control Building : Layout & RCC Details Of Transformer Yard	CIVIL	CIVIL	A
5041	XXXX-001-XXX-PVC-X-072	Fly Ash Silo : Layout & RCC Details Of Foundations & Pedestal	CIVIL	CIVIL	A
5042	XXXX-001-XXX-PVC-X-073	HSCD Silo : Layout & RCC Details Of Foundations & Pedestal	CIVIL	CIVIL	A
5043	XXXX-001-XXX-PVC-X-074	Settling Tank : Layout & RCC Details Of Foundation & Pedestal	CIVIL	CIVIL	A
5044	XXXX-001-XXX-PVC-X-075	Surge Tank : Layout & RCC Details Of Foundation & Pedestal	CIVIL	CIVIL	A
5045	XXXX-001-XXX-PVC-X-076	Bottom Ash Over Flow Tank : Layout & RCC Details Of Foundation & Pedestal	CIVIL	CIVIL	A
5046	XXXX-001-XXX-PVC-X-077	Vacuum Pump : Layout & RCC Details Of Foundation	CIVIL	CIVIL	A
5047	XXXX-001-XXX-PVC-X-078	Implant BA Slurry Pipeline Pedestal : Layout & RCC Details Of Pedestals From Bah To Slurry Sump	CIVIL	CIVIL	A
5048	XXXX-001-XXX-PVC-X-079	BA Slurry Disposal Pipeline : RCC Details Of Pedestals From BA Slurry Sump Upto Plant Boundary	CIVIL	CIVIL	A
5049	XXXX-001-XXX-PVC-X-080	Slurry Disposal Pipeline : Layout & RCC Details Of Culvert Upto Ash Dyke	CIVIL	CIVIL	A
5050	XXXX-001-XXX-PVC-X-081	Slurry Disposal Pipeline :Layout & RCC Details Of Pedestals Upto Ash Dyke	CIVIL	CIVIL	A
5051	XXXX-001-XXX-PVC-X-082	Slurry Disposal Pipeline :Layout & RCC Details Of garlanding Pedestals.	CIVIL	CIVIL	A
5052	XXXX-001-XXX-PVC-X-083	HSCD SILO AREA COMPLEX : Layout & RCC DETAILS OF PAVING INCLUDING DRAINS, SUMP, ETC.	CIVIL	CIVIL	A
5053	XXXX-001-XXX-PVC-X-084	FLY ASH BUFFER HOPPER TOWER WITH STAIRCASE(UNIT#1) - DESIGN CALCULATION FOR FOUNDATION	CIVIL	CIVIL	A
5054	XXXX-001-XXX-PVC-X-085	Silo Utility Building Complex -Analysis and Design	CIVIL	CIVIL	A
5055	XXXX-001-XXX-PVC-X-086	Transport Air Compressor Room -Analysis and Design of foundation	CIVIL	CIVIL	A
5056	XXXX-001-XXX-PVC-X-087	Bottom Ash Slurry Pump House foundation and sump -Analysis and Design	CIVIL	CIVIL	A
5057	XXXX-001-XXX-PVC-X-088	Ash Water sump -Analysis and Design	CIVIL	CIVIL	A
5058	XXXX-001-XXX-PVC-X-089	HSCD Pump House foundation -Analysis and Design	CIVIL	CIVIL	A
5059	XXXX-001-XXX-PVC-X-090	AHP Switchgear cum Control room building-Analysis and Design of Substructure	CIVIL	CIVIL	A
5060	XXXX-001-XXX-PVC-X-091	AHP Switchgear cum Control room building-Analysis and Design of Superstructure	CIVIL	CIVIL	A
5061	XXXX-001-XXX-PVC-X-092	Fly Ash Silo Foundation : Analysis and Design	CIVIL	CIVIL	A
5062	XXXX-001-XXX-PVC-X-093	HSCD Silo foundation: Analysis and Design	CIVIL	CIVIL	A
5063	XXXX-001-XXX-PVC-X-094	Surge and Settling Tank: Analysis & Design	CIVIL	CIVIL	A

PART-B

SINGARENI TPP-II (1X800MW)
EPC PACKAGE

SUB-SECTION-G-07
BID DOC NO.:CW-CM-11159-C-O-M-001

MDL
PAGE 65 OF 66

Si No	NTPC Drg No	DRG_ TITLE	SUB-SYSTEM	Dept	CATEGORY
5064	XXXX-001-XXX-PVC-X-095	DEWATERING BIN :FOUNDATION AND RC DETAIL OF DEWATERING BIN	CIVIL	CIVIL	A
5065	XXXX-001-XXX-PVC-X-096	DEWATERING BIN :GA SILO SUPER STRUCTURE	CIVIL	CIVIL	A
5066	XXXX-001-XXX-PVC-X-097	DEWATERING BIN :DESIGN CALCULATION FOR DEWATERING BIN FOUNDATION	CIVIL	CIVIL	A
5067	XXXX-001-XXX-PVC-X-098	DEWATERING BIN :DESIGN CALCULATION FOR DEWATERING BIN STRUCTURE	CIVIL	CIVIL	A
Note-1 Date of submission of MQP's shall be as per the L2 schedule subject to the condition that applicable data sheet shall be duly approved atleast in CAT-II by NTPC engineering.					
5068	xxxx-001-PVM-F-008	ERECTION MANUAL FOR COMPLETE PLANT			AA



SUB-SECTION–A-01

EQUIPMENT SIZING CRITERIA

**SINGARENI THERMAL POWER PROJECT
STAGE-II (1X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC NO.:CW-CM-11159-C-O-M-001**

CLAUSE NO.	TECHNICAL REQUIREMENTS																
1.00.00	STEAM GENERATOR AND AUXILIARIES The design/specifications/sizing of various plants/systems/equipment offered for Steam Generator(s) & Auxiliaries shall comply with the requirements detailed hereinafter:																
1.01.00	Steam Generator(s) Type and Other Features																
1.01.01	Type The Steam Generator shall be of single pass (Tower type) or two pass type using either spiral wall (inclined) or vertical plain / rifled type water wall tubing.																
1.01.02	Other Features of Steam Generator Design The Steam Generator shall be direct pulverized coal fired, top supported, single reheat, radiant, dry bottom, with balance draft furnace and shall be suitable for outdoor installation. The evaporator of Steam Generator shall be once-through type suitable for variable pressure operation from sub-critical to supercritical pressure range.																
1.02.00	Boiler Parameters Steam Generator shall be designed to cater to duty requirements/rating specified below:- <table><thead><tr><th>DESCRIPTION</th><th>RATED PARAMETERS</th></tr></thead><tbody><tr><td>i) Steam Flow at Superheater outlet:</td><td>Steam Flow at superheater outlet at Boiler Maximum Continuous Rating (BMCR) conditions, with rated steam parameters shall be 102% of the turbine VWO steam flow requirement</td></tr><tr><td>ii) Steam Temperature at BMCR:</td><td></td></tr><tr><td>a) At Superheater (SH) outlet :</td><td>To achieve turbine throttle main steam temperature as indicated in clause 2.01.02 of this Sub-section. The steam temperature at superheater outlet shall be atleast 3°C higher than the rated main steam temperature at HP turbine inlet.</td></tr><tr><td>b) At Reheater (RH) outlet :</td><td>To achieve reheat steam temperature at Turbine Inlet as indicated in clause 2.01.02 of this Sub-section. The steam temperature at Reheater outlet shall be atleast 3°C higher than the rated main steam temperature at IP turbine inlet.</td></tr><tr><td>iii) Feed water temperature at Economizer inlet :</td><td>Please refer clause 2.01.02 of this sub-section.</td></tr><tr><td>iv) Steam Pressure at superheater outlet at BMCR:</td><td>To achieve Turbine throttle steam pressure as indicated in clause 2.01.02 of this Sub-section. Steam pressure at super heater Outlet shall not be more than 9 Kg / cm² higher than the rated main steam pressure at HP turbine inlet.</td></tr></tbody></table>			DESCRIPTION	RATED PARAMETERS	i) Steam Flow at Superheater outlet:	Steam Flow at superheater outlet at Boiler Maximum Continuous Rating (BMCR) conditions, with rated steam parameters shall be 102% of the turbine VWO steam flow requirement	ii) Steam Temperature at BMCR:		a) At Superheater (SH) outlet :	To achieve turbine throttle main steam temperature as indicated in clause 2.01.02 of this Sub-section. The steam temperature at superheater outlet shall be atleast 3°C higher than the rated main steam temperature at HP turbine inlet.	b) At Reheater (RH) outlet :	To achieve reheat steam temperature at Turbine Inlet as indicated in clause 2.01.02 of this Sub-section. The steam temperature at Reheater outlet shall be atleast 3°C higher than the rated main steam temperature at IP turbine inlet.	iii) Feed water temperature at Economizer inlet :	Please refer clause 2.01.02 of this sub-section.	iv) Steam Pressure at superheater outlet at BMCR:	To achieve Turbine throttle steam pressure as indicated in clause 2.01.02 of this Sub-section. Steam pressure at super heater Outlet shall not be more than 9 Kg / cm ² higher than the rated main steam pressure at HP turbine inlet.
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA PAGE 1 OF 81														

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	v) Pressure drop in Reheaters Including cold and hot Reheater Piping under all operating conditions	:	To be optimized by the bidder	
1.02.01	Steam Generator Control range	:	50% TMCR to 100% BMCR Under the above control range, the steam temperatures at SH & RH outlets shall be maintained at their rated values	
1.02.02	Boiler Design Optimization for Performance			
	The Bidder shall size each heat transfer bank and select their disposition along the gas path in the radiant and convective zone so that steam temperatures are maintained at stipulated levels within the control range with minimum spray water and minimum metal temperatures. To this effect, the Bidder shall provide design basis the segmentation of heat duty among different heating segments viz. economizer, water walls, different super-heater segments and reheater segments for ensuring required steam generator performance under all operating conditions. The Bidder shall also furnish a steam temperature plot to indicate heat pick up in different heat transfer banks. The plot will include spray water and metal temperatures at different sections along the gas path for clean tube and dirty tube conditions. Further the considerations for thermo-hydraulic design of the evaporator and mechanical design of the water walls as well as selections pertaining to the offtake point to separator and the location of intermediate headers (if applicable) shall be clearly de-fined and brought out in the Technical datasheet. These shall include the limiting values of degree of superheat of steam (at minimum circulation flow and other loads), tube to tube temperature differentials at the evaporator outlet, tube (thickness/inner diameter/roughness) selection, furnace heat flux considerations and the cyclic loading and start-stop requirement that are specified in part-B sub-section A-01 of the technical specification.			
1.03.00	Fuel			
	i) Primary fuel		100% Coal	
	ii) Cold Start up / Black Start		LDO to cater to 30 % BMCR requirements of Steam Generators without any coal firing	
1.03.01	Minimum Load without Oil Support			
	Minimum Load without Oil Support for Flame Stabilization when firing any coal from the range of coals (design/worst/best/adequacy/ 30 % imported coal by weight blended with Indian coals)		40% TMCR requirements	
	a) Capacity of LDO burners for load carrying purpose		30% BMCR	
1.04.00	Boiler Operation			
i)	Mode	:	Suitable for variable pressure operation from subcritical to supercritical pressure range	
ii)	Startup	:	The steam generator shall also be capable of start-up without HP-LP by-pass system in service	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA
				PAGE 2 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS			
iii)	Load Throw Off	:	In case of sudden load throw-off, in worst case from 100% BMCR, the Steam Generator shall be capable of automatically bringing down the steam generating capacity to match with HP-LP bypass capacity	
iv)	Frequency Variation	:	The equipment and auxiliaries shall be suitable for continuous operation in the frequency range of 47.5 Hz to 51.5 Hz. unless otherwise specified	
v)	In line with the plant operating capability requirement indicated in sub-section G-01, the steam generator shall be designed for variable pressure operation. Thermal design of steam generator and the selection of material of pressure parts shall be suitable for variable pressure operation modes.			
	The Steam Generators shall be designed for minimum rate of loading/unloading mentioned below without compromising on design life of pressure parts:			
a)	Step Load Change	:	Minimum ± 10%	
b)	Ramp Rate	:	Minimum ± 1% per minute (55% to 40% load) Minimum ± 2% per minute (70% to 55% load) Minimum ± 3% per minute (100% to 70% load)	
	Bidder shall clearly bring out in his offer the maximum rates of loading/ unloading achievable with Steam Generator offered and the corresponding limiting variations (±%) of boiler parameters such as Oxygen in flue gas, SH/RH steam temp., furnace draft, etc.			
	Steam Generator shall be so designed such that during ramping, maximum metal temperature shall not exceed the design metal temperature of the material for the boiler pressure parts.			
	Specific care shall be taken in the design of the water walls for load ramping conditions.			
vii)	Rapid Load Change in downward direction	:	In case of external disturbances or equipment malfunction the system shall stabilize itself through proven concepts and controls and within the recommendations of National Fire Protection Association, USA, NFPA Latest Edition	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA
PAGE 3 OF 81				

CLAUSE NO.	TECHNICAL REQUIREMENTS		
1.05.00	Component sizing/Design Criteria		
1.05.01	Furnace/evaporator/waterwalls shall comply with following requirements at 100% BMCR and HP Heaters out conditions for the range of specified coals, under most stringent combination of conditions		
i)	Net Heat Input (NHI)/Plan area (Maximum) of furnace	4.75 x10 ⁶ kcal/hr/m ²	
ii)	Heat Liberation rate	106920 kcal/hr/m ³ (Maximum)	
iii)	Burner Zone Heat Release Rate (BZHRR)	1.9 x 10 ⁶ kcal/hr/M ² (Maximum)	
iv)	Maximum FEGT (MHVT value)	60 deg.C below Minimum IDT of ash.	
v)	Heat Input per burner(*)	650 X10 ⁵ kCal/Hr (Maximum)	
vi)	Furnace Cooling Factor	1.9 x 10 ⁵ kcal/hr/M ² (Maximum)	
vii)	Furnace residence time(**)	2.0 sec. (Minimum)	
viii)	No. of burner elevation being fed from one mill	1 (Maximum)	
ix)	Pressure withstanding capability	± 660 mmwc (Minimum) at 67% yield strength or Maximum conceivable head of fans, whichever is higher.	
x)	Furnace / Evaporator shall be designed for variable pressure operation over minimum load with separator running dry to 100% BMCR load range		
xi)	Maximum average flue gas Velocity before Gas flow changes direction (For velocity calculation , excess air shall be considered as 25% at Economizer outlet	10 m/sec. (The maximum localized velocities across the cross- section shall not exceed 12m/ sec.)	
xii)	Limiting Parameters for Steam Generator Design The Steam Generator design shall comply with the following limiting parameters with 'design coal' firing, under stipulated ambient air condition i.e. 27 degree Celsius temperature and 60 % relative humidity:		
a)	Excess air at economizer outlet at 100 %TMCR load	: 20% (minimum)	
b)	Flue gas Exit Temperature at Air Pre-heater outlet (corrected) at 100% TMCR load	: 125 deg.C (minimum)	
c)	Heat Loss due to un-burnt carbon in ash at all loads	: 1% (minimum)	
Bidder to note that no credit shall be given in the bid evaluation or in the evaluation of the results of the guarantee tests or performance predictions etc. if the values considered by the Bidder for parameters as specified at clause no 1.05.01 xii) of this chapter above are lower than those specified in this clause.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA PAGE 4 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	However, the Bidder shall also indicate in their bid proposal the minimum excess air & unburnt carbon loss at which unit can be operated on sustained basis meeting all other specification requirements. NOTE: Definition(s) of acronyms/terms for the above are as given at the end of this clause 1.05.00. (*) Minimum number of coal pulverisers to be provided for each steam generator shall not be less than Eight (8) (**) Selected Furnace Residence time by the Contractor shall be "COAL SPECIFIC". Definitions of Acronyms/Terms used in clause no. 1.05 .01 CLAUSE 1.05.01 (i)"NHI/FURNACE PLAN AREA" (a) Net Heat Input (NHI) or heat available in furnace is obtained by considering the GCV of the fuel minus the radiation losses, loss due to unburnt combustible, moisture in air & fuels, latent heat of moisture in fuel & that formed by combustion of H₂ in the fuel plus the sensible heat of combustion air (Primary plus Secondary air), all above 27⁰C. (b) Furnace Plan Area is the product of Furnace Width and Depth. CLAUSE 1.05.01 (iii) "BURNER ZONE HEAT RELEASE RATE" (BZHRR) Burner Zone is defined as the centre line distances between the Top and Bottom burner plus 3.05 meters of furnace height. Further, heat input is the input from coal. CLAUSE 1.05.01 (iv) "FEGT (MHVT)" (c) FEGT is the Furnace Exit Gas Temperature in degree Celsius. (d) MHVT Value is the flue gas temperature as measured by a Multi Shielded High Velocity Thermocouple (MHVT). CONTRACTOR TO NOTE: Furnace exit plane shall be defined as the plane, vertical for two pass Steam Generator and horizontal for single pass (tower type) Steam Generator, above the furnace nose tip or the plane beyond which the transverse tube pitching is less than 600 mm whichever is positioned first in the flue gas flow path. Further, all the predicted/guaranteed gas temperature including FEGT indicated by the Contractor shall be the actual MHVT value and not the HVT values. CLAUSE 1.05.01(vi) "FURNACE COOLING FACTOR" Furnace Cooling Factor in Kcal/hr/sq.m., is the ratio of NHI (Cl. 1.05.01 (i)) or heat released and available and Effective Projected Radiant Heat Absorbing Surface (EPRS). For arriving at Furnace Cooling Factor the calculated EPRS shall be reduced by at least 10% to account for deterioration of furnace walls surface condition due to fouling/slagging etc. CLAUSE 1.05.01(vii) "FURNACE RESIDENCE TIME" Furnace Residence Time shall be defined as the residence time of the fuel particles from center line of the top elevation coal burners to the furnace exit plane. For the purpose of residence time the exit plane shall be defined as the horizontal plane at the furnace nose tip		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 5 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS		
1.05.02	for two pass boiler & the horizontal plane at the entry to the radiant superheater/ reheater for single pass/ tower type boiler. Further, Furnace Residence Time shall be calculated by dividing the furnace volume between the center line of top coal burner and furnace exit plane by the flue gas volume at mean gas temperature in the above furnace volume DESIGN OF PRESSURE PARTS (a) The design of all pressure parts (tubes, headers, separators, vessels etc.) shall be as per Indian Boiler Regulations (IBR) or other international codes with the approval of the Employer. It is however, the responsibility of the Contractor to get various calculations and other technical documentations approved by the statutory authorities in the state and country of location of the plant. (b) Design pressure of the Steam Generator pressure parts shall be atleast 1.05 times the maximum operating pressure, or as required by IBR/ASME, whichever is higher. (c) The thickness of the pressure parts (steam and water tubes/headers, separators, pressure vessels etc.) shall be calculated using IBR formulae/factor of safety etc. (and not as per codes/formulae acceptable to IBR). Minimum tube thickness at the bends in no case shall be less than the minimum tube thickness for the straight tubes. For this purpose appropriate thinning allowance shall be considered by the Contractor while calculating the thickness of the bends. Additional erosion allowance on the calculated tube thickness shall be provided at specified locations as specified by the Employer in this specification. (d) The working fluid temperature to be considered for design of pressure part tubes starting from water wallbottom ring header upto and including the water wall outlet headers shall be arrived by adding an additional margin of minimum 40°C to the maximum predicted/expected fluid temperature in these pressure parts. The working fluid temperature to be considered for design of pressure parts starting from downstream of water wall outlet headers upto first stage of superheater attemperation shall be arrived by adding an additional margin of minimum 15 deg C to the maximum predicted/expected fluid temperature in these pressure parts. The margins as per IBR and other codes shall be taken over and above the working fluid temperatures so arrived. For the other pressure parts where no design margin is specified in the IBR and the above specified 40 °C or 15°C margin is not applicable, the working fluid temperature to be considered for design of pressure parts shall be arrived at by adding following margin to the maximum predicted/expected fluid temperature in these pressure parts: i) 5 °C for inlet headers and its connecting tubes, pipes downstream and upstream of attemperators and other pipes in pressure parts. ii) 15°C for outlet headers and their connecting tubes except at final super heater and final reheater outlet. iii) For final super heater and final reheater outlet a margin of 5°C shall be taken. (e) Materials for Steam Generator Components The material used for Steam Generator components i.e. boiler pressure parts including boiler tubing, headers, separators, piping, vessels, valves & fittings etc. and other components shall be equal to or better than the following unless specified otherwise:		
	SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 6 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS																				
		<table><tr><th></th><th>Design Metal Temperature</th><th>Material</th></tr><tr><td>(i)</td><td>Upto & including 400 degree Celsius</td><td>Carbon steel to ASME SA-106 Gr. B/C or SA 210 Gr. C or approved equivalent.</td></tr><tr><td>(ii)</td><td>Upto & including 550 degree Celsius</td><td>Alloy steel to ASME SA-335: P-11/P-12/P-22 ASME SA213:T-11/T-12/T-22/T23/ or approved equivalent.</td></tr><tr><td>(iii)</td><td>Upto & including 601 degree Celsius</td><td>Alloy steel ASME SA-335/213:P-91/T-91 or approved equivalent.</td></tr><tr><td>(iv)</td><td>Upto & including 610 degree Celsius (*)</td><td>Alloy steel ASME SA-335/213:P-92/T-92 or approved equivalent.</td></tr><tr><td>(v)</td><td>Upto & above 610 degree Celsius</td><td>Austenitic stainless steel, SA-213 UNS S30432 Shot Peened or approved equivalent.</td></tr></table>		Design Metal Temperature	Material	(i)	Upto & including 400 degree Celsius	Carbon steel to ASME SA-106 Gr. B/C or SA 210 Gr. C or approved equivalent.	(ii)	Upto & including 550 degree Celsius	Alloy steel to ASME SA-335: P-11/P-12/P-22 ASME SA213:T-11/T-12/T-22/T23/ or approved equivalent.	(iii)	Upto & including 601 degree Celsius	Alloy steel ASME SA-335/213:P-91/T-91 or approved equivalent.	(iv)	Upto & including 610 degree Celsius (*)	Alloy steel ASME SA-335/213:P-92/T-92 or approved equivalent.	(v)	Upto & above 610 degree Celsius	Austenitic stainless steel, SA-213 UNS S30432 Shot Peened or approved equivalent.	
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	* Note: (i) Bidder at his discretion can use ASME SA-335/213:P-92/T92 or approved equivalent material for the components which are outside the flue gas path for Superheater, Reheater tubes & headers and Interconnecting Piping. In case ASME SA-213:T-92 is used for terminal tubes (i.e. from header to coil) for ease of welding, , than such tubes can also be used beyond design metal temperature of 610 °C and the metal temperature of T-92 will be limited to 620 °C. If the Bidder offers Hot Reheat Steam Temperature (HRH) Temperature in the Specified range i.e. up to 610 deg C, Alloy Steel ASME SA -335/213 Gr.P-92 or equivalent can be used for HRH headers, up to & including 620 degree Celsius. (ii) Use of T91/T92 tubes for the pressure parts in the heated region of the boiler shall be limited to fluid temperature of 530°C.																				
	1.05.03	STEAM SEPERATOR(S)																			
		(i) Design Code IBR (ii) Design Temperature Max. fluid temperature plus 40°C (Min.) (iii) Design Pressure Atleast 1.05 times the maximum operating pressure, or as required by IBR/ASME, whichever is higher.																			
1.05.04	Superheater(s) and Reheater(s) shall be designed, suitably sectionalized and positioned to comply with the following, for the specified load(s), coal(s) and for normal, upset, most adverse and other operating conditions (refer as specified at clause no 1.00.00 of Sub Section-A-02 also) <table><tr><th>Parameter</th><th>Requirement</th></tr><tr><td>(1) Rated Steam Temperature</td><td></td></tr><tr><td>a) At Super heater outlet</td><td>To achieve turbine throttle main steam temp. as indicated in clause 2.01.02 of this Sub-section</td></tr></table>		Parameter	Requirement	(1) Rated Steam Temperature		a) At Super heater outlet	To achieve turbine throttle main steam temp. as indicated in clause 2.01.02 of this Sub-section													
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 7 OF 81																	

CLAUSE NO.	TECHNICAL REQUIREMENTS		
1.05.05	b) At Reheater outlet To achieve reheat steam temp at Turbine Inlet as indicated in clause 2.01.02 of this Sub-section		
	Note: The control system for SG shall be able to maintain SH/RH outlet temperatures within ± 5°C of above values over complete control range of Steam Generators with the range of specified coals.		
	(2)	Maximum average flue gas velocity in section/tube banks with transverse tube pitching 600 mm or less and with 20% excess air at economizer outlet	10 m/sec. (The maximum localized velocities across the cross- section shall not exceed 12m/sec.)
	(3)	Maximum allowable tube metal skin temperature	40 degree Celsius below oxidation limit for the tube metal.
	(4)	SH/RH outlet steam temperature characteristic below control range	(i) As close as possible to each other. (ii) Minimum drop from rated steam temperature.
	(5)	Means of Temperature Control	
	(a) SUPER HEATERS		Spray Water attemperation, (utilising water tapped off from downstream side of HP heaters or intermediate banks of economizer or Economizer outlet). Tapping of spray water upstream of top HP heater is not allowed.
	(b) REHEATERS*		Tilting of burners/gas biasing/gas recirculation (gas to be tapped off after ID fans)/excess air, spray water attemperation (utilising water tapped off from interstage of BFP)
	*Note : In case gas recirculation system is offered for reheat temperature control, minimum 2x100% gas recirculation fans with atleast 20% margin on flow and 44% margin on head over calculated maximum requirement of fan flow and head respectively shall be provided for each Steam Generator.		
	ECONOMISERS		
Economizer design shall conform to the following criteria/requirements under all condition of operation and for the complete range of specified fuels.			
	CRITERIA	REQUIREMENT	
	(i) Economizer Type	Non-steaming type with parallel cross flow or counter flow arrangement.	
	(ii) Approach Temperature within control range	17°C (minimum)	
	(iii) Maximum average flue gas velocity through the Economizer tube banks, with 20% excess air at Economizer outlet.	10 m/sec. (The maximum localized velocities across the cross-section shall not exceed 12 M/sec)	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA
			PAGE 8 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS																										
	(iv) Economizer tube thickness (v) Maximum allowable tube metal skin temperature (vi) Maximum depth of tube banks/sections in the direction of gas flow:	i) Provide erosion allowance of 1mm (minimum) in addition to thickness calculated as per IBR formulae. ii) Minimum tube thickness at the bends in no case shall be less than the minimum tube thickness for the straight tubes calculated in the manner described at (i) above. For this purpose appropriate thinning allowance shall be considered by the contractor while calculating the thickness of the bends.																									
1.05.06	Regenerative Air Pre-heaters (RAPH)																										
1.05.06.01	Regenerative Air Pre-heaters (for Bisector type RAPH)																										
	Air pre-heaters shall be sized / designed to cater to following requirements:																										
	<table><tr><th>DESCRIPTION</th><th colspan="2">BISECTOR TYPE</th></tr><tr><td></td><th>Primary Air Preheater (PAPH)</th><th>Secondary Air Preheater (SAPH)</th></tr><tr><td>1. No. of air preheaters per Steam Generator</td><td>Two</td><td>Two</td></tr><tr><td>2. Sizing shall be based on following criteria, all conditions considered to be occurring together:</td><td></td><td></td></tr><tr><td>i) Design ambient air temperature & humidity*</td><td>30°C* & 60% RH</td><td>30 °C* & 60% RH</td></tr><tr><td>ii) Type of coal firing</td><td>Worst coal, with max. moisture.</td><td>Worst coal, with max. moisture.</td></tr><tr><td>iii) Air temperature rise across Air preheater</td><td>Adequate to achieve the required coal/air mixture temperature at burner inlet at all loads and for complete range of specified coals.</td><td>Adequate to achieve the required secondary air temperature for stable combustion at all loads and for complete range of specified coals.</td></tr><tr><td>iv) Load Range</td><td colspan="2">a) 60% TMCR with Design/Best/worst coal and maximum moisture, whichever gives maximum flow with one set of PAPH & SAPH</td></tr></table>			DESCRIPTION	BISECTOR TYPE			Primary Air Preheater (PAPH)	Secondary Air Preheater (SAPH)	1. No. of air preheaters per Steam Generator	Two	Two	2. Sizing shall be based on following criteria, all conditions considered to be occurring together:			i) Design ambient air temperature & humidity*	30°C* & 60% RH	30 °C* & 60% RH	ii) Type of coal firing	Worst coal, with max. moisture.	Worst coal, with max. moisture.	iii) Air temperature rise across Air preheater	Adequate to achieve the required coal/air mixture temperature at burner inlet at all loads and for complete range of specified coals.	Adequate to achieve the required secondary air temperature for stable combustion at all loads and for complete range of specified coals.	iv) Load Range	a) 60% TMCR with Design/Best/worst coal and maximum moisture, whichever gives maximum flow with one set of PAPH & SAPH	
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			PAGE 9 OF 81																								

CLAUSE NO.	TECHNICAL REQUIREMENTS																																		
1.05.06.02		b) 100% TMCR with Design/Best/worst coal and maximum moisture whichever gives maximum flow with both sets of PAPH & SAPH																																	
	v) Minimum average cold-end metal temperature at 100% BMCR (with SCAPHs out of service)	76°C	76°C																																
	3. AH flue gas exit temperature (corrected) at 100% TMCR (800 MW unit load) with design Coal	125°C	125°C																																
	4. Min. flue gas exit temperature (for complete range of specified fuels)	5°C above acid dew point of flue gas	5°C above acid dew point of flue gas																																
	5. Air Leakage (at 100% TMCR i.e. 800 MW unit load for complete range of coals)	Less than 10% of the Flue gas weight entering airheater.																																	
	6. Rotational speed for drive selection	1 r.p.m. or actual offered whichever is higher	1 r.p.m. or actual offered whichever is higher																																
	*Note: The specified ambient temperature shall be considered for APH sizing. For evaluation & guarantee purpose the limiting values in indicated in clause 1.01.03.02, Sub-Section-IV, Part A & clause 1.05.01 xii), Sub-Section-A-01, Part B, Section-VI shall apply.																																		
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA																															
PAGE 10 OF 81																																			

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.05.06.03	3. AH flue gas exit temperature (corrected) at 100% TMCR (800 MW unit load) with design coal	125°C		
	4. Min. flue gas exit temperature (for complete range of specified fuels)	5°C above acid dew point of flue gas		
	5. Air Leakage (at 100% TMCR i.e. 800 MW unit load for complete range of coals)	Less than 10% of the Flue gas weight entering airheater.		
	6. Rotational speed for drive selection	1 r.p.m. or actual offered whichever is higher		
	**Note: The specified ambient temperature shall be considered for APH sizing. For evaluation & guarantee purpose the limiting values in indicated in clause 1.01.03.02, Sub-Section-IV, Part A & clause 1.05.01 xii), Sub-Section-A-01, Part B, Section-VI shall apply.			
1.05.06.03	For meeting the requirements of rated coal/air mixture temperatures at burner inlet at part load operations of steam generator with coals of excessive moisture and under conditions of low ambient temperatures the Contractor may, if required, size economiser bypass duct incase of bisector airpreheater along with necessary dampers, expansion joints, structures etc, and provide sufficient tempering air reserve incase of Trisectorairpreheater accordingly. Even in case of sizing of economiser bypass or sufficient tempering air reserve is provided by the Contractor due to above requirement, the sizing of air preheaters shall ensure that the rated mill outlet temperatures are achieved, for complete range of specified coals, from 100% TMCR (800 MW) to 100% BMCR loads with economiser by pass closed and without reducing tempering air reserve. Further, the bidder shall indicate the quantity of tempering air reserve considered for Trisector air preheater design for loads 100% TMCR (800 MW) to 100% BMCR loads for complete range of specified coals.			
1.05.07	Steam Coil Air Preheater(SCAPH)			
1.05.07.01	SCAPH shall be designed / sized to increase the air heaters inlet air temperature based on following criteria:			
	Sl. No.	DESCRIPTION	Primary SCAPH *	Secondary SCAPH
	(i)	Design ambient air temp.	6°C	6°C
	(Temperature rise across fan shall not be considered for sizing of SCAPH)			
	(ii)	Number of SCAPHs	One (1) for each PA fan	One (1) for each FD fan
	(iii)	Type of coal firing	Worst coal	Best coal
	(iv)	Air temperature at SCAPH outlet		
		(a) At 100% BMCR	27°C (Min.)	27°C (Min.)
		(b) At 30% BMCR	100°C (Min.)	100°C (Min.)
	(v)	Air temperature at the inlet of each	To keep average metal temp. (Cold end) at	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA
PAGE 11 OF 81				

CLAUSE NO.	TECHNICAL REQUIREMENTS		
1.05.07.02 1.05.08 1.05.08.01 			

CLAUSE NO.	TECHNICAL REQUIREMENTS														
1.05.08.03	clause 12.05.08.02 above	less. This condition shall be complied for the range of specified coals including the adequacy range of coals.													
	(b) Unburnt carbon loss to be considered at various steam generator loads, for sizing/ selection of coal pulverizers	1% or actual expected value, whichever is higher													
	(c) Rated Pulverized coal fineness* at rated capacity of the pulverizer, not less than	75% thru 200 mesh (75 microns) and 99% thru 50 mesh (300 microns)													
	(d) Input coal size	Upto 50 mm													
	Note: * To be demonstrated at site for each mill by coal sampling as per ISO 9931 & with grinding elements within the guaranteed wear life of respective wear element.														
	Minimum Guaranteed Life of Coal Pulverizer Wear Parts														
	The guaranteed life of different mill components in "equivalent hours" of continuous mill operation at its rated capacity, while firing the specified range of coals and meeting the requirements as specified at clause no 1.03.00 of this Sub-Section and without requiring any in between repair or replacement shall be as under:														
	<table><tr><th>ITEM</th><th>MINIMUM LIFE IN EQUIVALENT HOURS</th></tr><tr><td>(1) Seals</td><td>20000</td></tr><tr><td>(2) Grinding elements (Rolls/Balls and Rings/Race)</td><td>8000 [See note (a) below]</td></tr><tr><td>(3) Mill discharge valves</td><td>15000</td></tr><tr><td>(4) Classifier cone and other items lined with Ceramic material (as applicable)</td><td>25000</td></tr><tr><td>(5) Classifier vane (as applicable)</td><td>25000</td></tr></table>			ITEM	MINIMUM LIFE IN EQUIVALENT HOURS	(1) Seals	20000	(2) Grinding elements (Rolls/Balls and Rings/Race)	8000 [See note (a) below]	(3) Mill discharge valves	15000	(4) Classifier cone and other items lined with Ceramic material (as applicable)	25000	(5) Classifier vane (as applicable)	25000
	ITEM	MINIMUM LIFE IN EQUIVALENT HOURS													
	(1) Seals	20000													
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(3) Mill discharge valves	15000														
(4) Classifier cone and other items lined with Ceramic material (as applicable)	25000														
(5) Classifier vane (as applicable)	25000														
Note :															
(a) The YGP index for the specified coal is indicated in Project Information, Sub-section-I-B, Part-A, Section-VI of Technical specification when measured as per BS Standard BS-1016 Part-111. The Bidder shall furnish a curve alongwith his offer indicating the variation in guaranteed wear life with variation in YGP index of coal fired. Separate curves for different wear elements of mill shall be furnished e.g. for grinding rolls, grinding rings, clearly indicating its relationship with YGP index of coal. The curve shall be subject to Employer's approval.															
1.05.09	PULVERISED COAL PIPES														
1.05.09.01	Fuel air mixture velocity in coal pipes - minimum - 15 m/sec and maximum - 28 m/sec.														
	The coal air mixture velocity in the coal pipes shall not be lower than the critical fallout velocity under all conditions of mill operation from start up of boiler onward.														
1.05.09.02	The pipes shall be designed for an explosion pressures of 3.5 kg/cm ² (min.).														
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA												
			PAGE 13 OF 81												

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.05.09.03	Maximum permissible design stress shall be yield or 0.2% proof stress.			
1.05.09.04	The piping system shall be designed for a continuous operating temperature of 110 degree Celsius (minimum).			
1.05.09.05	Ceramic material specification: Alumina content of not less than 90% and guaranteed life 25000 Hrs (minimum).			
1.05.10	Raw Coal Feeders			
1.05.10.01	Each mill shall be fed with coal by an independent coal feeder.			
1.05.10.02	Provide the following minimum features in the RC feeder(s), in addition to complying with all the stipulations of NFPA (latest edition).			
	(i)	Feeder Type	:	Gravimetric, belt type with minimum size of 36"
	(ii)	Raw Coal Feeder Sizing	:	1.2 times maximum capacity of coal pulverizer.
	(iii)	Environment Withstand capability	:	(a) Ambient temperature 70°C (min.) (b) Explosion pressure: 3.5 Kg/cm² (min.) (c) Other environmental conditions
	(iv)	Feeder Accuracy	:	
		(a) Weighing Accuracy at works	:	± 0.5%.
		(b) Repeatability	:	0.1%
		(c)	Shall have in-built facility for calibration	
	(v)	System shall be capable of tolerating large supply voltage variation.		
	(vi)	All site equipment shall be suitable for 70°C ambient temperature and other environment conditions envisaged.		
1.05.11	PRIMARY AIR FANS			
1.05.11.01	Fan Design			
	(a)	Type of Fan	:	Two stage, constant speed, variable pitch, axial type.
	(b)	No. of fans	:	Two
	(c)	Type of fan blade	:	Stream lined/Aerofoil bladed type, designed to withstand high bending and axial load.
	(d)	Fan suction	:	From atmosphere
	(e)	Fan rotational speed	:	1500 (max)
1.05.11.02	Fan Sizing Criteria			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA
				PAGE 14 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.05.12	(a) Each fan shall be rated to meet requirement of 60% BMCR load (one stream in operation) with following conditions all occurring together. (1) Worst coal firing with maximum moisture content. (2) Power supply frequency - 49 Hz. (3) Ambient air temp. - 50 degree Celsius & RH 60%. (4) Air-heater primary air-in-leakage of 15% of flue gas flow entering in case of a Bi-sector APH (OR) primary air-in-leakage of 10% of flue gas flow entering in case of a Tri-sector APH (OR) guaranteed whichever is higher. (b) In any case the margins on flow & pressure shall not be less than 25% and 30% respectively over the calculated values at 100% BMCR condition. Above margin shall be under conditions indicated below all occurring together: (1) Worst coal firing with maximum moisture content. (2) Power supply frequency - 50 Hz. (3) Ambient air temp. - 50 degree Celsius & RH 60%. (4) Air-heater primary air-in-leakage of 15% of flue gas flow entering in case of a Bi-sector APH (OR) primary air-in-leakage of 10% of flue gas flow entering in case of a Tri-sector APH (OR) guaranteed whichever is higher. (5) All mills including standby mill shall be in service. Note to 1.05.11.02 (a) & (b): PA fans shall have a minimum stall margin of 10% over the Design duty points. Motor Rating; Motor rating at 50 deg.C ambient temperature not less than the maximum load demand of its driven equipment in its entire operation at frequency variations from 47.5Hz to 51.5Hz and motor not to be overloaded during any mode of operations of driven equipment.			
	Seal Air Fans (a) Type of Fan : Centrifugal, (b) No. of fans : Two (2)x100% common for all the pulverizers of one Steam Generator unit (c) Margin : a) On Flow - 25% b) On Pressure- 30% Above margins shall be based on an ambient temperature of 50 degree Celsius, relative humidity of 60 % and system leakages with mill operation at maximum duty. (d) Fan rotational speed : 1500 (max) under test block condition Motor Rating; Motor rating at 50 deg.C ambient temperature not less than the maximum load demand of its driven equipment in its entire operation at frequency variations from 47.5Hz to 51.5Hz and motor not to be overloaded during any mode of operations of driven equipment.			
1.05.13	DRAFT PLANT			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 15 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS				
1.05.13.01	The forced draft (F.D.) and induced draft (I.D.) fans shall be capable of maintaining balance draft conditions in the furnace over the entire load range with any one or both F.D. fans and any one or both I.D. fans in operation while firing the specified range of fuels.				
1.05.13.02	Fan Sizing Criteria FD & ID fans shall be sized such that they satisfy the criteria stipulated below.				
	S.N.	Description	FD Fans	ID Fans	
	1	Type of fans	Constant speed, axial type	Two stage, Constant speed, axial type.	
	2	No. of fans per unit	Two	Two	
	3	Fan sizing criteria with all the following conditions occurring together :	Each fan to be sized for 60% TMCR load (one stream in operation) calculated taking into account following factors occurring together:		
	(i)	Type of coal firing	Design / Best / Worst whichever gives maximum FD fan air requirement	Design / Best / Worst whichever gives maximum flue gas flow.	
	(ii)	Power supply frequency	49 Hz	49 Hz	
	(iii)	Excess air	20% over the Stoichiometric air	20% over the Stoichiometric air	
	(iv)	Fan inlet air/flue gas temperature	50°C with 60% relative humidity	Gas temperature corresponding to 50°C ambient temperature and 60% relative humidity	
	(v)	Air-heater air-in-leakage	Secondary air-in-leakage of min.10% of flue gas flow entering Bi-sector APH (OR) actual guaranteed value whichever is higher. For Tri-sector APH, actual guaranteed value of leakage will be considered for fan sizing.	Based on min. 15% of flue gas flow entering PAPH and 10% of flue gas flow entering SAPH in case of Bi-sector APH (OR) 12% of flue gas flow entering Tri-sector APH (OR) actual guaranteed value whichever is higher.	
	(vi)	Pressure drop through SCR System	Not applicable	Not Applicable	
	(vii)	Pressure drop through ESP	Not applicable	25 mm WC or actual whichever is higher	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 16 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS				
1.05.13.03	S.N.	Description	FD Fans	ID Fans	
	(viii)	Pressure drop through FGD System	Not applicable	150mm WC or actual whichever is higher (Alternately, separate booster fans for FGD system may be provided. if pressure drop through FGD system exceeds 150 mm WC. In such case, specified pressure drop through FGD system shall not be considered for sizing of ID fan.)	
	(ix)	Air in leakage	Not applicable	1% of ESP inlet gas flow & 2% of gas flow at common APH outlet through ducts	
	(x)	Pressure required at chimney inlet	Not applicable	+ 40 mm WC (In case separate booster fans for FGD system are provided, ID fans shall be sized for minimum +10 mm WC of pressure requirement at chimney inlet for any FGD bypass operation.)	
	The fans shall also fulfill following sizing criteria in addition to those mentioned at Clause 1.05.13.02 above		Each fan to be sized for 50% TMCR flow calculated taking into following conditions occurring together.		
	(i)	Margin over 100% TMCR flow	20%	20%	
	(ii)	Margin over 100% TMCR pressure requirement	44%	44%	
			Further for booster fan sizing, bidder to consider the margin over pressure requirement as 44% over the calculated head value excluding the static head. Margin on Static head shall be taken as 10%. For bubbling type Absorber, Bidder shall consider choking/ blockage of 10% sparger tubes while	Further for booster fan sizing, bidder to consider the margin over pressure requirement as 44% over the calculated head value excluding the static head. Margin on Static head shall be taken as 10%. For bubbling type Absorber, Bidder shall	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 17 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS				
	S.N.	Description	FD Fans	ID Fans	
			calculating the head requirements of fan.	consider choking/blockage of 10% sparger tubes while calculating the head requirements of fan.	
	(iii)	Type of coal firing	Design / Worst / Best coal whichever gives maximum FD fan flow	Design/Worst/Best coal whichever gives maximum flue gas flow	
	(iv)	Power supply frequency	50 Hz	50 Hz	
	(v)	Excess air at economizer outlet	20% over stoichiometric air requirement	20% over stoichiometric air requirement	
	(vi)	Fan inlet air/flue gas temperature	50°C and 60%	150°C or actual gas temperature corresponding to 50°C ambient and 60% relative humidity, whichever is higher	
	(vii)	Air-heater air-in-leakage	Secondary air-in-leakage of Min. 10% of flue gas flow entering Bi-sector APH (OR) actual guaranteed value whichever is higher. For Tri-sector APH, actual guaranteed value of leakage will be considered for fan sizing.	Based on min. 15% of flue gas flow entering PAPH and 10% of flue gas flow entering SAPH in case of Bi-sector APH (OR) 12% of flue gas flow entering Tri-sector APH (OR) actual guaranteed value whichever is higher.	
	(viii)	Pressure drop through SCR System	Not applicable	Not applicable	
	(ix)	Pressure drop through ESP	Not applicable	25 mm WC or actual whichever is higher	
	(x)	Pressure drop through FGD System	Not applicable	150 mm WC or actual whichever is higher (Alternately, separate booster fans for FGD system may be provided with flow and pressure margins as per (i) and (ii) above). , if pressure drop through FGD system exceeds 150 mm WC.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 18 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.05.14 1.05.14.01	S.N.	Description	FD Fans	ID Fans
				In such case, specified pressure drop through FGD system shall not be considered for sizing of ID fan.)
	(xi)	Air in leakage	Not applicable	1% of ESP inlet gas flow & 2% of gas flow at common APH outlet through ducts
	(xiii)	Pressure required at chimney inlet	Not applicable	+40 mm WC (In case separate booster fans for FGD system are provided, ID fans shall be sized for minimum +10 mm WC of pressure requirement at chimney inlet for any FGD bypass operation.)
	(xiv)	Air & flue gas control	Blade pitch	Blade pitch
	<u>Note to 1.05.13.02 & 1.05.13.03:</u>			
	ID/FD fan shall have a minimum stall margin of 10% over the Design duty points.			
	Motor Rating; The maximum continuous motor rating corresponding to maximum cooling water temperature to cooler inlet or the motor rating at 50 deg C ambient temperature (as applicable) not less than the maximum load demand of driven equipment at its entire range of operation at frequency variations from 47.5 Hz to 51.5 Hz and motor not to be overloaded during any mode of operations of the driven equipment.			
	Duct Work			
	Sizing Criteria:			
(a)	Allowable velocities in the duct work.			
	(1)	Maximum air velocity shall be 16 m/sec.		
	(2)	Maximum gas velocity shall be 13m/sec except flue gas duct from ESP outlet to chimney inlet.		
	(3)	Maximum Flue gas velocity from ESP out-let to chimney inlet shall be 15 m/sec.		
	The contractor shall select the flue gas velocities, within the specified limits, especially between boiler outlet to ESP such that the ash accumulations at part/low loads (corresponding to requirements specified in part-A-01 and anywhere else in the specifications) are minimized.			
	The flue gas flow & ash accumulation patterns at such part/low loads shall be studied based on the CFD/Physical model test (PMT) of ducts & ESP as part of this			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA
				PAGE 19 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.05.16.02	(ii)	Type of fuel oil	Light Diesel Oil (As per characteristics given in per given in Table-1, Annexure-IV-1 Sub-Section-IB, Part-A of Section-VI)	
	(iii)	Oil firing system capacity	To cater to 30% BMCR requirements of Steam Generators without any coal firing*.	
	(iv)	No. of independent oil firing streams	1 (Catering to requirements of steam generators)	
	* To arrive at 30%BMCR requirements for sizing of LDO/HSD, value corresponding to 30% of 100% Q fired at BMCR worst coal to be considered.			
	Oil Burners/Burner Components			
	(a)	Type - Air atomized to be able to operate together with pumping system offered for LDO		
	(b)	Burner tips shall be provided as per following table:		
		Description	LDO Firing System	
	(i)	Type of burner	Air atomized (air to be from compressed air system)	
	(ii)	Burner cooling medium	Air	
(iii)	Burner tip material	Resistant to corrosion due to fuel oils containing sodium, vanadium, sulphur, chloride etc.		
(iv)	Minimum life of burner tips, before needing any maintenance replacements	16000 hours		
(v)	Hardness of atomizer (The hardness to be retained even at 400°C)	Minimum vickers hardness number of 400		
(vi)	Type of oil igniters	High Energy Arc Igniters		
(vii)	Oil burner turndown	3:1		
1.05.17	THERMAL INSULATION, LAGGING, CLADDING & REFRACTORIES			
	Thermal Insulation shall be designed based on criteria mentioned in separate chapter on Thermal insulation.			
1.05.18	BLOW DOWN SYSTEM			
1.05.18.01	The atmospheric flash tank shall be sized to receive following:			
	i) Maximum possible start up recirculation & drain flow under all possible normal, abnormal, upset, accidental conditions and even with startup recirculation pump out of			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 21 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS																											
	service. ii) All drains from Steam Generator such as drains from water wall headers, attemperators headers, SCAPH drains, soot blowers drains, superheater, reheater etc. iii) Alternate drains from main steam lines, CRH lines, HRH lines, as required. iv) Any other drains from High Pressure piping. For sizing, combination of all the above occurring simultaneously to be considered. Atmospheric tank shall be located at suitable level in the Steam Generator area. 1.05.18.02 Drain receiving vessel shall be sized to receive drains from atmospheric tank and shall have storage for atleast 10 minutes of maximum possible start up recirculation & drain flow under all possible normal, abnormal, upset, accidental conditions with startup recirculation pump in operation. 1.05.18.03 2X50% condensate transfer pumps to be provided. For arriving the size of pump all drains as indicated in clause 1.05.18.01 shall be considered. This pump shall be used to transfer condensate from receiving vessel to main condenser either directly or through condenser flash tank located in TG area. 1.05.19 Not Used 1.05.20 ESP SIZING CRITERIA (A) Electrostatic Precipitator Design Data The Electrostatic Precipitator(s) shall be designed to comply with the requirements stipulated under 'Guarantee point and design point' in the table below: <table><tr><th>Sl. No</th><th>Item</th><th>Guarantee Point</th><th>Design Point</th></tr><tr><td>1</td><td>Boiler Load in MW (e)</td><td>TMCR</td><td>VWO</td></tr><tr><td>2</td><td>Type of Coal</td><td>Design coal</td><td>Worst coal (max. ash coal from range)</td></tr><tr><td>3</td><td>Ambient air condition</td><td>27 degree Celsius temp. and 60% RH</td><td>45 degree Celsius temp. and 60% RH</td></tr><tr><td>4</td><td>Gas flow per ESP at the ESP inlet when firing respective coal (m³/sec)</td><td>To be worked out by Bidder when firing the specified design coal at 100% TMCR (800 MW unit load) considering 25% excess air at economiser Outlet, 15% Air heater in leakage and 2% duct leakage as a minimum.</td><td>To be worked out by Bidder when firing the specified worst coal (with max. ash) at VWO considering 25% excess air at economiser outlet, 15% Air heater in leakage and 2% duct leakage as a minimum.</td></tr><tr><td>5</td><td>Gas temperature at ESP inlet (deg. C)</td><td>125 degree Celsius or as predicted by the bidder under conditions</td><td>145 degree Celsius or as predicted by the bidder under conditions stipulated</td></tr></table>				Sl. No	Item	Guarantee Point	Design Point	1	Boiler Load in MW (e)	TMCR	VWO	2	Type of Coal	Design coal	Worst coal (max. ash coal from range)	3	Ambient air condition	27 degree Celsius temp. and 60% RH	45 degree Celsius temp. and 60% RH	4	Gas flow per ESP at the ESP inlet when firing respective coal (m ³ /sec)	To be worked out by Bidder when firing the specified design coal at 100% TMCR (800 MW unit load) considering 25% excess air at economiser Outlet, 15% Air heater in leakage and 2% duct leakage as a minimum.	To be worked out by Bidder when firing the specified worst coal (with max. ash) at VWO considering 25% excess air at economiser outlet, 15% Air heater in leakage and 2% duct leakage as a minimum.	5	Gas temperature at ESP inlet (deg. C)	125 degree Celsius or as predicted by the bidder under conditions	145 degree Celsius or as predicted by the bidder under conditions stipulated
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5	Gas temperature at ESP inlet (deg. C)	125 degree Celsius or as predicted by the bidder under conditions	145 degree Celsius or as predicted by the bidder under conditions stipulated																									
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 22 OF 81																								

CLAUSE NO.	TECHNICAL REQUIREMENTS			
			stipulated above, whichever is higher	above, whichever is higher
6	Inlet Dust Burden (gms/Nm³)	To be worked out by the Bidder (based on 85% of Ash or actual predicted whichever is higher being carried forward to ESP While firing specified design coal		To be worked out by the Bidder (based on 85% of Ash or actual predicted whichever is higher being carried forward to ESP, While firing specified worst coal with maximum ash
7	No. of series electrical fields out of operation	Nil		ONE(One field in all passes)
8	ESP Dust Collection Efficiency (%)	To be worked out by Bidder to limit ODB to 17 mg/Nm³ (maximum) at ESP outlet before FGD system inlet		To be worked out by Bidder to limit ODB to 50 mg/Nm³ (maximum) at ESP outlet before FGD system inlet
9	Minimum specific collection area (m²/m³/sec)	285		-
10	Maximum flue gas velocity through the ESP (M/sec)	1.0		1.0
11	Treatment time of the flue gases in seconds	20 (min.)		20 (min.)
12	Refer 13 b) below			
13	Other design parameters:			
	a) Minimum Aspect Ratio	1.5		1.5
	b) Design internal pressure at 67% yield strength (mm wc)	± 660		± 660
	c) Precipitator mechanical Design temperature (deg.C)	200		200
	d) Short temp excursion temperature (for approx. thirty (30) minutes at a time) (deg. C)	300		300
	e) Ambient temperature	50 deg.C		50 deg.C
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA
PAGE 23 OF 81				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.05.21.01		(deg.C) for ESP design		
	f)	Minimum no. of T/R sets per stream per series electrical field	One (1)	One (1)
	g)	Maximum collection area served by one T/R set (M2)	4000	4000
	h)	Minimum no. of bus sections per T/R set	One (1)	One (1)
	i)	Minimum dust hopper storage capacity (upto the maximum trip level based on design point conditions while firing worst coal with maximum ash) (in Hrs)	Eight (8)	Eight (8)
	j)	Minimum hopper valley angle to the horizontal (degrees)	Sixty Five (65)	Sixty Five (65)
	k)	Spacing between the collecting electrodes (Centreline to centreline-transverse to the gasflow (mm)	400	400
	l)	Minimum installed corona power per unit effective collection area (Watts/M2) *	17.0	17.0
	m)	Maximum nos. of ash hoppers	Two (2) for one TR set	
	Note :			
* The corona power shall be defined as the product of, average bus voltage and mean current divided by the collection area served by one T/R set.				
** The flue gas volume in Nm ³ /sec shall be calculated at normal temperature and pressure.				
(B) The Electrostatic Precipitator System shall also be designed to achieve ODB emission of less than 30 mg/Nm ³ (6% O ₂ dry) for the range of loads at different operating conditions and for the range of coals as specified with no field out of operation.				
1.05.21.01	FGD SYSTEM SIZING CRITERIA			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA
				PAGE 24 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS				
1.05.21.01	The FGD system and all the associated auxiliaries shall be designed to comply with the requirements stipulated under 'Guarantee Point' and 'Design Point' conditions indicated below:				
	SN	Item	Guarantee Point	Design Point	
	1	Boiler Load in MW (e)	TMCR	VWO	
	2	Type of Coal	Design coal	Design/Best/Worst Coal whichever give maximum sizing determining values	
	3	Ambient air condition	27degree Celsius temperature and 60% RH	45 degree Celsius temperature and 60% RH	
	4	Gas flow (M ³ /sec)	To be worked out by Bidder when firing the coal as per SN (2) above at TMCR (800 MW) load, considering 20% excess air at economizer outlet, 10% Air heater in leakage and 1% duct and 1% ESP leakage as a minimum.	To be worked out by Bidder when firing the specified worst coal at VWO load, considering 20% excess air at economizer outlet, 15% Air heater in leakage & 2% duct and 1% ESP leakage as a minimum.	
	5	Gas temperature at FGD inlet (deg. C)	125 degree Celsius or as predicted by the bidder under conditions stipulated above, whichever is higher	145 degree Celsius or as predicted by the bidder under conditions stipulated above, whichever is higher	
	6	Inlet SO ₂ concentration (mg/Nm ³)	To be worked out by the Bidder (based on the above conditions).	To be worked out by the Bidder (based on the above conditions).	
	7.	SO ₂ Removal Efficiency	To be worked out by the Bidder to achieve SO ₂ emission in the chimney to less than 60 mg/nm ³ (6% O ₂ dry basis)	To be worked out by the Bidder to achieve SO ₂ emission in the chimney to less than 80 mg/Nm ³ (6% O ₂ dry basis)	
	* SO2 concentrations shall be measured at Absorber inlet and in chimney for the purpose of calculating removal efficiency.				
1.05.21.02	The Flue Gas Desulphurisation (FGD) System shall also be designed to achieve SO2 emission of less than 100 mg/Nm3 (6% O2 dry) for the range of loads at different operating conditions and for range of coals as specified in this Sub-Section below.				
1.05.21.03	The Flue Gas Desulphurisation System shall also be capable to limit SO2 to less than 100 mg/Nm3 (6% O2 dry) on sustained basis when Steam Generator is fired with upto 30% imported coal (by weight) blended with Indian coal as specified. System redundancies/				
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 25 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.05.22.01	margins on equipment/ auxiliary sizing need not be available under such fuel firing condition unless specifically mentioned otherwise. However, equipments/ systems shall not exceed their safety limits under such firing, and shall not transgress in to factors of safety as per specification/ codes. CHIMNEY A "wet Chimney" shall be installed downstream of Wet Flue Gas Desulfurization (FGD) system. Clean gas from the absorber shall be taken to the Chimney through three stage mist eliminators. Treated flue gas from the absorber shall be discharged through a wet stack without reheating of the flue gas. In such a case the flue gas will be saturated. However, provision has also been made for isolation of the flue gas flow through the absorber and also for bypass of the absorber, to allow maintenance of the absorber with the unit in operation. In such a case flue gas will directly go to the Chimney after ID Fans through bypass duct. Single-flue chimney shall be provided. There shall be one flue for the unit. In addition to compliance with statutory norms, the height of the Chimney shall be such that the flue gas emission point shall adequately clear the top most accessible elevation in the plant. In any case the height of the chimney above the plant grade level shall be at least 150 meters for Single-flue chimney . The Bidder shall furnish unit rates for addition and deletion in height of the chimney with respect to the height mentioned above in relevant schedule of BPS. The Contractor, shall take into account the entire characteristics of expected combination of fuels to be fired, for the complete load range of operation and the expected numbers of Steam Generator start-ups while designing the Chimney flue liner considering Steam Generator in operation both with & without FGD system in operation. The chimney flue liner cladding shall be made of 1.5 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 (ASTM B575, UNS N10276)alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done by explosion bonding or hot rolling to achieve the required quality as per ASTM B 898-11. Alternatively, Contractor can also provide chimney of 8 mm thick (minimum) mild steel with Borosilicate Glass Block Lining of minimum 38 mm thickness, which should have been in successful operation for similar application in at least two (2) units, located at different locations, for a period not less than two (2) years as on the date of Techno-Commercial bid opening. In such a case, Contractor/Lining supplier shall provide a ten (10) year full replacement guarantee and fulltime onsite QA supervision, during erection & commissioning, by the supplier of the lining system. Transition duct inside the chimney and chimney flue liner shall be painted with corrosion resistant paint for Borosilicate Lining and insulated for Titanium/C-276 cladding irrespective of surface temperature. For Titanium/C-276 lining, the top flue liner above the roof slab shall be made of solid C276 (ASTM B575, UNS N10276) / Titanium (Grade 2 as per ASME SB265) of minimum 10 mm thickness. For Borosilicate lining, top portion of the flue can shall be fitted with stop bar of 8 mm thick capping of Titanium / C-276 sheet to avoid any damage in between flue can and borosilicate lining. The minimum length of the capping inside the chimney shall be atleast equal to 150mm. The minimum length of flue liner projecting over the chimney roof shall be atleast equal to diameter of flue liner and the external surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet (over insulation for titanium/C-276 lining and without insulation for borosilicate lining).			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 26 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS																							
	The stack shall be designed as per the latest guidelines of EPRI Wet Stack Design Guide. The design of wet ducts and stacks system shall consider the Stack liquid discharge (SLD), Corrosion/chemical attack, Condensate collection system and its drainage etc. To cater to the requirements of FGD running in bypass mode, the components of Condensate Drain collection system (such as ring collectors, gutters, condensate drain piping etc.) exposed to high temperature flue gas shall be made of Alloy C276 / Alloy 59 / Titanium Gr-II. A wet stack study shall be performed by the Contractor for each unit with a wet stack installation where there does not exist an identical or mirror image installation that has already had a wet stack study performed. A wet stack model study shall consist of the following: (i) Condensation calculations (ii) Minimum 1:12 scale physical flow model for liquid collector design (iii) Computational flow model for plume downwash Analysis (iv) Physical or computational flow model for CEMS elevation flow performance Liquid collectors shall be designed and developed experimentally using a physical model. The model shall begin at the outlet of the absorber mist eliminator(s), include the absorber outlet and ducting, the stack breaching duct and a minimum of three (3) diameters of the stack liner above the top of the stack breaching duct. Physical model shall include any internal devices that may affect the gas flow, such as structural members, flow controls, and expansion joints. Liquid collectors shall be located where needed in the absorber outlet, the ductwork between the absorber outlet and the chimney liner, in the chimney liner, and in the exit nozzle. These collectors shall collect liquid from surfaces, prevent re-entrainment, and guide the liquid to locations where it can be drained out of the system and prevent the discharge of droplets from the top of the stack that are large enough to rain out to the ground before evaporation. The chimney liner & duct shall be designed & sized considering the following requirements as a minimum. However, minimum inside diameter of flue liner shall not be less than 8000 mm. <table><tr><th rowspan="2">SN</th><th rowspan="2">Item</th><th colspan="2">Design Point</th></tr><tr><th>Normal Operation with FGD in Operation</th><th>Operation with Bypass Operation</th></tr><tr><td>1</td><td>Boiler Load in MW</td><td>BMCR</td><td>BMCR</td></tr><tr><td>2</td><td>Type of Coal</td><td>Worst coal</td><td>Worst coal</td></tr><tr><td>3</td><td>Gas flow (M³/sec)</td><td>To be worked out by Bidder when firing the specified worst coal at BMCR load, considering 20% excess air at economizer outlet, 15% Air heater in leakage & 2% duct and 1% ESP leakage as a minimum.</td><td>To be worked out by Bidder when firing the specified worst coal at BMCR load, considering 20% excess air at economizer outlet, 15% Air heater in leakage & 2% duct and 1% ESP leakage as a minimum.</td></tr><tr><td>4</td><td>Gas temperature at Chimney inlet (deg. C)</td><td>To be worked out considering ambient temperature of 45 degree Celsius temperature and 60% RH & flue gas temperature at FGD inlet of 145 degree Celsius or as predicted by the bidder under conditions stipulated above,</td><td>To be worked out considering ambient temperature of 45 degree Celsius temperature and 60% RH & flue gas temperature of 145 degree Celsius or as predicted by the bidder under conditions</td></tr></table>	SN	Item	Design Point		Normal Operation with FGD in Operation	Operation with Bypass Operation	1	Boiler Load in MW	BMCR	BMCR	2	Type of Coal	Worst coal	Worst coal	3	Gas flow (M³/sec)	To be worked out by Bidder when firing the specified worst coal at BMCR load, considering 20% excess air at economizer outlet, 15% Air heater in leakage & 2% duct and 1% ESP leakage as a minimum.	To be worked out by Bidder when firing the specified worst coal at BMCR load, considering 20% excess air at economizer outlet, 15% Air heater in leakage & 2% duct and 1% ESP leakage as a minimum.	4	Gas temperature at Chimney inlet (deg. C)	To be worked out considering ambient temperature of 45 degree Celsius temperature and 60% RH & flue gas temperature at FGD inlet of 145 degree Celsius or as predicted by the bidder under conditions stipulated above,	To be worked out considering ambient temperature of 45 degree Celsius temperature and 60% RH & flue gas temperature of 145 degree Celsius or as predicted by the bidder under conditions	
SN	Item			Design Point																				
		Normal Operation with FGD in Operation	Operation with Bypass Operation																					
1	Boiler Load in MW	BMCR	BMCR																					
2	Type of Coal	Worst coal	Worst coal																					
3	Gas flow (M³/sec)	To be worked out by Bidder when firing the specified worst coal at BMCR load, considering 20% excess air at economizer outlet, 15% Air heater in leakage & 2% duct and 1% ESP leakage as a minimum.	To be worked out by Bidder when firing the specified worst coal at BMCR load, considering 20% excess air at economizer outlet, 15% Air heater in leakage & 2% duct and 1% ESP leakage as a minimum.																					
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 27 OF 81																					

CLAUSE NO.	TECHNICAL REQUIREMENTS				
	SN	Item	Design Point		
			Normal Operation with FGD in Operation	Operation with Bypass Operation	
			whichever is higher.	stipulated above, whichever is higher.	
	5	Pressure at chimney inlet (mmwc)	40	40	
	6	SO ₂ concentration (mg/Nm ³)	To be worked out by the Bidder (based on the above conditions).	To be worked out by the Bidder (based on the above conditions).	
	7	SO ₃ concentration (mg/Nm ³)	To be worked out by the Bidder	To be worked out by the Bidder	
	8	Flue Gas velocity (m/s)	< 16.8 for Titanium/C-276 Lining <18.3 for Borosilicate Lining	-	
	9	Short excursion temperature of inlet gas (for approx. thirty (30) minutes at a time) (deg. C)	-	300	
	2.0.00	STEAM TURBINE AND AUXILIARIES			
	2.01.00	Steam Turbine			
2.01.01	Type The steam turbine shall be tandem compound, single reheat, regenerative, condensing, multi cylinder design with separate HP, separate IP & separate LP casings OR combined casings for HP - IP and separate casings for LP Turbine, directly coupled with generator, suitable for indoor installation.				
2.01.02	Rating The steam turbine generator unit shall conform to the following design and duty conditions:				
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 28 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS																																							
	<table><tr><td>i)</td><td>Output under Economic Maximum Continuous Rating(EMCR) at Generator terminals</td><td>800 MW</td></tr><tr><td>ii)</td><td>Turbine throttle steam pressure</td><td>270 Kg/cm² (abs)</td></tr><tr><td>iii)</td><td>Turbine throttle main steam temp</td><td>600 deg.C</td></tr><tr><td>iv)</td><td>Reheat steam temp. at turbine inlet</td><td>To be optimized by the bidder between 600 and 610 deg.C (both values inclusive) but not less than 600 deg.C</td></tr><tr><td>v)</td><td>Design & operational requirement including variations in rated steam temp. & pressure</td><td>Generally as per IEC 45 or otherwise specified elsewhere in the specification.</td></tr><tr><td>vi)</td><td>Pressure drop in reheat circuit i.e between H.P. turbine exhaust & IP turbine inlet.</td><td>To be optimized by the bidder</td></tr><tr><td>vii)</td><td>Condenser pressure</td><td>77 mm Hg (abs)</td></tr><tr><td>viii)</td><td>Turbine speed</td><td>3000 rpm.</td></tr><tr><td>ix)</td><td>Frequency variation range around rated frequency of 50 Hz</td><td>+3% to -5%(47.5 Hz to 51.5 Hz)</td></tr><tr><td>x)</td><td>DM water make up to thermal cycle under EMCR condition</td><td>3% of throttle steam flow.</td></tr><tr><td>xi)</td><td>Final feed water temp. at TMCR/EMCR condition</td><td>To be optimized by bidder but not less than 305 deg C</td></tr><tr><td>xii)</td><td>Turbine protection against water induction</td><td>As per ASME-TDP-1- latest edition.</td></tr></table> The conditions corresponding to economic maximum continuous rating (EMCR) at generator terminals shall be 800 MW output under rated steam condition with 15 T/hr of steam extracted from CRH for auxiliary steam and total cycle make up of 3% of throttle steam flow and 77 mm Hg (abs) condenser pressure . The EMCR output at generator terminals shall be 800 MW plus power consumption by auxiliaries described in clause no.1.01.03.01 of Section-VI, Subsection IV" Functional Guarantee & Liquidated damages, Part-A. Note: "Throttle/Main Steam Conditions" means initial/main steam conditions (i.e. pressure, temperature and flow) at inlet to Main Steam Strainer. "Reheat Steam Conditions" means reheat steam conditions (i.e. pressure, temperature and flow) at inlet to Reheat Steam Strainer or Reheat Steam Stop valve whichever is placed upstream in the direction of steam flow. - Wherever in the specification "Main Steam / Throttle Steam / Reheat Steam / Rated Steam conditions" have been mentioned, in connection with turbine / turbine cycle rating and performance guarantees, the same shall be interpreted as per above two clauses of note. - Wherever in the specification, words or combination of words have been used to describe output of the turbine generator set (such as power at generator terminals, output at generator terminals, unit load, TG load, TG output, unit output etc.), it shall mean electrical power output at generator terminals after deducting the power consumption by auxiliaries described in clause no 1.01.03.01 of Section-VI, Sub-section – " Functional Guarantee & Liquidated damages, Part-A".				i)	Output under Economic Maximum Continuous Rating(EMCR) at Generator terminals	800 MW	ii)	Turbine throttle steam pressure	270 Kg/cm ² (abs)	iii)	Turbine throttle main steam temp	600 deg.C	iv)	Reheat steam temp. at turbine inlet	To be optimized by the bidder between 600 and 610 deg.C (both values inclusive) but not less than 600 deg.C	v)	Design & operational requirement including variations in rated steam temp. & pressure	Generally as per IEC 45 or otherwise specified elsewhere in the specification.	vi)	Pressure drop in reheat circuit i.e between H.P. turbine exhaust & IP turbine inlet.	To be optimized by the bidder	vii)	Condenser pressure	77 mm Hg (abs)	viii)	Turbine speed	3000 rpm.	ix)	Frequency variation range around rated frequency of 50 Hz	+3% to -5%(47.5 Hz to 51.5 Hz)	x)	DM water make up to thermal cycle under EMCR condition	3% of throttle steam flow.	xi)	Final feed water temp. at TMCR/EMCR condition	To be optimized by bidder but not less than 305 deg C	xii)	Turbine protection against water induction	As per ASME-TDP-1- latest edition.
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 29 OF 81																																				

CLAUSE NO.	TECHNICAL REQUIREMENTS												
2.01.03	5. Wherever in the specification, "Condenser Design Pressure", "Condenser Pressure", "Design Condenser Pressure", "Guaranteed Condenser Pressure" is indicated, the same shall mean average of all the condenser pressures. 6. Wherever in the specification Rated steam condition have been mentioned, the same shall be as follows: <table><tr><td>(i)</td><td>Turbine throttle steam pressure</td><td>270 kg/cm² (abs)</td></tr><tr><td>(ii)</td><td>Turbine throttle main steam temp.</td><td>600°C</td></tr><tr><td>(iii)</td><td>Reheat steam temp.</td><td>To be optimized by the bidder between 600 and 610 deg.C (both values inclusive) but not less than 600 deg.C</td></tr></table> 7. Extent and duration of permissible variations in rated steam temperature shall be same as per latest IEC-45. 8. Wherever in the specification reheat steam temperature is mentioned, the rated reheat steam temperature at Turbine inlet shall be according to the final selected temperature by the Bidder based on the optimization. The HBDs shall corresponds to the final reheat steam temperature selected. Other Features:- a) Turbine shall be capable of operating continuously with valves wide open (V.W.O.) to swallow at least 105% of EMCR steam flow to the turbine at rated main steam and reheat steam parameters and also the corresponding output shall not be less than 105% of rated load with 3% make up and 77 mm Hg (abs) condenser pressure. Bidder can offer overload valve (HP stage bypass) to meet the above specified VWO requirement, if it is a proven practice of the Turbine manufacturer. In such case VWO shall mean wide open condition of both, the turbine main control valves and the overload valves. However, if bidder offers overload valves, then bidder to ensure sufficient margin in the main turbine control valves so as to generate at least 102% of rated load at rated main steam & reheat steam parameters at condenser pressure of 77 mm Hg (abs) with 3% makeup. Load requirement beyond 102% of rated load can be met with overload valve. OLV operation shall also be envisaged for entire range of plant operation to meet the instantaneous increase in load demand. (b) The steam turbine generator unit shall be suitable for direct connection to steam generator having no inter connection with other units either on the boiler feed water side or main steam side. (c) The steam turbine shall have minimum eight uncontrolled extractions for regenerative feed heating based on optimised cycle and shall be suitable for satisfactory operation under tropical conditions. (d) The cycle will consist of minimum 3 nos. of HP heaters with extraction for top HP heater from HP turbine, one no. of deaerator and minimum 4 nos. of LP heaters. (e) For Auxiliary Steam system for Turbine Generator, Steam generator and station auxiliaries, refer requirements stipulated elsewhere in the specification.				(i)	Turbine throttle steam pressure	270 kg/cm ² (abs)	(ii)	Turbine throttle main steam temp.	600°C	(iii)	Reheat steam temp.	To be optimized by the bidder between 600 and 610 deg.C (both values inclusive) but not less than 600 deg.C
	(i)	Turbine throttle steam pressure	270 kg/cm ² (abs)										
(ii)	Turbine throttle main steam temp.	600°C											
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 30 OF 81									

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.01.04	TURBINE LUBRICATION OIL SYSTEM (1) Each Unit Lube Oil tank to have capacity to allow 5 to 8 oil charges per hour (at normal operating level), fitted with non-corrodable strainers, level measuring device & local indicators and necessary manholes, 2x100% duty vapour extraction fans, platforms, railings, necessary piping, supports and accessories etc. (2) Lube oil cooler 2x100% capacity oil coolers (either shell & tube type or plate type heat exchanger) with 15% margin on heat transfer surface area shall be provided for cooling the lubricating oil. The tube / plate material shall be SS316. Further the material of any other part of the lube oil cooler which is coming in contact of lube oil shall be SS316.			
2.01.05	Central Turbine Lubricating Oil Storage & Purification System Provide identical Dirty & Pure Oil tanks with capacity 1.5 times capacity of unit oil tank. Provide purification system identical to Unit purification system as specified for Main Turbine elsewhere in the specification.			
2.01.06	TURBINE CONTROL FLUID SYSTEM Control fluid purifying unit to purify atleast 2% of the total fluid charge in the system per hour on a continuous by pass basis alongwith 2x100% capacity A.C. driven purification pumps (for fluid circulation through purification system). 2x100% control fluid coolers designed as specified at clause no 2.01.04 of this chapter above and ensure all surfaces coming in contact with control fluid to be of stainless steel. 2x100% air cooled coolers are also acceptable depending upon standard practice of the manufacturer.			
2.02.00	Steam condensing plant			
2.02.01	Condenser i) Design, manufacturing and testing as per Heat Exchanger Institute, USA (latest edition) with proven design. The condenser shall be designed for heat load corresponding to 105% of TMCR Load, 0% make-up, guaranteed condenser pressure and conditions given in Clause No. 2.02.03. The value of condenser pressure to be measured at 300 mm above the top row of condenser tubes. The condenser vacuum shall be measured with a vacuum grid utilizing ASME basket tips. The grid is fitted at 300 mm above top row of tubes of condenser. Condensate temperature at all loads shall be near to the saturation temperature corresponding to condenser pressure. ii) The Condenser hotwell shall be sized for Three (3) minute storage capacity (between normal & low-low level) of total design flow with the turbine operating at VWO condition, 3% make-up, 77 mmHg (abs) condenser pressure. The low-low level of hotwell shall be at least 200 mm above the bottom of hotwell. (ii) Design for full vacuum and min. internal pressure 1.08 kg/cm²(g). Minimum shell side design temperature 120 deg. C. (iv) Sizing of steam dumping device to accept the steam from HP-LP bypass with necessary spray water including abnormal conditions like HP heaters out of service etc.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 31 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.02.02	(v)	Design of air removal section to cool the air and vapour mixture to atleast 4.17 deg. C below saturation temperature corresponding to 25.4 mm Hg (abs). Connections to air evacuation pumps shall be made at this section.		
	(vi)	Design for exhaust steam from steam turbine, BFP drive turbine (if applicable), HP-LP bypass system, heater drains and vents, boiler separator drains during start up low load and abnormal conditions and other miscellaneous drains.		
	(vii)	Designed to carry flooded weight (upto 1 meter above top row of condenser tubes) for hydraulic and hydrostatic testing of condenser without installation of temporary supports or bracing.		
	Condenser air evacuation pumps			
2.02.03	(i)	Each unit shall consist of 2x100% vacuum pumps per condenser with all accessories and instrumentation for condenser air evacuation.		
	(ii)	Pumps shall be sized as per latest HEI requirements. Holding capacity of each pump in free dry air at standard condition i.e. 760 mm of Hg (abs) and 21.1 deg.C and capacity during hogging operation shall not be less than as specified in the table below:		
		2 x 100 % vacuum pumps per condenser	Holding operation (with condenser operating at design pressure of 1 inch (25.4 mm) of Hg (abs) and sub cooled to 4.17 degC below temperature corresponding to absolute suction pressure)	20 SCFM (34 m³ per hour)
			Hogging operation (at 10 inch (254 mm) of Hg (abs) condenser pressure)	500 SCFM (850 m³ per hour under standard conditions i.e. 760mm Hg (abs) and 21.1 deg. C)
	(iii)	The above holding capacity of vacuum pump shall correspond to the vacuum pump I.T.D. (Initial Temperature Difference) calculated separately for each condenser shell as below: Vacuum pump I.T.D = Saturation temperature corresponding to optimized condenser pressure for the respective condenser shell (which is considered for guaranteed condenser pressure) – specified cooling water inlet temperature to vacuum pump seal water cooler. The hogging capacity of vacuum pump shall correspond to specified cooling water inlet temperature to vacuum pump seal water cooler.		
	Condenser and associated systems shall be designed for parameters as given below: Design parameters for condenser and associated systems			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA
PAGE 32 OF 81				

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	1. Condenser Design Parameters: (i) Number of Passes : Single pass/Double pass (ii) Design cold water temp. : 33 Deg. C (iii) Min. size (O.D) of the tube : 22.225 mm (iv) Minimum thickness of the tube : 22 BWG (v) Tube velocity : 1.6 to 2.2 m/sec. (vi) Guarantee Condenser pressure : To be optimised by bidder but not exceeding 65 mmHg (abs). (vii) Max. tube length between tube plates : 15 meters (Indicative) (viii) Temperature rise in circulation water across the condenser : to be optimised by Bidder (ix) Tube material : Stainless Steel as per ASTM-A-249-TP316L (x) Cleanliness factor : 0.9 (xi) maximum and minimum circulating water temperature : 36 deg.C (max.) and 15 deg.C (min.) (xii) Condenser arrangement : Perpendicular to T.G. axis. 2. Water box design pressure : 0.1 kg/cm² (abs) and 5 kg/cm²(g) 3. Water box test pressure : 1.3 times the design pressure 4. Water box design temperature : 60 deg. C 5. Shell side design pressure : Full vacuum and 1.08 kg/cm² (g) 6. Minimum Shell side design temperature : 120 deg.C 7. Design parameters for expansion joints: (a) Design pressure : Vacuum (0.1 kg/cm² (abs))		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA
			PAGE 33 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS		
		and 5 kg/cm ² (g)	
	(b)	Design temperature	: 60 deg.C
	(c)	Test pressure	: 1.5 times the design pressure
8.	Design parameters of isolating butterfly valves with actuator		
	(a)	Design pressure	: Vacuum (0.1 kg/cm ² (abs)) and 5 kg/cm ² (g)
	(b)	Design temperature	: 60 deg.C
	(c)	Test pressure	: 1.5 times the design pressure
9.	Condenser air evacuation system design parameters		:
	(a)	Source of vacuum pump heat exchanger cooling water	: Condenser cooling water as per analysis given elsewhere in the specification
	(b)	Source of sealing water	: Condensate
	(c)	Source of make-up water	: Condensate
	(d)	Design pressure (cooling water side for vacuum pump heat exchanger	: Vacuum (0.1 kg/cm ² (abs)) & as per ACW System Design Pressure
	(e)	Pressure of make-up water	: CEP discharge pressure
	(f)	Maximum temperature of condenser cooling water	: 36 deg.C
	(g)	Duty code	: HEI (Latest)
	(h)	Design condenser pressure	: 25.4mm (1 inch) of Hg (abs)
	10.	Design pressure for CW piping, valves, fittings, COLTCS equipment on the CW line etc.	: Vacuum(0.1 kg/cm ² (abs)) and 5 kg/cm ² (g)
2.03.00	Feed water heating plant		
2.03.01	The plant shall be designed as per ASME Boiler & pressure vessel code, Sec-VIII, Division-I (Latest), Heat exchange Institute Standards (USA). In addition the requirements of ASME-		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA
			PAGE 34 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	TDP-I - latest code for turbine damage prevention shall also be taken care of. Plant shall be designed for all operating conditions including transients like sudden load throw-off, HP LP bypass coming in operation, preceding one or two heaters going out of service etc.			
2.03.02	The plant shall be suitable for operation in conjunction with the turbine. It shall be designed for raising the temperature of feed water from that in the condenser to a final feed water temperature, as optimized by the bidder but not less than 305 deg C, at the outlet of top heater at rated output with zero percent make-up and design back pressure. TTDs and DCAs of heaters shall correspond to the 100% TMCR heat rate guarantee conditions.			
2.03.03	Design with Minimum pressure drop on tube side. Velocity of water through the tubes shall be restricted to 3.05 m/sec under all operating conditions.			
2.03.04	Each of the LP heaters and drain cooler shall be capable of handling 110% of the design condensate flow from 2x50% condensate extraction pumps without undue vibration and other deleterious effects. Each of HP heaters shall be capable of handling 110% of the design flow from one BFP without undue vibration and other deleterious effects.			
2.03.05	a) LP Heater Shell side Design Pressure: Not less than Max. Extraction Steam pressure and full vacuum with minimum design pressure of 3 kg/cm² (g). b) HP Heater Shell side Design Pressure: Not less than max. extraction steam pressure and full vacuum. Design pressure of HP heaters taking extraction from CRH line, shall be CRH extraction pipe design pressure and full vacuum.			
2.03.06	a) LP Heater Tube side Design Pressure: CEP shut off head at maximum possible speed of Variable Frequency Drive (VFD) and full vacuum. b) HP Heater Tube side Design Pressure: The design pressure of HP heaters' tube side shall not be less than maximum of the following: (i) 1.05 times the maximum operating pressure (including BMCR condition) at BFP discharge. (ii) Pressure required at BFP discharge under lowest spring loaded safety valve on boiler separator blowing condition. (iii) Design pressure as required by IBR/ ASME. However, pressure relief valve/ 3-way by pass valve across the HPHs shall be provided, as per the tender drawing, so that HPHs are not subjected to shut off condition. The HPHs shall be designed for full vacuum also. (d) Design for handling drains from preceding heaters for all operating conditions and emergency drains to condenser bypassing the drain cooling zone. (e) Provision of start-up and operating vents with orifices and relief valves and provision for removing non-condensable gases collecting on shell side individually to condenser. Vent orifice shall be sized to pass one half percent of TMCR extraction steam flow to respective heater under TMCR conditions. (f) Provide sentinel relief valve on tube side. Relief valve on shell side sized to pass flow from two ruptured tubes (four open ends) or 10% of water flow corresponding to VWO			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA
PAGE 35 OF 81				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.03.07	condition with 3% make up and 77 mmHg (abs) condenser pressure at 10% accumulation whichever is higher and set to open at heater shell design pressure. The deaerator shall be designed such that maximum oxygen content shall be 0.005 cc/litre at deaerator outlet measured as per ASTM D5543-09 or Indigo Carmine method at all operating conditions. Minimum feed water storage tank capacity shall be based on 6 (six) minutes of TMCR flow (approx.) between normal operating level and low-low level with a filling factor of 0.66. This capacity shall be exclusive of the volume of internal piping, baffles and volume of the dished end. It shall be designed for maximum incoming steam flow when none of the LP heaters are working under HP/LP bypass condition. Deaerator capacity below low-low level (BFP tripping point) shall have minimum value of 80 cubic meter (Without dished end volume). BFP tripping on NPSHa (at centerline) less than NPSHr shall be provided to avoid any damage during transient condition like sudden load throw-off i.e. turbine trip from VWO operating condition, no pegging steam is available for de-aerator or any abnormal condition arising out during plant operation. Quick measuring devices and sensors with high accuracy class and least response time shall be installed in BFP suction system for real time acquisition of NPSHa to enable instant tripping. Size of vent orifice for one half percent of TMCR extraction steam flow to deaerator. Deaerator shall be sized for handling all incoming condensate, HP heater drains etc.			
2.04.00	Turbine Hall E.O.T. cranes Two (2) number of electrically operated overhead travelling cranes with associated auxiliaries, along with electrical equipment, control & instrumentation as required and specified shall be provided in the turbine hall for erection and maintenance of turbo-generators and their auxiliaries. Each crane shall be capable of lifting at least 105% of the weight of single heaviest component/ equipment (except generator stator), including lifting beam and slings etc. (as applicable) to be handled in TG hall for erection as well as maintenance of the equipment provided in AB bay. The auxiliary hook capacity shall not be less than 20 Ton. In addition, it shall also be possible to handle Generator Stator with tandem operation of two Turbine Hall EOT cranes for which necessary arrangements shall be provided. In such case, the combined capacity of two EOT cranes shall not be less than 105% of weight of Generator Stator, including the weight of lifting beam with swiveling arrangement and slings.			
2.05.00	Condensate Extraction pump i) Pump sizing a) Design Capacity: Combined flow of 2x50% condensate extraction pumps to be based on 15% margin over highest Condensate flow envisaged during unit operation (excluding HP/LP by pass operation). Design Head: Corresponding to above considering 10% margin over deaerator pressure. b) Best efficiency point:			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 36 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	Combined flow of 2x50% CEPs shall be based on TG unit EMCR and corresponding head. Best efficiency point of the selected pump shall be preferably corresponding to above point. c) Maximum Capacity: One pump capable of handling the flow and head corresponding to 65% unit load. d) Other Capabilities: - 2 pumps shall be capable of handling the flow corresponding to Unit EMCR, all HPH out, 3% make-up and worst condenser pressure. - 2 pumps shall be capable of handling the flow corresponding to HP/LP by pass operation with turbine under tripped condition as well as turbine on house load. e) NPSH Margin NPSH (R) at 3% head drop shall not be more than half the NPSH(A) at design flow with low-low hotwell level and NPSH(R) at 3% head break shall be well below NPSH(A) under all conditions. (f) Suction specific speed Suction specific speed of first stage impeller not to exceed 11,000 U.S. units based on 3% head break of that impeller at design point. (g) Design Pressure (1) Bowls and discharge components design pressure shall correspond to shut off head at maximum possible speed of Variable Frequency Drive (VFD) and operating specific gravity and maximum suction condition. (2) Suction components shall be designed for 8 ata and full vacuum. ii) Motor Rating: Variable frequency drive motor with maximum speed of the motor shall atleast be 5% above the highest speed determined of the pump corresponding to the condition indicated at (i) above. Motor rating at 50 deg.C ambient temperature shall not be less than the maximum load demand of its driven equipment corresponding to maximum motor speed indicated above and motor shall not be overloaded during any mode of operation of driven equipment.		
2.06.00	Boiler feed pump		
2.06.01	Pump sizing		
	(i) Turbine Driven BFP		
	1) Design capacity and design head: Combined flow of 2x50% Turbine driven boiler feed pumps to be based on 10% margin over feed flow corresponding to turbine V.W.O condition, 3% makeup, 77 mm Hg (abs) condenser pressure and corresponding head. In case continuous overpressure operation of unit is envisaged then the capability of pump for such an operation shall be verified.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA
			PAGE 37 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	2) Best efficiency point: Combined flow of 2x50% TDBFPs shall be based on TG unit EMCR and corresponding head. 3) Runout point: One TDBFP shall be capable of handling flow and head corresponding to 65 % of unit rated load. 4) Emergency point: Two Turbine driven boiler feed pumps to be capable of generating the discharge pressure not less than steam generator highest safety valve set pressure corresponding to 105% of boiler maximum continuous rating (at 0% make up). 5) Other capabilities: Combined flow of 2X50% TDBFP shall meet the following: (a) BMCR flow and head corresponding to rated steam pressure (at 3% make up). (b) Output corresponding to VWO flow, 3% makeup, worst condenser pressure. (ii) Motor Driven BFP: 1) 1x30% MDBFP shall meet all the above conditions (i.e. (i) (1) to (5) above) except that the flow of 1x30% Motor driven Boiler feed pump shall be 30% of the total flow arrived for 2x50% TDBFPs. The head developed by MDBFP shall be calculated in the same way as done for TDBFPs for all the above conditions so that TDBFPs and MDBFP can be operated in parallel. 2) The conditions corresponding to (i) (5) shall be met by MDBFP at 47.5Hz. (iii) One TDBFP and one MDBFP operating in parallel shall be able to generate flow and head corresponding to minimum 95% of unit load. (iv) Bidder may consider the following for boiler feed pump sizing. (a) Design discharge flow of each TDBFP - not less than half of 110% of VWO feed water flow. Design discharge flow of MDBFP - not less than 60% of the discharge flow of each TDBFP. (b) Bidder to consider Rated discharge flow through interstage bleed off from turbine driven feed pump for reheater attemperation to meet Boiler requirements. Rated discharge flow through interstage bleed off from MDBFP - not less than 60% of the discharge flow through interstage bleed off from TDBFP. Note : Discharge flow of main pump not to include any seal flow, warm up flow and balance drum leakage flow.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 38 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS	
2.06.02	Motor Rating: The maximum continuous motor rating corresponding to maximum cooling water temperature to cooler inlet not less than the maximum load demand of driven equipment at its entire range of operation at frequency variations from 47.5 Hz to 51.5 Hz and motor not to be overloaded during any mode of operations of the driven equipment.	
2.06.03	(a) NPSH Margin The ratio between NPSH (A) and NPSH (R) at 3% head drop for booster pump and main pump shall be not less than 2.5 at design point corresponding to Low-Low level of deaerator. (b) Trip speed of TDBFP: 10% above the design speed of the feed pump.	
2.06.04	(a) Efficiency: Preferably not more than 83% (hot). However, if higher efficiency is selected then the drive power requirement shall be determined with 83% efficiency only. (b) First stage suction specific speed Not in excess of 10000 (US units) and 9500 US units based on 3% head break down of that impeller of main pump and booster pump respectively at their respective design point. (c) Casing design pressure TDH at minimum flow and operating at trip speed for TDBFP and TDH at minimum flow and maximum pump speed at 51.5 Hz for MDBFP under highest operating density plus maximum suction pressure at booster pump. (d) Axial thrust Balancing drum designed to balance 95% of total pump axial thrust. Balancing disc not acceptable. (e) Thrust bearing of booster pump and main pump Two times of the worst thrust from minimum speed to trip speed of TDBFP and minimum speed to maximum speed of MDBFP at all flow values from 0% to 125% and internal clearances being 100% or 200% of new clearance under which condition thrust is higher. Thrust bearing should be suitable for reverse rotation.	
2.06.05	GEAR BOXES (Applicable Code- AGMA 6011 and AGMA 6013 (Latest)) Service Factor MDBFP (combined gearing/Hydraulic coupling) 1.4 Between turbine drive and booster pump 2.0	
2.06.06	OIL COOLERS: In case of shell and tube type oil coolers tube material shall be SS 304 and in case of plate type heat exchanger plate material shall be SS 316. Applicable code-TEMA, Pressure parts-ASME Sec VIII.15% margin on plates shall be considered in case of plate type heat exchanger. Instrument connections alongwith temperature and pressure indicators on inlet and outlet branches of the water side and also on the shell side of each Coolers.	
2.06.07	Drive turbine Lubricating oil system Two full capacity oil coolers specified as under: (i) Rating Adequately rated with suitable fouling allowance in accordance with TEMA with necessary arrangements for changing over the cooler without interrupting the oil flow.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001
SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA		PAGE 39 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.07.00	(ii) Cooling Arrangement Cooling medium shall be demineralized water taken from closed loop cooling system. Cooling medium shall flow in tube side. (iii) Instruments Connections along with temperature and pressure indicators on inlet and outlet branches of the water side and also on the shell side of each Cooler. Adequate draining and venting of all parts of cooler. (iv) Alternatively, plate type heat exchanger with 15% area margin on plates also acceptable as per standard practice of bidder. Following requirement shall also be complied with: - Plate material shall be SS 316 and material for other component shall be compatible for the application. - Pressure part as per ASME Sec-VIII. - Thermal calculation considering fouling factor, overall heat transfer coefficient, corrosion allowance, plate thickness etc as per their standard practice shall be provided for employer's approval. - Oil reservoir with five minutes retention time. - Suitably sized hydraulic accumulators shall be provided in governing oil system to maintain system pressure, when there is a change over from one running pump to stand by oil pump. Also, provision shall be made for initial air purging of the governor system.			
	Drip pump (if offered) (a) Pump Sizing (i) Design Capacity 1x100% drip pump flow to be based on 10% margin over highest drip flow envisaged during unit operation. Design Head Corresponding to above considering 10% margin over deaerator pressure. (ii) Other Capabilities 1 pump shall be capable of handling the flow corresponding to Unit EMCR, all HP heaters out, 3% m.u. and worst condenser pressure at 47.5 Hz. (iii) NPSH Margin NPSH (R) at 3% head drop shall not be more than half the NPSH(A) at design flow with low low heater level and NPSH(R) at 3% head break shall be well below NPSH(A) under all conditions. (iv) Suction specific speed Suction specific speed of first stage impeller not to exceed 11,000 U.S. units based on 3% head break of that impeller at design point. (v) Design Pressure			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 40 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	(1) Bowls and discharge components design pressure shall correspond to shut off head at 51.5 Hz and operating specific gravity and maximum suction condition. (2) Suction components shall be designed for 8 ata and full vacuum. (b) MOTOR RATING Motor rating at 50 deg. C ambient temperature shall not be less than the maximum load demand of its driven equipment in its entire operation at frequency variations from 47.5 Hz to 51.5 Hz and motor shall not be over loaded during any mode of operation of driven equipment.	
2.08.00	HP-LP STEAM TURBINE BYPASS SYSTEM The HP and LP bypass system shall be designed and capable of meeting the following requirements: - Ensure HP bypass aggregate capacity not less than 65% of the main steam flow at BMCR condition considering rated main steam parameters at the upstream of valves & CRH steam parameters corresponding to 60% TMCR condition on the down stream. The HP bypass system shall have minimum 2x50% capacity valves. In addition, the aggregate capacity of HP Bypass valve shall be adequate to evacuate the required minimum steam flow from the boiler under various start up conditions (viz. Cold/warm/hot start up) as per combined boiler turbine start up curve. - LP bypass shall be designed to condition the incoming steam from re-heater corresponding to parameters resulting from operation as specified at clause no. 2.08.00(a) of this chapter above to parameters matching with those of LP Turbine exhaust steam. In addition to that LP Bypass system shall be sized for maximum rise of HRH steam pressure, temperature and steam flow during transient conditions. For LP bypass valve sizing, no steam will be extracted for regenerative feed heating except for deaerator pegging at a pressure optimized by the bidder with only MDBFP in service. The capacity shall be commensurate with that of HP bypass system plus the spray water used in HP bypass. Number of LP Bypass valves shall be as per bidder's standard practice subjected to a minimum of 2 numbers. - Quick startup of the steam generator from cold, warm & hot conditions. - HP-LP bypass operation under rated steam conditions with bypass valve open to full capacity and turbine on house load (50 MW). - Provide HP bypass station spray water requirement from Boiler feed pumps discharge, either upstream or downstream of HP Heaters & LP bypass spray water requirement from condensate extraction pump discharge. Spray system to include spray water control valves, NRVs and isolating valves. - Ensure HP bypass designed to accept continuous spray water at temp. corresponding to all HP heaters out of service and deaerator pegged at a pressure optimized by the bidder. - Ensure Suitability for operations under sliding pressure mode to enable short start-up time.	
2.09.00	Other System Sizing: - Ensure normal make-up to cycle in the condenser hot well at 3% which at times may go upto 5%. And, the emergency make up shall be sized for 5 % BMCR, 10 % BMCR & 15 % BMCR for Min/ Normal/ Maximum flow respectively. - Low Load Feed Control valve (0 to 30% BMCR capacity range) in Feed regulating station (FRS) for feed water flow control, downstream of BFPs, shall be sized with	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA
		PAGE 41 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	maintaining a differential pressure (DP) of 5kg/cm²(abs) during unit startup upto 30% BMCR Load. (c) All the Normal drain / Emergency Drain Control valves for Feed water Heaters shall be sized considering all the transient cases (including preceding heater out of service and corresponding increase in extraction flow to that heater accordingly) and the process requirements as finalized during detailed engineering stage.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA
			PAGE 42 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS																																																					
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			PAGE 43 OF 81																																																			

CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.02.00	o)	Sump invert level	As per HIS (Hydraulic Institute Standards)
	p)	Operating Floor level	Minimum one meter above Local Grade level.
	q)	Accessories to be provided with each pump	a) Required Instrumentation b) Anchor bolts, nuts, sleeves, and inserts to be embedded to concrete. c) Companion flanges with nuts, bolts, and gaskets, internal piping with valves, filters & Instruments for sealing/ cooling/ lubrication system up to and including isolating valve etc. e) Positioning dowels, eye bolts, lifting etc. g) Ladders, Platforms & Other Accessories
	Induced Draft Cooling Towers		
	SN	Particulars	Requirement
	a	Number of Cooling Towers	One(number)/Two (2) numbers as per configuration
	b	Type of Cooling Tower	RCC / FRP Induced Draft Cooling Tower
	c	Quantity of water to be cooled by Cooling Towers of One Unit	Quantity of water to be cooled by Cooling Towers of One Unit: CW pumps flow per unit (+5% margin to be considered in hot water distribution system to avoid overflow)
	d	Heat Load (Excluding Heat of Evaporation)	Heat Load (excl. Evaporation): Design range x Design CW pump flow
	e	Design Range	Temp. rise across condenser + 1 deg C
f	Hot Water temperature at cooling tower inlet	Design range +32 deg C	
g	Design Cold water temperature at cooling tower outlet	32 Degree C	
h	Re-circulation allowance	0.8 Degree C	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA
			PAGE 44 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	SN	Particulars	Requirement
	i	Design wet bulb temperature (WBT)	27 degree C
	j	Design inlet wet bulb temperature	Design Ambient WBT + Recirculation allowance in degree C
	k	Design Ambient Relative Humidity	50 %
	l	Terminal Pressure at FGL of Cooling Tower	As per Bidder System Design matching with fill type selected
	m	Quality of water	Same as Circulating Water
	n	Maximum Water level in CT Basin	Finished Ground Level (FGL)
	o	Normal Water level in CT Basin	Maximum Level minus 0.5 M
	p	Minimum Water level in CT Basin	Maximum Level minus 1 M
	q	Invert level of Basin	Normal Level minus 1 M
	r	Internal Diameter of pipes	To suit the design velocity of maximum 2 m/sec & ensuring uniform flow distribution in CT
	s	Size of Branch & Cell isolation Butterfly Valves (if applicable)	Same as that of pipe size
	t	Fasteners and other fitting materials	SS 316
u	Type of fill	Splash /Modular/ Trickle	
v	No of stop logs to be supplied	As per Civil section	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA PAGE 45 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS																																																								
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TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001																																																									
SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA																																																									
PAGE 46 OF 81																																																									

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	i	Heat transfer area (sqm)	Total Heat Load (in kCal.hr) U(d) x LMTD	
	j	Heat transfer area of PHE shall be selected based on maximum heat transfer rate of 6500 kCal/hr per sqm of heat transfer plate.		
	k	Frame of each plate type heat exchanger shall be able to accommodate minimum 25% extra plates.		
	l	The design pressure shall be equal to DMCW pump/ACW Pump shut off pressure (whichever is higher) with maximum suction pressure plus 5% margin		
	4	Self-cleaning Strainers(horizontal)		
	a	Quantity	2 X 100%	
	5	Overhead ECW (DM water) tank (separate for TG ECW system and SG ECW system)	1 X 10 cum (min.) (at 60% of the tank height)	
	6	Alkali dosing tank including agitator & drive (separate for TG ECW system and SG ECW system)	1 X 500 L (min.)	
	7	Complete piping, fittings, supports, valves, and specialties including instrumentation and electrical equipment as specified & required to complete the system.		
	8	Required orifices shall be provided in the primary and secondary circuit of Equipment Cooling Water system for balancing of pressure.		
3.04.00	All water systems including CW chemical treatment system shall be designed considering the total make-up water availability of 2400 m³/hr. Suitable cycles of concentration (COC) and the treatment chemicals shall be selected to achieve this objective. However, the minimum COC shall be 5.0.			
3.05.00	Auxiliary Water Systems (AWS) All the pumps shall be designed with head as per system requirement considering minimum water level +10% margin in frictional head loss. a) Raw Water System to Water PT Plant (Vertical turbine) Capacity of each Pump – As per system requirement with 5% margin. The pumps shall have rubber expansion joints with electric motor actuated discharge butterfly valve and Non return valve of required sizes. The system shall be designed with Forced water lubrication. Separate recirculation line with motor actuated butterfly valve for Raw water (PT) and Raw water (Ash) system. There shall be an interconnection of the Stage-II Raw water header with the existing Stage-I Raw water header with suitable provision of orifice for balancing of flow & head in discharge pipelines. b) Raw Water System to Water Ash Handling Plant (Vertical turbine) Capacity of each Pump – Water required for ash handling plant with 5% margin. c) Makeup (Clarified water) water system to CW system Capacity of each Pump – half of the total CW make-up requirement. d) AC & Ventilation System Makeup Pumps Capacity of each Pump – To meet complete makeup requirement of AC & Ventilation systems (all AC Plants and Air-washer units) of the complete station (minimum 100 m³/hr). e) FGD Gypsum wash System Makeup Pumps Capacity of each Pump – To meet complete makeup requirement of FGD Gypsum wash requirement.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA PAGE 47 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.06.00	f) DM Cycle make-up water System Capacity of each Pump – 100 % of Cycle makeup water requirement for one unit. (min flow 100m3/hr) g) Boiler Fill System Boiler fill system shall supply DM water to fill each Boiler for start-up or to conduct hydraulic test. Suitable tap offs shall be provided for filling of deaerators during initial stages or exigencies. Water for this shall be drawn from existing and new DM water Storage tanks in Water Treatment Plant. Number and Capacity of Boiler Fill Pumps shall be as follows: Capacity of each Pump - Adequate capacity as per system requirement (minimum 250 Cu.m/hr). h) Service Water System Clarified water from the clarified water tank shall be used as service water. Service water pumps shall take suction from this tank and supply water to the service water pipe network. Capacity of service water pumps shall be as follows: Capacity of each Pump – as per system requirement (minimum 200 Cu.m/hr). i) Potable Water System Potable water system shall meet the drinking water required for the plant facilities/ buildings included in Contractor's scope Presently no potable water pumps shall be envisaged for this unit. Bidder to laid the pipeline, valves & associated system from the existing potable water system. Requirement of any booster pump shall be provided by bidder. j) Condensate transfer pumps To meet the condensate transfer system two numbers(1W+1S) of horizontal centrifugal type pump for shall be provided. The capacity of each pump shall be designed considering minimum 20 % of the condensate flow and head to suit the system requirement. k) Air pre-heater wash water pumps Air pre-heater wash water pumps shall draw water from clarified water tank. The capacity of all the working pump(s) shall be designed considering washing of Air pre-heater(s), ESP etc. as per bidder's design and head to suit system requirement. However, minimum capacity shall not be less than 500 Cu.m/hr. Note: Requirement of water (DM water, process water, clarified water and service water) for other system shall be taken care while sizing the above pumps.			
	Water treatment plant A. Pre-treatment system Design criteria of Pre-Treatment Plant for Circulating Water (PT-CW) system: 1) “PT-CW” System with minimum two (2) reactor type clarifiers, one (1) number aerator (1x100%) & one (1) number stilling chamber (1x100%) (Common for all the Clarifiers), two (2) Inlet channels of RCC Construction with flow measuring element (Parshall flume), outlet Channels, Clarified Water Storage Tank, bypass channel to by-pass the clarifier(s). 2) One (1) number (1x100%) Filtered Water Transfer Pumps shall be provided in existing filter water pump house. 3) Chemical House: A common two (2) storey Chemical house of RCC construction shall be provided to install various Chemical dosing equipment, pumps, tanks, piping etc. of PT–CW : a) Lime preparation & dosing system consisting of minimum two (2) nos. of RCC lime slaking tanks, minimum two (2) nos. of lime solution Preparation			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 48 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	tanks of RCC construction, agitators, lime slurry transfer pumps (2x100%), lime solution dosing pumps (2x100%) etc. b) Alum Solution preparation & dosing system consisting of Alum Solution preparation & dosing system consisting of minimum two (2) nos of Alum solution preparation tanks, agitators, alum solution dosing pumps (2W+1S) for PT-CW Clarifiers,(2x100%) for Lamella clarifier/tube settlers etc. c) PAC dosing system shall consist of minimum two (2) numbers of storage cum dosing tanks, agitators, dosing pumps (2x100%), unloading pumps (2x100%) etc. d) Coagulant handling, storage, and dosage system with bulk Coagulant storage tanks (2), capacities of both tanks together shall be sized for one(1) month's storage, the tank shall be fitted with vent, drain, overflow seal pots etc., Coagulant unloading cum transfer pumps (2x100%), Coagulant preparation tanks (2) with motorized agitator, capacities of both tanks together shall be sized to prepare and store 1 day requirement of Coagulant, Coagulant dosing pumps (2x100%). e) Coagulant aid handling, storage, and dosage system with bulk Coagulant storage for one (1) month's storage with design dose, Coagulant aid dosing pumps (2x100%), Coagulant aid preparation tanks (2) with motorized agitator, capacities of both tanks together shall be sized to prepare and store 1 day requirement of Coagulant aid. f) Two (2) numbers of electrically operated mono-rail hoists each of 1 Ton capacity in chemical preparation area to handle chemicals from ground floor to first floor. g) Two (2) numbers of weighing scales at ground floor for weighing of chemicals being handled during storage and preparation. h) Emergency safety showers with eyewash units shall be provided in the Chemical Storage Handling facility at strategic locations such as Acid/Alkali Storage area, outdoor Chemical storage area, ClO₂ plant area and Chemical preparation & dosing equipment area. Filtered water shall be used for safety showers. i) One (1) number Overhead (OST) Storage Tank shall be provided on the top of chemical house to provide adequate storage of filtered water to be used for preparation of the chemicals, flushing of equipment, back washing of gravity filters etc. 4) Chemical house and Filter house shall be RCC buildings. B. CHLORINATION SYSTEM Chlorination plants for Cooling Water System (CW-Chlorination) and Pre-treatment plant (PT-Chlorination) shall preferably be installed at a common location. a) CW Chlorination systems is envisaged near CW pump house and CW Chlorination system would consist of three (3) (2W+1S) numbers of Chlorinator-evaporator sets. PT chlorination system shall comprise of two (2) (1W+1S) numbers of Chlorinator sets.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 49 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	b) Chlorination Plant shall consist of required numbers of Chlorine tonners, Evaporators (as applicable), Chlorinators, ejectors, Chlorine water booster pumps, Safety and supervisory Equipments such as Gas masks, Chlorine leak detectors and emergency kits etc. To take care of chlorine leakage, chlorine leak absorption system shall be provided. c) Mechanical Ventilation system shall be provided for complete building. d) One (1) no of EOT crane/Electric monorail hoist (Capacity-min 3 Ton), Two (2) no of Weighing scales (Capacity-2 Ton) shall be provided in each chlorination plant. If the chlorination building is common for PT & CW system, then two (2) numbers electrically operated hoists (Capacity-min 3 Ton each) shall be provided. C. Liquid effluent treatment plant (LETP) 1. PT - plant clarifier sludge disposal system a). One (1) number RCC sludge pit (in 2 sections) to collect sludge from all the clarifiers of PT-CW system, & Lamella clarifiers/tube settlers and any other effluent connected to this sump envisaged. b). Two (2) numbers air blowers (2x100%) for the air agitation system of the sludge pit. c). Three (3) (3x50%) numbers of sludge disposal pumps. 2. Waste service water treatment system a) One (1) number RCC waste service water sump (WSWS) in two (2) sections shall be provided for collection of waste service water. Service water effluents and other plant effluents from various areas of the plant shall be routed to this waste service water sump. Facility shall be provided to collect free oil from these sumps to MS Oil drum and oil skimmers (2 nos.), Portable oil Centrifuge (2x100%) of suitable capacity shall be provided for reuse of oil. b) Three (3) (3x50%) numbers of Waste Service water pumps. c) Two (2) (2x100%) numbers of Lamella Clarifier/tube settlers of RCC construction of suitable capacity shall be provided to treat the total waste service water & other wastewater of the plant for reuse. 3. Coal handling plant run-off water treatment system a) Two (2) number of Coal Slurry Settling (CSSP) Ponds (minimum size of 40m x 8m x 3m deep) of RCC Construction shall be provided. Suitable approach to be provided for mechanical cleaning of CSSP ponds. b) Two (2) numbers Coagulant-aid tanks (with SS-316 agitators) of MS rubber lined construction. c) One (1) number decanted water sump of RCC Construction (2 sections) to receive decanted water from above settling ponds. d) Two (2) numbers (2x100%) Coal Decanted Water Pumps for reuse of coal decanted water in CHP (Plain Water) dust suppression system. e) Two (2) numbers (2x50%) (2W) Clarifier Feed pumps (CSSP area). f) One (1) Reactor Clarifiers with stilling chamber, RCC channels, distribution chamber etc. shall be provided to receive excess storm water from settling ponds, along with piping, valves etc.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 50 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	g) 2x50% (2W) Transfer pumps in distribution chamber shall be provided to recycle the supernatant water to CW channel. Provision for diverting the excess water to storm water drain and WSWs shall also be kept with normally closed isolating valves. h) Lime preparation & dosing system consisting of lime slaking tanks (2), lime solution preparation tanks (2), agitators, lime slurry transfer pumps (2x100%), lime solution dosing pumps (2x100%) complete with all necessary piping, fittings, feed piping, water supply piping, overflow and drain piping, sampling connections etc. i) Alum Solution preparation & dosing system consisting of Alum solution preparation tanks (2), agitators, alum solution dosing pumps (2x100%) complete with all necessary piping, fittings, feed piping, water supply piping, overflow and drain piping, sampling connections etc. j) Suitable synthetic flocculent dosing shall also be provided to increase the settling rate suspended solids. Flocculent preparation & dosing system consisting of preparation tanks (2), agitators, dosing pumps (2x100%) complete with all necessary piping, fittings, feed piping, water supply piping, overflow and drain piping, sampling connections etc. shall be provided. k) The sludge removed from underflow of the clarifier shall be dewatered using the Filter press (2x50%) of suitable capacity for dried coal particles to be reused. Necessary pumps (2x100%), piping, valves etc. shall be provided. l) Chemical storage and dosing area shall be provided under shed. Chemical storage shall be designed to meet 15 days requirement. D. DM plant (Ion exchange process) Design criteria of DM plant: The capacity of DM plant shall be sized to meet the steam water cycle makeup at the rate of 1.5 % (minimum) of the BMCR, makeup water for closed cycle ECW system, regeneration. Additionally, DM water requirement for any other requirement as envisaged by the contractor in design shall also be considered. Bidder shall consider DM water consumption during boiler hydro test, cold startup of the both units in design calculation while sizing the DM plant and DM water storage tanks. However, the minimum capacity of DM plant and DM storage tanks shall be as specified. DM plant shall be designed for the inlet Silica value indicated in Raw water analysis of Project Information chapter. 1) Ion exchange-based DM plant a) Ion Exchange Demineralising Plant (1x100%) shall be provided. Weak acid Cation exchangers, Strong acid Cation exchangers, Weak base anion exchangers, Strong base anion exchangers shall be designed for 12 hours of operation cycle followed by 4 hours regeneration period. MB unit shall be regenerated after minimum 108 hours of operation followed by regeneration period not exceeding 6 hours.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 51 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	b) One (1) (1x100%) numbers of Activated carbon filters with all accessories. c) One (1) (1x100%) Weak Cation exchangers units & One (1) (1x100%) Strong Cation exchangers units with all accessories. d) One (1) (1x100%) Weak Anion exchangers units & One (1) (1x100%) Strong Anion exchangers units with all accessories. e) One (1) (1x100%) numbers of Degasser system comprising of Degasser Towers and storage tanks, Air Blowers (2X100% per Degasser tower), two(2) (2x100%) Degassed water transfer pumps etc. f) One (1) (1x100%) MB units along with Two (2) (2x100%) air blowers with its drives and all accessories. g) One (1) (1x100%) Ultrafiltration (UF) polishing Units, complete with all accessories for chemical treatment inclusive of UF feed tanks (2), 2x100% UF feed pumps, 2x100% backwash pumps, 2x100% fast flush pumps (if applicable) etc. h) One (1) no. UF CIP/CEB system for chemical cleaning, CIP/CEB pumps etc. as per manufacturer's standard. i) One (1) D.M. water storage tank (max dia 16m and min usable capacity of 2200m3) will beprovided to store DM water in Existing DM plant area and interconnecting with the existing DM Water tanks. j) Provision of hot water supply to the ACF units from the hot water tank shall be made for rejuvenation of activated carbon.			
3.07.00	Condensate polishing plant (CPP) 1) One (1) number of Condensate Polishing unit (CPU) for each of the TG (Turbine-Generator) units, along with complete external regeneration system for the CPPs. 2) The Condensate Polishing unit (CPU) for TG unit shall consist of either four (4) service vessels (4x33.33%) or three (3) service vessels (3x50%) along with emergency bypass system, resins, valves, piping etc. 3) Two (2) (2x50%) backwashable type cartridge pre-filters for each CPU shall be provided for the commissioning period, start-up period as first cleaning step as well as normal continuous operation, complete with automatically operated by-pass, associated piping, pumps (with at least one stand-by), pneumatically operated valves etc.			
3.08.00	Separation of Plant drain (effluents) from Storm water drain Arrangements shall be made that effluents and storm water do not get mixed. In general, the following philosophy shall be adopted for separation of plant drain from the storm water drain. a) Area wash water, Oil/Coal/Ash/Chemical contaminated water are considered as Plant Water. b) Plant water must be completely isolated from the Storm/Rainwater and only Plant water needs to be treated & recycled/reused for various plant use. Storm water drains will be separated out for free discharge.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 52 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.12.02	iii) Any other additional equipment not specifically mentioned in the technical specification but are found necessary to meet the requirements of TAC norms and also for safe and sound operation of the plant are to be included at no extra cost to Employer. iv) Fire water pipes shall not be routed below the bus duct in switchyard area. Hydrant System Design philosophy (minimum requirement) i) Category of Hazard and minimum terminal pressure shall be as per TAC norms. ii) At least two hydrant ring mains shall be provided. Separate ring main for the main plant (including transformer yard) to be provided. Isolation valves (gate valves) between various ring mains shall be provided so that ring mains can be interconnected and water from any of the ring main can flow to other mains. iii) Coal/Biomass conveyors at ground level shall be provided with external ground level hydrant valves at required intervals. At locations where water cannot reach conveyors through ground level hydrants, water monitors at required intervals shall be provided. In addition to above fire hydrant to be provided inside conveyor gallery on both the sides in all inclined conveyor (running at elevation more than 30M from ground level) at 45 Mtr. (viz in conveyor 1A at 90 meter interval, at conveyor 1B at 90 meter interval, but in staggered way so that from one hydrant to other hydrant distance is approximately 45 meters). Risers for these hydrant valves shall be supported through conveyor gallery legs/columns. For ESP area both ground hydrants (with landing valves) and fixed water monitors shall be provided. Further, fixed water monitors shall also be provided for coal/biomass conveyors / transfer points, etc. having elevation 20M or more. iv) All the landings of boiler staircases, turbine building, crusher house, track hopper, transfer points/junction house of CHP, bunker floors, etc. and other multi-storied structures of the entire plant shall be provided with hydrant landing valves. v) Each of the landing valves and external hydrant valves associated with the main plant (transformer yard, TG building, boiler and ESP area) areas shall be provided with a hose box. Each hose box shall contain two (2) numbers of 15M long hoses & coupling, branch pipes & nozzles, spanner etc as per TAC guidelines. For landing valves of various off-site buildings, the hose box shall have two (2) numbers 7.5 m long hoses, branch pipes, couplings, nozzles, spanners, etc. as per TAC guidelines. vi) The pipelines routed in RCC trenches shall be provided with coating and wrapping. Road, Rail or pipe trench crossing be through trestle/RCC hume pipes of appropriate pressure class and the pipe lines shall be provided with coating and wrapping as per specification. vii) Isolation valve (gate valve) shall be for each riser/downcomer of hydrant system. viii) Isolation valve (gate valve) shall be for each water monitor.			
	3.12.03	HVW & MVW Spray System Design Philosophy (Minimum Requirements) i) Design discharge density shall be as per the rules of TAC and/ or NFPA standards. ii) Deluge valve along with trims like pressure gauge, water motor gong, etc. shall be UL/FM or equivalent approved / listed. The deluge valve (auto resetting type) assembly shall consist of accessories such as water motor gong, alarm test valves, drip/drain valves, strainers for these valves, hydraulic releasing system, solenoid valves, etc.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 54 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.12.04	Further, the design features and make of all the projectors / spray nozzles shall be UL/FM or equivalent approved / listed. iii) A strainer ('Y' type) be provided at upstream of deluge valve. iv) Pressure switches be provided in spray and detector piping to exhibit "FIRE" and "SPRAY ON" annunciations and as well as for interlock. v) Wet type pipe detector network shall be provided for spray system using quartzoid bulb detectors. vi) Each of the outdoor deluge valve and accessories shall be provided with housing with RCC roof. vii) Remote manual operation of the deluge valves shall be possible from the respective fire alarm cum control panel through the keyboard operation of PC monitoring station when the system is selected in remote manual mode. The remote manual selection for the operation of spray system on any equipment or any zone shall also be through the monitoring station of the respective panel. Apart from the automatic operation of the deluge valve, the system shall have provision for manual operation of the deluge valve by means of hand operated lever close to the deluge valve assembly. There shall also be a provision to operate deluge valve electrically from a nearby local panel. viii) Isolation Valves (Gate Valves with limit switches) in spray mains/headers for isolation of individual area like Switchyard, transformer yard, TG Building, Boiler, ESP & Chimney Area, CHP area, etc. shall be provided for O&M purpose.			
	Bladder tank Foam Protection System Design Philosophy (Minimum Requirements) i) Complete system shall be designed as per NFPA -11 and TAC. ii) Water for the foam system may be tapped off from the hydrant system. iii) The operation of foam system shall be automatic with the aid of fire detection system provided for the HFO (if applicable) & LDO tanks with a provision for manual operation. Auto/Manual selection switch shall be provided at the local panel. iv) Foam concentrate shall be of 100% AFFF type and shall be provided in 2x100% capacity foam concentrate tanks. v) The minimum effective capacity of each foam bladder tank shall be designed considering the following: a) Simultaneous protection of any of the fuel oil tank or LDO tanks and operation of two foam hydrants (900 LPM each) for 60 minutes or b) Minimum capacity if specified elsewhere. ix) A design margin of atleast 10% shall be considered over the calculated foam concentrate capacity and tank capacity. vii) Foam bladder tank assembly shall consist of 2x100% foam concentrate tanks with bladder, fill & drain valve for water and foam concentrate, foam proportioner/ratio controllers along with concentrate supply control valve (hydraulically operated ball valves), vent valves, required instrumentation, etc. Horizontally mounted Tanks shall be of carbon steel as per IS:2062 Grade 'B'/ASME A516 Gr 70 and designed as per ASME code Section VIII for pressure vessels. Bladder tanks shall also be provided with sight gauge with shut-off & drain valve, ladder, pressure relief valve and filling kit.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 55 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	viii) One number foam proportioner (with NRV downstream) of adequate size shall be provided for each HFO (if applicable) & LDO tanks. ix) Besides these, one additional foam proportioner (with NRV downstream) of adequate size shall be provided for foam hydrant rings around dyke area. All the proportioners are interconnected by isolation valves (manually operated), in such a way that any of proportioner may cater to the requirement of others. Further, separate isolation valves (manually operated) shall be provided for each proportioner for maintenance. x) Automatic solenoid valve shall be provided in foam supply line to each of the HFO (if applicable) & LDO tanks at the upstream of foam proportioner. In the event of detection of fire, the signal shall operate the deluge valve and water inlet valve to the designated foam proportioners of the tank, and as well as open the foam solution inlet valve to foam proportioner and thereby foam is injected to the tank under fire from foam makers discharge outlets. xi) Apart from feeding the individual tank, each set of foam inductors shall deliver foam solution to foam hydrant piping ring around the tank dyke whenever foam injection system is initiated so that spill fires if any may be extinguished by means of foam hydrants, hoses & foam monitors. xii) Foam monitor shall conform to relevant International standard / manufacturer's standard. xiii) The maximum spacing of the foam hydrants around the dyke area shall be similar to that of water hydrant system. xiv) The minimum foam application rate of 3% foam solution shall be 6.1 lpm/Sq.m (complete surface area) for fixed roof type tanks. xv) The system shall incorporate features such as non-return valves to avoid mixing water with foam concentrate pipelines, isolation valves of ratio proportioning devices etc. xvi) Foam concentrate piping shall be of Stainless Steel (seamless) as per ASTM-A-312, TP-304, Schedule-40s. Fittings shall be of SS forged to ASTM-A-182, F-304 for sizes 15NB to 40NB and S.S. seamless to ASTM-A-403, WP-304, Schedule-40 for sizes 50NB & above. All the piping shall be laid over ground on RCC pedestals. Further, all valves, foam proportioners, etc. in foam concentrate line shall be of stainless steel construction.		
3.12.05	Fire Detection, Alarm and Control System Design Philosophy (Fire Alarm and Detection System) i. The PLC based panel at Booster pump house shall indicate the status of each pump, system pressure, operation of hydrant and/ or spray system, failure of starting of pumps, healthiness & failure of batteries/ chargers, main supply, low level of fuel oil of diesel engines, tripping of pumps, low level / very low level of water in the water supply system, status of batteries & chargers of panels and diesel engines etc. Alarms from these panels shall also be available to operator at fire alarm addressable panels, central monitoring station and DDCMIS. ii. The addressable type panels at control equipment rooms shall receive signal from sensors from various areas/ equipment's of the respective units. iii. The panel at coal handling plant control room shall exhibit alarms from detection and protection from coal handling plant and all other auxiliary buildings/areas. Further, panel provided at stacker-reclaimer machines shall also be hooked-up with fire alarm panel at CHP control room for alarm purpose.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 56 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.12.06 3.12.06.01	iv. The central monitoring station to be located at Central Control Room shall cover the fire detection and protection system of the complete plant. This shall give audio-visual annunciations for fire in each of the risk area / equipment / status of the fire protection system as well as system operator open / short circuit status of detector or control cabling, etc. Further, this shall activate a hooter/sounder in each of the area provided with fire/smoke detection system.			
	v. Alarms from all the panels shall be repeated simultaneously in repeater panel at fire station.			
	vi. The addressable panel shall evaluate the signals received from the detectors, transmit the fire or trouble alarms (audio-visual) to prearranged points, supervise and monitor the complete fire detection & extinguishing circuits, initiate control functions like shutdown of draft fans, air-conditioning and ventilation plant/equipment, closure of fire dampers in A/C & Ventilation system etc. Opening smoke extraction vents, switching on smoke extraction equipment emergency lighting, tripping of transformer lockout relays etc.			
	vii. All the circuits from the detectors to the panels and the circuits from the panels to the actuating devices (such as solenoid valves, deluge valves, push buttons etc.) shall be closed loop type and shall be supervised for open and short circuiting. The trouble signal also be annunciated in the respective panels.			
	viii. Facilities shall be provided on the fire alarm panel for simulating fire conditions, sensitivity adjustment, isolation of detectors etc. from the panel.			
	Total Flooding Inert Gas Extinguishing System			
	Design Philosophy (Minimum Requirements)			
	General			
	a) Complete design and all critical components / equipment like cylinder, cylinder valve assembly, hoses, check valve, actuation controls, restrictor/pressure reducer, directional/selecter valve, pressure relief device/safety valve, pressure gauge, pressure switch, nozzle, etc. shall be approved and listed by UL/FM /VDS /LPCB or equivalent.			
	Basic design parameters of inert gas extinguishing system like type of inert gas agent, extinguishing/design concentration, safety factor, discharge time, etc. shall be considered in strict accordance with NFPA-2001 (latest edition). Piping design/layout, nozzle arrangement/orientation, etc. shall confirm to UL/FM/VDS/LPCB or equivalent.			
Agent Supply, Design Concentration, Quantity & Discharge time				
a) System shall be designed to meet the minimum requirements of total flooding inert gas extinguishing system as per NFPA 2001. However higher concentration may be used if it is specified by the agent manufacturer/ system supplier for the area protected.				
b) The complete volume of the rooms including the above false ceiling shall be considered for estimation of quantity of gas and containers. When determining the gas quantity, the leakage losses from the enclosure shall be taken into account by the supplier. Further volume of re-circulating type air conditioning system & its duct work (at least up to the automatic fire dampers of the ducts) shall be considered as a part of the total volume so that the design concentration is achieved throughout the hazard area. Further gas quantity shall be adjusted for ambient pressure & temperature conditions. Bidder to provide primary supply of gas & its cylinders, along with 100% (one hundred percent) standby reserve gas quantity and cylinders for each room/area.				
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 57 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	c) However, if the system design permits provision of a common “ENGINEERED STORAGE SYSTEM” with directional valves for multiple rooms / areas of one unit, such a design is acceptable provided the total primary supply and/or reserve supply is equivalent to the requirement of largest area / room and such rooms /areas are perfectly separated from each other by means of wall / metal cladding or floor of minimum required fire rating. Such common storage system should have been listed & approved by UL/FM/VDS/LPCB or equivalent and bidder should produce documentary evidences for design and installation of such systems elsewhere in the past by them. d) In either of the case mentioned in above two clauses, both the main & reserve supply cylinders shall be permanently connected to the distribution piping through manifold and arranged for easy changeover from the panel. Suitable selector switches be provided for “Normal /Standby “supply selection. e) The discharge time period shall be such that the design concentration is achieved within time duration specified in NFPA-2001 (latest edition/amendment) The flow calculations shall establish this criterion. f) The quality of gas shall conform to relevant design standard such as NFPA – 2001(latest edition) or as specified by listing authorities. g) Clean agent discharge test shall be done for smallest inert gas protected zone. Storage containers a) The storage cylinders offered shall be of seamless type & brand new. Welded cylinders are not permitted. b) All the storage containers shall be provided under an enclosure. It shall not be kept open to atmosphere. c) The storage containers shall be securely installed as per the listed installation manual with a provision for convenient individual servicing and container weighing. Such servicing or weighing shall be possible without shutting down the system. d) Automatic means such as check valves shall be provided to prevent gas loss if the system is operated when any containers are removed for maintenance. e) The storage containers shall not be charged to a fill density or super pressurization level different from the manufacturer’s listing. f) The design pressure for storage cylinders shall be suitable for the maximum pressure developed at 55 °C and shall be designed to meet the requirements in NFPA-2001. g) All cylinders shall bear the marking as detailed out in NFPA -2001 and shall be duly listed by UL / FM /VDS/LPCB or equivalent in addition to approval by Chief Controller of Explosives -INDIA. h) The storage cylinders shall have accessories such as pressure gauges/ switches, liquid level indicators (if applicable), refilling connections, relief devices (if applicable) etc. A reliable means of indication other than weighing shall be provided to determine the pressure in cylinders. i) All the pressure gauges/switches, manifold connections etc shall be easily removable for servicing / maintenance without any loss of gas. DISTRIBUTION		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 58 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	a) Both main & reserve cylinders shall be permanently connected to the distribution piping through manifold and arranged for easy & auto changeover. Cylinder Manifold, directional valve manifolds, Piping, fittings & pressure relieving device shall be designed for the maximum design pressure of the system and shall conform to the requirements of NFPA -2001 (latest edition) or as specified by listing authorities. Material of construction for manifolds shall be as per listed design manual and shall be hydro-tested as per design manual or at 1.5 times the maximum design pressure, whichever is higher. b) Discharge nozzles along with deflector shields shall be listed for the intended use including the flow characteristics and area of coverage and quantity & design shall be such that complete quantity of gas is uniformly distributed throughout the hazard volume within the specified discharge time without disturbing the ceilings, lighting fixtures etc. c) The fire detection system to be employed shall be as specified elsewhere. Operating devices shall be by mechanical, electrical and pneumatic means conforming to NFPA-2001. The power supply to electrical actuators shall be backed up with reliable battery supply. Such batteries shall be charged automatically by battery chargers. Power supply be taken from the Fire detection /alarm system panels of the respective units. Required annunciations such as “Gas released”, “Failure of automatic actuation” etc shall be exhibited in the fire alarm panel. d) Where pilot cylinders are employed for actuation of the cylinder banks, the number of pilot cylinders shall be as per the listed design manual. e) Facility for manual release of gas through push buttons be provided along with selection facility of “Auto/Manual” from the panel. f) In addition to this, local manual release through lever operation shall also be provided near the cylinder banks. g) All manual-operating devices shall be identified to the hazard they protect by fluorescent paint. h) Manual abort switches shall be provided for each of the area/zone and the same shall be provided as per NFPA -2001 or as specified by listing authorities. i) The gas releasing devices at cylinder outlets shall be of re-usable type after discharge at any instant. j) Supervision of automatic actuation devices, power supply, manual actuation circuits, and complete wiring shall be provided through control system /panel and the healthiness shall be reported or indicated in the panel automatically. Complete control system shall be listed and approved by UL/FM/ VDS/LPCB. Design, Installation & Testing a) System design, specifications, working plans, flow calculations etc. shall be prepared in line with the NFPA-2001 or as specified by listing authorities and shall be approved by Employer. The system flow calculations shall be performed using a calculation listed or approved by UL/FM /VDS/LPCB. b) Calculation shall be provided by the designer to prove that the area is not pressurized and extinguishing capability is not affected due to provided ventilation of that area. Bidder to provide additional ventilation arrangement if required. c) After installation, the complete system shall be inspected and tested as per the recommendations of Chapter-4 & relevant Clauses of Appendix-A of NFPA-2001. Wherever testing is mentioned at a regular frequency in these chapters, the bidder shall carry out initial testing and records shall be presented to Employer for approval of the installation.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 59 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.12.07	d) Prior to handing over of the system to Employer, the supplier shall provide operational training to Employer's operating personnel which shall consist of control system operation, trouble procedures, emergency procedures, safety requirements etc. e) The complete installation, testing, commissioning & training shall be carried out by the Contractor under the supervision of the Manufacturer/ designer at site. f) The performance test of the system shall be carried out by releasing the agent gas in a selected area and design parameters shall be measured. All equipments, refilling of gas after test, instruments etc. shall be provided by the contractor for the same. SAFETY (a) All the safety requirements recommended in NFPA -2001 or as specified by listing authorities shall be incorporated in the installation by the bidder. (b) Appropriate warning signs shall be fixed outside of those areas protected by the system and also in areas where the gas may spread indicating clearly the hazard associated with the system such as Noise, turbulence, cold temperature, physiological effects on personnel etc. (c) Apart from written warning signs, audio-visual type warning signs (i.e) hooters & strobe lights shall be provided for pre-discharge and post-discharge activity. The sounder shall have selectable tone options. (d) The gas shall be discharged after a set time delay on receiving signal from the fire detection system. The duration of the timer shall be upto a range of 0- 5 minutes (adjustable in 1 minute variation) at site after conducting test to find out the duration for evacuation of the personnel from the area. (e) To prevent the loss/release of gas automatically or manually during maintenance, the system shall have the facility of "LOCKOUT". The status of the system lockout condition shall be annunciated audio-visually in the panel. Pressure Venting Since huge quantity of gas is envisaged to be released, proper pressure relief and ventilation systems such as fans, dampers, etc. shall be provided by the contractor. Required openings in the civil structure shall be provided by the owner. The contractor shall submit pressure relief, venting calculations, its requirement and suggestive mode of ventilation during detailed engineering for approval.			
	Fire protection for Biomass Silos: Bidder to provide primary supply of gas & its cylinders/storage system, along with 100% (one hundred percent) standby reserve gas quantity and cylinders/storage system.			
	AIR CONDITIONING AND VENTILATION SYSTEM			
	GENERAL REQUIREMENTS 1. The layout of all equipment and accessories shall be developed in a way to facilitate easy accessibility and maintenance of all equipments. 2. Each equipment shall be provided with suitable lifting arrangement, e.g. Lifting lugs, eye bolts, etc to facilitate maintenance.			
3.13.01	DESIGN PHILOSOPHY - Air conditioning system			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 60 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS															
	1. Design ambient conditions for all air conditioning system shall be as indicated below: <table><tr><th>Season</th><th>Dry Bulb Temp. (Deg. C)</th><th>Wet Bulb Temp. (Deg. C)</th></tr><tr><td>Summer</td><td>45.0</td><td>27.0</td></tr><tr><td>Monsoon</td><td>35.8</td><td>28.3</td></tr><tr><td>Winter</td><td>35.0</td><td>25.0</td></tr></table> 2. All equipments of Air Conditioning system shall be designed for continuous duty. 3. All air conditioned areas like control room, control equipment rooms etc. shall be maintained at 24 deg. C ± (plus or minus) 1 deg. C and relative humidity of 50% ± (plus or minus) 5%. 4. The fresh air quantity for air-conditioned areas of ESP Control Room / AHP Control Room /HCSD VFD room/FGD control room, Control Room / Control Equipment Room / UPS, Water System Control Room Building, AIS Control Room Building, etc. shall be 0.45 M3/minutes/person or 1.0 air change per hour whichever is greater. However, for other office areas quantity of fresh air shall be minimum 1.5 air changes per hour. 5. Lighting load shall be one (1) Watts/Sq.feet or actual whichever is higher. 6. The occupancy for general area shall be minimum one person per 10 Sq. M and for conference room/meeting room the same shall be one per 3 Sq.M. In the control rooms, control equipment rooms etc, the occupancy may be one person per 25 Sq.M (Minimum). 7. In Air conditioning system the return air shall be through ducts and use of plenum space for return air shall be avoided. Further, AHP Control room, HCSD VFD Room, FGD control room and ESP Control Room, etc. where various floors are air-conditioned and no intermediate or intervening floor are left non-air-conditioned, the space above false ceiling shall be used as return air plenum. 8. The supply and return air ducts shall be provided with automatic (motorised) fire dampers (of 90 minutes fire rating) at locations where ducts pass through walls (with perfect partition i.e. partition both above & below false ceiling) and floors. Operation of these dampers shall be interlocked with the fire alarm system and shall also be possible to operate manually from the remote control panel. Required electrical contacts shall be provided in control panel of A/C plant by the Contractor for further wiring upto fire alarm panels. 9. Soft water make up (if required) for complete air conditioning and ventilation system shall be provided by the bidder. 10. Design Chilled water flow shall not be less than 0.7 Cu.M/hr per TR air-conditioning load and design condensing water flow shall not be less than 1 Cu.M /hr per TR air-conditioning load. 11. Coil face area of Air Handling units shall be designed considering a face velocity of not more than 2.5 m/sec. Water piping shall be sized for a maximum velocity of 2.0				Season	Dry Bulb Temp. (Deg. C)	Wet Bulb Temp. (Deg. C)	Summer	45.0	27.0	Monsoon	35.8	28.3	Winter	35.0	25.0
Season	Dry Bulb Temp. (Deg. C)	Wet Bulb Temp. (Deg. C)														
Summer	45.0	27.0														
Monsoon	35.8	28.3														
Winter	35.0	25.0														
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA												
PAGE 61 OF 81																

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	m/sec. However, gravity flow / pump suction line shall be sized for a maximum water velocity of 1.5 m/sec. 12. Air distribution system shall be sized to have a constant frictional drop along its length and velocity through ducts shall not exceed 7.6 m/sec. 13. Requirement of Underdeck Insulation (for A/C area) 14. Underdeck insulation shall be provided if i) Non A/C area is located just above the A/C area. In this case, underdeck insulation shall be provided underneath of the ceiling of A/C area. ii) Non A/C area is located just below the A/C area. In this case, underdeck insulation shall be provided underneath of the ceiling of Non A/C area. iii) Underneath the ceiling of AHU room located below the non-A/C area or exposed to sun. Underneath the floor of AHU room located above the non-A/C area. iv) Underneath the ceiling of A/C areas exposed to sun. 15. For air handling unit (AHU) serving main plant control area, where microprocessor based equipments are located, the dehumidified air shall be filtered at three different stages i.e. pre (coarse) filter followed by fine filter followed by HEPA filter before discharge it to conditioned space. For all other areas, AHU's shall be provided with two stage of filtration i.e. pre and fine filter. All fresh air supply fans shall also be filtered using pre and fine filter. 16. A minimum design margin of ten (10) % shall be considered in design of AC Plant Capacity for each area. Twenty (20) % design margin shall be considered for the cooling tower capacity over the selected A/C capacity provided. Head of the pumps shall take into account min. ten (10)% margin on friction head. For pumps, continuous motor rating (at 50°C ambient) shall be atleast 10% above the maximum load demand of the pump in the entire operating range. 17. For other areas, where A/C load is of the order of 25-60 TR, Direct Expansion (D-X) type air cooled condensing units alongwith AHUs shall be provided depending on the availability of space/ layout etc. For areas, where A/C load is of the order of 5-25TR, ductable split/package A/C shall be provided. Smaller areas which are away from the D-X type condensing unit /central chilling units which may require air conditioning upto 5 TR rating shall be served with Hi-wall Split/Cassette air conditioner units as per requirement. Above 60TR of A/C load, chilled water type centralized A/C system shall be provided. 18. Valves at discharge of pumps, outlet of chillers and inlet of cooling towers or any other valve (if needed as per system requirement) in the system shall be motor operated type for remote operation of the Air conditioning system. 19. Mandatory Requirements to be followed for A/C Equipments: 19.1. Refrigerant : Refrigerant should be CFC/HCFC free. 19.2. Insulation for A/C air ducts: A/C ducts shall be insulated. 19.3. All types of Insulation used for HVAC application shall be CFC/HCFC free. 20. During normal operation period, all the working equipment shall run on A.C. power supply. However, in case of complete black-out condition, DG sets being provided are required to cater the load of some of the air-conditioning equipment so that Main Plant Control Rooms and CER remain air-conditioned. The equipment to run on DG set are: • 1 No. Chilling machine	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA
		PAGE 62 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS																						
	• 1 No. chilled water pump. • 1 No. condenser water pump. • 1 No. cooling tower fan. • 2 nos. AHUs for CR & CER • 1 No. fresh air fan. 21. As per ECBC codes minimum coefficient of performance (COP) for the chiller shall be as follows (based on AHRI conditions): A. COP of the water cooled chiller:<table><tr><th>Sl. No.</th><th>Chiller Capacity (kW_r)</th><th>Min COP</th></tr><tr><td>01.</td><td><260</td><td>4.7</td></tr><tr><td>02.</td><td>≥ 260 & < 530 TR</td><td>4.9</td></tr><tr><td>03.</td><td>≥ 530 & < 1050 TR</td><td>5.4</td></tr></table> B. COP for air-cooled chillers:<table><tr><th>Sl. No</th><th>Chiller Capacity (kW_r)</th><th>Min COP</th></tr><tr><td>01.</td><td>< 260</td><td>2.8</td></tr><tr><td>02.</td><td>≥260</td><td>3.0</td></tr></table>	Sl. No.	Chiller Capacity (kW _r)	Min COP	01.	<260	4.7	02.	≥ 260 & < 530 TR	4.9	03.	≥ 530 & < 1050 TR	5.4	Sl. No	Chiller Capacity (kW _r)	Min COP	01.	< 260	2.8	02.	≥260	3.0	
Sl. No.	Chiller Capacity (kW _r)	Min COP																					
01.	<260	4.7																					
02.	≥ 260 & < 530 TR	4.9																					
03.	≥ 530 & < 1050 TR	5.4																					
Sl. No	Chiller Capacity (kW _r)	Min COP																					
01.	< 260	2.8																					
02.	≥260	3.0																					
3.13.02	DESIGN PHILOSOPHY – Ventilation System 1. Minimum Air changes per hour in evaporative/ mechanically ventilated areas shall be as follows: i) For all evaporative cooled areas - 8 ii) General areas - 20 iii) Hydrogen generation plant/MCC/ Switchgear rooms and Battery rooms& other areas where gaseous fumes/ vapours are generated - 30 2. However in areas producing lot of heat, temperature shall be the criteria as follows:- a) Inside temperature shall be minimum 3 deg.C below the design ambient temperature during summer for evaporative cooled areas. b) Inside Temperature shall be maximum 3 deg.C above the design ambient temperature during summer for mechanically ventilated areas. Note : (i) Dry bulb temperature during summer season is is as mentioned in Air conditioning clause above. The criteria which gives higher number of air changes/higher quantity of air of either of condition (Cl. 1 or 2) flow shall be selected. (ii) To calculate air quantity based on air changes per hour (ACPH) method, height of operating floor (17M) in AB Bay shall be taken as 4 meter. 3. All ventilation systems shall operate on 100% fresh air. Fan envisaged for MCC & Switchgear rooms shall be provided with pre-filters and fine filters and for other areas shall be provided with pre-filter only. 4. All the equipments of ventilation system shall be designed for continuous duty.																						
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA																					
		PAGE 63 OF 81																					



5. The supply air ducts of evaporative type ventilation system shall be provided with automatic (motorised) fire dampers (of 90 minutes fire rating) entry in switchgear room, cable galleries etc. The operation of these automatic dampers shall be interlocked with the fire alarm system and shall also possible from the control panel remote manually.
6. Circulating water Capacity for Air washer units shall be minimum 1 Cu.M/hr per 1000 Cu.M /hr of air flow and for UAF it shall be minimum 0.7 Cu.M/hr per 1000 Cu.M /hr of air flow. Velocity through piping shall be limited to 2.0 m/sec and for gravity flow the same shall be limited to 1.5 m/sec. Air distribution system shall be sized to have a constant frictional drop along its length and air velocity through ducts shall not exceed 12.5 m/sec.
7. The air washer unit shall be designed for a maximum velocity of 2.7 m/sec and at least 90% saturation efficiency.
8. All mechanically ventilated areas shall be positively ventilated. However, Battery rooms and other fumes/odour generating areas like fuel oil pump houses, central lube oil purification room etc. shall be negatively. Type of ventilation for various buildings shall be as follows:

S.No	Area	Type of Ventilation system
(i)	General area like pump house, compressor houses, etc.	Combination of Supply air fan & Exhaust air fans/Roof Extractor Fans
(ii)	MCCs and Switchgear room, Cable Vault (other than served by evaporative ventilation system), etc.	Supply air fans & Back draft dampers
(iii)	Battery rooms & other fumes/odour generating areas	Combination of Air Intake Louvers & Exhaust air fans
(iv)	Cable Galleries of TG Building, ESP Building and FGD Control Room Building	AWU/UAF systems along with back draft dampers
(v)	Toilet/pantry etc.	Exhaust air fans
(vi)	For underground ventilation of CHP & Mill reject handling	Refer relevant clause in this sub section.

9. For pumps, continuous motor rating (at 50°C ambient) shall be atleast 10% above the maximum load demand of the pump in the entire operating range. For fans, compressors and blowers continuous motor rating (at 50°C ambient) shall be atleast 10% above the maximum load demand at the design duty point. However for V-belt driven fan, continuous motor rating (at 50°C ambient) shall be atleast 15% above the maximum load demand at the design duty point.
10. Supply air fans, exhaust air fans & ventilations of each area shall be provided with local starter panels.

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.14.00	Compressed Air System			
	The compressed air system shall consist of Instrument Air compressors & their motor drives, Air Drying (ADPs) Plants, Service Air compressors & their motor drives, air receivers for each Air compressors, instrumentation and control, control panels, interconnecting compressed air piping in the compressor house, Instrument Air Piping network, service air piping network and Unit Instrument Air receivers (One for each unit).			
	DESIGN CRITERIA / BASIS AND PERFORMANCE GUARANTEE			
	1. All the equipments shall be designed for continuous duty and as well as for intermittent operation. Frequent start/stop of the system shall not result deterioration in performance nor damage to the equipment.			
	2. The compressors and Air Drying plants shall operate under the following ambient conditions.			
	i. Minimum temperature : 10 deg.C			
	ii. Maximum temperature : 50 deg. C			
	iii. Design condition (temperature & Relative humidity) : 45 deg.C& 75% RH			
	iv. Height above MSL (m) : Refer Chapter “Project Information”			
	3. The design ambient conditions for the motors shall be as mentioned in relevant Electrical sub-sections.			
3.14.02	Selection of Capacity of Air Compressor			
3.14.02.01	Instrument Air Compressor			
	a) Instrument air Compressor shall be designed to meet the Instrument air requirement of all the equipments/plant/systems to be supplied by the Contractor and as well as to meet instrument air requirement of Employer’s systems /plant as follows:			
	Sl. No.	Continuous Requirement	Quantity (in NM³/min)	
	1.	For each Unit of Steam Generator & its auxiliaries (Continuous)	A	
	2.	For each Unit of TG & its auxiliaries (Continuous)	B	
	3.	Water Treatment Plant (Continuous)	C	
	4.	For Station C&I System	D	
	5.	For each Unit of Ash handling system, Silo Utility & its auxiliaries (Continuous)	E	
	5.	Instrument air requirement for 1 unit (Z)	=	[1.3x1.1x(A+B+C+D+E)] NM ³ /min
	6.	Total instrument air requirement for all	=	No of units X (Z)
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA
PAGE 65 OF 81				

CLAUSE NO.	TECHNICAL REQUIREMENTS				
3.14.02.02		units			
	7.	Minimum Capacity of instrument air compressor	=	No of units X (Z)/N Where N=Nos. of instrument Air Compressors (working) as specified.	
	Notes: While calculating the air requirement of Bidder's equipments/plant/systems, for continuous requirements of instrument air, no diversity factor shall be considered and they are to be assumed to be of "Simultaneous Requirements". The intermittent requirement of instrument air, if any shall be converted into continuous requirement by considering frequency of such requirements or selecting an appropriate diversity factor and such diversity factor shall not be less than 0.4.				
	Service Air Compressor				
	a) Service air Compressor shall be designed to meet the Service air requirement of all the equipments/plant/systems to be supplied by the Contractor as well as to meet service air requirement of LDO firing upto 30% BMCR and Employer's systems /plant as follows:-				
	Sl. No.	Continuous Requirement	Quantity (in NM ³ /min)		
	1.	For each Unit Steam Generator & its auxiliaries (Continuous)	F		
	2.	For each unit TG & its auxiliaries (Continuous)	G		
	3.	Water Treatment Plant (Continuous)	H		
	4.	Service air requirement for 1 unit (Y)	=	[1.3x1.1x(F+G+H)] NM ³ /min	
5.	Total service air requirement for all units (W)	=	No of units X (Y)		
6.	Service air requirement considering atomization for LDO firing of one units at a time	=	I		
7.	Total service air requirement for all units with LDO firing of one units at a time (Z)	=	W + I		
8.	Minimum Capacity of service air compressor	=	Z/M Where M=Nos. of Service Air Compressor as specified.		
Note:					
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA PAGE 66 OF 81	

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	While calculating the air requirement of Bidder's equipments/plant/systems, for continuous requirement of service air, no diversity factor shall be considered and they are to be assumed to be of "Simultaneous Requirements". The intermittent requirement of service air if any shall be converted into continuous requirement by considering frequency of such requirements or selecting an appropriate diversity factor and such diversity factor shall not be less than 0.4. The Service air requirement of mill reject shall not be included while sizing the compressor capacity, as separate & dedicated compressors are to be provided for the same. General 1. The compressor capacity & discharge pressure of instrument air system and service air system shall be identical. 2. The capacity of air drying plant shall be equal to the capacity of the individual air compressors.9 The Air drying plant, at its rated capacity, shall be designed to deliver continuously air at dew point of minus (-) 40 deg C at atmospheric pressure and the Quality of dry outlet air to conform to Instrument Society of American Standard S7.3 "Quality Standard for Instrument Air". 3. Discharge pressure available at the outlet of Air drying Plant shall be minimum 7.5 Kg/cm2 (g) or more as per the requirement of Contractor. 4. The discharge pressure of compressor shall be minimum 8 Kg/cm²(g). 5. The heat exchangers are DMCW cooled and the maximum cooling water temperature at compressor coolers inlet to be considered same as that of PHE outlet cooled DMCW temperature. 6. The temperature rise of cooling water in the heat exchangers of the Compressed air system shall be limited to 5-10 deg C. 7. Noise level shall not exceed 85 dBA to a reference level of 0.0002 microbar when measured at a distance of 1.5 meter above the floor and 1m horizontal distance. Required acoustic enclosures may be provided to meet the above condition. The discharge blow-off silencer and intake silencers shall be designed to meet the above noise limitation level. For eventual noise, from the discharge line, accessories and/or ancillary equipment which are not included, a correction factor of (+)8 dBA maximum shall be allowed for background & ambient noise. Similarly, vibration level of screw compressor shall be as per VDI-3836. However velocity vibration shall be limited to 10mm/sec (rms). Vibration level of centrifugal compressor shall be as per manufacturer standard & proven practice. 8. Parallel operation of compressors shall be possible without any undue vibration and noise. 9. The flow in compressed air piping shall be designed for the design capacity of each compressor and the flow in header and ring mains to be designed for the total capacity of working compressors. 10. The maximum velocity to be considered in compressed air and cooling water piping shall be as mentioned elsewhere in Subsection titled "Low Pressure Piping" in Part-B of this Technical Specification. 11. All hot vessels/pipelines/ valves shall be insulated to restrict the outside temperature within 60 deg.C or less with mineral wool (or equivalent), GI wire netting and aluminum cladding/cover.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 67 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.00.00	MATERIAL HANDLING			
4.01.00	Ash handling System			
4.01.01	Brief System Description			
	Ash handling system consists of the following sub systems:			
a)	Bottom Ash, Economizer, Eco outlet duct hopper (if applicable), APH, Duct hopper (If applicable) Ash Handling system			
	i) Jet pump and Water Impounded Hopper System – An intermittent system consisting of water impounded hoppers, clinker grinders, jet pumps etc.			
	OR			
	Submerged Scrapper Conveyor and dry type hopper System – A continuous system consisting of dry type Bottom Ash hoppers, submerged scrapper conveyors, clinker grinders, bottom ash slurry trench etc.			
	ii) Dewatering Bins system			
b)	Dry Fly Ash Conveying system			
	Two alternatives for pneumatic conveying system (i.e. vacuum conveying system or pressure conveying system) are specified for conveying of fly ash from ESP Hoppers to Buffer Hoppers or ESP Hoppers to Intermediate Silos/HCS D Silos and then to main fly ash storage silo in dry form.			
	i) Vacuum Conveying System			
	It shall consist of liquid ring vacuum pumps, material handling valves, cast iron and MS pipes, instrument air compressor etc.			
	OR			
	ii) Pressure Conveying System			
	It shall consist of screw compressors, air lock/pump tanks, ash intake & discharge valves, CI & MS pipes, instrument air compressors etc.			
c)	Ash Water System			
	Ash water system shall consist of bottom ash HP water pumps, bottom ash LP water pumps, flushing water pump, fly ash HP water pumps etc.			
d)	Ash Disposal System			
	Bottom ash, Economizer ash, air preheater ash shall be disposed off as lean slurry to disposal area using slurry duty centrifugal pumps. The fly ash conveyed from various ash collection areas will be disposed off by high concentration slurry disposal (HCS D) system.			
e)	Dry Fly Ash Transportation system			
	ESP ash from the buffer hoppers shall be transported to intermediate silos/HCS D Silos by pressure transportation system only and from intermediate silos to fly ash storage silos having rail cum road loading facilities			
	OR			
	ESP ash from the intermediate Silos shall be transported to fly ash storage silos having rail cum road unloading facilities by pressure transportation system only.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA
PAGE 68 OF 81				

CLAUSE NO.	TECHNICAL REQUIREMENTS															
	<table><tr><td></td><td>For Load Calculations</td><td>For Storage volume Calculations</td><td>(Tonnes per m³)</td></tr><tr><td>Bottom Ash, Eco, Eco duct hopper & APH ash</td><td>1.6</td><td>0.65</td><td>2.0</td></tr><tr><td>Fly Ash</td><td>1.6</td><td>0.75</td><td>2.0</td></tr></table>					For Load Calculations	For Storage volume Calculations	(Tonnes per m ³)	Bottom Ash, Eco, Eco duct hopper & APH ash	1.6	0.65	2.0	Fly Ash	1.6	0.75	2.0
		For Load Calculations	For Storage volume Calculations	(Tonnes per m ³)												
	Bottom Ash, Eco, Eco duct hopper & APH ash	1.6	0.65	2.0												
	Fly Ash	1.6	0.75	2.0												
	(D)	Cooling water Requirement for Bottom ash For calculating cooling water requirement, bottom ash collection rate corresponding to 15 % of total ash make, shall be considered. This is applicable only for sizing of cooling water requirement for BA hopper. For calculating the cooling water quantity, the relevant factors and the formulae to be used shall be as indicated at Annexure-I.														
	(E)	Bottom ash Overflow water The overflow water from the bottom ash hopper shall be led to an overflow water tank. Each overflow tank shall have an effective storage capacity of minimum ten (10) minutes of BA overflow water pump rated capacity. From overflow tank, the BA overflow water shall be pumped to minimum one (1) number settling tanks and one (1) no. surge tank, by BA overflow water pumps. The diameter and thickness of mild steel settling tanks shall be minimum 15 meters and 10 mm respectively. The total suspended solids of overflow water from settling tanks to ash water pump house should not exceed 100 ppm and the same shall be guaranteed. Should the bidder feel that the total suspended solids will be more than 100 ppm, even after settling tank and surge tank suitable chemical treatment/filtration/clarification shall be provided by the bidder before the overflow water is recycled to ash water pump house where the ash water pumps are proposed to be located.														
	(F)	Ash slurry disposal system The ash concentration (W/W) for shall be as given below: a) For bottom ash slurry disposal 25% max. Minimum pumping distance 3.5Km or as per actual distance to the farthest disposal point in ash dyke, whichever is higher b) Fly Ash Slurry disposal system in HCSD form The ash concentration (W/W) shall be 60% (rated). ii) HCSD system capacity shall be designed based on the following criteria: a) Design concentration for ash slurry pumping minimum 60% by weight. b) Range of concentration shall be 55% to 65% c) HCSD pump operating range – 10% to 100% of rated flow. d) The high concentration slurry shall be disposed in disposal area such that no significant free water is released from the slurry. e) The High Concentration ash slurry disposal pump shall be positive displacement type														
	SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA											
					PAGE 70 OF 81											

CLAUSE NO.	TECHNICAL REQUIREMENTS																																	
(G)	f) Maximum slurry velocity in disposal pipeline shall be 1.9m/sec @rated duty point																																	
	g) Elevation of top of ash dyke: RL (+) 154.0m																																	
	h) Minimum pumping distance – 3.3 Km or as per actual distance for the farthest disposal point in ash dyke, whichever is higher.																																	
	Velocities																																	
	Minimum / Maximum Velocity in Bottom Ash/Fly Ash/ Combined Ash Slurry Lines				2.3 /2.8 (m/s)																													
	Tip Speed for Centrifugal Ash Disposal Pump (Max)				1676 (m/min)																													
	(H) Rated flow of pumps shall be used for determining the pipe sizes. Further the following line velocities shall be considered for estimating the line sizes of water pipes and Air Pipes:																																	
	<table><tr><th rowspan="2">S. N.</th><th rowspan="2">Service</th><th colspan="3">Velocity, M/Sec</th></tr><tr><th>Pipe size below 50 mm</th><th>Pipe size of 50 to 150 mm</th><th>Pipe size of 200 mm and above</th></tr><tr><td>a)</td><td>Water pump Suction</td><td>0.6-0.9</td><td>1.2-1.5</td><td>1.2-1.5</td></tr><tr><td>b)</td><td>Water Pump Discharge</td><td>0.9-1.8</td><td>1.5-2.4</td><td>1.8-2.8</td></tr><tr><td>c)</td><td>Compressed air below 2 Kg per cm²(g)</td><td>15-20</td><td>15-20</td><td>20-30</td></tr><tr><td>d)</td><td>Compressed air, 2 Kg per cm²(g) & above</td><td>20-30</td><td>20-25</td><td>25-35</td></tr></table>						S. N.	Service	Velocity, M/Sec			Pipe size below 50 mm	Pipe size of 50 to 150 mm	Pipe size of 200 mm and above	a)	Water pump Suction	0.6-0.9	1.2-1.5	1.2-1.5	b)	Water Pump Discharge	0.9-1.8	1.5-2.4	1.8-2.8	c)	Compressed air below 2 Kg per cm ² (g)	15-20	15-20	20-30	d)	Compressed air, 2 Kg per cm ² (g) & above	20-30	20-25	25-35
	S. N.	Service	Velocity, M/Sec																															
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d)	Compressed air, 2 Kg per cm ² (g) & above	20-30	20-25	25-35																														
Note:																																		
a) Pipe Size in pump suction side shall be at least one pipe size larger than the corresponding pump discharge connection.																																		
b) The proposed sizes of the water and air pipes shall be submitted for Owner's approval.																																		
The water and air pipe supports shall be spaced as follows.																																		
<table><tr><td>Pipe size (NB)</td><td>25</td><td>50</td><td>100</td><td>150</td><td>200</td><td>300</td><td>400</td><td>500</td></tr><tr><td>Spacing meter in</td><td>2.1</td><td>3.0</td><td>4.3</td><td>5.2</td><td>5.8</td><td>7.8</td><td>8.2</td><td>9.8</td></tr></table>						Pipe size (NB)	25	50	100	150	200	300	400	500	Spacing meter in	2.1	3.0	4.3	5.2	5.8	7.8	8.2	9.8											
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Spacing meter in	2.1	3.0	4.3	5.2	5.8	7.8	8.2	9.8																										
(I)	Friction factor 'C' to be considered in Hazen-Williams formula:																																	

SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 71 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
4.01.03	(J)	i) Friction factor ' C ' for Bottom/Combined Ash Slurry Lines	140
		ii) Friction factor ' C ' for Sludge Lines	130
		iii) Friction factor ' C ' for Bottom Ash Over Flow Lines	100
		iv) Friction factor ' C ' for Water Lines	100
	Basis for selection of capacities of various tanks/sumps - (effective Maximum pumping capacity)		
	i)	Bottom Ash Over flow Tank	Ten (10) minutes
	ii)	Slurry Sump (each compartment) [between High level & pump trip level]	Five (5) minutes
	iii)	Ash Water Sump	Thirty (30) minutes
	(K)	Ash Storage silos The fly ash storage silos shall be at a pitching suitable for filling of ash into BOXN/BCCW/ BTAP/BCFC wagons.	
		(L) Buffer hopper /Intermediate surge hopper shall be sized for 30 minute storage of conveying stream capacity.	
		Margins on equipment Margins on equipments shall be as follows:	
		S.NO.	EQUIPMENT
		MARGIN	
	1.	VACUUM PUMPS	Minimum margin of 10% (percent) over the capacity determined based on ash removal rates.
	2	CONVEYING/ TRANSPORT AIR COMPRESSORS	At least 10% (percent) margin shall be provided on compressor capacity over and above the maximum flow requirement determined based on the ash removal rates.
	3.	BAG FILTER	Number of bags shall be sized considering 10% of the bags plugged. Air to cloth ratio taken for bag selection shall be
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	
SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA		PAGE 72 OF 81	

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.01.04			taken as maximum 0.8m/min.	
	4.	WATER PUMPS	At least 15% (percent) margin shall be provided in the pump capacity over and above the maximum seal water/cooling water and other flow requirements.	
	5.	ASH SLURRY PUMPS/ HCSD PUMPS	Minimum 10% margin shall be considered for ash slurry pump sizing over and above the total slurry disposal head requirement comprising the straight pipeline frictional loss and bends loss	
	Standby arrangement for Ash handling system			
	Ash handling system shall have the provision for following standby arrangement:			
Bottom Ash System - 100% standby for clinker grinders, jet pumps with independent pipelines for each jet pump.				
<u>Or</u> 100 % standby for submerged scrapper conveyor (SSC) and clinker grinders				
Fly Ash System - 100% standby for vacuum pumps, buffer hoppers. Independent vacuum air line from each buffer hopper to vacuum pump (for ESP Hoppers).				
- 100% standby blowers for buffer hopper and at least one no. standby blower for storage silos.				
- Specified standby for air locks/pump tanks.				
- Specified standby for conveying and transport air compressors to be used for transporting ash				
Ash Disposal System - One pump stream as operating standby and one stream as maintenance standby. Independent pipelines for each pump stream				
Water system - Specified standby for ash water pumps, sludge pumps, drain pumps etc.				
ANNEXURE-I				
GUIDELINES FOR ESTIMATING COOLING WATER QUANTITY FOR BA HOPPER				
1.0	Formulae for calculating the make up water quantity for BA hopper			
	Heat input to BA hopper	=	Heat output to BA hopper	
	$Q_{ba} + Q_{fr}$	=	$Q_C + Q_{ow}$	
	Q_{ba}	=	$F_{ba} \times C_{ash} \times (T_1 - T_2)$	
	Q_{fr}	=	$A_{fa} \times R_f$	
	Q_C	=	$A_{fa} \times E \times C_v$	
	Q_{OW}	=	$F_W \times C_{water} \times (T_2 - T_3)$	
	Q_{ba}	=	Sensible heat of bottom ash (BTU/hr.)	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA
PAGE 73 OF 81				

CLAUSE NO.	TECHNICAL REQUIREMENTS																																													
	<table><tr><td>Q_{fr}</td><td>=</td><td>Furnance radiation to BA hopper (Btu/hr.)</td></tr><tr><td>Q_c</td><td>=</td><td>Heat leaving in evaporated</td></tr><tr><td>Q_{oW}</td><td>=</td><td>Heat leaving in overflow water (Btu/lb)</td></tr><tr><td>F_{ba}</td><td>=</td><td>Collection rate of bottom ash for cooling water requirements (lb/hr) (For calculating cooling water requirement, bottom ash collection rate corresponding to 15 % of total ash generation shall be considered. This is applicable only for sizing of cooling water requirement for BA hopper.)</td></tr><tr><td>Cash</td><td>=</td><td>Specific heat of ash = 0.25 btu/lb⁰F</td></tr><tr><td>T_1</td><td>=</td><td>temperature of bottom ash in hopper =1050⁰C (1922⁰F)</td></tr><tr><td>T_2</td><td>=</td><td>Temp. of water to be maintained in BA hopper=60 deg. C (140 deg.F)</td></tr><tr><td>A_{fa}</td><td>=</td><td>Furnance aperture above hopper(ft²)</td></tr><tr><td>R_f</td><td>=</td><td>Radiation rate from furnace =15,000 btu/ft²/hr or higher as applicable to the boiler offered.</td></tr><tr><td>E</td><td>=</td><td>Evaporation rate from hopper = 15 lb/hr.ft²</td></tr><tr><td>C_v</td><td>=</td><td>Latent heat of evaporation at140 deg.F(60 deg.C) =1014 btu/lb</td></tr><tr><td>Cwater</td><td>=</td><td>1 Btu/lb/^o</td></tr><tr><td>T_3</td><td>=</td><td>Temp. of incoming make-up water (40 deg.C or 104 deg.F)</td></tr><tr><td>Fw</td><td>=</td><td>Make up water flow in BA hopper (Lb/hr)</td></tr></table>	Q_{fr}	=	Furnance radiation to BA hopper (Btu/hr.)	Q_c	=	Heat leaving in evaporated	Q_{oW}	=	Heat leaving in overflow water (Btu/lb)	F_{ba}	=	Collection rate of bottom ash for cooling water requirements (lb/hr) (For calculating cooling water requirement, bottom ash collection rate corresponding to 15 % of total ash generation shall be considered. This is applicable only for sizing of cooling water requirement for BA hopper.)	Cash	=	Specific heat of ash = 0.25 btu/lb ⁰ F	T_1	=	temperature of bottom ash in hopper =1050 ⁰ C (1922 ⁰ F)	T_2	=	Temp. of water to be maintained in BA hopper=60 deg. C (140 deg.F)	A_{fa}	=	Furnance aperture above hopper(ft ²)	R_f	=	Radiation rate from furnace =15,000 btu/ft ² /hr or higher as applicable to the boiler offered.	E	=	Evaporation rate from hopper = 15 lb/hr.ft ²	C_v	=	Latent heat of evaporation at140 deg.F(60 deg.C) =1014 btu/lb	Cwater	=	1 Btu/lb/ ^o	T_3	=	Temp. of incoming make-up water (40 deg.C or 104 deg.F)	Fw	=	Make up water flow in BA hopper (Lb/hr)			
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4.02.00	Coal & Biomass Handling Plant																																													
4.02.01	Rated capacity of Coal Handling Plant shall be 1500 TPH and minimum belt width shall be 1400 mm. For Coal Handling, Belt speed of trough conveyors shall not be more than 3.4 m/s. Rated capacity of Biomass Handling Plant shall be 240 TPH and minimum belt width shall be 800 mm. For biomass Handling, Belt speed of trough conveyors shall not be more than 2 m/s.																																													
4.02.02	All conveyors (except boom conveyor of S/R) shall be designed for 110% of rated capacity. The boom conveyor of S/R shall be designed for 125% of rated capacity. Rated capacity (corresponding to CHP & BHP capacity) shall be guaranteed capacity for 100% duty equipment. For 55% / 75% duty equipment rated capacity shall be guaranteed capacity. For purpose of guaranteed power consumption rated capacity shall be considered in either case.																																													
4.02.03	2x100 % (one working + one standby) conveying stream shall be provided in the Coal Handling Plant, except yard conveyor One working conveying (Conveyors & Bucket elevator) stream shall be provided up to Silos for biomass handling plant & 2x100% (one working + one standby) conveying stream shall be provided from after silos.																																													
4.02.04	Design capacity of the conveyor system shall be considered for the selection of belt width, belt speed and the continuous motor rating at 50 deg C Ambient																																													
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 74 OF 81																																										

CLAUSE NO.	TECHNICAL REQUIREMENTS																		
4.02.05	Belt conveyor system shall be designed as per the 5th edition of 'Belt Conveyors for Bulk Materials' published by Conveyor Equipment Manufacturer's Association' or equivalent International Standard. Ai value for idler shall be considered 2.8lb (min.) for the purpose of conveyor design calculation only.																		
4.02.06	All mechanical, electrical, civil and structural system design shall consider: a) Simultaneous running of both conveyors at rated capacity. b) Starting of one stream with other stream in standstill condition. c) Starting of one stream with other stream in operation at rated capacity. d) Round the clock operation of Coal Handling Plant. e) The following aspects shall be taken care of coal/biomass i) The coal delivered to power station, shall be of size 250 mm and below. However, occasionally 1-2% coal of 400 mm lump size may also be encountered. Terrified Biomass shall be delivered to power station, of size 35 mm and below with fines up to 5 % and maximum moisture content 15 %. ii) HGI of coal shall be between 44 to 65. Normally, moisture content in coal vary between 12% to 15%. However, for design purposes moisture content of 20% shall be considered for both coal and limestone. iii) Due to open cast method of mining involved, the coal may contain shale and sand stone as high as 20%. Also, occasionally, metal pieces like broken shovel teeth, brake shoe, wires etc. may also come along with coal/ Limestone. iv) The coal as received' shall contain varying percentage of fines. This may form adhesive lumps particularly during monsoon when surface moisture is at its maximum value. The sizing and selection of all equipment shall take care of above. f) For the purpose of volumetric computation, bulk density of coal shall be taken as 800 kg/m and for biomass 600 kg/m³ and blending ratio of Biomass with Coal is 20 % (by weight). Therefore, for calculation of belt conveyor capacity for their drives and drive motors KW requirement and sizing (volume calculations) of chute, hoppers etc., the above bulk density shall be considered. For all other purpose (viz) for stresses/load on structures, torque calculations of bucket wheel of Stacker Reclaimer, loading of VF tables, sizing of actuators, calculation of plugged chute, Hoppers loads etc., the bulk density of coal shall be taken as 1100 Kg/m3.																		
4.02.06	COAL HANDLING EQUIPMENT a) Design capacities & margins <table><tr><th>Sl no</th><th>Equipment</th><th>Duty requirement</th><th>Design capacity as %age of duty requirement</th></tr><tr><td>1</td><td>Crushers</td><td>2x55%</td><td>110%</td></tr><tr><td>2.</td><td>Vibrating feeders</td><td>2x55%</td><td>110%</td></tr><tr><td>3.</td><td>Apron feeders</td><td>1x110%</td><td>110%</td></tr></table>			Sl no	Equipment	Duty requirement	Design capacity as %age of duty requirement	1	Crushers	2x55%	110%	2.	Vibrating feeders	2x55%	110%	3.	Apron feeders	1x110%	110%
Sl no	Equipment	Duty requirement	Design capacity as %age of duty requirement																
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 75 OF 81															

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	4	Belt feeder for crusher house	2x55%	110%
	5	Stacker-reclaimer	1 X100%	110% for stacking & 125% for reclaiming
4.02.07	Drive equipment Rating Continuous Motor Rating (Name Plate Rating) at 50 Degree Centigrade Ambient temp. for Electric Motors a) For conveyors of belt conveyor systems *110% of actual power at drive motor output shaft at specified design capacity. The same shall be applicable for all drive motors of belt conveyors of Coal handling, biomass, Mill reject handling system, Limestone and Gypsum handling. b) Crushers, elevators, rack and pinion gates, all the drives in sampling units, various pumps of DS/DE systems, service water systems, cooling water system, potable water system and sump pumps, Ventilation Fans. *110% of actual power requirement at drive motor output shaft at guaranteed (rated) capacity. *The actual power at drive motor output shaft shall be calculated after considering all the losses of down the line equipment's of the drive train. Gear Box Rating: a) For belt conveyor systems @ Service factor X {1.2 times the actual power requirement at drive pulley shaft at design capacity} In any case, gear box rating shall not be less than motor nameplate rating. b) For other equipment @ Service factor X {1.2 times the actual power requirement of the driven equipment} @ Service factor shall include all the components considered by the supplier and should be clearly indicated in manufacturer's gear box selection catalogues Coupling Not less than motor nameplate rating.			
4.02.08	General practice for dust control system a. All pumps in dust suppression, portable water and service water system shall be designed for 100% capacity and with 100% standby.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA PAGE 76 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	(2) Location of spray : At all coal discharge & receipt point in all transfer points & crusher house (3) Capacity & Pressure : 0.5 Kg/cm² for water (min.) at inlet of spray head and 5.0 Kg/cm² for air (min.) Pressure at inlet of spray head (Cold Fog) : 70 Kg/cm² (min)		
4.02.15	Stockyard Dust Suppression System (1) Maximum number of nozzles : Two (2) Nos. operating simultaneously for each stacker cum reclaimers (2) Capacity & Pressure : 500 Lpm/4.5 kg./sq cm(g) of each spray nozzle		
4.02.16	Dust extraction system (a) For Coal Handling Plant Type : Venturi scrubber type Location : Belt feeder after crusher & Vibrating Feeder at crusher house. (b) For Biomass Handling Plant Type : Dry type Location : Truck unloading point, TPs & Silos		
4.02.17	Service Water System Service water connections are to be provided in trough conveyor galleries & tunnels at 50 meter interval and one (1) no. on each floor of Transfer Points, toilets and minimum two (2) nos. on each floor of crusher house. (a.) Flow at each valve : 5 cub.m/hr (b.) Minimum discharge Pressure at tap point : 2 kg/sq.cm (c) No. of valves operated : 6 nos. Simultaneously		
4.02.18	Ventilation System A Mechanical Ventilation System: Underground Areas: Minimum 15 supply air changes and minimum 7 exhaust air changes per hour.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA
			PAGE 79 OF 81

CLAUSE NO.	TECHNICAL REQUIREMENTS							
	B. Pressurized Ventilation System: Refer 3.13.02 C. Air Conditioning System: Adequate number of air changes to Maintain in uniform temp. & humidity as specified elsewhere.							
4.02.19	Chutes: Minimum clear cross section of chute: 1800 mm X 1200 mm (inside both ways) for Coal Handling plant & 800mm x 600mm (inside both ways) for biomass handling plant							
4.02.20	Bidder to comply Safety guidelines while designing Coal & Biomass Conveying Plant, and to follow safety requirement as mentioned elsewhere in the Technical Specification.							
4.03.00	MILL REJECT HANDLING SYSTEM							
4.03.01	Mill Reject system shall be provided for all vertical type mills.							
4.03.02	The capacity of mill rejects system shall be at least 1% of mill design capacity for worst coal or maximum actual, whichever is higher, considering maximum no. of working mills.							
4.03.03	In case of mechanical conveying system, a vibrating feeder (if required) and metallic belt/chain flight conveyor carry mill reject from hopper to subsequent metallic /chain flight conveyor for further conveying to Bucket elevator for final storage at Silo.							
4.03.04	Each Mill Bay shall be provided with an independent `SILO` having a collection capacity of 16 effective hours of mill reject considering all mills of that particular bay are working. Clear head room of minimum 4.5 m below silo outlet shall be kept for truck entry.							
4.03.05	For the purpose of design temperature of rejects shall be assumed as 200°C or as specified by the boiler/ mill manufacturer, whichever is higher. However quenching system shall be provided.							
4.03.06	Sizing grid shall be provided in mill reject pyrite hopper to remove mill reject of size >40mm. The mill reject systems shall be designed for input size of 40mm.							
4.03.07	Bulk density of mill reject shall be considered as: <table><tr><td>i) For volumetric computation</td><td>-1600 kg/m³</td></tr><tr><td>ii) For load/ strength</td><td>- 2400 kg/m³</td></tr></table>				i) For volumetric computation	-1600 kg/m ³	ii) For load/ strength	- 2400 kg/m ³
i) For volumetric computation	-1600 kg/m ³							
ii) For load/ strength	- 2400 kg/m ³							
4.04.00	Not Used							
4.05.00	FUEL OIL HANDLING AND STORAGE SYSTEM							
4.05.01	Fuel oil unloading & storage system shall be designed to handle light diesel oil (LDO).							
4.05.02	Fuel oil system shall meet the requirements of steam generator.							
4.05.03	Not Used							
4.05.04	Storage tanks shall be designed and /or modified as per IS: 803 (As applicable).							
4.05.05	The velocity of oil in gravity flow lines shall be limited to 0.6-1.0 m/s.							
4.05.06	The entire fuel oil handling installation (In Bidder's scope) shall have the approval of Chief Commissioner of Explosives, Nagpur.							
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 80 OF 81				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.05.07	Dyke size shall be as per OISD-118 guidelines.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-01 EQUIPMENT SIZING CRITERIA	PAGE 81 OF 81



SUB-SECTION–A-02

STEAM GENERATOR AND AUXILIARIES INCLUDING ESP

**SINGARENI THERMAL POWER PROJECT
STAGE-II (1X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC NO.:CW-CM-11159-C-O-M-001**

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.01.02	Fuel Oil (a) Description of Fuel Oil Unloading & Storage System The fuel oil requirements for steam generator shall be drawn from the LDO tanks to be provided by the contractor. The fuel oil pressurizing and firing system shall be in the scope of contractor. Bidder shall include all required piping, valves, fittings, instrumentation etc. upto the terminal point. (b) Fuel Oil Firing System (1) The fuel oils having characteristics as given at Table-1, Annexure –IV-1, of Part-A, Sub-section-I-B shall be used for start-up, coal flame stabilization and low load operation of the main Steam Generator. (2) The design and construction of the Steam Generator shall be suitable for firing the fuel oils mentioned above for continuous operation of the Steam Generator.			
1.02.00	Codes & Standards (1) All equipment, systems and work covered under this specification shall comply with all latest statutes, regulations and safety codes, as applicable in the locality where the equipment will be installed. This shall however be subject to change in Laws & Regulations as specified in Section-IV GCC. (2) The design of Steam Generator shall meet or exceed all the requirements of latest editions of Indian Boiler Regulations (IBR). This is subject to provision in Section-IV, GCC. (3) Any other standard acceptable to IBR can also be considered, provided that the requirements of that standard are equivalent or more stringent than the IBR requirements. (4) Wherever the specification stipulates requirements in addition to those specified in IBR, the same shall also be complied with, by the Contractor. (5) In all above cases specific approval of concerned Chief Inspector of Boilers shall be obtained by the Contractor before manufacture of the equipment. (6) In cases where IBR does not govern, other International Standards, established to be equivalent or superior to the Codes and Standards specified are also acceptable. However, in the event of any conflict between the requirements of the equivalent codes and standards, and the requirements of the Indian Standards/ Regulations, the latter shall govern, unless, specified otherwise in the specification. (7) NFPA requirements including that for load changes & stabilization.			
1.03.00	Statutory Approval It shall be responsibility of the Contractor to obtain the necessary approvals of Inspection Authority/Chief Inspector of Boilers Registration Authority etc. on behalf of the Employer, as may be required for designing and design calculations, manufacturing and erection procedure, testing etc. as called for under the IBR. All such documentation submitted to statutory authorities shall also be submitted to the Employer for his review.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP	PAGE 2 OF 67

CLAUSE NO.	TECHNICAL REQUIREMENTS											
1.04.00	Minimum Load Without Oil Support for Flame Stabilization The design of Steam Generator shall be such that it does not call for any oil support for flame stabilization beyond 40% TMCR load when firing any coal from the range specified, with any combination of adjacent mills (to Employer's choice) in service. This shall be demonstrated by the Contractor											
1.05.00	Loading/Unloading Pattern and Adaptability for Sudden Load Changes/Load Throw off (i) To match the desired plant operating capabilities, the Steam Generator shall also be designed for cyclic/two shift operation. Expected numbers of Steam Generator start-ups during 25 years of design life are as follows: <table><thead><tr><th>Type of Starts</th><th>Number of Starts</th></tr></thead><tbody><tr><td>a. Hot start (after 8 hours of unit shut down)</td><td>4000</td></tr><tr><td>b. Warm start (after 36 hours of unit shut down)</td><td>1000</td></tr><tr><td>c. Cold start (after 72 hours of unit shut down)</td><td>150</td></tr></tbody></table> To make unit capable of continuous two shifting operation, the number of hot start ups shall be increased from 4000 numbers to 6700 numbers without changing cold and warm start up as well as daily N1 (minimum 13400 cycles in total design life) and N2 (minimum 6700 cycles in total design life) requirements as defined Sub section -G-01 operating capability of Plant, Part-B,Section VI. (ii) In case of sudden load throw-off, in worst case from 100% BMCR, the boiler design shall ensure balanced draft condition, avoid overheating of reheater tubes and such other conditions that jeopardize the safety and life of boiler. (iii) In line with automatic run back capability of the unit load on loss of critical auxiliary equipments, the Steam Generator equipment and systems shall also ensure smooth and stable runback operation. Steam generator shall be capable of operation with HP heaters out of operation. The steam generator heat output under HP heaters out condition shall not be less than heat duty required for generating rated power output or design BMCR heat duty, whichever is lower. For turbine trip & HP/LP bypass mode operation condition the economizer shall be suitably designed to take a thermal shock of sudden change of feed water temperature from rated value(s) to 140°C. The superheater and reheater outlet temperature shall be maintained during HP/LP bypass operation at above mentioned superheater outlet flow.				Type of Starts	Number of Starts	a. Hot start (after 8 hours of unit shut down)	4000	b. Warm start (after 36 hours of unit shut down)	1000	c. Cold start (after 72 hours of unit shut down)	150
Type of Starts	Number of Starts											
a. Hot start (after 8 hours of unit shut down)	4000											
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1.06.00	Steam Generator Control Range The automatic control range of Steam Generator shall be from 50% TMCR to 100% BMCR. Under the above control range, the steam temperatures at SH & RH outlets shall be maintained at their rated values.											
1.07.00	Following anticipated parameters shall be considered in boiler design. (i) Air infiltration in ESP : 1% of ESP inlet gas flow (ii) Pressure drop in ESP : 25 mmWC (iii) Temperature drop in ESP : 2 ⁰ C											
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP								
PAGE 3 OF 67												

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.08.00	NA			
1.09.00	Limits of NOx Emission			
1.09.01	Combustion system along with wind box, air ducting and other associated parts shall be designed for guaranteed maximum NOx emission of 300 mg/Nm3 at 6% O2 on dry gas basis at Economizer Outlet. Minimum two levels of separated overfire air (SOFA) shall be provided. The value of NOx shall include both fuel and thermal NOx and shall not be exceeded during 40% to 100% TMCR load condition from the range of specified coals.			
1.09.02	NOT USED			
1.09.03	Bidder to submit details of NOx emissions achieved by itat other stations using similar fuels burner/furnace designs, to substantiate his claims.			
1.10.00	Capital Overhaul of Steam Generator			
	Employer envisages to carryout the capital overhaul of units once in three (3) years. The design and materials for various equipments/auxiliaries etc. shall be selected by the Contractor keeping in view the above requirement of the Employer, such that no major repairs/replacements, requiring shutdown of the unit, are needed in between the capital overhauls.			
1.11.00	Maintenance			
1.11.01	The Contractor shall provide adequate handling facilities & approach as for carrying out on-line and off-line maintenance of the Steam Generator and its auxiliaries. In order to carry out on-line maintenance, it shall be possible to readily disassemble, repair and reassemble the equipment supplied in the shortest period.			
1.11.02	A minimum of two accesses and clean out doors shall be provided to permit access to the furnace, superheater, reheater, the area between tube bank, Separator, economizer and any other area requiring maintenance.			
1.11.03	Material handling equipment consisting of monorails, cranes, motorized hoists and motorized trolleys and any other lifting device, as may be required, alongwith all supporting structure etc. shall be provided for maintenance of all auxiliaries like ID, FD & PA fans, air preheaters, pulverizers, Steam Coil Air Preheaters, fuel oil pumps etc.			
1.11.04	A vertical & straight garbage chute of minimum 500 mm diameter and made from minimum 10 mm thick mild steel pipe shall be provided for each Steam Generator, from pent house level to ground level for disposal of debris & scrap generated during erection, operation and maintenance. The chute shall be provided with branch connections with doors and suitable access to the doors at all platform levels. Garbage collection trolleys shall also be provided at the ground level.			
1.11.05	Header to be provided with hand hole at end cover for ease of inspection and removal of foreign material.			
	Enclosures for headers outside the gas path shall have provisions to avoid dust accumulations & facilitate dust removal & cooling in order to aid access for maintenance & inspection activities.			
1.12.00	NA			
2.00.00	STEAM GENERATOR ENCLOSURE			
2.01.01	Steam Generator enclosure shall form air/gas tight envelope from secondary air and			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
PAGE 4 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	hopper and corresponding to ash density of 1600Kg/m³. Further minimum sixteen (16) Nos. of load cells shall be installed by Contractor in the furnace roof enclosure to give indication of ash build up in the furnace bottom hopper. The contractor shall provide the design basis for the selection for number of load cells, their distribution and fixing up of alarm set points. (*) Refer Sub-Section-A-01, Part-B, Clause No. 1.05.08.02(i).			
3.02.00	Furnace / Evaporator shall be designed for variable pressure operation over 30% to 100% BMCR load range.			
3.02.01	Water/steam walls shall be of membrane wall construction and shall be made of seamless cold drawntubes. Furnace / evaporator shall be formed using spiral wound / inclined tubing or vertical plain / rifled tubing as per the proven practice of the manufacturer for boilers of similar capacity. Irrespective of the type of water wall tubing offered for the evaporator, the design offered shall ensure that no readjustment of tube mass flow is required during entire operating regime of the Steam Generator for complete range of specified coals. In case such readjustment becomes necessary over a period of five years from the date of successful completion of initial operation of respective Steam Generator, the cost of carrying out such flow readjustment/modifications including cost towards rectifying any damages to the Steam Generator tubing resulting from the inappropriate mass flow in the tubes shall be borne by the Contractor. Contractor in its proposal shall indicate the approximate time required for such readjustment of tube mass flow and the period of unit shut down. The thermo-hydraulic design of the offered evaporator shall be stable under varying heat flux and mass flux conditions as well as other system disturbance that the evaporator may encounter during operation. The stability of the thermo-hydraulic design of the evaporator shall be demonstrated by the contractor by conducting stability analysis (both static and dynamic) of the finalized evaporator design. As a part of the static stability, interalia, the outlet temperature profile for each tube at the intermediate header inlet (if applicable) and vertical wall outlet header be calculated. The variance of tube outlet temperature shall be validated by carrying out site demonstration for the first boiler during commissioning by affixing metal temperature thermocouples at each evaporator outlet tube (at intermediate header inlet, if applicable, and vertical wall outlet). These thermocouples shall be over and above the requirements for metal temperature thermocouples specified elsewhere. In case the temperature variance in the evaporator tubing temperature during such demonstration is found to exceed the design considerations necessary modifications to the evaporator flow circuits shall be done by the contractor to control the tube temperatures. The mechanical design of the evaporator shall be carried out considering its primary stresses due to internal pressure as well as secondary stresses due to loads like weight membrane panel, buckstays, ash, and other elements loaded on evaporator, differential stresses restrained thermal expansion between evaporator tubes and the evaporator support elements etc. The calculations in support of the same shall be submitted by the contractor.			
3.02.03	A minimum allowance of 0.6 mm over and above the calculated thickness as per IBR shall be provided for entire water wall. An additional tube thickness of 1.0 mm over and above the tube thickness of water wall tubes calculated as per above shall be provided on all water wall tubes coming within a radius of one meter around each wall blower to guard against premature tube failure due to soot blowing steam erosion.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
PAGE 6 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.02.04	Flame impingement on steam/water walls is not permitted. Suitable provisions, including the extent of combustion staging, shall be made to minimize the water wall corrosion. The bidder shall demonstrate that the average thinning of tubes in the burner zone due to corrosion, erosion etc. shall not be more than 0.1 mm/per year.		
3.02.05	Headers shall be located external to gas path and shall be completely drainable. If locating headers in gas path becomes unavoidable, then suitable erosion shields must be provided.		
3.02.06	For, vertical tubing arrangement, Minimum 10 mm dia. Wear bars of suitable wear resistant material shall be welded along the full length of first 40 tubes of inclined water wall tubes of S-panel of bottom hopper from each corner up to hopper opening. In case of spiral tube arrangement, wear bars shall be welded on each of the inclined water wall tubes of S-panel up to a length of 3.3 m from each corner. Alternatively, instead of welding wear bars to the inclined wall tubes as indicated above, in order to take care of tube erosion due to sliding ash, contractor can also provide 1.0mm additional tube thickness on entire inclined tubes of the 'S' panel over and above the tube thickness calculated as per IBR and other specified requirements. Extra thickness of corner tubes shall be provided and suitable erosion prevention measures to be considered during erection stage itself.		
3.02.07	Minimum tube thickness at the bends in no case shall be less than the minimum tube thickness for the straight tubes calculated in the manner described at 3.02.03& 3.02.06 above. For this purpose appropriate thinning allowance shall be considered by the contractor while calculating the thickness of the bends.		
3.02.08	Provide adequate nos. of furnace observation and tapping points for local instruments, gauges, switches, test pockets etc.		
3.02.09	Not used		
3.03.00	The Steam Generator shall be designed for the following minimum operational requirements at all loads and for the specified range of coal(s).		
	PARAMETER	REQUIREMENT	
(i)	Soot Blowing Frequency	Soot Blowing Frequency as per bidder's recommendation to ensure adequate cleaning of heating surfaces for specified range of coals	
(ii)	Preferred mill combination	Any combination of mills (to Employer's choice without any restriction).	
(iii)	Max. coal flow unbalances in coal pipes from same mill, from the average	5.0%	
(iv)	Slagging :		
	a) Inter burner	Nil	
	b) In furnace/ash hopper/water wall areas	Nil	
(v)	Control range of boiler	50% TMCR to 100% BMCR	
(vi)	Maximum permissible Reheat Spray Water Flow with rated steam temperature at Reheater outlet	3% of steam flow at reheater outlet	
(vii)	Min. load without oil support	Refer Clause 1.04.00	
(viii)	Maximum gas temperature variation across furnace width	45°C (Max.)	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
			PAGE 7 OF 67

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	(ix) Maximum steam side temp. imbalance in the LHS & RHS at boiler outlet (with the average) 10 deg C (max.) (x) Min. load with separator running dry 30-40 % TMCR (As per Manufacturer's proven practice) (xi) Header unbalance (steam side) 6 % (Maximum) (xii) Air ingress from furnace bottom hopper As per manufacturer's Predictions		
	Note: -(a)No ingress of air from any opening like bottom hopper, soot blower, any manhole or peep hole, ducts etc. shall be considered for sizing of secondary and primary air fans while the same shall be considered for performance predictions. (b) Temperature upset due to maximum gas temperature variation across furnace shall be considered while selecting pressure part materials.		
3.04.00	Provide following:		
	(a) Water cooled hinged doors at furnace hopper, for introduction of power operated maintenance cradle into furnace. (b) Inspection opening with welded forged caps for each header.		
3.05.00	Provide the following:		
	(a) Provision for future installation of additional Soot Blowers shall be made in the furnace. Necessary space provision in layout for providing approach and platform for future soot blowers shall be kept in the original design itself so that same can be installed whenever the future soot blowers are required. The loads for these platforms shall be considered in the boiler structure design. In case of such a necessity of installation of additional soot blowers, the Contractor shall install these soot blowers and associated access and platforms without any cost implication to the Employer. (b) Erosion resistant shields for tubes/header affected by gas impingement/laning effects (e.g. in a between SH/RH, Economizer and furnace walls openings for economizer bypass etc.) (c) Tapping points at five levels for furnace vacuum monitoring (in addition to routine monitoring) (d) All round seal plates of stainless steel type 430 or better (6-mm thick minimum) welded to furnace hopper for sealing against air ingress. (e) Corrosion resistant shields/coating for tubes/header affected by splashing of water from bottom ash hopper, due to fall of ash clinkers.		
3.06.00	Panel to panel welding in burner zone to be avoided to maximum possible extent. Profile shields/ erosion prevention measure to be provided on top and bottom burner panel bends.		
3.07.00	Provide stainless steel expansion markers/indicator on all the four furnace walls to monitor thermal expansion. Predicted thermal expansion at different levels to be indicated.In addition to local indicators, measurement system (4-20mA Output) for remote indication shall also be provided on all the four furnace walls.		
3.08.00	For continuous monitoring of water wall tube metal temperatures provide 100 numbers of		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
			PAGE 8 OF 67

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	thermocouples outside the gas path as per specification specified elsewhere in the Technical Specification. Note: (a) The exact location and number of thermocouples shall be finalized during contract stage. However, Bidder shall furnish unit rates for addition/deletion of the thermocouples with respect to the numbers mentioned above. (b) Alarm set point for tube metal temperature shall not exceed the design temperature of respective tube.			
3.09.00	Suitable temperature monitoring system consisting of 80 nos. of thermocouples should be provided for Bottom hopper, Pent House, Economizer, APH hoppers etc. The exact location and number of thermocouples shall be finalized during contract stage. However, Bidder shall furnish unit rates for addition/deletion of the thermocouples with respect to the numbers mentioned above			
3.10.00	Insulation skin temperature measuring system consisting of 40 nos. of thermocouples to be provided in critical areas like Burner panel and critical piping areas. The exact location and number of thermocouples shall be finalized during contract stage. However, Bidder shall furnish unit rates for addition/deletion of the thermocouples with respect to the numbers mentioned above.			
4.00.00	STEAM GENERATOR CASING AND FRAMING			
4.01.00	Steam Generator casing/pent house (as applicable) shall be provided. The casing/pent house design shall ensure:			
	(a) Complete enclosure of Steam Generator including superheater, reheater& economizer headers.			
	(b) The casing/pent house and its supporting system shall be capable of taking additional loads due to accumulations of ash upto 300 mm height or actual expected (in between two overhauls of the units), whichever is higher. This additional load is over and above other loads considered for casing design. The ash density for the purpose of ash loading shall be at least 1300 kg/m³.			
	(c) Temperature upset due to maximum gas temperature variation across furnace shall be considered while selecting pressure parts materials.			
4.02.01	Steam Generator casing/pent house shall:			
	(a) Form rigid self containing structure, with adequate stiffening.			
	(b) Be welded wall construction, sectionalized to allow easy removal/replacement of casing/penthouse wall sections.			
	(c) Be weatherproof and water tight construction for protection from monsoon rains/winds.			
	(d) Have all drainage arrangement like gutters, drain pipes etc., connected to plant drainage system at ground level.			
	(e) Be provided with boiler roof arrangement of proven design & architecture. The boiler main roof arrangement shall be provided with monitor for ventilation and light. The overlap between the monitor and the main roof should be such that it prevents ingress of rain to the steam generator casing/penthouse. The boiler roof shall be extended downwards all around the boiler to a level of atleast 2 meters below the penthouse casing roof. Suitable ventilation provision shall be provided			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
PAGE 9 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	in these side walls. All necessary sealing collars/wall boxes shall be provided where the pipes pass through the boiler roof or its extended side walls.			
4.02.02	Provide at least two pent house ventilation/cooling/pressurizing fans with their air inlet openings at opposite ends.			
4.02.03	The casing/pent house shall be provided with: (a) Accesses and access platforms for easy and quick installation of scaffolding for furnace inspection/maintenance. (b) All necessary access, observation and cleaning doors with frame for building brickwork's and securing the casing shall be provided. The doors shall be insulated and perfectly air tight. It is considered highly important to ensure proper closure of doors to maintain minimum air-in-leakage.			
4.03.00	A common drain pipe shall be provided in the boiler from boiler penthouse roof to the nearest identified drain separation trench. Various open water drains and vents for shall be connected with this drain pipe.			
5.00.00	STEAM SEPERATOR(S) In addition to the sizing design criteria requirement elaborated at Sub-section- A-01, following design requirements shall also be adhered:			
5.01.00	Steam Separator construction shall have: (a) Materials as specified at clause no 1.05.02of Sub-section- A-01 to suit maximum design pressure/temperature. (b) Fusion welded/forged construction with welded hemispherical dished ends. (c) Nozzles for Steam/Water connections and tappings for instrumentation, sampling and other mountings/fitting etc. (d) Nozzles/tapping to comply with heat treatment, weld and other requirements as per ASME Section I/BS 5500. (e) Handhole with forged steel cap.			
6.00.00	BOILER STARTUP RECIRCULATION AND DRAIN WATER SYSTEM Boiler start-up recirculation & drain system shall be provided with start-up drain re-circulation pump and alternate drains to Atmospheric flash tank. 2x50% condensate pumps shall be provided for pumping the flash tank condensate to turbine condenser. Necessary control valves shall be provided in the condensate line for maintaining the level in the flash tank / drain receiving vessel.			
6.01.00	The start-up recirculation & drain system shall comply with following design requirements: (i) Designed for fast start-up and cyclic load operation of Steam Generator. - Start-up with and without the recirculation pumps (Condenser vacuum shall be available at such times) - Black Start-up with recirculation pumps in service. Under black startup of steam generator, the condenser vacuum may not be available due to non-availability of auxiliary steam for turbine gland sealing and therefore it may not			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
PAGE 10 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	be possible to dump boiler drains into the condenser of turbine. Bidder shall, therefore, make necessary arrangement of draining of boiler startup drain (required to maintain the necessary feed water quality) to facilitate the black start of the unit.			
	(ii) Designed for maximum possible recirculation & drain flow under all possible normal, abnormal, upset and accidental conditions.			
	(iii) The drain piping, valves, flash tank, drain receiving vessel and condensate pumps shall also be sized to cater to the maximum drain requirement as per clause 6.01.00 (ii) above. Design of the flash tank shall conform to the specification as stipulated elsewhere in the specification.			
	(iv) Pressure transmitter to be installed downstream on control valves in the line connecting individual level control valves with flash tank (4 Nos.)			
6.02.00	Start up recirculation & drain piping and its supports shall be designed to take care of excessive vibration, which may result from two phase flow conditions, if it occurs.			
6.03.00	The start-up drain re-circulation pumps shall be of proven design. Boiler start-up drain recirculation pumps and their motors shall meet the following requirements:			
	(i)	Number of pump	1x100% (sized for maximum flow as specified at Clause6.01.00 (ii) above)	
	(ii)	Type of pump	Gland less zero leakage type with overhung impeller.	
	(iii)	Motor specification	Submerged type with wet stator with water coolers. Motor for Steam Generator start up recirculation pumps shall be a wet motor, specifically designed by the pump manufacturer for the application and shall be as per the standard adopted by the pump manufacturer subject to Employer's approval. Motor windings shall be of non-hygroscopic material and shall be designed to withstand continuous water pressure & temperature variation.	
	v)	Cooling system	One number external high pressure cooler for each motor rated for 100% duty shall be provided to remove the heat generated by the motor and bearings during operation. The temperature of high pressure cooling water leaving the motor cavity to the cooler shall not exceed 60 deg. C. The cooler shall be adequately sized to reduce this temperature to 50 deg. C. A high temperature motor cavity alarm / trip shall be provided to operate the alarm at 63 deg. C and to trip the motor at 66 deg C while the pump is in operation. The design shall be such that during hot standby service of the pumping unit, sufficient cooling effect is provided by natural circulation of the coolant so as to prevent over heating of the motor.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
PAGE 11 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
6.04.00	Provide suitable features in pumps and motors to reduce the radial and axial thrust. Provide suitable design feature and material of construction to reduce electrolytic action, corrosion, erosion and cavitation. The recirculation pumps/motors shall be provided with necessary handling arrangement including runway beams, trolleys etc. Pumps & motors shall be hermitically sealed.Heavy duty design & construction suitable for operating pressure & temperature.Pumps to be mounted & supported directly from the Steam Generator recirculation piping system and motor to be mounted beneath the pump. The pump shall be suitable for cyclic operation as specified in sub section-A-01 of part-B of the technical specifications. The specific features adopted in this regard shall be brought out by the contractor like casing shape & design including its curvature/corner radius, stress concentration areas, no. of pieces/joints for a pump casing, materials adopted, performance monitoring etc. with proper justification. A CFD and FEM analysis to conform to specified cyclic requirements shall be carried out and furnished by the contractor alongwith the pump data sheet. Online monitoring requirements on the pump casing/heat barrier shall be recommended by the OEM like an array of thermocouples to give adequate indication of temperatures. The pump OEM shall share the test/inspection/feedback data of high load cycling power plant cases where the offered pump design has been successfully run.			
7.00.00	SUPER HEATERS & REHEATERS			
7.01.00	In addition to the sizing design criteria requirement elaborated in Sub-section- A-01, following design requirements shall also be adhered:			
7.01.01	Construction of Superheaters(s) &Reheater(s) shall have following features:			
7.01.01	1	Heating surfaces arrangements		
		(a) Completely drainable tubes/banks/ sections for SH/RH tube banks in case of tower type gas path arrangement. For the two pass boilers, the arrangement of SH/RH banks shall have a drainable layout to the maximum possible extent. (b) Banks/sections/tubes should be made from seamless tubes. (c) Ensure even temperature distribution at gas and steam side by criss-crossing the steam paths between LHS and RHS. In case the contractor is able to limit the steam temperature imbalance between LHS and RHS to withing 10°C by employing suitable furnace/ burner configuration like twin furnace, the contractor may not provide crisscrossing arrangement. Bidder shall, however, submit the information relating to the performance of reference steam generators to the Employer so substantiate such decision. The contractor shall demonstrate steam temperature imbalance across two paths (LHS and RHS) to be within 10°C during commissioning. Incase the temperature difference between the two paths of more than 10°C is observed beyond reasonable extent, the contractor shall provide criss-cross arrangement along with other suitable measures (as required) without any extra cost implication to NTPC.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
				PAGE 12 OF 67

CLAUSE NO.	TECHNICAL REQUIREMENTS
	All necessary provisioning for installation of criss-crossing or any other measures (as required) including space/hanger tapping points etc. shall be made by the contractor so that the same can be installed if the operational experience warrants the same. (d) Use of girdling loops not permitted. (e) Uniformly spaced elements to avoid gas bypassing. (f) Use of radiant wall super heater is not allowed. Note: If Contractor intends to utilize design with Radiant wall reheater, the use of such radiant wall reheater shall be restricted to only on one of the furnace walls (i.e. either on the front wall or on one of the side walls). Further, the lowest portion of wall RH shall not be below the furnace nose tip level. 2 Minimum transverse tube pitching in the direction of gas flow path (a) 600 mm for banks/sections placed in areas where gas temperature exceeds the FEGT (MHVT) value. (b) For bank/sections placed in areas where gas temperature exceeds IDT of ash for the range of coals specified, the minimum transverse pitching shall be under: i) For tower type boiler - 960 mm ii) For two pass boiler- 762 mm 3 Maximum depth of tube banks/sections in the direction of gas flow: 2 Meters or maximum soot blowing radius, whichever is lower. Bidder can also provide the higher depth limited to 2.5 m also, only if it's a bidder's proven practice. References shall be provided in support of the same. However, it will be limited to maximum soot blower radius. 4 Supporting arrangement All horizontal heat transfer surfaces shall be supported by steam or water cooled hanger tubes designed for a minimum of 2 times the calculated load so as not to cause any dislocation/damage to the tube banks/sections. Necessary calculations in support of this shall be furnished by the bidder. The stress in the hanger tubes under such condition also shall not exceed the maximum permissible limits as per IBR. One(1) mm erosion allowance shall be provided over and above the calculated thickness of hanger tubes. 5 Arrangement of headers Located outside the gas path, fully drainable. Wherever, locating the headers in the gas path becomes unavoidable these shall be suitably protected with erosion shields. Further, the nipples and studs of the header shall also be provided with wear resistance stainless steel shields of minimum 2.5 mm or higher thickness. The arrangement of headers shall be such that it does not cause the high localised flue gas velocity on tubes down stream side of the header. 6 Attemperators (a) Location

CLAUSE NO.	TECHNICAL REQUIREMENTS			
7.02.00	(b) BALANCE OF TUBES IN THE BANK: Provide 0.6 mm (min.) over and above the calculated thickness as per IBR (Ref. as specified at clause no 1.05.02 of Sub- Section A-01 of this document for erosion allowance). (c) Minimum tube thickness at the bends in no case shall be less than the minimum tube thickness for the straight tubes calculated in the manner described at (a) and (b) above. For this purpose appropriate thinning allowance shall be considered by the contractor while calculating the thickness of the bends.			
	8	Tube/Header Material (a) Appropriate for most adverse operating conditions and as per conditions specified in this Sub-Section (Alloys containing Molybdenum only, without any suitable stabilization with Vanadium and Chromium shall not be used. Total content of Molybdenum, Tungsten, Silicon, Vanadium, Titanium, Tantalum etc., individually or all together, if not otherwise specified, shall not exceed the limit specified in relevant material codes). (b) Contractor to minimize/limit use of different grades of tube materials in one SH/RH bank to three. One SH/RH bank is defined as tubes/elements connected between two headers. (c) Dissimilar Metal Welds (DMW) in gas path shall be avoided. Also refer cl. no 2.03.00 of this Sub- Section in this regard		
	9	Max no. of material grades in Three (3) flue gas path inside the boiler can be used in one bank		
	10	Space Provision Keep provision of space for atleast 20% addition of additional economizer and 10% for the reheater surfaces in future. The surface provisioning shall be flue gas upstream section of the economizer. Structure/hanger design shall be suitable for loads due to these additional surfaces (filled with water) also.		
	Superheater(s)/Reheater(s) design shall cater to following operational requirements throughout the control range of Steam Generator, with whole range of specified fuels and under all operating conditions like, H.P. Heaters out of service, HP/LP bypass operation, top mills in service etc:			
	(i)	Preferred mill combination	Any mills (To Employer's choice)	
	(ii)	Maximum permissible spray attemperation flow (as percentage of main steam flow at super heater/Reheater outlet)		
	(a)	Superheater attemperation	8% of main steam flow at superheater outlet.	
	(b)	Reheater attemperation	3% of Reheat flow at reheater outlet.	
	Above permissible limits shall be applicable to all boiler loads with any combination of Mills in service and shall be guaranteed by the Contractor. The SH/RH attemperation system shall, however, be sized for 12% of the rated main steam flow requirement for superheater and 8% of rated reheat flow for			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP	PAGE 14 OF 67

CLAUSE NO.	TECHNICAL REQUIREMENTS			
7.02.01	reheater, both at 100% BMCR load			
	The steam temperature downstream of desuperheater shall have at least 10°C superheat to ensure proper evaporation.			
	(iii)	Spray water carryover	Nil	
	(iv)	Maximum steam side header unbalance	6 %	
	(v)	Ash bridging between the tubes	Nil	
7.02.02	Note: The Steam Generator design shall ensure that no damage is caused to the Reheaters with sudden closure of turbine interceptor valve.			
	For continuous monitoring of tube metal temperatures of SH and RH elements, minimum number of thermocouples as per the following shall be provided:			
	(i)	450 numbers of Chromel-Alumel thermocouples located outside the gas path for measurement of tube metal temperature covering all stages of Superheaters and Reheaters.		
	(ii)	80 numbers of Acromat/ Drilled Pad type metal temperature thermocouples located inside the gas path for measurement of gas side metal temperature covering all stages of Superheaters and Reheaters.		
	Note:			
7.03.00	(a)	The exact location and number of thermocouples shall be finalized during contract stage. However, Bidder shall furnish unit rates for addition/deletion of the thermocouples with respect to the numbers mentioned above.		
	(b)	Alarm set point for tube metal temperature shall not exceed the design temperature for respective tube.		
	For continuous monitoring of temperature variation across the length of the headers, six (06) thermocouples shall be provided on each Superheater header and reheater header except the final superheater header. The number of thermocouples for each final superheater header shall be 30. This requirement is over and above the requirements specified in clause no. 7.02.01 above.			
	For maintenance/inspection of SH/RH, provide:			
	(i)	1.5 m clear cavity height between two sections/banks of horizontal heat transfer surfaces for personnel access. For vertical surfaces, minimum clearance between the two banks shall be 600 mm.		
	(ii)	Access openings along with air/gas tight hinged doors for approach to above maintenance spaces without any hindrance from hanger tubes.		
	(a)	All access doors shall be of 500x500 mm size (minimum).		
	(b)	Access doors 800 mm above the nominal floor level shall have access platform.		
	(c)	Hanger tubes of horizontal banks shall have access opening for crossing over.		
	(iii)	Stainless Steel Erosion shields for all bends of outer most tube/coil of all SH/RH sections and hanger tubes in areas where flue gas temperature is below FEGT.		
	SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE			
	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001			
SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP				
PAGE 15 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	For the pendant tube sections, the erosion shield on the leading tubes and wherever else considered necessary by the Contractor as per the proven product is acceptable.			
	(iv) Arrangement for internal inspection of attemperators / headers.			
8.00.00	ECONOMISERS			
8.01.01	In addition to the sizing design criteria requirement elaborated at Sub-section- A-01, Economizer design shall conform to the following criteria/requirements under all conditions of operation and for the complete range of specified fuels.			
8.02.00	Economizer shall be: (a) Bare tube and inline type, arranged for counter flow of feed water and flue gases in case of two pass boiler and parallel cross flow of feed water and flue gases in case of tower type boiler configuration with modular construction. (b) Not Used (c) Provide minimum 3.0 mm thick stainless steel erosion shields for leading tubes of each tube bank of economizer. In addition minimum 5.0 mm thick sturdy cassettes baffles shall be provided for all front side and rear side bends of the economizer banks. The cassette baffles shall cover complete bends and additional 300 mm straight tube length. (d) Supported by steam or water cooled hanger tubes forming part of Steam circuit with hanger tubes designed for a minimum of 2 times the calculated load so as not to cause any dislocation/damage to the tube banks/setting. Necessary calculations in support of this shall be furnished by the bidder. Structural type hanger support will not be acceptable. (e) With minimum 63.5 mm clear side spacing (gas lane), with proper barriers installed, to avoid gas laning. (f) Without any valve in the pipeline from the economizer outlet to evaporator section of Steam Generator. (g) If the Steam Generator has the flue gas down-flow section with horizontal tube banks, the top most row shall be shielded to reduce erosion. (h) Headers shall be located external to gas path and shall be completely drainable. If locating headers in gas path becomes unavoidable, than suitable erosion shields must be provided. (i) Provided with ash hoppers alongwith high ash level switches/alarms,if economizer is placed in the second pass of Steam Generator.			
8.03.00	Economizers shall be provided with:- (a) Minimum 1.5 m clear cavity height between two sections/banks of the economizer for maintenance access. (b) Access /Opening for each tube banks alongwith air/gas tight hinged doors. (c) Arrangement for off load water washing with necessary drainage connected to			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
PAGE 16 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	nearest drain shall be provided for economizer if two pass boilers are offered.			
	(d) The header shall be provided with drains and suitable opening with forged weld on caps for internal inspection and chemical cleaning. Inspection openings with forged weld on caps for headers.			
8.04.00	On gas inlet side of the Economizer, provision of space shall be kept for future addition of minimum 20% economizer surfaces. Structure/hangers design to be suitable for loads due to this additional water filled surfaces also.			
9.00.00	REGENERATIVE AIR PRE-HEATERS AND STEAM COIL AIR PREHEATERS			
9.01.00	Regenerative Air Preheaters can be either (a) Bisector type or (b) Trisector type.			
9.01.01	In addition to the sizing design criteria requirement elaborated at Sub-section- A-01, Air preheaters shall be sized / designed to cater to following requirements also:			
9.01.02	APH inlet/outlet flue gas/air ducts shall have aerodynamic design for even distribution of air/flue gas at all loads.			
9.01.03	Air preheater Construction shall conform to following:			
	Design	Requirements		
(1)	Type	Rotary, regenerative, (Ljungstrom or approved equivalent), counter flow with vertical axis of rotation, enclosed with air/gas tight casing.		
(2)	Heating Elements	a) Cold end	Made of Corten steel of minimum 1.2 mm thickness	
		b) Hot end/Intermediate End	Made of carbon steel minimum 0.8 mm thick.	
(3)	Bearings (forced lubricated and oil cooled)	a) Cold end	Spherical roller thrust (Kingsbury thrust bearings are not acceptable)	
		b) Hot end	Radial guide bearing.	
	Note: Only metallic hoses shall be used for bearing cooling/lubrication. Rubber hoses are not acceptable. The bearings shall have a minimum L10 life of 100,000 hrs.			
(4)	Air heater seals.			
	(i) Externally adjustable and easily replaceable seals.			
	(ii) The maximum air-in-leakage to flue gas of the Steam Generator with coal shall be guaranteed and the same shall be demonstrated along with the Boiler PG test. The Contractor shall also demonstrate that the drift in air heater leakage (percentage change in air-in-leakage) does not exceed 1%, one year after demonstration of above guaranteed air-in-leakage. Within this period of operation till all air heater leakage demonstrations are completed there will be no need for any shut down for seal replacements or any internal adjustments. The seal design/construction shall be such that the above requirements are satisfied.			
	(iii) Seals shall have life not less than 2 years (with leakages not exceeding guaranteed limits)			
	(iv) The seal should be of flexible soft thin material and hardness should be less than that of sector plate / seal plate.			
	(v) Alternatively, the bidder can also select the seal material based on its standard practice and proven design only for similar applications so as to ensure that			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
PAGE 17 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	these offered seals meet the above guaranteed life. The bidder will provide the basis for the selected material & seals type along with proven references. (5) Air Heater drive system (i) 1 No. peripheral / centrally mounted AC VFD drive, with gear box and automatic clutching/declutching facility. Alternatively, centrally mounted APH AC VFD Drive system having sufficient space for mounting emergency drive and having handling facility with proven experience may also be acceptable. (ii) 1 No. independent air motor drive, with its gear box and automatic clutching, declutching facility for rotation during non availability of A.C. drive system. (iii) An air receiver tank of storage capacity adequate to operate air pre-heater using air motors for 10 minutes (minimum) with no air make-up during this period. Air motor valve for air supply from air receiver tank to APH shall have lock open arrangement. (iv) One of the drive of each of the air preheater shall be provided with VFD for speed regulation from full design rotational speed or 1 rpm, whichever is higher, to about 0.3 rpm. The Contractor shall carry out a test after commissioning to detect the optimum speed of the air preheater to maximize gas temperature reduction at its gas side outlet. Optimum rotation speed for 100% TMCR, 80 % TMCR and 60% TMCR unit loads shall be recommended by the contractor based on such tests. The test shall be made by incrementally reducing the speed in steps of 0.1 rpm from its present maximum operating speed onto the minimum specified speed. Suitable soaking time at each speed step shall be given during the test before recording the temperatures and other performance parameters. Test procedure shall be furnished during detail engineering. Specifications of the electric motor to be operated through VFD shall be selected to operate at lower speeds for long durations. The insulation and cooling for the motor shall be selected/designed suitably for the operation duty. (v) The APH motor sizing should be designed for maximum torque required in the condition of radial, axial, circumferential seals are touching with corresponding sealing plates both at hot end and cold end and motor should be capable running the APH. (6) APH Guarantee Condition 1. Air Leakage (at 100% TMCR i.e. 800 MW unit load for design coal) – 10% (Max.) 2. Design Ambient Temperature & Relative Humidity: 25 deg.C& 60% RH 3. Excess Air – 20% 4. The maximum air-in-leakage to flue gas with coal shall be guaranteed and the same shall be demonstrated along with the boiler PG test. 5. Contractor shall demonstrate that the air-heater air-in-leakage do not exceed the guaranteed or specified value (whichever is lower) as per description at Sub section-A-01 & A-02, Part-B (Mechanical), of Technical specifications. 9.01.04 Provide hoppers in air heaters for ash collection alongwith high ash level switches/alarms. 9.01.05 Facilities/openings along with the grids for flue gas sampling and gas temperature traverses on both the inlet and outlet sides of APH(s) shall be provided. 9.01.06 Alarms for failure of drive, lubrication system etc. shall be provided. 9.01.07 Air preheater rotor stand-still sensing device with alarm shall be provided. 9.01.08 Off load water washing facilities (including hoppers, water connections etc.) with drainage		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP	PAGE 18 OF 67

CLAUSE NO.	TECHNICAL REQUIREMENTS			
9.01.09	connected to nearest station drain shall be provided. Provide: (a) Sufficient space provision for future installation of minimum additional 15% of APH heating surface area shall be made in the design so that, the same can be installed, if required. The bearings, supports, casings, drives for APHs etc. as well as APHs supporting structures and foundation loads are designed to take care of all the requirements due to the above addition of heating surface. APH design shall enable easy modular installation of heating surfaces including 15% additional surface. (b) Soot Blowers in the Flue gas hot end and cold end. A pressure transmitter shall be provided at the downstream of each Soot blower valve for APH. (c) NOT USED (d) Air heaters elements arranged in baskets and easily removable in groups/baskets for maintenance. (e) Basket removing facility alongwith/without removal gear, if applicable as per vendor's standard design. (f) Handling facility (covering structural steel/runway beams, trolley/hoists, along with platform along runway beams) for conveying, lowering and placement of elements/baskets to ground level. (g) Hinged / bolted access doors in air heater housing for internal inspection / cleaning / maintenance and for replacements of elements without dismantling airheaters or alternate arrangement for replacements of elements without dismantling airheaters as applicable based on standard design. (h) Observation ports with vapour proof light at air inlet duct for rotor inspection. (i) Facility for positioning of rotor while element replacement (manual or otherwise), (j) Galleries and platform around air heater and access to observation ports/access doors etc. Platforms to be capable of taking load and storing elements for at least one sector. (k) Special T&P kit for removal of bearings and for replacement of shaft. (l) Leakage control system - sector plate (s) system with drive unit & accessories shall be provided at hot end to reduce the hot end leakage and energy loss. This shall also online maintain the seal gap/radial seal clearance based on pre-set temperature and thereby ensure leakage control at various loads. The bidder at its discretion can also optimize the above clearances, over & above the methodology as given above, by also measuring the actual gap between seals and sealing surface. However, in such case suitable calibration and checks to be ensured during commissioning for synchronism in above two approaches. In any case, all the guarantees as specified are to be ensured by the bidder			
9.01.10	Provide thermocouple type fire sensing device and redundant temperature element for each bearing and oil sumps. Fire fighting facilities on cold end and hot end of the air preheaters shall be provided and the fire fighting facilities shall cover both flue gas side as well as air side of air preheaters. Deluge system water quantities for hot end firefighting facilities shall comply with NFPA 850 requirements. Necessary water draining system, connected to station drains shall also be provided.			
9.01.11	The complete installation of air heaters shall be under the supervision of the air heater manufacturer.			
9.02.00	Steam Coil Air Preheaters (SCAPH)			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
PAGE 19 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
9.02.01	In addition to the sizing design criteria requirement elaborated at Sub-section- A-01, SCAPH suitable for Bisector type RAPH/Trisector type APH, as applicable, shall be designed / sized to increase the air heaters inlet air temperature based on following criteria also:			
	SI. No.	DESCRIPTION	Primary SCAPH*	Secondary SCAPH
	(i)	Number of SCAPHs	One (1) no. for each PA fan at the outlet of each fan in bypass duct	One (1) no. for each FD fan at the outlet of each fan in bypass duct
	* In case Bidder offers Tri-sector RAPH, Bidder at his option may or may not provide the SCAPH in primary air side if bidder can meet the specification requirement of preventing cold end corrosion with sizing of SCAPH in secondary air side. Bidder will furnish the relevant details, calculations, curves etc. along with his offer establishing the same.			
9.02.02	Condensate from SCAPH, through SCAPH tank, shall lead to atmospheric flash tank in the boiler area.			
9.02.03	Not used			
9.02.04	Provide facilities for complete SCAPH isolation from the airflow path.			
9.02.05	SCAPH shall be suitable to operate during start-up, low load operation of unit and at abnormal conditions when an increased air inlet temperature is considered desirable.			
9.02.06	The boiler design shall ensure that the SCAPH is not required to operate under normal operation for the complete specified range of fuel.			
9.02.06	Provide:			
	(a)	Side entry for removal of SCAPH modules by sliding out of modular frame or alternatively, top entry for removal of SCAPH module along with proper lifting arrangement is also acceptable.		
	(b)	Approach to the side entry if applicable.		
	(c)	Handling facility (runway beam/hoist, platforms/approach etc.) for removal and placement of SCAPH modules on ground.		
10.00.00	COAL PREPARATION AND FIRING SYSTEM			
10.01.00	GENERAL			
10.01.01	The coal preparation and firing system shall commence with the shut-off valve at Raw Coal Bunker outlet and shall include raw coal feeders, coal pulverizers, primary air & seal air fans, pulverized fuel pipes, coal burners, coal valves and associated auxiliaries.			
10.01.02	The coal preparation and firing system design shall ensure:			
	(a)	Complete safety of the plant, equipment and the personnel.		
	(b)	Complete compliance with the latest NFPA, (USA), requirements and other requirements specified.		
10.02.00	Bunker Shut Off Gates & RC Feeder inlet & outlet gates			
10.02.01	Bunker shut off gate(s) & RC feeder inlet gate having following features shall be provided:			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
PAGE 20 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS									
	(a) Size of gates/valves shall be suitable for 914.4 mm (36") round bunker opening. (b) Bunker Shut Off Gates shall be motor operated & RC Feeder outlet gates shall be motor/pneumatic operated and RC Feeder inlet gates shall be manually operated with double rack and pinion drive arrangement and shall be designed for non-jamming. (c) Manual isolating SS rod type needle gate before Bunker Shut off gate shall be provided.									
10.02.02	The Bunker shut off gates and feeder inlet & outlet gates shall have: Stainless steel material for following: (i) All components coming in contact with coal. (ii) Gate and shaft roller bearing.									
10.02.03	Shut off and inlet gates shall be designed to operate with "bunker full of coal" condition without its motor getting overloaded. Further, normal motorized as well as inching operation of these shut off gates should be possible from the feeder floor.									
10.02.04	The bunker shut of gate shall insure 100% closure of bunker outlet even "bunker full of coal" & "static column of coal in the chute between bunker & feeder" conditions.									
10.02.05	Local push buttons for open/close command & chain wheel & chain for manual operation from floor level shall be provided for each gate/valve.									
10.03.00	Coal Chutes The requirements specified herein apply to the following coal chutes: (a) Chutes between outlet of raw coal bunker shut off valves and inlet to the coal feeders. (b) Chutes between outlet of coal feeder and inlet to the pulverizers. (c) Permanent chutes and temporary chutes									
10.03.01	The internal diameter of coal chutes selected shall not be less than following: <table><thead><tr><th>Coal Chute</th><th>Minimum I.D</th></tr></thead><tbody><tr><td>(i) Between bunker outlet gate & feeder inlet *</td><td>914.4 mm</td></tr><tr><td>(ii) Between feeder outlet &pulveriser inlet</td><td>600 mm.</td></tr></tbody></table> *Note : Chute length and gate size shall be to 'Employer's' approval.				Coal Chute	Minimum I.D	(i) Between bunker outlet gate & feeder inlet *	914.4 mm	(ii) Between feeder outlet &pulveriser inlet	600 mm.
Coal Chute	Minimum I.D									
(i) Between bunker outlet gate & feeder inlet *	914.4 mm									
(ii) Between feeder outlet &pulveriser inlet	600 mm.									
10.03.02	Chutes at (a) & (b) above shall be made of minimum 12 mm thick stainless steel SS-410 material and shall be of full welded construction. Chutes at (c) above shall be of minimum 6 mm thick and provided with suitable liner at bends and suitable reinforcements									
10.03.03	Provision shall be made for the insertion of poke rods in two directions at right angles to each other at following locations on the chute. (a) Outlet of the bunker. (b) Inlet to the feeders.									
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP						
PAGE 21 OF 67										

CLAUSE NO.	TECHNICAL REQUIREMENTS			
10.03.04	The chute between feeder outlet and pulverizer inlet shall have a stainless steel lined hopper with suitable reinforcement.			
10.03.05	Slip-on coupling for chute connections (at inlets of the R.C. feeder and the coal pulverisers) with SS 410 inner ring shall be provided.			
10.03.06	Permanent Chutes shall be provided at the feeder floor near each feeder for unloading of coal from bunkers on trucks at ground level. Each bunker outlet chute shall have arrangement for fixing a temporary chute for diversion of coal flow to the permanent emptying chute near each feeder. Two (2 nos.) of temporary chutes shall be provided for each steam generator for the above purpose. Necessary handling/lifting arrangement & suitable platform & approach shall be provided for quick installations and removal of temporary chutes.			
10.03.07	Approved type of suitable indicators shall be provided in the downspout between bunker and feeder to detect presence or flow of coal to ensure minimum seal height at inlet to R.C. feeder and trip the R.C. feeder if the level of coal tends to be below this seal height.			
10.04.00	Raw Coal Feeders			
10.04.01	Each mill shall be fed with coal by an independent coal feeder.			
10.04.02	In addition to the sizing design criteria requirement elaborated at Sub-section- A-01, following minimum features in the RC feeder(s), in addition to complying with all the stipulations of NFPA (latest edition) shall be provided:			
	(i) "NO COAL" flow detection to be provided to stop the feeder when no coal is detected on the conveyor and when pluggage occur at feeder outlet. Paddle type coal alarm switch shall be provided for this purpose at the following location:			
	(a) Over the feeder conveyor chain/belt	For indication of loss of coal flow to feeder.		
	(b) Near the feeder discharge	to stop the feeder in the event of coal pluggage at the feeder outlet.		
10.04.03	The feeder belt shall be of multiply reinforced rubber of single piece construction with arrangement for tracking and to prevent spillage.			
10.04.04	Width of the belt shall have sufficient margin while operating in conjunction with the feeder inlet opening provided.			
10.04.05	All R.C. feeder components coming in contact with coal (except belt), shall be made of stainless steel.			
10.04.06	Provide suitable arrangement to adjust belt tension.			
10.04.07	Provide following facilities for the feeders:-			
	(a)	Spraying water inside the casing.		
	(b)	Providing purge air to the feeder.		
10.04.08	The feeder control system shall be microprocessor based. Coal weighing shall be automatic and shall include local & remote indication of rate of flow &totaliser counter.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
PAGE 22 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
10.04.09	Provide adequate nos. of manholes on the feeder for quick and easy release of the feeder jamming.			
10.04.10	Easy access to any part of the feeder internals shall be possible without dismantling the complete casing.			
10.04.11	The feeder cabinet shall be located in control equipment room (CER).			
10.05.00	Coal Pulverizers			
10.05.01	In addition to the sizing design criteria requirement elaborated at Sub-section- A-01, following design requirements shall also be adhered:			
A)	Classifier design			
	(a) Provide dynamic classifier with Variable Frequency Drive (VFD) capable of maintaining rated conditions of fineness [as per clause 1.05.08.02 (iii) (c) of Sub-Section-A-01, Part-B, Section VI of Technical Specification under all conditions of operation, load changes and specified fuels. Further the classifier vanes (if applicable) shall be lined with approved wear resistant material to ensure the guaranteed wear life.			
	(b) Dynamic classifier height shall be selected for minimal pressure drop & as per the proven practice and its design shall be based on optimized guide vane assembly and rotor design. Aerodynamic shapes shall be utilized especially for the outlet to prevent eddies. The classifier shall be provided with replaceable, statically and dynamically balanced vanes.			
	(b) Fineness adjustment shall be possible while the mills are in service			
	(c) The classifier shall ensure reduction in particle of 50 mesh without increasing 200 mesh percentage to ensure uniform sizing and distribution of particles.			
	(d) Aerodynamic shape for the outlet to prevent eddies. The classifier vanes and cones shall be lined with approved wear resistant material to ensure the guaranteed wear life.			
	(e) Proper adequate space shall be identified for placing the classifier & its parts while maintenance.			
A1)	Following specific key features for the Dynamic Classifier shall be ensured/provided:			
	(a) Slope on R-R scale shall be as per fineness requirements.			
	(b) The operation/classifying capability of dynamic classifier shall be optimized for a particular speed and the same should be automatically controlled during load variations/fluctuations. Speed monitoring shall be provided.			
	(c) Bearing temperature measurements shall be provided.			
	(d) Blades to be made of wear resistant material.			
A2)	Not used			
B)	Ensure adequate vibration isolation of pulverizers so that no adverse effects are transmitted to the nearby structure/installations.			
C)	Pulverizer Sound Level			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
PAGE 23 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS																			
D)	Shall not exceed specified values. While selecting lagging, background noise from adjacent mills, drive system and other secondary & stray noises shall be taken into account. Seal Air System (a) 2x100% centrifugal seal air fans with electrically operated Inlet Guide Vaness (Alternatively Electrically operated 'Inlet dampers' shall also be acceptable based on bidder's proven practice) common for all the pulverizers of one Steam Generator unit shall be provided. The seal air fans shall preferably be located at ground flooraway from Economiser hopper evacuation systems, milling systems & ESP hoppers without disturbing the maintenance space of around equipment. (b) The sealing system shall prevent ingress of any dust into the bearings and leakage of coal-air mixture to atmosphere. (c) Seal air connections shall be provided at all locations including bearing, journals, feeders etc.																			
10.05.07	The design shall ensure that each pulverizer shall supply coal to only one burner elevation.																			
10.05.08	Separate mill lubricating oil tank and associated pumps shall be provided. Complete system shall be dust proofand placed above ground. The design of lubricationsystem shall ensure continuous operation of pulverizerbearings. Mill lubricating oil system breather should beof adequate capacity. For taking care of any additionaltorque and high vibration, mill coupling should be of failsafe type.																			
10.05.09	Pulverizer Gear Box: Planetary type gearbox shall be provided. The gearbox design shall ensure that there is no ingress of coal dust into gearbox under all conditions of operation. The gearbox shall be guaranteed for trouble free operation of not less than 100,000 hrs. of operation of pulverizer.																			
10.05.10	Pulverize Motor Capability: Ensure minimum pulverizer motor capability to restart the pulverizer after a trip with pulverizer full of coal. Such restart shall not call for any emptying of pulverizers.																			
10.05.11	Inlet pipe of pulverizer between RC feeder and the pulverizer shall not have any reduction in section throughout the length, including at entry point on top of the pulverizer.																			
10.05.12	Each pulverizer shall be fed with coal by an independent coal feeder.																			
10.05.13	Material of Construction The material of construction of wear parts shall be selected taking into account highly abrasive nature of coal resulting from coal contamination with silica sand and Alpha-quartz as specified at clause no. 1.01.00 of this subsection <table><tr><th colspan="2">PULVERIZER COMPONENT</th><th colspan="2">SPECIFICATION</th></tr><tr><td>(i)</td><td>Classifier</td><td></td><td></td></tr><tr><td>(a)</td><td>Cone</td><td>-</td><td>Lined with minimum 15 mm thick ceramic tiles on both inside and outside surfaces of the cone</td></tr><tr><td>(b)</td><td>Vanes</td><td>-</td><td>Lined with suitable material to provide mini- mum specified wear life.</td></tr></table>				PULVERIZER COMPONENT		SPECIFICATION		(i)	Classifier			(a)	Cone	-	Lined with minimum 15 mm thick ceramic tiles on both inside and outside surfaces of the cone	(b)	Vanes	-	Lined with suitable material to provide mini- mum specified wear life.
PULVERIZER COMPONENT		SPECIFICATION																		
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP																
PAGE 24 OF 67																				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(ii)	Grinding Rings/Race	-	Material with hardness 550 BHN (min.) at surface (with adequate chilled depth)
	(iii)	Grinding balls/rolls	-	Material with hardness 350 BHN (min.)
10.05.13A	Mill body thickness at grinding zone shall be suitable to take care of coal abrasion. Suitable thickness material or/along-with liners shall be provided to accommodate the high wear at such areas.			
10.05.14	Ensure that flap / knife in the power (electric / pneumatic) operated pulverizer discharge valve is totally out of coal path during operation of the pulverizer.			
10.05.15	All pulverizer wear parts shall be arranged so as to facilitate easy replacements without total dismantling of pulverizer(s).			
10.05.16	Ensure minimum mill turn-down ratio(s) of 3:1.			
10.05.17	Provide suitable arrangement for readily determining the oil level in the gear box(es) and all other lubricated parts.			
10.05.18	For pulverized coal sampling for fineness and distribution:			
	(a)	Provide tapping points on each PF pipe at pulverizer outlet suitable for coal sampling as per IS 16617: 2018.		
	(b)	Ensure that the coal sampling provisions are complete with screwed plugs, compressed air purging connections at tapping points, heating arrangement and other requirements as required for IS 16617: 2018 sampling.		
	(c)	Provide		
	(1)	Rota Probe for coal sampling as per IS 16617: 2018 and ASME respectively.		
	(2)	Dirty Pitot tubes per Steam Generator, suitable for measurement of coal-air velocity in coal pipes.		
	(d)	Provide convenient approach/access for above coal sampling/measurement points, from nearest platform floor.		
10.05.19	Provide suitable arrangement for readily determining the oil level in the gearboxes and all other lubricated parts.			
10.05.20	Provide mill outlet temperature control capable of achieving and maintaining rated values for adequately drying the specified coal range for all unit loads.			
10.05.21	Primary Air Flow Measurement			
	(a)	Each PA flow measuring device shall be provided with three sets of tapings.		
	(b)	The location, type and design of flow measuring devices shall be to Employer's approval.		
	(c)	Necessary tapping points for temperature compensation shall be provided.		
10.05.22	Mill Rejects System:			
	(a)	Mill reject system shall automatically discharge the tramp iron and other non grindable material through an outlet connection at a suitable height (to be		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
				PAGE 25 OF 67

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	approved by Employer).The conveying system shall be as defined elsewhere in the specifications. Pyrite hopper outlet spout should be having adequate ground clearance. Adequate maintenance space (as approved by employer) should be provided for various C&I instruments, valves and other equipment of mill reject system. (b) Mill rejects collection & discharge system shall be designed (as detailed in Mill Reject sub-sectionin Part-B of Technical Specification) to ensure sequential automatic operation of the coal mill discharge gates for flow of rejects into the reject spout. (c) The necessary mill isolation dampers/valves should be provided, to facilitate automatic continuous or automatic intermittent discharge of rejects to the conveyor.			
10.05.24	Fire Detection and Extinguishing System shall be provided for the complete coal preparation firing system including coal feeding system.			
10.05.25	Lubrication of bearings & other parts shall be automatic and continuous.			
10.05.26	Handling of Pulverizer Parts			
	(a) The pulverizer shall be designed to facilitate ease of handling of heavy parts for maintenance purpose. (b) Motorized hoists shall be provided for lifting of heavy parts including mill discharge valves.In case the weight of such part is below 500 kg, manual hoist shall also be acceptable. (c) All pulverizer wear parts shall be arranged so as to facilitate easy replacements without total dismantling of pulverizer(s)			
10.05.27	Accessible gear case suitable for removing gearing without removing upper structure for vertical mills.			
10.05.28	Access Doors/Windows			
	(a) Adequate numbers of hinged access doors/windows with access ladders shall be provided to facilitate access to various parts of pulverizer. The access doors shall be suitable for on load inspection and maintenance of pulverizer. (b) Oil pumps & filters shall be readily accessible.			
10.05.29	Approach platforms			
	Access & platform shall be provided to carryout maintenance of pulverizer for replacement & removal/installation of pulverizer wear parts. Continuous platform of adequate width/area (more than the mill diameter plus sufficient margin at both side) connecting all adjacent mills (at each side) at around roller level (grinding part) shall be provided to facilitate ease of removal of grinding parts & their maintenance. While platform shall suit the specific offered design of mill, it should facilitate the O&M requirements of other parts/components of the milling system. This continuous platform (at each side) shall be approachable from ground floor at both sides through suitable stairs. Suitable ladder & platform shall be provided to approach & inspect mill discharge valve andalso dynamic classifier including its vane inspection/setting requirements.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
PAGE 26 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Necessary ladders and approach platforms for mill bay hoist shall be provided to carry out any maintenance activity on hoists.			
10.05.30	The mill and its motor, gear box foundation bolts shall have adequate maintenance space and accessibility for tightening both from top and bottom side of foundation bolts. Alternatively, additional minimum four (04) numbers of extra foundation bolt shall be provided at extreme corners of base plate which can be used in case of failure of existing foundation bolts.			
10.06.00	PULVERISED COAL PIPES In addition to the sizing design criteria requirement elaborated at Sub- Section A-01, following design requirements shall also be adhered:			
10.06.01	The design and arrangement of fuel pipe shall ensure uniform distribution of primary air and pulverized coal between all burners served by one pulverizer under all conditions of loading.			
10.06.02	Calculated static loading of each support of the PF pipes shall be increased by at least 25% to arrive at the design load, to take care of the shock loading occurring in the pipe work under abnormal conditions of operation.			
10.06.03	The guide plates, wherever provided in the coal pipe, shall be removable, and access to them shall be obtained through detachable cover.			
10.06.04	The guide plates shall be made up of suitable abrasion resistant material.			
10.06.05	Coupling and toggle section arrangement for fuel piping shall be provided to take up the furnace expansion.			
10.06.06	Following PF pipe portions shall be ceramic lined with ceramic thickness not less than 15 mm. (a) From mill outlet to first bend and two times pipe diameter straight length down stream of first bend. (b) All bends between 11 degree&30 degree angle and straight length downstream of the bends equivalent to one pipe diameter. (c) All bends 30 degree and higher and two times diameter straight length downstream of the bend. (d) The burner inlet elbow and the pipe piece after the elbow. PF pipe from mill to the classifier (in case of separate classifier).			
10.06.07	The pipe/bend base material thickness, wherever ceramic liners are provided, shall not be less than 8 mm.			
10.06.08	The straight unlined PF pipe length shall be of mild steel having a thickness not less than 12.7 mm with a minimum wear allowance of 4 mm.			
10.06.09	Mill discharge valve on pulverized fuel line shall also have provision of manual operation mechanism locally and provision of its external local position indication.			
10.06.10	Suitable devices shall be provided in each pulverized coal pipes to enable on load adjustment for equalizing flow.			
10.06.11	Purge air connections shall be provided after the mill outlet valve to clean pulverized coal			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
PAGE 27 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	pipes of any deposits etc.			
10.06.12	Fuel pipes shall be arranged and supplied so that they are easily replaceable.			
10.07.00	COAL BURNERS			
	In addition to the sizing design criteria requirement elaborated at Sub- Section A-01, following design requirements shall also be adhered:			
10.07.01	Each coal burner shall be served by one separate coal pipe and shall be provided with one knife edge type gate valve at burner inlet. The valve shall be power operated (electric / pneumatic) and hooked up to Burner Management System.			
10.07.02	Compartmented wind box shall be provided for supply of secondary air for combustion.			
10.07.03	The material and construction of burner shall withstand radiation from the furnace, when not in use and shall not get damaged.			
10.07.04	Parts subjected to high temperature, which cannot be protected by other means, shall be made of alloy steel.			
10.07.05	Burner design shall ensure freedom from distortion under all operating condition in the furnace.			
10.07.06	Burner design shall ensure freedom from deposits.			
10.07.07	Burner shall not require adjustment to maintain flame shape.			
10.07.08	Air register (If applicable) construction shall be such that:			
	(i) The tangential air vanes are always free to move.			
	(ii) The support bearings shall be preferably located outside. In case the support bearings are located inside minimum period of operation shall be 16000 hrs without calling for any type of maintenance during this period.			
10.07.09	The angle at confluence between the coal burner primary air and secondary air shall be such that the inherent carbon monoxide produced is removed by scrubbing action without any significant reduction in velocities of the air stream.			
10.07.10	Burner parts subject to abrasion that may require replacement at frequent intervals shall be easily removable.			
10.07.11	Minimum operating life of burner parts without requiring any maintenance and replacement shall be 16000 hrs. Further, burner design shall ensure that no cooling of burner is envisaged by primary air from PA Fan during oil firing and in part load operation.			
10.07.12	Burner shall be removable or replaceable from outside the Steam Generator without entry to the furnace.			
10.07.13	Scanner Air System			
	2 x 100% Scanner Air Fans for all the scanners of one Steam generator unit shall be provided preferably at firing floor and away from Economiser Hopper ash evacuation system to avoid any ash ingress in scanner air fan system.			
10.08.00	PRIMARY AIR FANS			
	In addition to the sizing design criteria requirement elaborated at Sub- Section A-01,			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
PAGE 28 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
10.08.01	following design requirements shall also be adhered:			
	Fan Characteristics			
	(a) Shall be compatible with Pulverized Fuel system resistance and boiler operation at rated loads, during boiler startup& low load operation with minimum number of mills.			
	(b) The system resistance curves shall always be sufficiently below the fan stall line.			
	(c) Best efficiency point shall be close to TMCR (800MW load) operating point of fan.			
10.08.02	Fan control System:			
	(a) Fan flow control			
	(i) By blade pitch control.			
	(ii) The final control element shall be electrically operated.			
	(iii) The actuators shall be compatible with selected automatic control system.			
	(b) The system shall be designed to achieve:			
	(1) Stable and satisfactory operation.			
	(2) Primary air flow control.			
	(3) Primary air pressure control.			
	(i) The system shall be capable of working on automatic mode for all regime of operation in a steady and stable manner.			
	(ii) The final control element shall not have a backlash or play etc.			
10.08.03	Primary air flow measurement			
	(a) Provision for measurement of PA flow required for total airflow measurement & control.			
	(b) PA flow measuring devices shall be provided at air inlet to each pulverizer as well as at the suction of each fan. PA Fan inlet flow measurement shall be provided using fan inlet elbow. However, if such an arrangement is not possible flow element (venturi/aerofoil / orifice system) shall be provided with three pair of tapping points at suction of each PA Fan.			
	(c) Location, type and design of flow measuring devices shall be subject to Employer's approval.			
	(d) Necessary tapping points for temperature compensation in the flow measurement shall also be provided.			
	(e) Independent tapping points with necessary isolating valves shall be provided for control, measurement & test.			
10.08.04	Fan casing shall be properly stiffened to minimum vibration and distortions during operation.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
PAGE 29 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
10.08.05	Material of Construction			
	(a) Fan blades - high strength Aluminium alloy with minimum hardness of BHN-75.			
	(1) Base plate - cast iron or welded steel.			
	(2) Casing - sheet steel of suitable thickness.			
	(b) Fan inlet boxes, diffuser and intermediate pieces fabricated with sheet steel of thickness not less than 6.00 mm.			
10.08.06	Special construction Feature			
	(a) Fan components shall be designed for torsional stresses of three times the normal full load motor torque at all speed.			
	(b) The fans shall be suitable for parallel operation and sharing the load capacity over the entire range without hunting.			
	(c) The fan suction shall be provided with rigid bird and trash screen assembly and shall have suitable arrangement to prevent rainwater from directly entering the fan.			
	(d) The fan suction shall be so located that it does not suck-in dirty air and shall be subject to Employer's approval.			
10.08.07	Fan bearing lubrication system			
	(a) The rotor assembly shall be supported over a oil lubricated bearing assembly consisting of antifriction/sleeve bearing adequately sized to take care of radial thrust loads.			
	(b) For mounting of vibration pads/pickups, flat surfaces shall be provided both in X and Y directions, by the Contractor on the bearing housing.			
	In case of oil lubricated bearing the design shall be such that bearing are lubricated by external oil lubricating system in which oil is cooled by external cooler. Bearing shall contain sufficient oil to take care of fan coasting down period.			
	(d) Three nos. Duplex Pt-RTD (100 ohm at 0 deg.) with dual input temperature transmitters shall be provided for local and remote monitoring of each bearing metal temperature of fans.			
10.08.08	NOT USED			
10.08.09	Fan Vibration Monitoring			
	All accessories/ arrangements like flat surfaces, vibration pads/ pick-upsetc shall be provided for fan vibration monitoring as per OEM recommendations			
10.08.10	Silencers shall be provided to limit the noise level to specified values.			
10.08.11	Fan housing shall be designed for ease of maintenance and access to the fan wheel or impeller. The casing shall be split type to provide easy removal of the fan wheel or impeller for replacement and repairs. The casing section shall have gasket joints to ensure air-tight sealing.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
PAGE 30 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS		
10.08.12	Access doors shall be provided in each suction chambers, casing and diffuser.		
10.08.13	Drain connections shall be provided at the bottom most point of the fan housing.		
10.08.14	Layout of PA fans shall ensure inter-changeability of impellers. Similar fans shall have same direction of rotation.		
10.08.15	Acoustic insulation for suction duct, discharge duct and casing of PA fans shall be provided for the purpose of noise reduction. Thermal insulation for this purpose shall not be permissible.		
10.08.16	PA fans shall operate with highest possible efficiency, which shall be nearly equal at 100%TMCR (800MW) and test block points.		
10.08.17	NOT USED		
10.08.18	Stall detection probes shall be installed on the PA fans. The probes shall be integrate with the stall duration measurement and integrator to enable assessing to total stall duration of the fans during the life time of operation.		
11.00.00	FUEL OIL SYSTEM		
11.01.00	GENERAL Light Diesel Oil (LDO) firing requirements of Steam Generator, as per characteristics specified at Sub-Section-I-B of Part A. The fuel oil system shall comprise of: (a) Fuel oil preparation and firing system. (b) Fuel oil drain system		
11.02.00	Fuel Oil Preparation and Firing System Fuel oil preparation and firing system shall comprise of LDO firing system. (a) Not Used. (b) LDO Firing System LDO shall be used for initial start-up, low load operation and as secondary fuels for pulverized coal flame stabilization at the startups/low load operation. The scheme as envisaged for firing these oils shall cater to requirements of the Unit. (c) Fuel Oil Drain System The fuel oil drains from different equipments and piping etc. of a Steam Generator shall be brought by gravity to a drain oil tank provided for Steam Generator and pumping provision back to Fuel Oil storage tanks.		
11.03.00	Fuel Oil Preparation and Firing System In addition to the sizing design criteria requirement elaborated at Sub- Section A-01, following design requirements shall also be adhered:		
11.03.01	The Fuel Oil preparation and firing system shall be designed to function in total		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP	PAGE 31 OF 67

CLAUSE NO.	TECHNICAL REQUIREMENTS					
11.03.02	association with the Burner Management System;					
11.03.04	The adequacy for firing HSD shall include compliance to NFPA 70 requirements of classification of locations for class I liquids.					
11.03.04	Design/Sizing of various pump shall be based on following Criteria					
	Design Criteria		Requirements			
		LDO Pumps	Drain Oil Pumps	Sump pump		
	1	2	3	4		
(i)	Type of fuel to be handled	LDO	LDO	Oil & Water		
(ii)	Pump Suction Temperature	Ambient	Ambient	Ambient		
(iii)	Temperature of fuel oil to be handled	Atmospheric	Atmospheric	Atmospheric		
(iv)	Pump design/ construction code	HI Standards, ASTM, ASME or equivalent (subject to Employer's approval)				
(v)	No. of pumps	2 (1 working +1 standby)	2	2 (1 working + 1 standby)		
(vi)	Capacity of each pump	To cater to 30% BMCR requirements of one Steam Generator without coalfiring plus 10%	4 m ³ /hr	10 m ³ /hr		
(vii)	Pump suction head	considering zero tank level	considering zero tank level	---		
(viii)	Pump discharge head	To suit the requirements of burners.	25 MLC (minimum) or as required to pump oil from drain to main oil storage tank @ 4m ³ /hr, whichever is higher	50 MLC (minimum) or suiting site requirements whichever is higher		
(iv)	Materials					
	(a) Casing	:	Close grained Cast Iron/ Carbon Steel, as per the manufacturer's standard practice.			
	(b) Shaft	:	Carbon steel			
(d)	Material of filtering mesh shall be stainless steel.					
11.03.08	Trip and Nozzle Valves					
	Light oil trip valves & individual burner nozzle valve solenoid shall be:					
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP		PAGE 32 OF 67

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(i) Of single coil heavy duty construction having class 'H' insulation. (ii) Having closing time less than one (1) second (iii) De-energized/air fail to close type. (iv) Designed for operating voltages as under: (a) Trip valve solenoid 24 Volts DC (b) Nozzle valves solenoid 24 Volts DC Light oil Trip valves and nozzle valves shall be suitable to handle oils at temperature/pressure required at the burners. Further, these valves shall confirm to ANSI leakage Class-VI under shut off pressure conditions of respective pumps.			
11.03.09	Oil Burners/Burner Components			
	Type –The oil burners should be air atomized to be able to operate together with pumping system offered. The oil gun design shall not be of pre-mix type.			
11.03.10	Following maintenance facilities shall be provided in the fuel oil system for the Steam Generator:			
	(a) Burner maintenance trolley alongwith accessories. (b) Fixed drip trays with easy means of emptying for each oil burner to contain any oil leakage. The drain from each drip tray shall be connected to the drain oil tank. (c) Handling facility (with runway beam, hoists, equivalent structure etc.) for all pumps (d) Oil gun cleaning station and the facility for blow off of the oil guns using compressed air at each firing floor. For this purpose compressed air tapping with necessary isolation valves and necessary hose connection shall be provided.			
11.03.11	The design of fuel oil system shall ensure that compliance with the following operational requirements:			
	(a) Facilities for Auto start of standby LDO pressuring pumps in event of tripping of any running pump or low fuel oil pressure. (b) Facility for Auto start and shutdown of drain oil pumps in conjunction with level in the drain oil tanks. (c) Facility for automatic as well as manual start/ignition of oil burners (in association with BMS) (d) Maximum turn down ratio, for the oil burners (without needing burner tip changes) (e) Automatic purge interlock to facilitate restarting of oil firing system after prior trips/shut down of oil firing. (f) Separate flame viewing opening/facility for boiler operation and for flame monitoring at each burner from out side of the boiler viewing heads to have provision: (i) To keep it cool below 75°C			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
PAGE 33 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
11.03.12	(ii) To keep optical system clean during firing/non firing by pressurized air.			
	(g) Means of determining oil flow to each burner like calibration curves and pressure measurements at the burner as a minimum requirement.			
	Following features shall be provided for interfacing with other systems/equipment's			
11.04.00	(a) Adequate local instrumentation such as temperature, pressure, differential pressure, flow switches for independent high and low signaling contacts required for Burner management system and other interlock/alarm.			
	(b) Adequate potential free contacts for status of individual pumps.			
11.04.00	Fuel oil drain system			
11.04.01	Drain oil tank(s) design/construction shall comply with following requirements.			
	S.No	Drain Oil Tank		
	(i) Medium to be Stored	LDO		
	(ii) No. of tanks	One (1) for Steam generator in SG area and one (1) in FO pressurizing pump house area		
	(iii) Tank capacity	6m ³ (each) (min. effective volume) in SG area and 10m ³ (min. effective volume) in FO pressurizing pump house area		
	(iv) Dimensions	3M x 2M x 1M, 2.5MX2MX2M		
	(v) Design and construction code	IS:800		
	(vi) Design temperature	50 deg.C (min)		
	(vii) Tank design pressure	-----		
	(viii) Type of construction	Rectangular		
	(ix) Material of Construction	As per IS:2062 plates		
	(x) Corrosion allowance in tank thickness	1.8 mm		
	(xi) Insulation	Not Required		
	(xii) Nominal Venting capacity	-----		
	(xiii) Tank design, fabrication, erection, commissioning and testing	-----		
11.05.00	Piping fitting and valves in fuel oil firing system:-			
11.05.01	The Piping in fuel oil (LDO) firing shall confirm to following codes			
	Piping		Code	
	i) Fuel Oil Piping	a) IS1978 or ASTM-A-106 Gr. B or approved equivalent		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
PAGE 34 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
11.05.02	ii) Piping/Valve sizing	LDO: All piping system shall be sized to meet the fuel oil requirements of 01 (one) number Steam Generator operating simultaneously at 30% BMCR load.		
	Piping fittings shall be of carbon steel butt welded connection (where possible) conforming to ASTM-A 234 (or approved equivalent standard). All the flange connections shall conform to IS: 6392 (or approved equivalent standard) and shall be suitable to withstand design conditions of system, to which they are connected.			
11.05.03	Valves shall conform to following requirements:			
	S.No.	Parameter	Requirement	
	i)	Type of valves (for oil services)	Plug type (metallic seated), leak proof, fire safe as per the requirement of API 6FA	
	ii)	Material of valves on oil lines		
		a) On pump suction side	Cast Iron/ cast steel	
		b) On pump discharge side	Cast Steel	
	iii)	Material of valves on steam/ condensate lines	Cast Steel	
11.05.04	Instrument root valves on LDO lines shall be of 15 NB size, flanged OS & Y type, with body rating in ASA as per process condition.			
12.00.00	DRAFT PLANT			
12.01.00	In addition to the sizing design criteria requirement elaborated in Sub section A-01, following requirements shall also be adhered.			
12.02.00	Both FD fans and both ID fans shall operate with highest possible efficiency which shall be nearly equal (not lesser than the best values given for the reference fans by the OEM of the fan) at the 100% TMCR (800MW) and test block points.			
12.03.00	Fan components alongwith servo/blade pitch control mechanism shall be designed to withstand and continuously operate with the maximum air or flue gas temperature that these fans will be required to handle. ID fan component shall also be designed to withstand the excursions in flue gas temperature up to 300 degree Celsius, which may persist for about 30 minute duration. Such temperature excursion will not inhibit the safe and smooth operation of fans or cause any damage or increased maintenance.			
12.04.00	The construction of FD & ID fans shall also comply with following requirements			
	DESCRIPTION	FD Fans	ID Fans	
	Type of fan blades	Stream lined, aerofoil shaped section	stream lined, aerofoil shaped section	
	Blade material	high strength aluminum alloy, BHN-75 (min.)	Nodular Cast Iron or High Wear Resistant Steel with or without Hard coating as per the proven practice of the fan manufacturer	
	Fan rotational speed	1500 rpm (max.)	745 rpm (max.)	
	Air/Flue gas flow	blade pitch control	blade pitch control	
	Fan critical speed	not less than 125% of fan	not less than 125% of fan	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP PAGE 35 OF 67

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	DESCRIPTION	FD Fans maximum operating speed	ID Fans maximum operating speed	
	Fan component design*	to withstand torsional stresses three (3) times the normal/full load motor torque at all speeds	to withstand torsional stresses three (3) times the normal full load motor torque at all speeds	
	Fan casing material thickness	6.00 mm (min.)	Abrasion and wear resistant, high BHN steel having minimum 8.0mm thickness or 12mm mild steel with liner of thickness 10mm (min.) Alternatively, 22 mm thickness casing of mild steel is also acceptable.	
	Fan Housing design	for shut off head of fan	for shut off head of fan	
	*Note: (a) Areas of high stress concentration and residual stresses, like welded attachments shall be avoided on the fan rotor/shafts. Combined static, dynamic as well as residual stresses shall be demonstrated to be within allowable limits. These fan components shall last the life of the plant with such combined stresses present in them. (b) Although employer envisages installation of a highly efficient electrostatic precipitator to control particulate emission, however, bidder shall select the ID fan components such as blades, hubs, casing etc. to encounter the high dust burden of the order of 250 mg/Nm³. The minimum wear life of ID fan components shall not be less than 25000 hours of operation from the date of commissioning.			
12.05.00	Fan Bearings			
	(a)	Bearing shall be provided with oil bath to prevent damage in case of complete loss of plant auxiliary power when the fans must coast down without power.		
	(b)	Size oil reservoir in bearings housing for maintaining lubrication for extended periods in case of oil circulation system is out of service.		
	(c)	Three nos. Duplex Pt-RTD (100 ohm at 0 deg.) with dual input temperature transmitters shall be provided for local and remote monitoring of each bearing metal temperature of fans.		
12.06.00	Fan balancing			
	(a)	The fans shall be statically and dynamically balanced before shipment.		
	(b)	Balancing of each fan shall be checked and adjusted at site, if necessary.		
	(c)	Natural frequency of all fan components shall be established by vibration testing to ensure that no part of the wheel is adversely excited by any force generated at operating speeds.		
	(d)	The fan blade shall be subjected to natural frequency test. The other components of ID & FD fan wheels need not be subjected to natural frequency test if supplier can prove that these components are very rigid and have very high natural frequency compared to the operating frequency of respective fans giving justification.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
PAGE 36 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
12.07.00	FD and ID fans shall meet following operational requirements.			
	Description	FD Fans	ID Fans	
(a)	Mode of operation	i) two fans in parallel ii) one fan (one stream in operation)	i) two fans in parallel. ii) one fan (one stream in operation)	
(b)	Fan control system	i) capable of operating in automatic mode for all regimes of operation in a steady and stable manner ii) The final control element shall not have any backlash, plays etc., and shall operate in the range of 20% to 80% depending upon generating loads upto Boiler MCR.	i) capable of operating in automatic mode for all regimes of operation in a steady and stable manner ii) The final control element shall not have any backlash, plays etc., and shall operate in the range of 20% to 80% depending upon generating loads upto Boiler MCR	
(c)	Bearing metal temperature monitoring	shall be possible from remote as well as locally, using atleast three (03) nos. of duplex platinum RTD's per bearing(100 ohms at 0 deg.C)	Shall be possible from remote as well as locally, using three (03) nos. of duplex platinum RTD's (100 ohms at 0 deg. C) per bearing	
12.08.00	The fans shall be suitable for parallel operation and sharing the load capacity over the entire range of operation without hunting. Pulsation shall be avoided by suitable design of fans and connected ductwork.			
12.09.00	Flow Measuring Devices			
(a)	The draft plant shall include flow measuring devices in the air system for total air flow measurements and control with adequate number of tapping points.			
(b)	The location, type and design of the flow measuring devices shall be subject to Employer's approval.			
(c)	Three independent pairs of tapping points with the necessary isolating valves shall be provided for control, measurement and test.			
(d)	Two nos. duplex temperature element with thermowells for temperature compensation shall be provided.			
(e)	Fan inlet flow measurement shall be provided using fan inlet elbow. However, if such an arrangement is not possible, flow element (venturi/aerofoil) shall be provided with three pairs of tapping points at suction of each FD fan.			
12.10.00	Fan Casing :			
(a)	The fan casing shall be split to provide easy removal of the fan hub/impeller for replacement and repairs.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
PAGE 37 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
12.11.00	(b) The sections shall have gasket joints to ensure airtight sealing.	(c) Access doors shall be provided in each suction chamber casing and diffuser.		
	Drain Connection:			
	Drain connections shall be provided at bottom most point of the fan housing to the nearest trench.			
12.12.00	Fan Suction:			
	(a) Silencers shall be provided at the suction of FD fans to limit the noise level as specified.	(b) FD fan suction shall be provided with rigid bird and trash screen assembly and shall have suitable arrangement to avoid rainwater from directly entering the fan.		
	(c) Location of FD fan suction hood shall prevent entry of dusty air into fan and shall be subject to Employer's approval.			
12.13.00	The layout of FD and ID fans shall ensure interchangeability of the impellers. Similar fans shall have same direction of rotation.			
12.14.00	Acoustic insulation for suction duct, discharge duct and casing of FD and ID fans shall be provided for the purpose of noise reduction. Thermal insulation for this purpose shall not be permissible.			
12.15.00	The complete installation of FD and ID fans shall be under the supervision of the FD and ID fan manufacturer respectively.			
12.16.00	Stall detection probes shall be installed on the ID and FD fans. The probes shall be integrate with the stall duration measurement and integrator to enable assessing to total stall duration of the fans during the life time of operation.			
13.00.00	DUCT WORK AND DAMPERS:			
13.01.00	In addition to the sizing design criteria requirement elaborated at Sub section A-01, following requirements shall also be adhered:			
13.01.01	CFD Modeling			
	1. Contractor shall develop Computational Fluid Dynamics (CFD) model for design of the duct layout, assessment of flue gas/ash flow distribution in the flue gas duct work and ESPs and intervention to improve the flow pattern in the duct/ESPs			
	2. CFD modeling shall be developed using established commercial Computational Fluid Dynamics software like Ansys, Star CCM+ etc., though Ansys shall be a preferred option.			
	3. The result of the CFD model shall be validated by the physical model test which is specified in the technical specification. The validated CFD model shall be used for duct/ESP layout and internal design.			
	4. The aim of the CFD aided design/layout/internals of flue gas duct and ESP is achieving the following in the ducts:			
	a. Minimize the adverse flow phenomenon of:			
	i. Pressure drop in the duct/duct section/ESP			
	ii. Recirculation/stagnation zones			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
PAGE 38 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS								
13.01.02	iii. Localized high velocities iv. Ash accumulation b. Achieve the following flow criteria of: i. Equal distribution of flow in ESP inlet ducts as per the limit given elsewhere in the specifications ii. Equal distribution of flue gas flow in different ducts wherever duct diverges and uniform flow in the common duct wherever two or more duct section converges. 5. The CFD modelling shall be carried out in two steps. a. First Step: Single phase flow model to establish the optimized duct layout among different options and the location of flow guides to achieve the criteria mentioned in point 4 above. b. Second Step: In the second step of CFD modeling, 2-phase flow model shall be developed for analyzing the sensitivity of ash settlement in different segments while considering different ash particle sizes and velocities. The results of the 2-phase CFD model shall be used to locate fly ash hopper location in different duct segments. c. The reports for the first step and second step CFD model along with the CFD Modelling file shall be submitted before the finalization of flue gas duct layout.								
	Loads for Duct and Structure Design The duct design shall take into account following loads all occurring together: (a) Wind loads as specified. (b) Dead weight including weight of insulation, lining, wash water and the vertical live load. (c) Horizontal ducts to be designed for minimum 245 kg/m² additional fly ash loading on the surface or for one fourth of duct full of ash or for maximum possible accumulation of ash in the ductwork, under all normal, upset or abnormal operating conditions, whichever is higher. For flue gas ducts downstream of ESP, additional fly ash loading on the surface or for one tenth of duct full of ash or for maximum possible accumulation of ash in the ductwork, under all normal, upset or abnormal operating conditions, whichever is higher. The ash accumulation considered for economizer bypass duct (if provided) upto Guillotine gate shall be 100% filled with ash. The ash density for the purpose of loading shall be at least 1300 kg/m³. For economizer/APH/duct hopper design, the fly ash bulk density shall be considered as 650 kg/m3 for volumetric calculation, and for load/structure calculations it shall be as per Cl. No. 4.01.02 (C), Sub-sec. A-01, Part B, Section VI. (d) Expansion joint reaction. (e) The following minimum load factors shall be applied to the design loads: Temperature (Deg C)273793149205260316321 Loading factor1.001.021.121.191.251.291.341.42								
13.01.03	Duct design pressure: All flue gas duct, air ducts and the wind boxes shall also be designed for +/- 660mmWC								
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001				SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP		PAGE 39 OF 67	

CLAUSE NO.	TECHNICAL REQUIREMENTS				
13.01.09	(a)	The stiffeners provided on the ducts walls shall be of such a design and layout that no rainwater can accumulate on the duct surfaces. All necessary wall boxes and floor collars shall be provided where the ductwork pass through walls, floor and roof. The same shall also be ensured for duct entry into chimney.			
	(b)	Air and gas ducts shall not counter internal bracings, which cause excessive pressure drop.			
	(c)	Guardrails inside the flue gas ducts at the bends shall be provided, as a safety measure, to prevent fall while maintenance work is in progress.			
	Duct Work Structure				
13.01.10	(a)	Ductwork sections between expansion joints shall be investigated with regard to their ability to transmit loads to supports. Care shall be exercised to identify uplift condition.			
	(b)	Internal stiffeners:			
	(1)	Duct shape shall be maintained by providing internal stiffening elements at or near supports. However, these internal stiffeners shall be used, if and only if, it is not possible to provide external stiffeners.			
	(2)	Internal stiffening elements shall consist of trusses, preferably comprised of extra-strong steel pipes (min. dia. 76.2 mm) acting in conjunction with external stiffeners. Such internal stiffeners for the flue gas duty between boiler and ESP shall be provided with erosion protection shields.			
	(c)	Field welding and all connections of bracing (stiffening elements) to stiffeners shall be well designed in order to develop full strength of the members. The gusset plates shall be of 10 mm minimum thickness.			
13.01.11	(d)	Fabrication shall be as per IS specification for Design, fabrication and erection of 'Structural Steel for Building.			
	(e)	Welding shall be in accordance with Section IX of ASME code.			
13.01.10	NOT USED				
13.01.11	Expansion Joints				
	i)	Metallic type expansion joints suitable for the service conditions shall be provided. The expansion joint design shall conform to the requirements of the EJMA Standards.			
	ii)	Expansion joints shall not support the ductwork.			
	iii)	The expansion joints shall be of heavy duty construction. The expansion joint material shall be compatible with the flowing medium, the external environment and the operating temperature. Suitable corrosion and erosion allowances shall also be taken.			
	iv)	All parts of expansion joints shall be suitably designed for all stresses that may occur during continuous operation and for any additional stresses that may occur during installation and also during transient condition. No movement of the			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP	PAGE 41 OF 67

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	expansion joint due to duct misalignment, if any, shall be imposed which has not been anticipated and designed into the movement capability of the expansion joint. v) For the flue gas ducts or for air ducts where ingress of ash/dust particles from atmosphere or air preheaters etc. is expected, the expansion joints shall be designed with suitable internal cover/canopy fixed at one end and freely supported (sliding type) at the other end in the direction of flow to avoid dust accumulation. The cover/canopy should be suitably designed so as not to interfere with any internal duct support and material should be selected taking into account expansion at the operating temperature. vi) If expansion joints are procured as bought out items then complete installation of expansion joint shall be under supervision of the expansion joint manufacturer. The expansion joints shall be tested as per requirements specified elsewhere in the Technical Specification. Each identical type (corresponding to various size, operating/design parameters, material, design etc.) from the given populace shall be selected for representing the identical sets. The number of EJs to be selected for performing tests shall be discussed and finalized. A minimum of 5 expansion joints, however, shall undergo performance testing. The type test of expansion joints shall also be governed by EJMA requirements. vii) The minimum trouble free operational life of expansion joint shall not be less than 20000 hrs of operation from the date of commissioning. viii) Expansion joints in the flue gas side after air- preheater shall also be designed to withstand the excursions in flue gas temperature up to 300 degree Celsius, which may persist for about 30 minute duration. Such temperature excursion shall not inhibit the safe and smooth operation or cause any damage or increased maintenance.			
13.01.12	Blanking Plates			
	Bolted plates or other positive closure shall be supplied in order to permit pressure testing of the Steam Generator enclosure.			
13.01.13	Access and inspection door shall be of minimum 450 mm x 450 mm size.			
13.02.00	DAMPERS			
13.02.01	Power operated gas tight isolation dampers along with their drives shall be provided at all locations required for carrying out internal repair and maintenance of pulverizers, electrostatic precipitators and induced draft fans when the Steam Generator is on load. As a minimum following locations shall be provided with power operated gas tight dampers: (a) In each hot air and cold air duct to each of the mills (pneumatically operated only). (b) On each inlet and outlet to each ESP stream (there being Six (6) ESP streams, with twelve inlets and twelve outlets) (c) Before and after each I.D. fan. (d) At inlet to each of the Regenerative Air Pre-Heaters on flue gas side in case of Bisector APH			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
PAGE 42 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS				
13.02.02	(e)	After each of the Regenerative Air Pre-Heater, SCAPH bypass duct & after each SCAPH on airside.			
	(f)	At discharge of each of PA fans.			
	(g)	At discharge of each of FD fans.			
	(h)	NOT USED			
13.02.02	(i)	At each economizer by pass duct (2 x 100%) (if provided).			
	Heavy Duty multi louver dampers shall be provided at locations not requiring tight shut off duty. As a minimum following locations shall be provided with Heavy Duty multi louver dampers:				
	(i)	Before each SCAPH on airside.			
	(ii)	On common duct from Primary and Secondary regenerative Air-Pre heater to ESP on flue gas side in case of Bisector APH OR on duct from each RAPH outlet to ESP on flue gas side in case of Tri-sector RAPH.			
13.02.03	(iii)	In addition to gas tight isolation damper at discharge of each of PA fans as per 13.02.01(f), a fast acting pneumatically operated Bi-plane damper shall additionally be provided between isolation damper & PA fan to save the unit when one PA fan trips and unit has to run back part load, with other PA fan in running condition.			
	(iv)	Flue gas biasing damper in boiler second pass (if applicable).			
	Pneumatically operated control dampers shall be provided at the following locations as a minimum:				
	(i)	Hot and cold air inlet to each mill.			
13.02.03	(ii)	At each air preheater outlet on flue gas path (only incase of Bi-sector APH).			
	(iii)	NOT USED			
	Type of power operated gas tight dampers at various locations shall be as follows:				
	(i)	Guillotine Damper Type	at locations Cl. no. 13.02.01 (a), (b), (c), (d), (f), (g) &(i).		
13.02.04	(ii)	Double multilouver (Biplane) type	at location Cl. no. 13.02.01(e), 13.02.02(ii) & 13.02.02(iii)		
	(iii)	Multilouver Type	at location Cl. no. 13.02.02 (i)		
	Damper Gas Tightness				
	The dampers mentioned at Clause No. 13.02.04 (i) & (ii) above shall have a guaranteed gas tightness efficiency (on flow), along the duct as well as from the duct to atmosphere or from atmosphere to the duct, depending on the pressure in both the damper open and damper closed condition without the use of seal air fans of the damper, as follows:				
13.02.05	Damper at locations		Min. Guaranteed Gas Tightness Efficiency		
	As per Clause No.		Without Seal Air	With Seal Air**	
	13.02.01 (e), 13.02.02(ii),		99.50%	100%	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP	PAGE 43 OF 67

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	& 13.02.02 (iii)			
	13.02.01 (a) & (f)	99.60%	100%	
	13.02.01 (b), (g)& (i)	99.80%	100%	
	13.02.01 (c), (d) & (h)	99.95%	100%	
	** Applicable for Dampers which are provided with pressurization fans/ Seal Air line from cold air duct/ Atmosphere			
13.02.06	Pressurization Fans:			
	(a) All dampers at ID Fan discharge, primary and secondary APH outlets on air side, primary and secondary APH inlets on flue gas side and in hot air ducts to mill inlet shall be provided with 2X100% pressurization fans to achieve 100% sealing efficiency. As an alternate offer, the above dampers can be provided with a sealing air from cold air bus duct suitably meeting the specification requirement of 100% sealing. The Bidder shall furnish the applicable rebate for such alternate offer in the relevant Bid Proposal Sheets for Employer's review and acceptance.			
	(b) The location and scheme for pressurization system shall be subject to Employer's approval.			
13.02.07	All dampers shall be designed to withstand the operating air and flue gas temperature without distortion.			
13.02.08	Components of regulating dampers coming in the flue gas path, including gas biasing dampers (if applicable), shall be made of erosion resistant material, having minimum life of 16,000 hrs. Material of the shaft for all types of dampers shall be stainless steel. Dampers associated with FGD and its bypass system shall be as per material specified elsewhere in the specification.			
13.02.09	There shall not be any backlash, play, etc. with linkage mechanism, actuator and final control element.			
13.02.10	All pneumatically operated interlocked dampers actuators shall be provided with solenoid valves. For open and close feed back of hot air dampers, Proximity (i.e non-contact) type limit switches (2NO+2NC) shall be provided. These shall be suitable for working hot & dust environment.			
13.02.11	Dampers:			
	(a) Guillotine Dampers			
	All guillotine dampers shall be located in horizontal duct to avoid fly ash build up when in closed position and shall be of top entry type. The damper sealing efficiency shall be as per cl. no.13.02.05 on flow without seal air and with seal air.			
	(b) Multilouver Dampers & Double multilover (Bi-plane) dampers			
	(1) The double multilouver type damper sealing efficiency shall be as per clause 13.02.05 on flow without seal air and with seal air.			
	(c) All dampers shall be arranged to facilitate local manual operation also from a gallery or floor level.			
	(d) The force required to operate the damper shall be limited to 35 kg (maximum) at			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
PAGE 44 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS																	
	the rim of the hand wheel. (e) The operating gear shall be fitted with a graduated indicator and shall be designed such that the damper may be retained in any position. (f) The isolating dampers shall in addition be fitted with locking devices to permit locking in the fully open and shut positions. (g) All powered dampers shall also have provision for manual operation during emergency/maintenance along with graduated local position indicator. (h) Suitable all round approach and platform for manual operation of dampers and for carrying out maintenance on damper shall be provided. The same shall be provided including that for actuator and in a safe manner. Necessary handling arrangement should also be ensured. (i) The layout of the isolating guillotine gates should be such that, it opens and closes only in vertical direction. Further, in case of flue gas duct, layout should take care for minimum straight duct length, in order to avoid any ash accumulation during closed condition of gates.																	
14.00.00	STEAM GENERATOR INTEGRAL PIPING, VALVES, FITTINGS AND MOUNTINGS																	
14.01.00	General In addition to certain specific requirements indicated in the subsequent paragraphs below, the Steam Generator integral piping, valves, fittings and mounting shall also comply with all specifications requirements indicated in other subsections of Part-B.																	
14.01.01	Safety valves and relief valves shall have minimum discharge capacities as under: <table><thead><tr><th>Valve</th><th>Minimum Discharging Capacities</th></tr></thead><tbody><tr><td>(i) Spring loaded safety valves</td><td></td></tr><tr><td>a) Separator & Superheater</td><td>Combined capacity 105% BMCR.</td></tr><tr><td>b) Reheater System</td><td>Combined capacity 105% of reheater flow at BMCR</td></tr><tr><td>(ii) Electromatic Relief Valve)/ Electromatic ball valve (EBV) at:</td><td></td></tr><tr><td>a) Super heater outlet</td><td>15 %BMCR</td></tr><tr><td>b) Reheater outlet</td><td>20% of Reheat flow at BMCR</td></tr></tbody></table> Note: Number of safety valves shown on the piping (refer corresponding tender drawing) is indicative only. This shall be as per specification/ manufacturer's standard practice. However, at least two numbers of spring loaded and one ERV in each SH outlet and HRH outlet pipeline shall be provided.				Valve	Minimum Discharging Capacities	(i) Spring loaded safety valves		a) Separator & Superheater	Combined capacity 105% BMCR.	b) Reheater System	Combined capacity 105% of reheater flow at BMCR	(ii) Electromatic Relief Valve)/ Electromatic ball valve (EBV) at:		a) Super heater outlet	15 %BMCR	b) Reheater outlet	20% of Reheat flow at BMCR
Valve	Minimum Discharging Capacities																	
(i) Spring loaded safety valves																		
a) Separator & Superheater	Combined capacity 105% BMCR.																	
b) Reheater System	Combined capacity 105% of reheater flow at BMCR																	
(ii) Electromatic Relief Valve)/ Electromatic ball valve (EBV) at:																		
a) Super heater outlet	15 %BMCR																	
b) Reheater outlet	20% of Reheat flow at BMCR																	
14.01.02	Set pressure of SH spring loaded safety valves shall be such that they are lifted before spring loaded safety valves on separators.																	
14.01.03	Sizing of spring loaded safety valves shall be such as to ensure minimum safe flow through superheater coils is ensured at all conditions.																	
14.01.04	Other means of operation (Opening and Closing) for all valves shall be in line with control and monitoring philosophy specified under 'Control and Instrumentation'.																	
14.01.05	Provide:																	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP														
PAGE 45 OF 67																		

CLAUSE NO.	TECHNICAL REQUIREMENTS																	
14.01.06	(a) Two valves in series one motorized, isolating type and one motorized regulating type (low noise, erosion resistant type) on all drains and vents required to be operated during startup and shutdown of unit																	
	(b) Silencers on all start up vents and lowest set pressure safety valves.																	
	(c) Temperature element on all drain lines, including soot blower drain line.																	
	(d) Motorized remote operated air release valves at locations, two in series, as required connected to a funnel, leading drains to drain trench.																	
	(e) Start-up vents shall be sized for a minimum flow of 15% TMCR corresponding to steam pressure at turbine start up curve.																	
	Note: Contractor to submit the following documents for Employer's approval:																	
	(i) Complete valve schedule in Employer's approved format indicating the make and model no. power supply requirements tube of control station etc.																	
	(ii) Control valve sizing calculation, characteristics, and data sheets.																	
	Provide drain valves (two in series, one manually operated isolation and one motorized regulating) for draining furnace wall, super heater, reheater, economizer and feed water lines. Arrangement of drainage system shall comply with following requirements:																	
	<table><thead><tr><th></th><th>Parameters</th><th>Requirements</th></tr></thead><tbody><tr><td>(i)</td><td>Sizing of Drainage system</td><td>To enable drainage of complete pressure parts in one (1) hour</td></tr><tr><td>(ii)</td><td>Type of drain valves</td><td>Low noise, erosion resistant</td></tr><tr><td>(iii)</td><td>Limiting noise level through regulating drain valves</td><td>90 dBA – 115dBA</td></tr><tr><td>(iv)</td><td>Flow velocity through valves</td><td>90 m/sec.</td></tr></tbody></table>					Parameters	Requirements	(i)	Sizing of Drainage system	To enable drainage of complete pressure parts in one (1) hour	(ii)	Type of drain valves	Low noise, erosion resistant	(iii)	Limiting noise level through regulating drain valves	90 dBA – 115dBA	(iv)	Flow velocity through valves
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(iv)	Flow velocity through valves	90 m/sec.																
14.01.07	Provide plugging/locking for each isolating drain valve such that to open the valve, the key has to be inserted and key can be withdrawn when the valve is closed.																	
14.01.08	Drain lines upto drain valves and drain valves to be designed for the maximum operating parameters of main process line to which it is connected.																	
14.01.09	Provide two in series, blowdown valves, at the lowest point of each water wall header comprising of one manually operated isolation valve and one motorized regulating valve. Valves shall have plugging/locking keys as specified at clause no 14.01.07 of this chapter and shall be located at appropriate location for convenient operation. Piping from this blow down valve shall be connected to atmospheric flash tank.																	
14.01.10	For all remote operated control valves provide:																	
	(a) 100% bypass control valves, remote operated and exactly identical to main control valve.																	
	(b) Separate power operated isolation valve on upstream side of each of main and bypass control valve.																	
	(c) Separate manual isolation valves on downstream side of each of main and bypass control valve.																	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP														
PAGE 46 OF 67																		

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	(d) Pressure gauge at inlet and outlet of each control station. If the control valve is local operated, systems from (a) to (d) shall be provided with 100%, local operated control valve. 14.01.11 Drains from separator, headers, gauge glasses, and integral piping of Steam Generator shall be terminated into one or more drain collection headers, which in turn will be connected to atmospheric flash Tank. 14.01.12 All valves and piping for the blow down system shall be provided upto and including the atmospheric flash Tank. 14.01.13 Provide a connection at an approved location fitted with a non-return valve, size not less than 100 mm nominal diameter, a stop valve and the related pipe work in the boiler fill line. 14.01.14 Provide all required sampling points alongwith root valves including that for feed water at economizer inlet, separator drain, separator outlet steam pipes, superheated steam, reheated steam. Sampling nozzle design shall be such as to have minimum protrusion in the pipe and shall be designed for collecting the isokinetic sample complying the code ASTM D1066. The exact location of the isokinetic sample shall be finalized at a later stage. For laboratory samples, necessary sample shall be taken from the outlet of primary coolers to be supplied by the contractor along with necessary valves and cooling water pipes. In addition two spare coolers designed for highest parameters shall be provided. The root valves shall be of stainless steel. The impulse pipe size shall be to the approval of the Employer. Sampling arrangement shall include valve, pipe work and the necessary connection. The cooling water shall be taken from the main cooling water system. Drain from sample coolers shall be terminated at basement floor level. Each steam and water terminal connection for vent, drain, instrument tapping point and sampling shall be equipped with two valves. 14.01.15 Provide tapping points for all the instrumentation and controls and guarantee tests with Employer approved orientation on the pipeline. 14.01.16 Provide remote, motorized operation (a) For all valves (including drain, vent and air release valves) required to be operated during startup/shut down of Steam Generator. (b) For valves located in inaccessible locations. 14.01.17 Provide valves/actuators, remote operation facility etc. so as to enable startup, shutdown, and load monitoring of Steam Generators from unit control room. 15.00.00 SOOT BLOWING SYSTEM 15.01.00 Type of Soot Blowers: (i) For furnace chamber :Short Rotary, Single nozzle retractabletype (ii) For horizontal heat exchanger :Long Rotary, Multiple nozzle, section retractabletype (iii) Air-preheaters :Power Driver swinging arms/ Sweep action/ Long retractable and non-rotating Soot blower or retractable multi-nozzle soot blowers		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP	PAGE 47 OF 67

CLAUSE NO.	TECHNICAL REQUIREMENTS			
15.02.00	Soot Blowing System shall be			
	(a) Fully automatic sequentially controlled through SG C&I control system.			
	(b) Capable of effectively removing deposited ash from Steam Generator heat transfer surfaces with on load cleaning devices.			
15.03.00	The design of air-heater soot blowing system including piping, valves & fittings shall allow use of high temperature steam from high temperature auxiliary steam header during start-up. For the purpose of efficient soot blowing, permanent arrangement of steam source from cold reheat and superheater circuit for normal operation shall be provided. A check valve and/or motor operated valve shall be provided on this high temperature line to prevent normal soot blowing steam from entering auxiliary steam header.			
15.04.00	In case soot blowing steam is required at parameters other than those available from auxiliary steam system, for the purpose of efficient soot blowing during start-up and other loads, a permanent arrangement shall be provided for the same, by the Contractor.			
15.05.00	The soot blower design shall be of self draining type.			
15.06.00	Material of Construction			
	(i)	Soot Blower Elements	:	Extra heavy seamless tubing from solid bars with heat, corrosion & erosion protection for parts in permanent contact with hot gases.
	(ii)	Blowing element	:	High temperature alloy steel
15.07.00	Requirement for soot blower nozzles:			
	(a) Single or multiple row of nozzle welded to prevent falling out during service.			
	(b) Venturi or straight bore nozzles shall be installed as required.			
15.08.00	Retractable Soot Blowers (RSB)			
	(a) Shall be retractable even during emergencies such as:			
	(1)	Drop in steam supply pressure,		
	(2)	Low steam flow, etc.		
	(b) Long RSBs shall be half of Steam Generator width on each side.			
	(c) Double helix cleaning pattern shall be used.			
	(d) Dual electric drives, one for rotary and other for linear motion shall be provided for each soot blower. Alternatively, soot blower design having both linear as well as rotary motion achieved through single drive motor shall also be acceptable.			
	(e) Controlled from soot blower panel.			
15.09.00	The location of elements, travel and nozzle angles shall be such that maximum cleaning is obtained with a minimum of flowing medium.			
15.10.00	Soot blowers Motor Control Centre (MCC) shall be as per Electrical Sub-section.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
PAGE 48 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS				
15.11.00	The soot blowing system shall be capable of performing functions as specified in Control & Instrumentation Sub section of this Specification.				
15.12.00	Warm up of complete piping system before the start-up of soot blowing operation shall be facilitated by providing adequate number of pneumatic flow control valves. Each pneumatic flow control valve shall have bypass line with adequately sized orifice plate for draining the system when the valve is closed.				
15.13.00	Temperature detectors along with temperature transmitters on the drain lines shall be provided to ensure satisfactory warming up and initiation of soot blowing operation.				
15.14.00	All soot blowers shall be suitable for local and remote automatic sequential operation.				
15.15.00	The lubricants, if any shall be suitable to withstand hot conditions.				
15.16.00	Platforms/galleries shall be provided at and around all the soot blowers to facilitate, maintenance, inspection.				
15.17.00	The soot blowers shall be accessible from local operating platform.				
15.18.00	The furnace should be provided with wall blowers so selected such that cleaning coverage per wall blower should not be more than 2m in radius and there should be no left out portion. One wall blower elevation below the lowest burner elevation shall be provided along with wall blowers located immediately above top elevation coal burners upto the horizontal plane at the furnace nose tip at entry to the radiant superheater. Wall blowers in the burner zone shall also be supplied as per the practice of contractor.				
15.19.00	Provision shall be made to maintain the soot blower heads free of deposits during the periods when they are retracted and not in operation.				
15.20.00	Provision shall be made for additional soot blower installation(s), if required in future. In case, after the unit is commissioned, if the operational experience warrants the necessity of additional soot blower(s), Contractor shall install additional soot blowers(s) along with proper approach and platform(s), as specified for other soot blowers, without any cost implication.				
15.21.00	While deciding coverage of LRSBs the maximum coverage of LRSB shall not be considered more than 2m of blowing radius.				
16.00.00	AUXILIARY STEAM PRESSURE REDUCING & DESUPERHEATING STATION				
16.01.01	GENERAL To meet the continuous and startup auxiliary steam requirements of the unit, two auxiliary pressure reducing and desuperheating stations, one High Capacity pressure reducing and desuperheating stations (HCPRDS) taking tap off from Main Steam (MS) or intermediate stage of superheaters and other Low Capacity pressure reducing and desuperheating stations (LCPRDS) taking tap off from Cold Reheat (CRH) lines shall be provided. Auxiliary steam header(s) shall be provided taking steam from both the above PRDS stations. The operating parameters of the aux. steam header(s) shall be optimized by the bidder maintaining a 50 deg.C superheat and minimum temperature of 310°C During cold startups when main steam pressure is more than 90 kg/cm² and cold reheat pressure inadequate, the low capacity PRS shall be inoperative and the auxiliary steam requirements shall be catered only by the high capacity PRDS. The auxiliary steam systems of multi units shall be suitably interconnected through the				
<table><tr><td>SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE</td><td>TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001</td><td>SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP</td><td>PAGE 49 OF 67</td></tr></table>		SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP	PAGE 49 OF 67
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP	PAGE 49 OF 67		

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	auxiliary steam station header. A branch connection along with isolating valve(s) and a blanking flange(s) shall also be provided for interconnection with the future units on station header. Output steam of the auxiliary boiler shall be connected to the station header. If steam for the Steam Generator unit auxiliaries is required at pressure/ temperature other than that of the auxiliary steam header, suitable arrangements shall be made by the Contractor in design of the Steam Generator to meet such requirements. Further, availability of the auxiliary steam at the specified temperature may not be possible at all the loads when the steam is tapped from CRH or when only low capacity PRS is in operation. When auxiliary steam system is being fed from CRH, the temperature in the auxiliary steam header will be floating depending on the unit load and the CRH steam parameters, in which case the temperature auxiliary header shall vary approximately in the range of 300 °C to 400°C depending on unit load. Bidder is advised to take note of this and provide suitable arrangement of charging aux. steam header if high temp. auxiliary steam is continuously required for any use. Further, the Bidder shall provide an interconnection arrangement at station header with High Temperature Aux. Steam station header of existing stage-I (2x600 MW) units. Auxiliary steam when sourced through this interconnection shall be available at a maximum rate of 60 T/hr with parameters 16 ata/310°C at Stage-I TP. Bidder shall consider the same for start-up procedures during initial commissioning. Auxiliary steam pressure reducing and desuperheating stations, alongwith all pipings etc. shall be supplied as per Tender drawing of AUX. STEAM SYSTEM attached in Part-E of the Technical specification, section-VI.			
16.01.02	High Capacity PRDS of the unit shall be suitably sized for meeting auxiliary steam requirement of 190 TPH (minimum). However, the exact capacity shall be finalized during the detailed engineering stage. High capacity PRDS shall be generally sized to cater to the auxiliary steam requirements for following: (a) Intermittent requirement of the unit and station (b) Steam coil Air Preheaters (c) Air heater soot blowing (d) Boiler feed pump turbine (e) Deaerator pegging (f) Turbine gland sealing (g) Startup requirement of other Unit (h) As standby to low capacity PRS station. (i) For coal mill inerting (if required). (j) For any other system as required by bidder (with proper justification)			
16.01.03	Low Capacity PRDS shall be suitably sized for supplying steam for normal continuous requirements of its own unit. However, the exact capacity shall be finalized during detailed engineering stage, subject to minimum 35 TPH. The complete interconnecting station (including valves, lines, etc.) between stage-I and stage-II units shall be sized for minimum 60 TPH.			
16.01.04	Bidder shall furnish, along with the bid, writeup and P&ID for Auxiliary Steam System indicating the sources of steam, parameters of auxiliary steam header(s), various pressure reducing and desuperheating stations, tap offs for various systems as listed above, drain points, vents, instrumentations, flow elements etc.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
PAGE 50 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS																					
16.01.05	Sharing of Load requirement between HCPRDS & LCPRS shall be possible in case low capacity PRDS is unable to meet Auxiliary steam requirement on its own. The change over from HCPRDS to LCPRS & vice versa shall be automatic.																					
16.01.06	De-aerator pegging pressure for cold, warm, hot start up and during HP-LP bypass operation, shall be as optimized by the bidder and shall be suitable to ensure required deaeration and water quality required for boiler. The optimized pressure should be same during warm, hot start up conditions and during HP-LP bypass operation.																					
17.00.00	WALK WAYS, PLATFORMS AND STAIRS Access platforms, walkways, handrails, stairs, ladders and gratings etc.for proper approach during maintenance shall be provided for steam generator, all auxiliaries, equipments and accessories in the scope of this package. Walkways, platforms, stairs & ladders shall be provided in accordance with following .requirements unless specified otherwise: <table><tr><th>Sl.No.</th><th>Description</th><th>Minimum clear width***</th></tr><tr><td>1.</td><td>Main access walkways</td><td>1500 mm</td></tr><tr><td>2.</td><td>Maintenance access walkways</td><td>1000 mm *</td></tr><tr><td>3.</td><td>Staircase</td><td>1200 mm</td></tr><tr><td>4.</td><td>Ladders **</td><td>450 mm</td></tr><tr><td>5.</td><td>Platforms</td><td>1500 mm</td></tr></table> Note: * Maintenance access walkways are applicable only to areas identified in clause no. 17.01.05, 17.01.06 & 17.01.14. All other areas shall be connected by Main access walkways. ** Ladders shall be acceptable only in such cases where it is not possible to provide stairs and shall be subject to specific approval of NTPC except at places where ladders have been specifically specified. Further the same shall be provided along with cage at heights and subject to specific approval of Employer. Any reference applicable standards shall also be followed. *** Clear width shall be without any interruption from the intervening pipes, columns, actuators, instrument enclosures, racks etc.				Sl.No.	Description	Minimum clear width***	1.	Main access walkways	1500 mm	2.	Maintenance access walkways	1000 mm *	3.	Staircase	1200 mm	4.	Ladders **	450 mm	5.	Platforms	1500 mm
Sl.No.	Description	Minimum clear width***																				
1.	Main access walkways	1500 mm																				
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3.	Staircase	1200 mm																				
4.	Ladders **	450 mm																				
5.	Platforms	1500 mm																				
17.01.01	Platforms shall be provided at all burner levels, all around the furnace, such that: (a) There is adequate space for operation, service and maintenance of all burners and associated auxiliaries. (b) The platforms are minimum 3000 mm wide and shall extend from furnace walls. (c) Platforms shall allow complete burner withdrawal within boiler room enclosure. (d) Platforms at each burner elevation shall be continuous and run at the same level without any interruptions from intervening steps, obstructions etc. Burner platforms within 200 mm of an igniter shall be welded steel checkered-plate with welded-in-place drains to prevent oil spillage from spreading.																					
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP																		
PAGE 51 OF 67																						

CLAUSE NO.	TECHNICAL REQUIREMENTS		
17.01.02	Burner platforms shall have direct access to elevator, unless levels are so close together that the 3500 mm minimum elevator door spacing does not permit separate elevator opening at each level. Access stairs to each burner level shall also be provided. Platforms of minimum clear width of 1500 mm shall be provided on at least three sides of the control station/ equipment. The platforms shall be all along the length of soot blower control station, Fuel oil control station, SH & RH spray control stations, SCAPH control station, steam/water sample coolers, APH lube oil station etc. Access through Elevator, staircase and main access walkways for reaching the platforms shall be provided. The above equipment including scanner air fans should be located at firing floor elevation for ease of operation and maintenance. Platform/walkway leading to cold air/hot air gate/damper mechanical lock area shall be free from any obstruction/cross beam/bracing/process pipe line/duct etc. and use of vertical ladder/monkey ladder shall not be permitted in order to ensure safe operational practices.		
17.01.03	Soot blowers shall have platforms on both sides along the entire length of retractable soot blowers and adequate space and service area for removal and handling of rotary blower elements in one piece. All LRSB's shall have minimum 1500 mm wide platforms on both sides along the entire length of soot blowers. Platform width should provide adequate space and service area for removal and handling of blower elements in one piece. Access through Elevator/staircase and main access walkways for reaching the LRSB platforms shall be provided. For soot blower locations which are envisaged / identified for future installation, provision shall be kept in the layout space and their loads shall be accounted for in the structure design so that the necessary access/platforms, as required, can be installed in future.		
17.01.04	All manholes, all access doors, all observation ports, all instruments including flame scanners, flame cameras & ash level indicators, Junction Boxes for control and instrumentation, all instrument test/sampling points including that for all dirty pitot tube & coal sampling points shall be accessible from main access walkway/platforms. In case the lowest point of the manhole/access door/ exceeds 800 mm and of observation ports/ dirty pitot tube & coal sampling points/instruments exceeds 1200 mm from the nearest walkway/platforms level then suitable intermediate platform to each of the above access doors, observation port, sampling points, instruments etc. along with suitable approach from nearest platform level shall be provided. Minimum height of the observation port shall be 500 mm from the platform/intermediate platform.		
17.01.05	Suitable all round platform for manual operation of all valves, for all dampers, for ash hoppers, APH drives, for all lubricated equipment bearings and equipments requiring access during operation for normal day to day inspection & maintenance shall be provided. Suitable access to these platforms shall also be provided. Suitable pathway from air preheater to ESP shall be provided in a safe manner.		
17.01.06	All around platforms of adequate size to permit at least two persons to simultaneously work (1.5 sq.m. minimum) shall also be provided for all damper actuators, valve actuators, safety valves, instrument source connection point, Y pieces, Expansion joints and other areas requiring access only monthly or annually. Suitable access to above platforms with walkways, stairs/ladders etc shall be provided. Approach platforms shall also be provided for boiler expansion indicator, dampers.		
17.01.07	Platform should be provided for removal and handling of startup drain re-circulation pump, motor, cooler. Direct access through Elevators without use of stairs for reaching		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP	PAGE 52 OF 67

CLAUSE NO.	TECHNICAL REQUIREMENTS			
17.01.08	the platforms shall be provided.			
17.01.09	Adequate additional space for placing local instrument enclosure/racks and performing maintenance work on the same (including enough space for door opening) without intruding into area of walkways or platforms shall be provided.			
17.01.10	Annular platforms of 1200 mm clear width accessible by stairs/ladders shall be provided for Mill discharge valves & Bunker outlet gates.			
17.01.10A	Continuous platforms of minimum clear width of 1500 mm shall be provided all around Furnace seal trough level. Access to these platform levels will be by staircase.			
17.01.11	The platforms layout design should ensure two exit points from any location at elevation over 3 m from ground level. In case a dead end becomes unavoidable such platform areas shall be clearly marked for caution and cordoned from general platforms. Layout shall be designed in such a way that fans of boiler should not be placed below coal conveyor and additional canopy with proper approach should be provided as required. All ladders at height should be provided with cage. Storage Platforms In addition to maintenance platforms, walkways etc. specified above the Contractor shall provide storage platforms for storing of scaffoldings& APH baskets in accordance with the following: (a) Scaffoldings Platforms around scaffolding entry point for storing of maintenance cradle/quick erected scaffoldings (minimum 50 Sq m of platforms on each side) prior to commencement of maintenance/overhaul activities. Weight of maintenance cradle/quick erected scaffoldings shall be accounted in the structure and platform design. (b) APH Baskets Platforms (minimum 100 Sq m of platforms) with proper approach near APH(s) for storage of APH Baskets. Weight of stored APH baskets shall be accounted in the structure and platform design. Note: (i) Weight of APH baskets indicated above shall be including the weight of elements. (ii) Storage platform shall be solely for storage of APH baskets and shall not be part of maintenance/operating platform.			
17.01.12	Platforms together with ladders shall be provided for access to all maintenance hoists.			
17.01.13	Contractor shall ensure that the layout of PF coal pipes is routed in such a way so as to ensure that horizontal sections of PF coal pipes and bends are accessible from the nearest platform or walkway level, to the extent possible, to facilitate replacement of PF coal pipes and PF bends during maintenance. Where direct access from nearest platform/walkway is not possible, Contractor shall provide proper procedure to facilitate Employer erect scaffolding, temporary ladders, platforms and safety nets to safely perform the replacement/repair of coal pipes.			
17.01.14	Maintenance access areas, where access is only required for painting, re-insulation or replacement of components which have a service life of 10 years or more shall have			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
PAGE 53 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	facilities to enable the Employer to erect scaffolding, temporary ladders, platforms and safety nets to safely perform the work involved.			
17.01.15	Access to all pent house cooling doors shall be provided through maintenance walkways.			
17.01.16	Walkways/platforms/Staircase etc. shall comply with following requirements also:			
	(a)	Platforms at same elevation on each side of Steam Generator shall have a walkway connecting the two sides.		
	(b)	Platforms requiring access from the elevator shall extend to the elevator entrance by main access walkways and be attached to the elevator steel as required.		
	(c)	Minimum headroom (free height) under all floors, walkways and stairs shall be 2.1m.		
	(d)	The interconnection between two platforms/floors at different elevations shall be through proper staircase. Ladders shall be considered only in exceptional case where provision of staircase is not possible.		
	(e)	Hand railings shall be provided for all walkways, platforms, openings, staircases etc. complying with the requirements specified in chapter of “civil works”, Part B of the Technical Specification.		
	(f)	Gratings shall comply with all requirements specified in chapter of “civil works, Part B of the Technical Specification.		
	(g)	If material is stacked or stored on a platform or walkway, or near a floor opening, kick plate/toe guard must be increased in height or solid or mesh panels of appropriate height must be installed to prevent the material from falling.		
	(h)	All areas subject to lube oil or chemical spills will be provided with curbs and drains.		
17.01.17	Two main stairways shall be provided one on each side of the Steam Generator. One stairway shall extend continuously from grade to the highest operating level and the other shall extend continuously from grade to the boiler roof. Steel framing for penthouses for each stairway shall be provided. The portion of main stairway within the enclosed portion of the building, if any, shall be designed for one hour smoke/fire proof requirements.			
17.01.18	For meeting the above requirement in respect of platforms the Bidder shall include in his proposal platform area of 20,000 m ² (clear of all intervening pipes, columns, actuators, instrument enclosures, racks etc. and excluding area covered by stairways & excluding area required for ESP & FGD)			
	Contractor shall furnish detail floor plan drawings covering all platforms and shall clearly indicate all the dimensions of platforms and clear platform floor area in each drawing.			
17.01.19	Bidder shall provide a common working/maintenance platform in the area of bunker discharge gate, connecting all feeders in each side.			
18.00.00	ELEVATORS			
18.01.00	Elevators shall be designed based on following criteria:			
	(i)	Type of service	:	One (1) no. Passenger-elevator and one (1) no passenger cum goods elevator for the unit.
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
PAGE 54 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	(ii) Design/construction/ installation codes (iii) Load carrying capacity (iv) Min. Rated speed (v) Total Travel (vi) Number of floors to be served (vii) Entrances (viii) Entrance and platform size (xiii) Machine room and lift Shaft (xv) Automatic Rescue Device (ARD) - (Battery Drive) (xvi). Emergency Safety: Devices (xvii) Door opening size for Passenger cum Goods elevator (xviii) Door opening type (a) Latest edition of IS:14665 (All parts) AND also meeting any additional requirements of IS:4666 and IS:1860 (b) Any other equivalent code, subject to Employer's approval. 1088 Kgs. (equivalent to 16 person) for Passenger Elevator & 3000 kgs for passenger cum goods elevator. 0.55 meter/sec. for 3 Ton elevator and 1.0 m/sec for 1088 kg elevator. As per Steam Generator supplier's recommendations subject to Employer's approval. Twelve (minimum) Twelve (12) (minimum) (all on same side) As per design/installation codes at (ii) above Pressurized dust proof or Air conditioned machine room as per the requirement of lift manufacturers. Contractor to provide a modern Advanced electronic drive system of "RESCUING Passengers Trapped in ELEVATOR". The lift shall be provided with safety Device attached to the lift car frame and placed beneath the car. The safety device shall be capable of stopping and sustaining the lift car up at governor tripping speed with full rated load in car. 1800mm (min.) Centre opening Power operated Horizontal bi-parting type 18.02.00 Landing doors of the elevators shall have fire resistance of atleast one hour. These doors shall also be smoke tight as far as possible. 18.03.00 Construction of the elevators shall specifically meet all requirements of the codes indicated at Cl. 18.01.00 (ii) and shall have following additional features: (i) Flooring of Cabin (ii) Design, Construction and finish of car & car door Passenger cum goods elevator - 6 mm thick Checkered Plate flooring. Passenger Elevator - 6 mm thick Checkered Plate flooring. Car inside enclosure including inner side of door shall be of stainless steel plate of grade SS:304 of bright finish.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP	PAGE 55 OF 67

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(iii)	Car entrance and landing doors	:	As per BS:476 (Part 20 & 22)
	(iv)	Door construction	:	Hollow metal construction from 16 gauge thick steel sheet spray painted.
	(v)	Signals	:	Car position informer in car both visual and audio, hall position indicator at all floors, telltale lights at all floors, battery operated alarm bell and emergency light with suitable battery, charger & controls.
	(vi)	Type of Indicators	:	Soft touch keys and digital luminous display in car operating panel and on all floors landings. (All fixtures in stainless steel face plates).
18.04.00	Technical requirements of Electrical items shall be as per details given in Electrical Sub-Section, Part-B.			
18.05.00	Provide sound reducing material below machines in machine room.			
18.06.00	Provide special corrosion resistant treatment on all elevator components. The protective treatment shall be subject to Employer's approval.			
18.07.00	Fireman's switch shall be provided for each elevator.			
19.00.00	THERMAL INSULATION, LAGGING, CLADDING & REFRACTORIES			
19.01.00	In addition to the sizing design criteria requirement elaborated at Sub section A-01, refer separate chapter of "THERMAL INSULATION".			
20.00.00	PAINTING			
	Supply of paints including painting of all surfaces, equipment's and structures for Steam Generator shall be as per Employer's standard color coding scheme. Painting of various surfaces shall be as separate chapter on "Painting".			
21.00.00	BLOW DOWN SYSTEM			
	In addition to the sizing design criteria requirement elaborated at Sub section A-01, following requirements shall also be adhered:			
21.01.00	The blow down system shall comprise of an atmospheric flash tank and drain receiving vessel, 2 X 50% condensate transfer pumps located in Steam Generator area and shall be complete with all necessary valves, piping, level control system etc.			
21.02.00	Atmospheric flash tank design shall not allow discharge of any free water from vent. Water drops leaving vent pipe shall have sizes not more than 0.127 mm. The size of vent pipe shall ensure no pressurization of atmospheric flash Tank. Steam velocity through the vent pipe shall not exceed 90 m/s. Calculation to this effect shall be submitted.			
	The steam from the atmospheric flash tank shall be vented out to the atmosphere above steam generator roof level. Emergency drain shall be connected to the sewage after the same has been cooled by the cooling water. Necessary cooling system for this shall also be provided. Suitable arrangements to prevent overflow in this tank shall be provided.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
PAGE 56 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
21.03.00	Design/Construction of Atmospheric flash tank and drain receiving vessel shall conform to following:			
21.03.01	Tanks shall be designed and fabricated as per requirements of IS: 2825/BS:806.			
21.03.02	Provide wear plates in the tank to prevent erosion due to high pressure/velocity drains.			
21.03.03	All drain connection to the Tanks to be tangential.			
21.03.05	Provide mating flanges for level switches and other instruments.			
21.03.06	Provide manholes with bolted doors on BDT. Doors shall be hung on hinges.			
22.00.00	TYPE TEST			
22.01.00	Full scale type tests using actual equipment shall be conducted by the Contractor for the equipment mentioned in the subsequent clauses below:			
22.01.01	Full range and full scale performance testing shall be conducted at shop on one number each of the following Fans as per BS 848-1:2007 / BS EN ISO 5801:2008. (a) Induced Draft Fan (b) Forced Draft Fan (c) Primary Air Fan (d) Seal Air Fan (e) GR Fan (if applicable) The performance testing at shop shall be conducted using actual fans			
22.01.02	Leak tightness testing of dampers for each type and size of damper at shop to demonstrate the guaranteed gas tightness efficiency (on flow). The minimum guaranteed gas tightness efficiency of dampers shall not be less than that indicated in clause no. 13.02.05of this Sub-Section, Part-B, Section-VI.			
22.01.03	Following tests for Steam Generator Startup drain recirculation pump at shop on assembled unit: (a) Tests to establish unit functioning of pump at temp. & pressure (b) Hot standstill and startup tests			
22.01.04	Following tests on Coal Feeder (a) Explosion proof test at 50 psi as per NFPA codes (b) Weighing accuracy test at various speeds with coal flow. (c) Calibration and repeatability test at various speeds			
22.02.00	The Bidder shall indicate the charges for each of these type tests separately in the relevant price schedule of Bid Proposal Sheet (BPS) and the same shall be considered for the evaluation of the Bids. The type test charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the Employer's Engineer.			
22.03.00	The type tests shall be carried out in presence of the Employer's representative. Contractor shall inform the Employer about his readiness for conducting the type test and issue such notice to the Employer 30 days in advance, alongwith schedule of the type tests. The Contractor shall obtain the Employer's approval for the type test procedure before notifying the Employer about his readiness for conducting the type test. The type			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
PAGE 57 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
22.04.00	test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out. Irrespective of the requirement of conducting the type tests under this contract, the Contractor shall submit the reports of the type tests listed above in clause no. 22.01.00 and carried out within last five years from the date of bid opening. These reports should be for the tests conducted on the equipment similar (model / type / size / rating) to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The Employer reserves the right to waive conducting of any or all of the specified type tests under this contract, in which case the type test charges shall not be payable for the type tests waived by the Employer.			
22.05.00	All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP	PAGE 58 OF 67

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
2.00.00 2.01.01	b) Rapper panel rooms should be fully air conditioned, leak and dust proof. c) One number Passenger elevator of minimum capacity (408 Kg) per unit should be provided to Rapper panel room. All works related to the elevator shall be in the scope of the Contractor. d) The machine room for the elevator shall be dust proof and shall be provided with an air conditioner of suitable capacity. Specification of the Elevator for Rapper Panel rooms shall be as per Cl. 1.00.00, Sub-Section A-24, Part B, Section-VI of Technical Specification and Mandatory Spare shall be as per Mandatory Spares Part-A Section-VI of Technical Specification. MODEL STUDY The Contractor shall perform model study (Physical scale modelling) to achieve an optimum size and layout of the ducting, uniform flue gas distribution, maximum particulate collection, minimum draft loss, minimum dust drop out and build up and minimum re-entrainment from within the precipitator. (a) The Contractor shall conduct physical model testing of ESP by fabricating a transparent scaled model of ESP. The model testing shall be in accordance with ICAC publication no. EP-7. As a minimum the study shall be conducted to simulate 100% and 80% of gas flow. While the requirements of EP-7 shall have to be met at the 100% guarantee point gas flow, efforts shall be made to meet this requirement for 80% of guarantee point gas flow also. The Contractor shall fabricate a three dimensional complete model of the precipitator and its ducting with a scale of not less than 1:10. The model study shall also include a gas distribution study in the inlet and outlet duct as well as, the cross over duct to find out the effect of isolation of one stream of the ESP. The Contractor shall submit the detailed procedure for carrying out model study for the approval of the Employer. (b) The model study shall include all connecting duct work from air preheater gas outlets to the induced draft fans inlets, induced draft fan outlet to FGD inlet, FGD outlet to chimney flue inlet and also from the induced draft fan outlet to chimney flue inlet (in FGD bypass condition) including the inlet duct transition piece, including all dampers, turning vanes and distribution devices. Based on the model test studies, the Contractor shall finalize the design of the ductwork, guide vanes, sampling points etc. The model study shall be carried out in the presence of the Employer. Test instruments similar to those used by the supplier shall be made available during the model test so that the readings could be verified manually by Employer's Representative during the test. A test report shall be submitted covering the complete model study including the details of the recommend external duct work, baffles or vanes etc. The contractor shall be required to maintain the precipitator model until the Electrostatic Precipitators have successfully met all the performance guarantees. In case the ESP contractor can not maintain the ESP model till completion of ESP guarantee test, he can retain the model in dismantled form. However, in such a case, if the repeat model testing is required based on site performance/guarantee test of the first unit, ESP contractor shall make the model ready by re-assembly for such repeat testing within four (4) weeks of notice by the employer in this regard. MAINTENANCE REQUIREMENTS The design of the precipitators shall allow adequate space above and between the adjacent fields to carryout necessary inspection and maintenance. A permanent walkway shall be provided at each rapper level both for the discharge and collecting electrodes.		
3.00.00 3.01.00	MAINTENANCE REQUIREMENTS The design of the precipitators shall allow adequate space above and between the adjacent fields to carryout necessary inspection and maintenance. A permanent walkway shall be provided at each rapper level both for the discharge and collecting electrodes.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP	PAGE 60 OF 67

CLAUSE NO.	TECHNICAL REQUIREMENTS	
3.02.00	Minimum 2.0 m wide platforms shall be provided between the two casings of the ESP's to facilitate maintenance work and minimum 1.5 m wide platforms shall be provided all around all ESP passes at intermediate and TR set elevation. Minimum 1.0 m wide platforms shall be provided all around the hoppers at hopper level. The protection (like canopy arrangement) for the rapping motors from exposure to rain shall also be provided. Five (5) nos. of staircases (one each between the two ESP casings, three located towards the boiler side and the other two towards the chimney side of the ESPs) of minimum 1200mm clear width shall be provided from ground to the roof of the ESPs with landings connected at all platforms. Further, the platforms between all the ESP casings shall be interconnected at least at one intermediate elevation.	
3.03.00	A monorail system with movable trolley and an electrically operated hoist mounted on the precipitators roof shall be provided for handling and maintenance of T-R sets, rapper motors, fans (if applicable) etc. By this arrangement, it shall also be possible to lower the T-R sets down to the ground level and/or onto a truck. Normal and special maintenance tools shall also be furnished for attending to different equipment.	
3.04.00	Access for maintenance of each high and low level indicator shall be provided. For this purpose two (2) numbers portable aluminium ladders (light weight & easy to transfer) to be provided per 800 MW unit.	
4.00.00	GAS DISTRIBUTION SYSTEM Gas distribution system shall be provided at the precipitator inlet as well as in the outlet nozzle to achieve uniform gas distribution throughout the unit with maximum utilisation of collection areas at the inlet and outlet. It shall be designed to minimise local velocity regions and to avoid bypassing & re-entrainment of dust. To achieve the above, internal baffles, etc., shall be provided. The distribution screens shall be of modular design. The Contractor shall give full description of the gas distribution system, stating the means he proposes to keep the distribution screens clean.	
5.00.00	COLLECTING ELECTRODES Collecting electrodes shall be designed for dimensional stability and to maintain the collection efficiency at the specified level. The specific collecting plate area shall in no case be less than the value specified in Sub section A-01. The profile of the collecting plate shall be such as to minimise the re-entrainment of collected dust at the time of rapping. Minimum plate thickness shall be 18 BWG / 1.2 mm. Each plate shall be shaped in one piece construction and shall be stiff enough to carry the rapping intensity. The swaying and warping tendencies shall be prevented by suitable means. These means shall be clearly brought out in the proposal.	
5.01.00		
5.02.00	The collecting plate height shall in no case be higher than maximum height which has been successfully tested and proved by the Contractor or his principals for the design offered, over a minimum period of two years of commercial operation in at least one plant, where the ESPs are operating for a coal fired boiler in conjunction with oil firing. In support of the above, the Contractor shall furnish sufficient data, to the Employer's satisfaction, with reference to the operating experience as stipulated elsewhere.	
6.00.00	DISCHARGE ELECTRODES The high tension discharge electrodes shall be of rigid frame type design, located mid-way between the collecting electrodes. The electrodes shall be self tensioned, or restrained in pipe frames. They shall be constructed from durable, corrosion and erosion resistant material. In case spiral type discharge electrodes are being offered, the material for the same shall be UHB 904 L or approved equivalent. Vertical and horizontal members shall be rigid enough to maintain the alignment of the system without warping	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001
SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP		PAGE 61 OF 67

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	or distortion even at elevated temperatures. Provisions made to maintain alignment of electrodes during normal operation, including rapping and thermal transients, shall be clearly brought out in the offer. However, no antisway insulators shall be used at the bottom of the discharge electrodes frame to accomplish the above.	
7.00.00	RAPPING SYSTEM	
7.01.00	Independent rapping system shall be provided for discharge and collecting electrodes with control systems as per the requirement specified in Electrical Sub-Section. The rapping mechanism shall be of either electric impact type or tumbling hammer type. This shall be adjustable in frequency, intensity (for electric impact type only) and duration (for tumbling hammer type) to provide an efficient cleaning rate. Separate rapping equipment, shall be provided for the discharge and collecting electrodes served by one T/R set so that each mechanism can be suitably adjusted when required. It shall be so arranged that the rapping frequency can be independently set from the control room in accordance with the operating requirements. The rapping frequency range shall be adjustable in wide range from 0 to a minimum of 24 hours, and this facility shall be such that it does not require any stoppage of rapper operation. Sufficient number of rappers and rapper drives shall be provided so that minimum collection area and discharge electrode lengths are rapped at a time, which shall not be more than 4.8% of the total collection area for atleast the last two fields/discharge electrode length of each field served by one T/R set. The Bidder shall provide necessary calculations in support of fulfilling the above requirements alongwith the offer. In case any special features are added to meet this stipulation the same should be clearly brought out in the offer. The rapping system shall be designed for continuous sequential rapping to prevent puffing under any conditions of precipitator operation.	
7.02.00	A minimum rapping acceleration of 75 g measured normal to the plane of the plate shall be imparted on all parts of all the collecting electrode. These levels shall have been demonstrated in the Contractor's shop tests or field tests with comparable size collecting frames and rapping gear.	
7.03.00	All internal parts of the rapping mechanism shall be accessible for inspection and they shall be placed on wide access passages and shall be easily accessible for operational and maintenance purposes. Major part of the rapping mechanism shall be located external to the precipitator. Necessary lubrication system shall be provided for the rapping mechanism.	
7.04.00	The perforated plates and/or guide vanes furnished for gas distribution system shall also be provided with rapping systems. The rapping mechanism shall produce sufficient force to keep the perforated plates/guide vanes clean. Further at the ESP outlet gas distribution screen may be of perforated or non-perforated plate type with or without rapping system.	
8.00.00	DUST HOPPERS	
8.01.00	Dust hoppers shall be of conical type. ESP hoppers other than that of conical type shall not be acceptable. The hopper shall be designed with proper valley angle and arrangement shall be such that the ash flows freely without any arching or clogging. Each dust hopper shall have a storage capacity of minimum of eight (8) hours corresponding to the minimum 70% ash collection rate in the first field. The hopper capacity shall be based on the inlet dust burden, gas flow rate and gas temperature indicated in ESP sizing criteria (refer Sub section A-01 of section -VI) for the design point condition while firing the maximum ash. (Storage shall be upto a level which will not reduce the overall efficiency of the precipitator due to re-entrainment). Ash storage capacity shall be atleast 10% higher than the ash storage capacity theoretically required for each dust hopper. Specific weight of ash shall be assumed as 650 kg/m ³ for calculating storage capacity and 1350 kg/m ³ for structural design. Further for hopper strength and ESP structural calculations the level of ash in ESP shall be considered at least up to the top of hopper	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
		PAGE 62 OF 67

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	partition plane or the bottom of electrodes (whichever is more) along with additional ash build-up from the end of the third field up to the ESP flue gas inlet duct bottom level at a natural repose angle (not less than 30 degree to the horizontal in any case). In case a bidder desires to adopt any level higher than that calculated as above, this higher level may be adopted. Necessary calculations supporting the same shall be furnished along with the bid. The number and arrangement of dust hoppers shall be such that there is at least one dust hopper per T/R set. Further, an arrangement with one hopper being shared by more than one T/R set is not acceptable. The hoppers for all fields shall be identical in shape and size. Hoppers shall be in welded steel plate construction with 5 mm minimum plate thickness. The lower 1/3rd or 1.5 meter whichever is higher shall be lined with 16 gauge or heavier, type 304 stainless steel. All hopper internal sloping corners shall have 100 mm radius. Hopper valley angle to the horizontal shall not be less than sixty five (65) degrees. Hopper outlet flanges shall be terminated tentatively at an ELoF (+) 3.5 meters. 8.02.00 Out of total height of conical hopper, minimum 2/3rd height should be conical and transition piece with slope of sixty five (65) degrees may be accommodated in the remaining 1/3rd of height. The hopper shall be properly supported by hangers/other supports and necessary calculation in support of this shall be furnished by the bidder. 8.03.00 The dust hoppers shall be electrically heated up to a minimum of lower one third (1/3) of the dust hopper height but not less than 1.5 metre in height by thermostatically controlled curved panel heating elements matching with curved surfaces of conical hopper to prevent ash bridge formation by maintaining the ash temperature above 140 deg C. All heaters on each level shall have same wattage and be capable of maintaining internal hoppers temperature in excess of 140 deg.C and capacity selection of these heaters shall be as per Employer's approval. This temperature must be maintained even when there is no flow of flue gases through the precipitator. The wall temperature of 140 deg.C must be maintained near hopper mouth for which thermostat has to be located within 18 inches of hopper mouth and sufficiently away from hopper heaters in all the hoppers of all the ESP passes. The cut in and cut out set point of thermostat shall be adjusted at 135 deg.C & 140 deg.C respectively. Separate thermostat shall be provided for wrap around heaters if used for adapters. The temperature settings shall be same as provided for other thermostat on hopper heaters. Maximum excursion of flue gas temperature upto 350-400°C, while the air heaters are out also shall be considered for heater mechanical design. They shall be arranged in at least three groups i.e. for the lower, middle and upper half of the heated height. The heating system shall be of low watt density (less than 3W/square Inch of heater area), panel type to avoid hot spots and to have more uniform distribution of heat. Hopper heater shall have a heating capacity not less than 10 KW (excluding wrap around heaters for adapters (if any) per hopper where two nos. of hopper per TR set are provided and not less than 15 KW (excluding wrap around heaters) per hopper where one hopper per TR set is provided. The hopper heaters shall be complete with local panel having, indicating lamps and test lamps. Individual indicating lamp should be provided for each heaters & alarm should come in case of nonworking of individual heater on the local panel. Further, provision for alarm shall be provided incase temp at hopper mouth falls below a preset. The Minimum heat input shall in no case be less than 500 watts/m² of hopper surface area. These heaters shall have high reliability by connecting multiple parallel circuits (not less than six), thereby ensuring that burn out of one element does not affect the other heater element. Heating elements shall be of sturdy construction and made with Inconel 600 (punched type) or flat type Nichrome foil suitable for ESP application in power plants. These heaters shall have design life of 25 years and shall be able to withstand the thermal cycling as well as dynamic forces such as hopper poking, vibrations, sledge hammering to the hopper anvil or hopper itself. Each hopper shall be provided with separate thermostats.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP	PAGE 63 OF 67

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	External surface of the hoppers shall be properly insulated. To prevent sneakage, hopper insulation shall be applied directly into the face of hopper stiffeners essentially forming a series of sealed cavities throughout the areas of hopper that are being heated. Special attention must be paid to the corners where two stiffeners meets and any gaps left by the formation of converging stiffeners & bottom of hoppers must be plugged and sealed with insulation & cladding sheet. Bottom of hopper should be insulated and well sealed to prevent ingress of Ambient Air. Insulation on Hopper heater shall be provided such that there should be variable Air gap maximum from the Top layer of heaters element to minimum at the bottom layer of heating element. (Example of Typical Draft Barriers & convection stops are shown in tender drawing no. 0000-104-POM-A-003 for reference only). Adopter piece if any, required to connect conical hopper to ash evacuation system shall also be heated and thermally insulated. For heating the adopter piece, curved panel heaters shall be used. However, wrap around heaters are allowed to use heating adopter piece only. Provision for half heaters cutting and adjustment of temperature with indication for each hopper heater shall be provided. Facility for switching 50% heating capacity from local switch shall also provided.			
8.04.00	Each hopper shall be provided with two (2) nos. of hundred (100) mm dia poke hole in mutually perpendicular directions, with threaded caps. The caps shall have flat iron bars suitable for striking with a hammer, to assist in breaking free any seized threads. The hoppers, adapter piece, spool piece, & bend up to Knife Edge Gate valve shall also be provided with suitably designed and located rapping anvils for loosening the fly ash by striking with sledge hammer.			
8.05.00	Provision shall be made on the two sides of each hopper for future installation of aeration block (if applicable).			
8.06.00	Hopper baffles shall be designed to be capable of withstanding the unbalance of pressure created when one side of the hopper is filled with fly ash and the other side is empty. All bracing and stiffening shall be on the external side of the hoppers. Internal bracing, stiffening etc., shall not be accepted.			
8.07.00	Each dust hopper (except first field ESP hoppers) shall be provided with a high level and a low level dust level monitor operating on proven Radiofrequency measurement principle. The level monitoring system shall incorporate all the necessary accessories including two nos. level switches per hopper (one for high and other for low level), each with 2 NO + 2 NC contacts, local and remote signalling lamps and high and low level alarms. The high level ash switch will provide contact closure and activate the alarm when the ash level reaches a level high enough to cause deterioration of ESP performance and possibility of damage to ESP structure if not corrected. After a preset time elapses with the ash under high alarm activated, the logic shall have provisions to de-energise the TR set of the particular field of the affected ash hopper. The level control device shall be unaffected by ash build up, due to moisture or charged ash on either the hopper walls or on the probe itself. Acoustic 3D Level Scanner Based Level Monitoring System / NOGS (Naturally Occurring Gamma Sensor) based level monitoring system for each ESP Hopper in the First Three Fields shall be provided complying with requirements indicated in Sub-Section-IIIC-03 Main Equipment Related Control and Instrumentation System, Part-B, Section-VI of Technical Specifications.			
8.08.00	Each hopper shall be provided with a quick opening access door of not less than dia 600 mm, if round or not less than 450 mm x 600 mm, if rectangular. Access doors shall be hinged vertically and provided with a safety chain and grounding strap. Suitable access			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP	PAGE 64 OF 67

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	ladders shall be provided from the walkway beneath the hoppers to facilitate approach to the access doors.			
9.00.00	CASING			
9.01.00	Each of the ESP streams shall be housed in its own separate and independent casing. The casing height and lengths etc., necessary to obtain the required minimum collection area shall be such that the overall size and layout of ESPs fit into the space limitations as brought out in the relevant tender drawings.			
9.02.00	The precipitator elements shall be enclosed in gas tight, weather proof, all welded reinforced steel plates. Sway bracing, stiffener and other local members shall be incorporated into the shell construction. The precipitator casing shall be fabricated from all welded reinforced, 5 mm minimum thickness, carbon steel plates conforming to IS 2062: 2011. The exposed surfaces shall be self draining and seal welded to prevent ingress of moisture during monsoon.			
9.03.00	The precipitator casing and its elements shall be designed to withstand a pressure $\pm$ 660 mmwc at 67% of yield strength and a temperature of 200°C. In case of any unscheduled outage of the air heater, the temperature of flue gas at inlet to ESP may rise to about 300°C. This temperature excursion may persist for about five (5) to thirty (30) minutes until preventive measures are taken. The precipitator and its elements shall be designed to withstand this temperature excursion without damage or increased maintenance. All the calculations shall be furnished to substantiate this. Adequate provision shall be made to accommodate thermal expansion and movements as required by the arrangement and operating conditions. The casing shall be gas tight. In order to prevent distortions, the structural design shall take care of unequal expansions. Care shall be exercised in the design and fabrication of the precipitators to reduce air in leakage to a minimum. All joints which do not require opening during maintenance and/or inspection shall be seal welded.			
9.04.00	The precipitator casing and hoppers shall form a common structure reinforced to withstand the wind load (in accordance with IS:875), load due to dust storage in the hoppers etc.			
9.05.00	The inlet of the precipitators shall be provided with suitable flanged connections with the flue gas ducting which shall be completely seal welded inside and outside after assembly.			
9.06.00	Access door of quick opening type, shall be provided to allow entry to all sections of the precipitators for maintenance and access, the size of these doors shall not be less than 600 mm dia if circular or not less than 450 mm x 600 mm if rectangular. They shall be provided with safety chain and grounding strap. Doors shall be capable of being pad locked. Design shall be such as to eliminate air in leakage through the doors. All doors providing access to high voltage parts shall have warning signs permanently attached and marked "Danger High Voltage".			
9.07.00	The precipitator shall be guided, anchored or supported by lubricated plates/roller bearings/spherical bearings at such locations as may be required to limit precipitator, duct work or expansion joint forces or movement. Each casing shall be restrained to grow in a radial direction from the anchor point. In case lubricated plates are used these shall be covered under all conditions of precipitator movements by 1.6 mm, type 305 stainless steel plates.			
9.08.00	The casing shall be gas tight. In order to prevent distortion, the structural design shall take care of unequal expansion.			
10.00.00	PENT HOUSE COVERING			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP	PAGE 65 OF 67

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	ESPs shall be provided with weather proof pent house. The pent house shall be covered continuously with sheet as specified in civil section. Further, in case TR sets are kept above pent house then complete weatherproof roof on the pent house shall also be provided which should cover entire ESP including stairs.			
11.00.00	OPACITY MONITORS			
11.01.00	Each of the ESP gas streams shall be provided with one opacity monitor, installed on the ducting between ESP and the common duct at ID fan inlets. Sufficient straight duct length as recommended by the opacity monitor manufacturer shall be provided by the Bidder upstream of the proposed point of location to ensure laminar flow of the flue gas. Finalisation of location of opacity monitor shall be finalised as per the opacity monitors suppliers recommendations, as far as possible. However, all necessary approach, platform etc. for the opacity monitor shall be provided for maintenance of each opacity monitor by the contractor.			
11.02.00	Separate isolated 4-20 mA DC signals shall be provided for indication on unit control room from each flue gas opacity monitor. Dust emission in terms of mg/Nm³ shall be monitored. The system shall include all devices, softwares necessary for computing dust emission in mg/Nm³. The monitoring system shall be of visible type and shall meet the requirements stipulated by EPA regulations of USA.			
12.00.00	THERMAL INSULATION, LAGGING, CLADDING & REFRACTORIES			
	Thermal Insulation along with aluminum cladding shall be provided for all the equipments/surfaces having skin temperature more than 60 degree Celsius. The insulation shall be sized & designed based on criteria's specified in Sub section A-13,Part-B, Section-VI. However the thickness of the insulation shall not be less then 75 mm in any case.			
13.00.00	Refer Sub- Section A-12, Part B, Section VI for painting requirements.			
14.00.00	ASH FLOWABILITY STUDY OF ESP HOPPERS			
	A comprehensive flowability study of fly ash from ESP hoppers shall be conducted by the contractor to ensure smooth flow of ash under various operating conditions of the plant including Steam Generator, ESP and Fly Ash Removal System. The hoppers are required to promote mass flow without arching and rat holing problems. The main aim of the flowability study is to ensure consistent flow from each hopper to the ash removal system and following requirements shall be met by the contractor in this connection:			
	i) The study could be conducted on scaled down model of ESP hopper prepared by the bidder and at different relevant temperatures. Ash flowability to be carried out with three different samples of the fly ash collected from the			
	a) First Field			
	b) Last field			
	c) Intermediate field.			
	Contractor shall collect the fly ash sample from Employer's operating plant (to be identified by Employer at the contract stage). NTPC will facilitate collection of fly ash sample at its power plant. However, Contractor shall make his own arrangement for collection and transportation of ash sample to its works / laboratory from Employer's plant.			
15.00.00	ELEVATORS FOR ESP CONTROL ROOM			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP
PAGE 66 OF 67				

CLAUSE NO.	TECHNICAL REQUIREMENTS																						
15.01.01 15.01.02	Design Elevator shall be of conventional for ESP Control room. The elevator shall meet the quality of international standard. Elevators shall be designed based on following criteria : <table border="1"> <tr> <td>i)</td><td>Design/construction/installation codes.</td><td>:</td><td>Latest edition of IS: 14665 (all parts)</td></tr> <tr> <td>ii)</td><td>Load carrying capacity</td><td>:</td><td>680 kgs. (equivalent to 10 persons) for passenger elevator for ESP control room.</td></tr> <tr> <td>iii)</td><td>Rated speed</td><td>:</td><td>1.0 m/sec.</td></tr> <tr> <td>iv)</td><td>Position of machine room</td><td>:</td><td>Directly above the elevator shaft.</td></tr> <tr> <td>v)</td><td>Machine room</td><td>:</td><td>Machine room shall be provided with Window air conditioner of minimum 2T capacity per elevator shall be provided by bidder.</td></tr> </table>			i)	Design/construction/installation codes.	:	Latest edition of IS: 14665 (all parts)	ii)	Load carrying capacity	:	680 kgs. (equivalent to 10 persons) for passenger elevator for ESP control room.	iii)	Rated speed	:	1.0 m/sec.	iv)	Position of machine room	:	Directly above the elevator shaft.	v)	Machine room	:	Machine room shall be provided with Window air conditioner of minimum 2T capacity per elevator shall be provided by bidder.
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-02 STEAM GENERATOR & AUXILIARIES INCLUDING ESP	PAGE 67 OF 67																				



SUB-SECTION-A-05

FLUE GAS DESULPHURISATION SYSTEM

**SINGARENI THERMAL POWER PROJECT
STAGE-II (1X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC NO.:CW-CM-11159-C-O-M-001**

	 TECHNICAL REQUIREMENTS		
	FLUE GAS DESULPHURIZATION (FGD) SYSTEM		
1.00.00	GENERAL The design/specifications/sizing of various plants/systems/equipment offered for Flue Gas Desulphurisation (FGD) System shall comply with the requirements detailed hereinafter along with limestone as specified in Part-A:		
1.01.00	System Description The Flue Gas Desulphurisation (FGD) System shall be based on Wet Limestone Forced Oxidation process. The FGD system shall be installed downstream of the Induced Draft (ID) fans. The flue gas temperature may approach the economiser outlet temperature of about 300°C in case the regenerative air preheaters fails to operate. The Contractor shall take this aspect into account while designing the Flue Gas Desulphurisation (FGD) System.		
1.02.00	Service Conditions The Steam Generators which are designed to burn pulverised coal will use LDO during startup and at low loads for warm up and flame stabilization. Further, the frequency and duration for startup and low loads operation may be quite high during the first year of unit commissioning and operation. The Steam Generator has been designed for cyclic/two shift operation. Expected numbers of Steam Generator start-ups during 25 years of design life shall be as per clause 1.05.00, A-02, Part B. The Contractor shall take into account the entire characteristics of expected combination of fuels to be fired and the expected numbers of Steam Generator start-ups while designing the FGD system.		
1.03.00	Design Criteria		
1.03.01	The Flue Gas Desulphurisation (FGD) System shall be designed to meet all the conditions specified above. Representative coal and ash analysis for the expected coal and oil are given in the Technical Specification. The FGD system and all the associated auxiliaries shall be designed to comply with the requirements stipulated indicated in Equipment sizing Criteria in Sub-Section A-01, Part B of the Technical Specification. The values indicated for FGD sizing shall be considered as minimum design criteria. These shall be modified to more conservative values if Contractor experience warrants the same. However, no credit shall be given to the Contractor for this during evaluation of the bids. Utilization of these values in no way relieves the Contractor of his responsibility to meet all the guarantee requirements. The Contractor shall also furnish along with his offer the detailed calculations and data along with his Bid to establish as to how the Bidder will meet the efficiency requirements both at design and guarantee point as specified in FGD sizing criteria.		
1.03.02	The FGD system shall be designed to achieve the required SO ₂ capture without the use of oxalic acid or any other additives. The FGD System shall be designed so as to be in operation when Steam Generator is in operation.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION-A-05 (FGD) PAGE 1 OF 25

	TECHNICAL REQUIREMENTS 				
1.03.03	The wet absorber system shall be designed to maintain the required SO ₂ removal.				
1.03.04	In order to be compatible to all possible modes of operation, the design of the FGD plant shall enable short start-up times, compatible with load changes in the Steam Generator and shall ensure reliable mode of continuous operation.				
1.03.05	NA				
1.03.06	The FGD and the ancillary facilities shall be suitable for unlimited operation with all transients and at any load point between the minimum and maximum load point of the Steam Generator. Further, the FGD plant shall be suitable for an unlimited operation at any pollutant concentrations between minimum and maximum without exceeding the emission values of SO ₂ emission of less than 100 mg/Nm ³ (6% O ₂ dry) for the range of loads and coals.				
1.03.07	In case of failure of the SG and ancillary equipment, the FGD plant shall be brought automatically to the off-load operation without restriction by the current load case by suitable measures.				
1.03.08	In case of a power failure all items of equipment (e.g. minimum one agitator in absorber and limestone slurry tank, Process water pump & lube oil system of Booster Fan) which may cause irreversible damage to the FGD System shall be connected to the emergency power supply system to be provided by the Contractor. Bidder shall furnish a list of all such Auxiliaries in their bid proposal. Further, all the vital & critical valves, dampers etc. shall be designed for fail safe condition for any abnormalities, trips in the FGD system and its associated equipments/items. For details refer Part-C (GTR).				
1.03.09	Draining and flushing for the items in contact with limestone/gypsum slurry (pipes, tanks, pumps etc.) which are required even during short time outages or an emergency shutdown shall be started automatically and by remote control from the Control Room.				
1.03.10	All items or equipment which are subject to wear, abrasion or failure (e.g. nozzles, pumps, pipe work, etc.) shall be designed and installed for easy replacement, repair and maintenance.				
1.03.11	The design and the construction shall be performed so as to avoid stress corrosion cracking, galvanic or other types of corrosion. Especially when using two different alloys, appropriate measures shall be taken to avoid corrosion. This is subject to approval by the Employer.				
1.03.12	All items of equipment including flue gas ducts, expansion joints, etc. shall be designed considering thermal and mechanical strength as a function of the maximum temperature which might occur in case of a failure of any upstream equipment.				
1.03.13	NA				
1.03.14	In case distance from Limestone Grinding system/ Gypsum dewatering system and Absorber is more than 500 m, Bidder shall provide the following Flushing system at intermittent locations for the limestone /gypsum slurry pipeline which shall contain tank and pumps. Intermittent location distance of flushing system shall be based on their proven practice.				
1.03.15	NA.				
<table><tr><td>SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE</td><td>TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001</td><td>SUB-SECTION-A-05 (FGD)</td><td>PAGE 2 OF 25</td></tr></table>		SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION-A-05 (FGD)	PAGE 2 OF 25
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION-A-05 (FGD)	PAGE 2 OF 25		

	TECHNICAL REQUIREMENTS 				
1.04.00	Justification of Proposed Design				
1.04.01	All the design procedures, systems, and components proposed shall have already been adequately developed and have demonstrated good reliability under similar or more arduous conditions elsewhere.				
1.04.02	The Bidder shall submit with the offer, comprehensive information on how the L/G ratio, mass balance, spray nozzle cone angle, spray nozzle arrangement, limestone consumption etc. of the proposed design has been arrived at. The Contractor shall also submit alongwith the offer, a detailed write up on the proposed design features with recent design modifications, if any, and their specific advantages over the previous designs. The offered system should be designed in a manner to comply with the design & guarantee conditions (specified elsewhere) and should have good O&M features to ensure the plant sustained smooth operation for the envisaged life.				
1.05.00	Statutory Approval The engineering, design, supply and installation of FGD system and the associated auxiliaries shall comply with the applicable safety code and regulation of the locality where the system is being installed.				
1.06.00	Location & Layout Requirements				
1.06.01	The Contractor shall offer the best design to accommodate the Flue Gas Desulphurisation (FGD) System within the confines of the space available. The location of FGD System have been indicated in the General Layout Plan.				
1.07.00	Capital Overhaul of FGD System Employer envisages to carry out the capital overhaul of units once in three (3) years. The design and materials for various equipments/auxiliaries etc. shall be selected by the Contractor keeping in view the above requirement of the Employer, such that no major repairs/replacements, requiring shutdown of the unit, are needed in between the capital overhauls.				
1.08.00	Maintenance				
1.08.01	The Contractor shall provide adequate handling facilities & approach as for carrying out on-line and off-line maintenance of the FGD system and its auxiliaries. In order to carry out on-line maintenance, it shall be possible to readily disassemble, repair and reassemble the equipment supplied in the shortest period.				
1.09.00	Noise level shall be in line with the applicable codes. Following to be ensured other then as defined elsewhere in specifications: Crusher: 100 dBA.				
<table><tr><td>SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE</td><td>TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001</td><td>SUB-SECTION-A-05 (FGD)</td><td>PAGE 3 OF 25</td></tr></table>		SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION-A-05 (FGD)	PAGE 3 OF 25
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION-A-05 (FGD)	PAGE 3 OF 25		

TECHNICAL REQUIREMENTS



2.00.00

EQUIPMENTS AND SYSTEMS SPECIFICATIONS

Specified hereafter are the minimum acceptable functional requirements of the Employer, and all components, equipments and systems for the Flue Gas Desulphurisation System shall be designed to cater to these requirements. Compliance to various stipulations of the Technical Specifications, functional requirements of Employer and utilization of various parameters and their values in the specification by the Contractor shall in no way relieve the Contractor of his responsibilities to meet all guarantee requirements or of providing completely safe and reliable operating equipment/systems.

The complete FGD system and the associated auxiliaries shall be designed by the standard industrial practices. Only field proven materials for similar application shall be used for the system. The complete installation of liners shall be made under the supervision of the liner supplier as per their guidelines. In the execution of the welds contractor must ensure that welding material has same corrosion resistance as the actual plate surface.

Alloy to carbon steel welds must either be hidden behind a covering strip of alloy material, or be executed by a special welding procedure ensuring the same quality at the weld surface as the alloy lining. All welding which shall be in the contact with process fluids shall be executed under the supervision of the designer/manufacturer.

3.00.00

FLUE GAS SYSTEM

3.01.00

The entire flue gas system, flue gas ducts inlet to absorber and bypass duct etc. shall be designed to meet the following conditions:

1.	Design internal pressure at 67% yield strength (mmwc)	+660 and -150 mmwc or maximum conceivable head of Booster fan (if provided), whichever is higher, at 67% of yield strength of material
2.	Design Inlet Gas Temperature (deg.C)	145 or as per Design Point conditions, whichever is higher
3.	Short temp excursion temperature of inlet gas (for approx. thirty(30)minutes at a time) (deg. C)	300
4.	Inlet Dust Burden in Gas (mg/Nm3)	50 to 200
5.	Maximum flue gas velocity through the Absorber (m/s)	Not more than 4 m/s at Design Point Conditions(not applicable for bubbling type absorber)
6.	Recirculation Slurry pH	Not less than 5.5 under all operating conditions. For JBR (Jet Bubbling Reactor) technology, pH range - between 4 and 6 (Justification of the selected pH shall be provided with proven references).

	TECHNICAL REQUIREMENTS 		
3.02.00	Design		
3.02.01	The flue gas ducts shall be sized and designed to meet all the criteria as specified in Cl. No 16.00.00 this subsection.		
3.02.02	All ducts with operating temperature above 60°C shall be insulated in accordance with Sub-Section A-13 (Thermal Insulation), Part B, of the Technical Specification		
3.02.03	The duct layout shall ensure that there is no accumulation of acid mist on the duct floor.		
3.02.04	The duct to Absorber inlet shall be made of Carbon steel of minimum 7mm thickness. The duct from Absorber outlet to bypass duct & duct after bypass damper/gate to chimney inlet shall be made of clad sheet of minimum 2 mm thickness of either Titanium (Grade 2 as per ASME SB265) or C-276 over 7 mm thick (minimum) mild steel base metal. Cladding shall be done to achieve the required quality as per ASTM B 898-11.		
3.02.05	Wherever required, expansion joints of proven design shall be provided by the Contractor in the ducts to take care of differential expansion in the system. The material chosen for expansion joints shall be suitable for the duty conditions and the corrosive atmosphere of the FGD system and shall be field proven for similar applications. The expansion joints shall be guaranteed for faultless material and workmanship, for a minimum guaranteed life of not less than 20000 hrs. of operation. During Guarantee period any defects noticed in the expansion-joints due to faulty material and workmanship shall be rectified by the Contractor free of cost.		
3.03.00	Gates & Dampers		
3.03.01	Provision shall be made for facilitating operation of unit with FGD bypass. This shall also facilitate the online maintenance of absorber system and associated equipment's. The arrangement of the flue gas system shall allow complete isolation of the absorber from the gas side, with the unit in operation. For this purpose, Motorized Guillotine type gates shall be provided at (i) hot gas inlet to Absorber (in case booster fan is not provided by the bidder) and (ii) cold gas outlet from Absorber. Motor operated Guillotine gate shall also be provided by the Contractor at the outlet of each Booster fan, in case Booster fan is provided by the Contractor. The Gates shall be provided with 2x100% seal air fans. Gates at outlet to Absorber shall also be provided with 2x100% electrical heaters. The Gates shall be designed for tight shut-off. The design of the gates shall ensure 99.95% leak tightness, on flow basis, without seal air. The gates shall be 100% leak tight with seal air fans under the above conditions.		
3.03.02	Regulating type pneumatically operated bi-plane damper with quick opening facility along with 2x100% seal air fans & 2x100% electrical heaters shall also be provided in the by-pass duct. The design of the damper shall ensure 99.5% leak tightness, on flow basis, without seal air. The damper shall be 100% leak tight with seal air fans under the above conditions.		
3.03.02A	Bidder may provide common seal air skid for FGD Outlet guillotine gate and the bi-plane damper in the FGD bypass duct. Seal air skid (with 2x100% fans + 2x100% heater) shall be sized considering either the requirements of FGD outlet gate (when FGD loop is closed / FGD not in operation) OR for bypass damper (when bypass loop is closed / FGD under operation), whichever is higher.		
3.03.03	The design of the gates shall ensure 99.95% leak tightness without seal air on flow basis		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION-A-05 (FGD) PAGE 5 OF 25

	TECHNICAL REQUIREMENTS 			
	along the duct as well as from the duct to atmosphere.			
3.03.04	The blade and other components in the gas path, of the bypass damper and gate at Absorber outlet shall be made of Carbon steel with C276 cladding of sheet of minimum thickness 1.6 mm or better material. The seals shall be made of Alloy C-276 or better material.			
3.03.05	The gates/dampers shall be controlled from the control room with auto opening of bypass damper in case of emergency. Manual gate operation should be easy for O&M.			
3.03.06	NA			
3.03.07	All gates shall be designed to withstand the operating air and flue gas temperature without distortion.			
3.03.08	All guillotine gates shall be located in horizontal duct to avoid fly ash build up when in closed position and shall be of top entry type.			
4.00.00	BOOSTER FAN (If Required):			
4.01.00	To take care of the additional pressure drop in the FGD System, Contractor at his own discretion can provide 2x60% Booster Fans. The Booster Fans shall be located downstream of the ID Fans (Induced Draft Fans) in the inlet duct to Absorber shall be capable of handling the additional pressure drop in the FGD system & ducting and maintain required chimney inlet pressure over the entire load range with any one or both Booster fans in operation in conjunction with one or both ID fan in operation while firing the specified range of fuels. Booster Fans shall be sized & designed as per the Sizing Criteria and specification requirements specified for ID Fans elsewhere in the Technical Specification. All the margins on flow & head shall be same as that considered for ID Fans.			
5.00.00	ABSORBER			
	The unit shall be provided with an independent/dedicated absorber.			
5.01.00	The contractor may offer either a spray type absorber, with single or multiple levels of spray, or an absorber with gas bubbling through the slurry, as per Bidders/Collaborator's proven practice. Only proven system in successful operation in previous installations supplied by the contractor shall be offered. A Spray System (if offered) (i) The contractor shall provide spray system and minimum spray levels required to meet the stipulated guarantee and design requirement. The spray system (including slurry recirculation pump & nozzles) shall be sized to achieve a desired L/G ratio required to meet the guarantees SO₂ removal efficiency, with redundancies specified under this clause. (ii) In case the contractor offers an absorber with multiple levels of spray nozzles, each spray level shall be provided with independent 2x100%			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION-A-05 (FGD)	PAGE 6 OF 25

	TECHNICAL REQUIREMENTS 		
	pumps. Alternatively, the contractor may offer a spare spray level with each spray level served by an independent 100% capacity pump. In case the contractor offers a single level of spray, one number of standby pump of the same capacity & head as the working slurry recirculation pumps shall be provided. The contractor shall provide spray system / spray levels only as per his proven practice, which should be in successful operation elsewhere. (iii) The slurry recirculation pumps shall have a minimum margin of 10% on flow and 10% on frictional head, over the actual requirement for meeting the guarantee and design point conditions. All slurry recirculation pumps including motors shall be of the same size and type. (iv) The slurry recirculation pumps shall have motor /pneumatic driven knife gate valve at pump suction and motor/pneumatic operated Butterfly Valves at discharge side as per the standard practice of bidder. In order to optimise power consumption of FGD system at part load operation, bidder to provide atleast one slurry recirculation pump preferably lower level with Variable Frequency Drive (VFD). (v) The slurry recirculation pumps shall be wear-resistant and equipped with flushing devices and single mechanical seals with automatic flushing with a connection for additional manual flushing. (vi) The slurry pumps shall also comply with the requirements stipulated in Clause 8.00.00 of this sub-section. (vii) Sufficient redundancy, as per the proven practice of the contractor, shall be provided in the spray nozzles. Minimum 10% spare nozzles shall be provided at each level. B Bubbling Type Absorber (i) In case the bidder offers an absorber with gas bubbling through the slurry, the complete gas distribution system to the slurry shall be in bidder's scope. No recirculating pump and spray header and nozzles shall be required in such case. However, 3 x 50% Gas Cooling Pumps instead of Slurry Recirculation shall be provided. The spray headers & piping which are in contact with hot flue gas shall be made of Alloy 59 or C276 and nozzles shall be made of Silicon Carbide or ceramic or equivalent having a minimum guaranteed life of 20,000 hrs. Cooling Pump discharge piping and valves outside the flue gas path shall be in line with the requirements specified for slurry recirculation pumps. The Cooling Pumps shall be installed in a shed with roof sheeting (ii) The sparger and gas riser tubes shall be made of proven material which shall have a minimum life of 5 years. Minimum10% of the number of Sparger Tubes required for one JBR to be provided as warehouse spares for the project in case JBR technology adopted by the Bidder.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION-A-05 (FGD)	PAGE 7 OF 25

	 TECHNICAL REQUIREMENTS												
5.02.00	Absorber Recirculation Tank Sufficient number of agitators, as per the proven practice of the contractor, shall be provided for thorough mixing of the re-circulating slurry. In case the Contractor's Absorber includes side entry agitators, the contractor shall offer and demonstrate mixing arrangement such that n-1 number of agitators are sufficient to avoid the slurry settlement in the absorber tank in case of one agitator under breakdown (n-total no. of working agitators). In case vertical absorber agitators are offered, one complete mechanical assembly of agitator shall be supplied as warehouse spare for each Absorber. In alternate cases of absorber design also, the bidder to provide no.of agitators as per its proven practice (minimum two (02) nos.) and additional one agitator shall be provided as warehouse spare.												
5.03.00	Absorber Oxidation Systems												
5.03.01	The contractor may offer either a grid type oxidation system or a sparge jet oxidation system or lance type or air rotary sparge system or jet air sparger system for oxidation of sulfite sludge to sulfates, or any other proven system as per the practice of the FGD vendor.												
5.03.02	The oxygen required for oxidation shall be supplied by 2x100% oxidation air blowers for each absorber. The blower shall be sized to supply atleast 2.5 times the stoichiometric air requirement for spray tower process & at least 4.0 times the stoichiometric air requirement for Bubbling Type process or the actual requirement, whichever is higher, under the following condition, all occurring simultaneously. The natural oxidation of sulfite by residual oxygen in flue gas shall not be considered for this purpose. <table><tr><td>Load</td><td>Design point Flow</td></tr><tr><td>Flow</td><td>Minimum 2.5 times for spray tower process & 4.0 times for Bubbling Type process of the stoichiometric requirement</td></tr><tr><td>Head</td><td>For spray tower process actual requirement considering choking/ blockage of minimum 10% of the oxidation nozzles / sprayers or minimum 8500 mmwc whichever is higher. For Bubbling Type process actual requirement considering choking/ blockage of minimum 10% of the oxidation nozzles / sprayers or minimum 3500 mmwc whichever is higher.</td></tr><tr><td>Margin on Head</td><td>10% margin on the higher value of above.</td></tr><tr><td>Ambient Conditions</td><td>45°C / 60% RH.</td></tr></table>			Load	Design point Flow	Flow	Minimum 2.5 times for spray tower process & 4.0 times for Bubbling Type process of the stoichiometric requirement	Head	For spray tower process actual requirement considering choking/ blockage of minimum 10% of the oxidation nozzles / sprayers or minimum 8500 mmwc whichever is higher. For Bubbling Type process actual requirement considering choking/ blockage of minimum 10% of the oxidation nozzles / sprayers or minimum 3500 mmwc whichever is higher.	Margin on Head	10% margin on the higher value of above.	Ambient Conditions	45°C / 60% RH.
Load	Design point Flow												
Flow	Minimum 2.5 times for spray tower process & 4.0 times for Bubbling Type process of the stoichiometric requirement												
Head	For spray tower process actual requirement considering choking/ blockage of minimum 10% of the oxidation nozzles / sprayers or minimum 8500 mmwc whichever is higher. For Bubbling Type process actual requirement considering choking/ blockage of minimum 10% of the oxidation nozzles / sprayers or minimum 3500 mmwc whichever is higher.												
Margin on Head	10% margin on the higher value of above.												
Ambient Conditions	45°C / 60% RH.												
5.03.03	Oxidation nozzles / spargers shall have a minimum redundancy of 10% or as per the contractor's proven practice whichever is maximum and justification to be provided during detailed engineering.												
5.03.04	Quenching system for oxidation system shall be provided for cooling & avoid deposits.												
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION-A-05 (FGD)										
			PAGE 8 OF 25										

	 TECHNICAL REQUIREMENTS										
5.04.00	Gypsum Bleed Pump The absorber shall be provided with 2x100% Gypsum Bleed Pumps for supply of gypsum slurry to Gypsum Dewatering system. Each Gypsum bleed pump shall be sized to bleed-off the gypsum slurry from the absorber with slurry solid concentration of 15% (to match the Employer's existing FGD gypsum bleed solid concentration, in order to feed to Employers Common primary hydrocyclone feed tank), under the following conditions, all occurring simultaneously: <table><tr><th>Load</th><th>Design point</th></tr><tr><td>Flow</td><td>100% of gypsum produced at Design point condition</td></tr><tr><td>Head</td><td>As per system requirement</td></tr><tr><td>Margins</td><td>Flow -- 15% Head – 20%</td></tr></table> The Bidder may also size Gypsum bleed pump to bleed-off the gypsum slurry from the absorber with slurry solid concentration other than the value specified above as per their proven practice subject to not exceeding 30%. However, in this case the Gypsum slurry shall be taken to Bidder's own Primary Hydrocyclone tank. The pumps shall be designed to meet the stipulations of Clause No.8.00.00 of this Sub-Section. Provision shall also be provided in the Gypsum Bleed Pumping system by provision of tap off, valves etc. for pumping the gypsum bleed to alternate source.			Load	Design point	Flow	100% of gypsum produced at Design point condition	Head	As per system requirement	Margins	Flow -- 15% Head – 20%
Load	Design point										
Flow	100% of gypsum produced at Design point condition										
Head	As per system requirement										
Margins	Flow -- 15% Head – 20%										
5.05.00	Emergency Spray System An emergency cooling system for automatic spray of quenching water for a sufficient time (minimum 15 min) at the inlet to the absorber in case the gas temperature exceeds the design temperature due to failure of upstream equipment's shall be provided to protect the FGD and all other sensitive downstream equipment against high flue gas temperatures. The water shall be supplied from an elevated tank (emergency water tank) installed near to the absorber. The system shall be designed to fill/refill the emergency water tank in 2 hours in case dedicated pump is used for filling of tank. The tank volume and the injection lances/nozzles shall be designed to protect the inlet duct and the lining of the absorber& absorber internals. The inlet duct shall be sloped towards the absorber.										
5.06.00	Design										
5.06.01	The design and arrangement of the absorber shall be field proven for successful long-term operation in conjunction with a coal fired power plant.										
5.06.02	The design of flue gas ducts and inlet and outlet hoods of the FGD as well as [guide vanes and baffle plates shall ensure a homogeneous fluegas flow with respect to the distributions of: (i) temperature (ii) velocity (iii) dust content										
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION-A-05 (FGD)								
			PAGE 9 OF 25								

	 TECHNICAL REQUIREMENTS		
	(iv) slurry injection and distribution. The above shall be proven by two phase Computational Fluid Dynamics simulations (liquid and gas). The scope of modelling shall include flue gas path inside the absorber vessel including inlet and outlet duct. Homogeneity shall be ensured, if the deviation from average is less than $\pm 10\%$. Further, in the Absorber outlet hood no internals such as guide vanes and baffle plates shall be allowed.		
5.06.03	NA		
5.06.04	The absorber shell shall be designed for pressure loads, piping forces and moments, wind and seismic loads and all other loads imposed on the absorber. Bracing and reinforcement shall be adequate to prevent deflection and vibration. Internal supports for mist eliminator sections, etc. shall be designed to withstand the flooded weight of the supported section. The absorber and its structural supports shall be designed for the maximum operating loads including design positive & negative internal pressure, static head, external attachment loads (such as exerted by piping) wind load using the allowable stresses permitted by the applied standards.		
5.06.05	It shall be possible to reach the SO₂ emission guarantees, at Guarantee point condition, with at least one spray level continuously out of service (in case the absorber is equipped with several spray levels) or one spare pump continuously out of service. (This clause is not applicable for JBR technology)		
5.06.06	Three stage chevron type Mist Eliminators (ME) made of polysulfone or stainless steel shall be provided at the exit of the absorber. Provision shall be made for washing of both ends of the first & second stage and the front section of the third stage of mist eliminators. Wash water arrangement shall also be provided at the back end of the second stage of mist eliminator. If the mist eliminator washing system is designed for cyclic washing of different sections, all the valves required for cycling shall be motorized or pneumatically operated. The ME system shall be equipped with washing and drain provisions, where drains are directed into the absorber. Washing provisions shall include external and internal piping systems with replaceable nozzles, water pressure booster pumps (if required) complete with all piping, valves, instrumentation and controls. The mist eliminator wash piping/header shall be constructed of Chlorobutyl / Bromobutyl rubber lined carbon steel or glass fiber reinforced plastics. Polypropylene or PVC is also acceptable for mist eliminator wash headers provided Contractor or its Collaborator has proven experience for the same. Carbon steel pipe can be selected outside pipe up to the nozzles at Mist Eliminator casing only for the portion which is not exposed to slurry. Ease of replaceability and placement of the mist eliminator on maintenance platforms is an important requirement. The ME shall be designed to allow for efficient cleaning in process. Test ports shall be provided downstream of the mist eliminator to enable performance testing. The mist eliminator system shall be capable of withstanding high velocity spraywater jets typically employed during manual cleanings. The ME shall be constructed in individual cells. The design shall safely avoid ME vibration and/or humming. Walkways shall be arranged and also measures shall be taken as appropriate to permit the internal components to be disassembled and reassembled during repairs without the necessity for time-consuming preparatory work. The headroom shall have a height of more		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION-A-05 (FGD)
			PAGE 10 OF 25

	TECHNICAL REQUIREMENTS 				
	than 2200 mm. The mist eliminator support beams shall be designed to act as maintenance walkways approximately 300 mm wide and shall allow for a minimum 500 Kg/m² load. Adequate number of viewing ports with flushing devices connected to automaticallyoperating washing system shall be delivered at following locations: (i) upstream of 1st stage (ii) between 1st and 2nd stage (iii) downstream of 2nd stage. (iv) downstream of 3rd stage The regular flushing shall be done in a defined time sequence.				
5.06.07	The absorber oxidation tank shall be provided with an over flow line (for spray tower process) complete with sealing pot, over flow and drain line. The absorber over flow shall be taken to a sump in the absorber region, from where the slurry shall be pumped back to the absorber by a sump pump.				
5.06.08	Materials used shall be suitable for the chemistry of the absorber process and resist abrasion from any particulate contained in the incoming flue gas and from the particulate of desulphurization process.				
5.06.09	NA				
5.06.10	The raw gas inlet duct of the absorber shall be equipped with a flushing device of the side walls and the ground, which shall operate continuously as well as intermittently.				
5.06.11	The complete absorber vessel (absorber oxidation tank, absorber tower & absorber outlet duct upto absorber outlet flange) shall be made of clad sheet of C276 / Alloy 59 (minimum 2 mm thickness) by explosion bonding or hot rolling, having minimum 7 mm thick carbon steel as base material.				
5.06.12	The material of process equipments of flue gas desulphurization system shall be appropriate for the chloride content and pH level at which the process is to operate.				
5.06.13	All internal members shall be lined with minimum 2 mm Alloy 59/ C276. All metallic fasteners which are provided inside the absorber/absorber wet-dry interface ducting shall be of Alloy 59/ C276.				
5.06.14	The absorber wet-dry interface shall be made of solid Alloy 59 or C276 of minimum 6 mm thickness.				
5.06.15	The other bridges (supports) shall be lined with minimum 2 mm Alloy 59/ C276.				
5.06.16	Lining material and technical application requirements shall be furnished by manufacturer experienced with similar FGD plants. Proof of such experience shall be provided by the Contractor.				
5.06.17	The spray headers (if provided) and air supply headers(exposed to slurry in any form) shall be made of FRP or Carbon Steel with Chlorolobutyl/Bromobutyl rubber lining (minimum 10 mm rubber lining), corrosions and erosion resistant in the inner and outer side (Silicon Carbide coating on metal/FRP surface exposed to slurry). Optionally ceramic coating is also acceptable provided bidder has proven experience for the same. The slurry spraying system shall be made of material resistant to erosion and corrosion. During the lifetime of the plant, only the nozzles shall be replaced. The distribution system of the slurry shall be hydraulically				
<table><tr><td>SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE</td><td>TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001</td><td>SUB-SECTION-A-05 (FGD)</td><td>PAGE 11 OF 25</td></tr></table>		SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION-A-05 (FGD)	PAGE 11 OF 25
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION-A-05 (FGD)	PAGE 11 OF 25		

	 TECHNICAL REQUIREMENTS		
	optimized.The spray nozzles shall be of silicon carbide or ceramic or equivalent having a minimum guaranteed life of 20,000 hrs. The design of the spray nozzles shall be such that rapid wear, encrustation and plugging are avoided.Nozzle pipes and slurry spray nozzles shall be with bolted flanged connections. Nozzle pipes shall be installed easily to be removed partially through absorber modules. In case of JBR technology, following shall apply: 1. Slurry spray headers shall be made of Nickel based alloy in gas cooling section. 2. Air supply header inside JBR shall be made of FRP. 3. Slurry spray nozzles in gas cooling section shall be made of SiC. Other slurry spray nozzles are made of SiC or High Alumina or equivalent having a minimum guaranteed life of 20,000 hrs. All wash and water nozzles and pipes shall be made of FRP. SiC coating shall be provided inside FRP slurry pipes.		
5.06.18	In case the absorber is equipped with several spray levels they shall be designed as follows: (i) For spray type Absorber, the last spray level upstream the mist eliminator shall be operated only in counter-flow. (ii) Depositions at downstream spray level and mist eliminator by co-flow injection of slurry shall be avoided. (iii) The spray lances shall be equipped with bars for installation of scaffolding without any offset. The spray levels shall be designed for a load of minimum 500 kgf/m². (iv) A flushing device of the spray levels with water shall be installed. Flushing shall take place if spray levels are out of operation.		
5.06.19	The absorber shall be self-supported from the bottom to suit site conditions. Absorbers which are externally supported from the structure are also acceptable provided Bidder or its Technology Collaborator has proven experience of supplying such Absorbers which are operating for more than 5 years. The absorber shall have adequate stiffening arrangement on the external side. Internal stiffeners shall be used only where it is not possible to provide proper external stiffening with approval of employer.		
5.06.20	It should be possible to build platforms inside the absorber for access to all parts of the absorber during maintenance. In case the contractor offers a multiple spray level design, minimum distance of 1.5 m shall be maintained between individual spray levels. Arrangement shall be properly designed to facilitate access for maintenance and replacement of spray nozzles.		
5.06.21	The spray piping, mist eliminators and its supporting structure shall be designed to carry sufficient load during maintenance.		
5.06.22	The bottom of the absorber sump shall be designed so that there will be an easy entrance (adequately sized doors) for a man with a wheelbarrow and should be full drainable easily.		
5.06.23	In case of Spray Tower System, Suction screens shall be installed inside or outside the Absorber vessel to protect the Slurry recirculation pumps. In case of Bubbling type, suction strainers shall be installed at the suction line side of Gas Cooling Pumps. The Screens shall be made of made of Alloy 59 /C276 or abrasion resistant FRP/Polypropylene (in case Contractor/Collaborator has proven experience).For the agitators a flushing system for start-ups shall be provided.		
5.06.24	It should be possible to discharge the absorber sump into the auxiliary absorbent tank within 2 hours.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION-A-05 (FGD)	PAGE 12 OF 25

	TECHNICAL REQUIREMENTS 															
5.06.25	At the head of the absorber two manholes shall be provided to reduce the draught of the stack during outage.															
5.06.26	Equipment's required for internal & external inspection shall be furnished by the contractor in brand new condition. List of all such items shall be furnished along with the Bid. The formation of agglomeration, deposition & caking shall be avoided. For areas, where this might occur, (e.g. mist eliminators, spray levels) the Contractor shall submit a cleaning procedure including the required safety measures as part of the inspection concept.															
6.00.00	LIMESTONE GRINDING AND SLURRY PREPARATION SYSTEM: Not Used															
6.01.00	Not used															
6.02.00	Not used															
6.03.00	Not used															
6.04.00	Not used															
6.05.00	Not used															
6.06.00	Limestone Slurry Preparation / Storage Tank: Not used															
6.07.00	Limestone Slurry Supply Pumps & Piping															
6.07.01	2x100% centrifugal type limestone slurry pump shall be provided for the unit. Each limestone slurry pump shall be sized to supply the limestone requirement of one (1 no.) unit, under the following conditions all occurring together. <table><tr><td>(i)</td><td>Load</td><td>Design point</td></tr><tr><td>(ii)</td><td>Flow</td><td>110% of one absorber requirement with the limestone requirement at Design point.</td></tr><tr><td>(iii)</td><td>Head</td><td>As per system requirement.</td></tr><tr><td>(iv)</td><td>Margins</td><td>Flow 10% (minimum) Heads 15% (minimum)</td></tr><tr><td>(v)</td><td>Solids Concentration</td><td>Max. 30% by weight or actual as per suppliers practice, whichever is minimum.</td></tr></table>	(i)	Load	Design point	(ii)	Flow	110% of one absorber requirement with the limestone requirement at Design point.	(iii)	Head	As per system requirement.	(iv)	Margins	Flow 10% (minimum) Heads 15% (minimum)	(v)	Solids Concentration	Max. 30% by weight or actual as per suppliers practice, whichever is minimum.
(i)	Load	Design point														
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(iii)	Head	As per system requirement.														
(iv)	Margins	Flow 10% (minimum) Heads 15% (minimum)														
(v)	Solids Concentration	Max. 30% by weight or actual as per suppliers practice, whichever is minimum.														
6.07.02	The limestone slurry pumps shall be designed to meet the requirements stipulated in Cl. No.8.00.00. of this Sub-Section.															
6.07.03	The limestone slurry pipes shall be sized to minimize erosion and avoid settling of the limestone at part load operation. The slurry pipes shall be lined with replaceable wear resistant natural rubber lining of minimum 6mm thickness. Additional thickness of 2 mm in rubber lining shall be provided at bends.															
6.07.04	Automatic flushing equipment for all lime slurry pumps and pipes shall be supplied.															
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION-A-05 (FGD)	PAGE 13 OF 25													

	TECHNICAL REQUIREMENTS 				
7.00.00	GYPSUM DEWATERING SYSTEM				
7.01.00	A common gypsum dewatering system for the unit is envisaged. Contractor shall supply part of the gypsum dewatering system for the unit, consisting of two streams of (2X100%) of primary and secondary hydrocyclones. The water removed from the Primary hydrocyclones and Secondary hydrocyclones shall be recycled to the absorber. All the equipments supplied shall be proven design with previous installations for similar capacities.				
7.02.00	All other stipulations with respect to sizing and design of the dewatering system, auxiliaries and other systems shall be in line with this specification.				
7.03.00	Primary Dewatering Hydro-cyclones				
7.03.01	Each set of primary dewatering hydro-cyclone shall be sized to dewater the gypsum slurry produced by the unit operating at Design point with an additional 10% margin. The solid concentration of Primary Hydrocyclone underflow shall be 45% or more to match the inlet slurry concentration requirement of the Employer's vacuum belt filters.				
7.03.02	Each set of primary hydro-cyclone shall be provided with 10% spare hydro-cyclones. The capacity defined in the previous clause shall be met with spare hydrocyclones out of service.				
7.03.03	The primary hydro-cyclone shall be installed directly above the Employer's belt filters for easy flowability of underflow. The overflow of the hydro-cyclones shall be taken to Hydrocyclone Waste Water tank via secondary hydrocyclone feed tank and secondary waste water hydrocyclone as shown in the relevant tender drawing.				
7.03.04	Hydro-cyclones shall be of modular construction. It shall be possible to remove and replace individual hydro-cyclone with the set in service. Individual isolation valve shall be provided for each hydro-cyclone for this purpose.				
7.03.05	The hydro-cyclone shall be of proven design The primary hydrocyclone shall me made up of made of polyurethane, Urethane or with replaceable rubber lining. The feed chamber shall be provided with a minimum lining thickness of 12 mm. The liners shall have a minimum wear life of not less than 8000 hrs.				
7.04.00	Vacuum Belt Filters: Not used				
7.05.00	Vacuum System: Not used				
7.06.00	Filtrate System				
7.06.01	Water from the secondary waste water hydrocyclone underflow shall be taken to a common filtrate tank for recirculation to the absorber tanks.				
7.06.02	2x100% horizontal centrifugal pumps shall be provided for recirculation of filtrate water to absorber. .				
7.06.03	The pump shall be capable of pumping of filtrate water with solid concentration of not less				
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION-A-05 (FGD)	PAGE 14 OF 25		

	TECHNICAL REQUIREMENTS 			
	than 10% & particle lumps of 6-7 mm. A 10% margin shall be provided in the pump.			
7.07.00	Waste Water System			
7.07.01	The overflow of the primary hydro-cyclones shall be taken to a secondary hydrocyclone feed tank for feeding the secondary waste water hydro-cyclones.			
7.07.02	The secondary hydrocyclone feed tank shall be sized to provide a minimum storage of 1 hr. of primary hydro-cyclone overflow with all the units operating at Design Point and no outflow from the tank.			
7.07.03	2x100% horizontal centrifugal pumps shall be provided to feed the secondary hydro-cyclones.			
7.07.04	Each set of hydro-cyclone shall be sized to process the maximum discharge from the secondary hydro-cyclone feed pumps. A minimum 10% spare hydro-cyclones shall be provided in each set. Secondary Hydro-cyclones shall be of modular construction and of proven design. The secondary hydro-cyclone shall be made up of polyurethane or urethane materials or replaceable rubber lining. It shall be possible to remove and replace individual hydro-cyclone with the set in service. Individual isolation valve shall be provided for each hydro-cyclone for this purpose.			
7.07.05	The secondary waste water underflow shall be taken to the adequately sized filtrate tank, while the overflow shall be taken to waste water tank. In case Bidder opts to provide additionally Lamella separator before the waste water tank and after the secondary hydro cyclone for removing impurities from the system, the solids concentration in waste water up to max 10% can be acceptable. However, the required moisture content in Gypsum & required Gypsum quality shall be complied.			
7.07.06	1x100% Waste water tank shall be provided which shall be sized for 8hrs storage of waste water with all the units operating at design point and no out flow from the tank. The Waste water tank shall be complete with agitator, level transmitters etc. The Waste water collection tank shall be of Steel construction with corrosion protection as per clause 10.01.00 of this sub-section. 2x100% horizontal centrifugal pumps shall be provided for pumping the waste water from waste water tank to the mixing tanks of HCSD system or in any other area with suitable treatment so as to suit/not to disturb the destination fluid quality. The material of Casing shall be rubber lined or Hi-chrome steel. The impeller shall be made of Hi-chrome steel. Shaft shall be of stainless steel 410 and shaft sleeve shall be stainless steel.			
7.07.07	All piping, valves & instrumentation shall be in the contractor's scope. Provision to correct the pH of the waste water by lime dosing shall be provided and after mixing of the effluent (using re-circulation system of the pumping system), the effluent shall be discharged once the waste water has been neutralized to desired pH. A pH monitor shall be provided at the discharge of the pumps for measurement and control. Complete lime storage, feeding & dosing system shall be in contractor scope. The complete waste water neutralization system shall be automated and controlled from the control room. Feeding of lime to bucket elevator can be manual.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION-A-05 (FGD)	PAGE 15 OF 25

	 TECHNICAL REQUIREMENTS				
7.07.08	Contractor shall provide 2x100% Lime Neutralization tanks which shall be of minimum 8 hr capacity made of carbon steel with rubber lining along with 2x100% Lime storage silos. The tanks shall be provided with SS dissolving basket, Agitator of SS construction, drain, over flow and dosing connection, level transmitters, Agitators etc. The storage silos and hopper cones shall be fabricated of minimum 10 mm thick carbon steel with a SS lining of grade SS304 of minimum 4 mm thickness in the complete cones to ensure reliable discharge of material. The design of storage silos shall confirm to IS 9178 or any other proven international standards. The storage silo shall be capable of feeding the lime by motorized rotary feeding system to the Lime Neutralization tank.				
7.07.09	Contractor shall provide 2x100% Lime Storage Silos for feeding lime to the Lime Neutralization tanks. The lime storage silo shall be of minimum 24 hr capacity equivalent to the requirements of FGD system of 1x800 MW at Design point and shall be complete with supporting steel structure, platforms, power operated outlet gates, level switches, air relief devices, etc. Hydrated lime shall be supplied by the employer in the form of bags. For sizing purpose, bulk density of hydrated lime shall be considered as 480 kg/m ³ . For dust free operation each silo should be provided with a covering arrangement and a self-cleaning bag filter system of suitable capacity containing blower, automatic/on-load cleaning system, etc.				
7.07.10	Bucket conveyors shall be provided by the contractor to feed lime to each of the lime storage silos from ground level. The Bucket conveyors shall be sized to completely feed each lime silo within 2 hrs. Adequate storage and feeding system required for feeding the lime to the Bucket conveyors is also in the Contractor's scope.				
7.07.11	A storage room for storing minimum one (1) month requirement of lime for the unit shall also be provided by the contractor.				
7.08.00	Auxiliary Absorbent Tank				
7.08.01	The Contractor shall provide a common auxiliary absorbent tank, for the unit, sized to contain the complete slurry of one absorber tank at its maximum level equipped with all necessary pumps, valves, piping and controls to transfer the tank's contents back to the absorber to refill the absorber sump. It should be possible to discharge each absorber into the Auxiliary Absorbent tank within 2 hours up to pump trip level in both the technologies i.e. spray tower & Jet Bubbling type Further, Bidder to provide the portable pumps of suitable capacity to drain the remaining slurry from the tank in max 2 hour into absorber area sump.				
7.08.02	The contractor shall provide 1x100% pump to pump back the slurry from the sump back to the absorber in a maximum time of 8 hours.				
7.08.03	Agitation shall be provided to prevent settlement of slurry by sufficient no. of Top entry agitators or side entry agitators (as per the proven practice of bidder) with emergency flush start system.				
7.08.04	The Auxiliary Absorbent tank shall be made of minimum 7 mm thick carbon steel with minimum 4 mm thick rubber lining of best quality bromine butyl rubber and shall also be				
<table><tr><td>SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE</td><td>TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001</td><td>SUB-SECTION-A-05 (FGD)</td><td>PAGE 16 OF 25</td></tr></table>		SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION-A-05 (FGD)	PAGE 16 OF 25
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION-A-05 (FGD)	PAGE 16 OF 25		

	TECHNICAL REQUIREMENTS 				
	equipped with man entry provisions doors, all necessary pumps, valves, piping and controls to transfer the tank's contents back to the absorber.				
7.08.05	NA				
7.08.06	Coarse-screen(s) of suitable material at suction-side of the pumps shall be provided.				
7.09.00	Hardness of rubber lining wherever applicable (tank, pipes etc) shall be 55±5 durometer (Shore A).				
8.00.00	SLURRY PUMPS				
8.01.00	This Clause covers the design, manufacture and erection of all slurry pumps for the FGD system including the Absorber slurry recirculation pumps, Gypsum bleed pumps, Limestone slurry feed pumps, Mill circuit pumps and any other pump handling slurries.				
8.02.00	The design, manufacture, installation and testing of the pumps shall follow the latest applicable Indian / International (ASME / EN / Japanese) Standards.				
8.03.00	The pumps shall be designed for continuous operation. The pump shall be single stage centrifugal type capable of delivering the rated flow at rated head. Minimum 10% margin on capacity and 10% margin on computed frictional head shall be considered for selection of pumps, wherever not specified. The slurry concentration in the pump shall not exceed 30% by weight except for Mill circuit slurry pumps for which the slurry concentration in the pump shall not exceed 55% by weight.				
8.04.00	All the slurry pumps shall be provided with motorized suction and discharge valves. In addition, flushing water lines with motorized/pneumatic valves shall be provided for each pump for automatic flushing of the pump after each shut down.				
8.05.00	In case of pump with rubber lined casing, the casing should be radially split to allow easy removal of impeller.				
8.06.00	All the pump wear parts in contact with the slurry shall be provided with replaceable rubber/elastomer liners suitable for the fluid handled. The Bidder can also offer a hi- chrome casing or hi-chrome alloy lined pump if the Bidder has previous experience of the same for similar applications. The material used by the contractor shall be proven in previous installations.				
8.07.00	For absorber recirculation service a Silicon carbide/hi-chrome impeller and SiC lining for casing can also be accepted if the manufacturer has supplied a similar pump for a previous installation for similar service.				
8.08.00	In case of Hi-chrome casing pump the Guaranteed wear life of casing shall not be less than 24000 hrs. In case of lined pump the Guaranteed wear life of liner and other wear parts of the pump shall not be less than 14000 hrs..				
8.09.00	The design of the shaft shall ensure that the critical speed is at least 20% above the operating speed of the shaft.				
9.10.00	The pump shall be provided with seals of proven type and shall be designed for minimization				
<table><tr><td>SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE</td><td>TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001</td><td>SUB-SECTION-A-05 (FGD)</td><td>PAGE 17 OF 25</td></tr></table>		SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION-A-05 (FGD)	PAGE 17 OF 25
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION-A-05 (FGD)	PAGE 17 OF 25		

	 TECHNICAL REQUIREMENTS			
	of seal water consumption. The shaft shall be supported on heavy duty ball/roller bearings.			
9.00.00	VERTICAL SUMP PUMPS			
9.01.00	Contractor shall provide sumps of adequate capacity in the each absorber area, limestone grinding area and gypsum dewatering area for containing the over flow from the respective systems. Contractor shall make arrangements for pumping the drainage water back to the respective system with 2x100% vertical sump pumps. Agitators shall also be provided to avoid settling of solids in the sump.			
9.02.00	The contractor shall offer only proven design in successful operation in similar application at previous installations. The design, manufacture, installation and testing of the pumps shall follow the latest applicable Indian / International (ASME / EN / Japanese) Standards.			
9.03.00	The pumps shall be designed for continuous operation. The pump shall be single stage centrifugal type with semi open or open impeller. The pump impeller shall be cantilever type and shall not be supported below the base plate for easy withdrawal.			
9.04.00	The pump shall deliver the rated flow at rated head. Minimum 10% margin on capacity and 10% margin on computed frictional head shall be considered for selection of pumps wherever not specified. The pump shall be capable of pumping of filtrate water with solid concentration upto 10% & particle lumps of 6-7 mm. Sump pumps handling slurry shall be designed with a maximum concentration of 30% solid by weight.			
9.05.00	The material chosen for the pump components shall be suitable for the fluid handled and shall be proven in similar application.			
9.06.00	The pumps shall not be supported below the base plate level for easy withdrawal without entering the sump.			
10.00.00	SLURRY TANKS			
10.01.00	All the Slurry tanks (Slurry tanks, Filtrate tank Secondary hydro cyclone feed tank, Waste water tank, Lime Neutralization tanks etc.) shall be designed, fabricated, erected and tested in accordance with the IS:803, latest edition. Additional Corrosion allowance of 1.5 mm on the minimum tank shell thickness as calculated by IS:803, latest edition shall be provided by the Contractor. Tanks shall be made from IS:2062 quality mild steel plates of tested quality. The tanks shall be of welded construction. Interior surface of the tanks shall be lined with the following: Wastewater tank, Filtrate tank, Secondary hydro cyclone feed tank: Chlorobutyl/Bromobutyl rubber lining of minimum 5 mm thickness or Vinyl Ester based flakeglass lining/ Polymeric Epoxy of minimum 3 mm thickness. Other Slurry tanks: Replaceable Chlorobutyl/Bromobutyl rubber lining of minimum 5 mm thickness The outside surface of the tanks shall be coated with paint as approved by the Employer. Coarse-screen(s) at suction-side of slurry recirculation pumps shall be provided.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION-A-05 (FGD)	PAGE 18 OF 25

	 TECHNICAL REQUIREMENTS				
11.00.00	AGITATORS				
11.01.00	Agitators shall be supplied in tanks and vessels to prevent caking and settlement of particles out of the slurry, e.g. in the absorber vessel, Secondary hydrocyclone tank, Auxiliary Absorbent tank and sumps etc.				
11.02.00	All agitators shall be designed for continuous operation unless otherwise specified. Horizontal agitators shall be used for Absorber. Vertical agitators can also be used for Absorber, if it is only the standard & proven practice of the Contractor for the offered Absorber design. In other vessels and tanks vertical agitators are also acceptable if they are of proven make and the Bidders standard practice which can be proven by means of suitable references. The design of the agitators shall be of proven type.				
11.03.00	Standard type agitators with suitable characteristics shall be used wherever practical. The agitators shall be complete with motor, gearbox, agitator shaft, coupling, safety guards, mechanical seal (for side entry agitators), impeller, support legs, agitator mounting flange including bolts nuts and gasket etc.				
11.04.00	All agitator parts and accessories in contact with the stirred fluid shall be constructed of materials specifically designed for the conditions and nature of the stirred fluid and be resistant to erosion and corrosion.				
11.05.00	The material for the shaft (which is continuously in contact with slurry) and agitator blades of the Absorber Agitators shall be made with Alloy 926 or better material. For Agitators in other tanks, agitator blades shall be made with Alloy 926 or better material & shaft can be rubber lined. This does not release the Contractor of the responsibility for selecting the correct materials.				
11.06.00	NA				
11.07.00	To prevent mechanical blocking load start-up after standstill of pumps, piping and agitators for slurries shall be applied with C-hose connection.				
11.08.00	NA				
11.09.00	Static and dynamic (as far as applicable) balancing of all agitators shall be carried out after assembly.				
11.10.00	All agitator parts and components shall be designed and calculated for fatigue life, considering maximum bending loads, induced by fluctuating hydraulic forces and torsional loads, based on the installed motor power. For side entry agitators the alternating bending moment resulting from impeller and shaft weight has to be considered additionally.				
11.11.00	All exposed moving parts shall be covered by guards.				
11.12.00	Side entry agitator shall be flange mounted.				
11.13.00	The shape of the impeller blades of side entry agitators shall be designed to avoid wear on the impellers which will affect the agitator performance as specified for a minimum period of 2 years of continuous operation under design conditions for the range of coal & limestone specified in the specification. In order to avoid excessive wear impeller tip speeds must not exceed 12 m/s.				
11.14.00	Belt drives (if applied) shall be properly designed to provide a minimum lifetime of 2 years under design conditions				
12.00.00	SLURRY LINES AND VALVES				
12.01.00	Slurry pipes shall be designed to keep the velocity above the settling velocity under all operating conditions. The contractor may provide a recirculation line with mo-torized isolation				
<table><tr><td>SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE</td><td>TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001</td><td>SUB-SECTION-A-05 (FGD)</td><td>PAGE 19 OF 25</td></tr></table>		SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION-A-05 (FGD)	PAGE 19 OF 25
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION-A-05 (FGD)	PAGE 19 OF 25		

	TECHNICAL REQUIREMENTS 		
	valve / restriction orifice made of erosion resistant material for the above purpose.		
12.02.00	All the pipes handling slurry shall be provided with replaceable rubber lining of proven quality. The Contractor can provide slurry pipes size up to 400 NB made up of FRP material as per ASTM 2310 and testing as per ASTM B2583 (silicon carbide coating on slurry exposed surface) if it has previous experience of providing the same. The outer surface of the pipes should be fire retardant.		
12.03.00	The isolation valves provided in all the slurry lines shall be of knife gate type/butterfly type unless specifically mentioned. Motorized actuators shall be provided for valves requiring frequent operation as indicated in the relevant scheme.		
12.04.00	The valves shall be of proven type and the contractor shall submit a detailed valve schedule for employer's approval. Reference list for previous installations for similar application shall also be furnished to the employer.		
12.05.00	Bidder shall provide all necessary arrangements for purging & flushing of all the process pipelines, equipments etc.		
13.00.00	PROCESS WATER STORAGE TANKS & PUMPS		
13.01.00	Two (2) Process water Storage tanks (each tank catering to the requirement of 1 x 800 MW unit) along with two numbers of 2x100 % Booster water pumps, if required, (Each pump catering to the process water requirements of 1 x 800 MW unit) along with all necessary piping, valves, control & instrumentation to feed the clarified water shall be provided by the Contractor. Process water Storage level shall be automatically controlled at operating level by controlling the water flow from the makeup water from terminal point. The two tanks shall be interconnected with an isolation valve. Contractor shall provide 2x100% Booster Pumps of required capacity & head to feed process water (clarified water) to the two (2) no. of process water storage tank designed to store 15 minutes of maximum water required for the entire FGD process (including absorber system and mist eliminator washing system, limestone grinding and slurry preparation system and gypsum dewatering system, etc.) for 1x800 MW units. The tank shall receive clarified water. The Tanks shall be provided with drain, manholes, over flow & inlet level control valves etc.		
13.02.00	2x100% Process Water Pumps shall be provided for unit connected to each of the Process water Storage tanks along with all necessary piping, valves, control & instrumentation. Each pump catering to process water requirement of one unit. The capacity of the pumps shall be such that it shall meet the maximum process water requirement of one unit. A further 10% margin shall be provided over the above capacity for all the above pumps.		
13.03.00	2x100% Mist Eliminator Wash Water Pump for unit connected to each of the Process water Storage tanks along with all necessary piping, valves, control & instrumentation shall be provided by the Contractor. Alternatively, Contractor can use process water pumps for mist eliminator washing if it is the standard & proven practice of the Contractor or its Technology Collaborator. Each pump shall cater to maximum mist washing requirement of one unit. The		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION-A-05 (FGD)	PAGE 20 OF 25

	TECHNICAL REQUIREMENTS 
	capacity of the pumps shall be such that the total capacity of working pumps is sufficient to meet the maximum wash water requirements of mist eliminators of the absorber. A further 10% margin shall be provided over the above capacity for all the above pumps.
13.04.00	The type of pumps shall be horizontal centrifugal type designed for continuous operation with semi open or closed impeller. Casing, Gland and Stuffing Box shall be of 2.5 Ni Cast Iron to IS:210 Grade FG 260 or equivalent. Impeller, Wearing rings (as applicable) shall be of Stainless Steel -316 grade and Shaft & Shaft sleeves shall be of SS-410 grade. Pump re-circulation line shall be provided for pumping system. Pumps shall be provided with accessories such as Y-type suction strainers, Coupling guard, drain plugs, vent valves etc.
13.05.00	All the Process water tanks (Process water Storage tanks, Clarified water tank, Emergency water storage tanks etc.) shall be designed, fabricated, erected and tested in accordance with the IS: 803, latest edition. Additional Corrosion allowance of 1.5 mm on the minimum tank shell thickness as calculated by IS: 803, latest edition shall be provided by the Contractor. Tanks shall be made from IS: 2062 quality mild steel plates of tested quality. The tanks shall be of welded construction. Interior surface of the tanks shall lined with replaceable chlorobutyl/bromobutyl rubber lining of minimum 4 mm thickness or with vinyl ester based flake glass lining of minimum 3 mm thickness or Epoxy lining minimum three coats of 150 micron thickness and the outside surface shall be coated with paint as approved by the Employer. The Tanks shall be provided with drain, manholes, over flow & inlet level control valves etc.
14.00.00	APPROACH AND HANDLING FACILITIES
14.01.00	Proper approach shall be provided for access to all equipments during normal operation and maintenance. Unless otherwise specified, platforms, staircase and ladders shall follow the stipulations specified elsewhere in this specification. Each equipment requiring maintenance (over and above as specifically mentioned) shall be provided with suitable handling provisions, lifting provisions (lugs, supports, brackets etc.) and access. Similarly, adequate & suitable inspection provisions shall also be kept for equipment/facilities for smoother O&M and monitoring purposes.
14.02.00	Equipments requiring monitoring during regular operation shall be approachable from the ground floor through staircase. Staircase with minimum width of 1200 mm shall be provided for approach to elevated structures at 5m height from the nearest platform. Below this height a vertical ladder with minimum clear width of 600 mm may also be acceptable.
14.03.00	Platform with a minimum clear width of 1000 mm shall be provided all around the lowest absorber spray levels and mist eliminators. Similar platforms shall be provided at subsequent elevations if they are more than 3000 mm apart from each other. An adequately sized manhole with platform (min. 2 sq. m) shall be provided above each spray level. Ladders/staircase shall be provided for the access to the platform.
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001 SUB-SECTION-A-05 (FGD) PAGE 21 OF 25	

	TECHNICAL REQUIREMENTS 				
14.04.00	The absorber slurry recirculation pumps, gypsum bleed pumps and limestone feed pumps shall be mounted on the ground level. Suitable approach and platforms shall be provided for all the valves required during regular operation.				
14.05.00	A 1500 mm space shall be provided around all pumps, except absorber recirculation pumps, where a 2000 mm space shall be provided.				
14.06.00	Not used				
14.07.00	A 1000 mm wide platform with suitable approach shall be provided around each hydro-cyclone.				
14.08.00	Not used				
14.09.00	Contractor shall provide motorized hoists and trolleys for all items requiring maintenance and weighing 500 kg or more. All auxiliary structures, monorails, runway beams for all lifting tackles, hoists etc., are included in Contractor's scope of supply. Access ladders with suitable platform shall also be provided for approach to all motorized hoists/trolleys mounted on their runway beams for the maintenance of hoists/trolleys. Items weighing more than 50 kg and required to be replaced for maintenance shall be provided with manual hoists/trolleys with runway beams/supporting structure etc/chain pulley block mounting arrangement.				
14.10.00	The regular basement floor is not acceptable in FGD area. Further local Pits/trenches shall be avoided as far as possible.				
14.11.00	Handling arrangement of Booster fans, Slurry recirculation pumps, oxidation blower, belt feeder system etc. complete with crane/monorail along with removal space for maintenance shall be provided by the Contractor.				
14.12.00	Approach for removal of equipment for maintenance shall be provided.				
14.13.00	All other safety requirements as per the Factories Act, National Electricity code shall be complied with while developing Layout.				
14.14.00	Cable trenches/slits, if unavoidable, shall be provided with adequate cushioning of sand and the same shall be covered with PCC.				
14.15.00	Each Equipment room shall be provided with alternate exits in case of fire/accidents as per requirements of Factories Act and Statutory bodies/insurance companies.				
14.16.00	Minimum Headroom (free height) under all floors, ducts, walkways and stairs shall be 2.50 M.				
14.17.00	Inter-connecting pipes/cables between various facilities of FGD plant shall be routed on the steel trestles to be provided by the Contractor. The clear head room for the same shall be minimum 8 m at rail/road crossings and 3 m or higher at other places as per system requirement.				
<table><tr><td>SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE</td><td>TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001</td><td>SUB-SECTION-A-05 (FGD)</td><td>PAGE 22 OF 25</td></tr></table>		SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION-A-05 (FGD)	PAGE 22 OF 25
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION-A-05 (FGD)	PAGE 22 OF 25		

	TECHNICAL REQUIREMENTS			
15.00.00	ELEVATORS			
15.01.00	Elevators shall be designed based on following criteria:			
	(i)	Type of service	One (1) no. Passenger cum goods elevator per Absorber (higher than 15 m) and MCC cum control room building of FGD plant.	
	(ii)	Design/construction/installation codes	(a) Latest edition of IS:14665 (All parts) AND also meeting any additional requirements of IS:4666, IS:1860 and IS:3534. (b) Any other equivalent code, subject to Employer's approval. Load carrying capacity	
	(iii)	(c) ELEVATOR CAPACITY	1000 kg (minimum) For absorber (higher than 15 m) and 680 kg For MCC cum control room building.	
	(iv)	Rated speed	1.0 m/s.	
	(v)	Total Travel	As per FGD supplier's recommendations subject to Employer's approval.	
	(vi)	Number of floors to be served	As per requirement and subject to Employer's approval	
	(vii)	Entrance	As per requirement and subject to Employer's approval	
	(viii)	Entrance and platform size	As per design/installation codes at (ii) above	
	(ix)	Drive/motor	As per Electrical Specifications.	
	(x)	Method of control	As per Electrical Specifications.	
	(xi)	Machine room and lift Shaft	Pressurized dust proof or Air-conditioned machine room as per the requirement of lift manufacturers.	
	(xii)	Position of machine room	Directly above the lift shaft.	
	(xiii)	Power Supply	As detailed in Electrical Specification	
15.02.00	Landing doors of the elevators shall have fire resistance of at least one hour. These doors shall also be smoke tight as far as possible.			
15.03.00	Construction of the elevators shall specifically meet all requirements of the codes indicated at Cl. 15.01.00 (ii) and shall have following additional features:			
	(i)	Flooring of Cabin	:	6 mm thick Checkered Plate flooring. Flooring of passenger elevator for MCC cum control room building can also be vitrified ceramic tiles
	(ii)	Design, Construction and finish of car & car door	:	Car inside enclosure including inner side of door shall be of stainless steel plate of grade SS:304 of bright finish/hair line finish.
	(iii)	Car entrance and landing doors	:	As per BS:476 (Part 20 & 22)
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION-A-05 (FGD) PAGE 23 OF 25

	 TECHNICAL REQUIREMENTS		
	(iv) Door construction : Hollow metal construction from 16 guage thick steel sheet spray painted.		
15.04.00	Technical requirements of Electrical items shall be as per details given in Electrical Sub-Section, Part-B.		
15.05.00	Provide sound reducing material below machines in machine room.		
15.06.00	Provide special corrosion resistant treatment on all elevator components. The protective treatment shall be subject to Employer's approval.		
15.07.00	Elevators shall have provisions to meet following operational requirements: Easy access and landing level controls for ease of human operation and their travel with user friendly operating features including open holding time for any floor level.		
15.08.00	Fireman's switch shall be provided for each elevator.		
16.00.00	DUCT WORK AND DAMPERS: Details as specified in sub-section A-02, part-B to be referred for design and other requirements.		
17.00.00	THERMAL INSULATION AND CLADDING		
17.01.00	Thermal Insulation along with aluminum cladding shall be provided for all the equipments/surfaces having skin temperature more than 60 degree Celsius except for absorber. Further, Thermal insulation of min 70 mm shall be provided for absorber outlet flue gas duct irrespective of skin temperature.. The specification of the insulation including type, density, thickness, heat conductivity and finish shall be as specified in Sub-Section A-13, Part B of the Technical Specification.		
18.00.00	TYPE TEST		
18.01.00	Full scale type tests using actual equipment shall be conducted by the Contractor for the equipment mentioned in the subsequent clauses below:		
18.01.01	Full range and full scale performance testing shall be conducted at shop on one number each of the following Fans as per BS 848, Part-1: (a) Booster Fan (in case Booster Fan is provided by the Contractor) The performance testing at shop shall be conducted using actual fans		
18.01.02	Leak tightness testing of gates &dampers for each type and size at shop to demonstrate the guaranteed gas tightness efficiency (on flow). The minimum guaranteed gas tightness efficiency of dampers shall not be less than that indicated in clause no. 3.03.00 of this Sub-Section.		
18.02.00	The Bidder shall indicate the charges for each of these type tests separately in the relevant price schedule of Bid Proposal Sheet (BPS) and the same shall be considered for the evaluation of the Bids. The type test charges shall be paid only for the test(s) actually		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION-A-05 (FGD)
			PAGE 24 OF 25

	TECHNICAL REQUIREMENTS 
18.03.00	conducted successfully under this contract and upon certification by the Employer's Engineer. The type tests shall be carried out in presence of the Employer's representative. Contractor shall inform the Employer about his readiness for conducting the type test and issue such notice to the Employer 30 days in advance, along with schedule of the type tests. The Contractor shall obtain the Employer's approval for the type test procedure before notifying the Employer about his readiness for conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.
18.04.00	Irrespective of the requirement of conducting the type tests under this contract, The Contractor shall submit the reports of the type tests carried out for the equipments listed above in clause no. 18.01.00 and These reports should be for the tests conducted on the equipment for the model / type / size / rating to those proposed to be supplied under this contract and the test(s) should have been either be conducted at an test facility/shop/independent laboratory or should have been witnessed by a client. The Employer reserves the right to waive conducting of any or all of the specified type tests under this contract, in which case the type test charges shall not be payable for the type tests waived by the Employer.
18.05.00	All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001 SUB-SECTION-A-05 (FGD) PAGE 25 OF 25	



SUB-SECTION–A-07

STEAM TURBINE & AUXILIARIES SYSTEM

**SINGARENI THERMAL POWER PROJECT
STAGE-II (1X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC NO.:CW-CM-11159-C-O-M-001**

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
1.00.00 1.01.00 1.02.00 1.03.00 1.03.01 1.04.00 1.05.00	TURBINE GENERATOR AND AUXILIARIES STEAM TURBINE AND AUXILIARY SYSTEMS Steam Turbine MAINTENANCE REQUIREMENTS Provision of Wet steam washing (if applicable), forced cooling arrangement, turbine preservation system (Portable, skid mounted) and Boroscopic Inspection ports in turbine for in situ inspection of turbine internals as per standard practice of turbine manufacturer with latest portable boroscopic inspection system. TURBINE CASING The turbine casing design shall have following features: (a) Adequate drainage facility and temp. sensing devices in casings, strainers housings, stop and control valves, extraction lines etc and in drain lines at upstream of the isolating valve to detect any chocking and passing of high energy drains. The power operated high energy drain isolating valves seat tightness shall be conforming to MSS SP61. (b) Bearing inspection should be possible without necessity of dismantling the turbine casing. (c) Provide a completely self-contained exhaust hood spray system for L.P casing(s) to protect the turbine against excessive temperature due to windage at no load / low load and HP/LP bypass operations. STEAM TURBINE ROTORS (a) Provide forged alloy steel rotor. (b) Maximum permissible shaft vibration measured at bearing housing will be as per zone A of ISO 7919 and maximum permissible bearing vibration measured at bearing housing will be as per zone A of ISO 10816-2. (c) Turbine assembly radial seal clearances at rotor blade tip and interstage area shall not be less than 0.8 mm. (d) Critical speed of composite rotor and blade assembly shall not be within - 10% and +15% of rated speed. (e) The design of radial seals shall be such that it should be easily replaceable, maintenance friendly and repairable close to design condition post repair. NOZZLES AND BLADES			
	SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB SECTION-A-07 STEAM TURBINE AND AUXILIARIES SYSTEM PAGE 1 OF 26

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(a) Ensure material is hard, corrosion & erosion resistant alloy steel. (b) Ensure that there is no resonance of LP blading in the continuous operating frequency range of 47.5 Hz. to 51.5 Hz. Furnish Campbell diagrams for all free standing blade stages offered for LP blading. (c) Ensure LP stage design for effective removal of moisture. (d) Ensure stress induced in LPT blading due to back end steam loading under V.W.O.conditions not to exceed 90% of design stress value. (e) Ensure quick & easy site replacement of blading.			
1.05.01	On-line Blade Vibration Monitoring System (a) Bidder shall provide online blade vibration monitoring system for LP Turbine last stage free standing blades (as applicable). In case the Blade design comprises integral shroud and snubber which becomes integral at higher speed due to continuous centrifugal force shall not be treated as free standing blade.			
1.06.00	BEARINGS (a) Tin base babbit lining properly secured to the bearing shell. (b) Provision for measuring bearing temperature as near the point of heat generation as possible and for measuring the oil temperature leaving the bearing (c) Provide following instrumentation for each Journal/Thrust bearings. (1) Local temperature indicators in each bearing lube oil drains. d) Horizontally split with the ability to dismantle and replace lower half with minimum shaft lift.			
1.07.00	TURNING GEAR Provide suitable turning gear device, either High-speed hydraulic type or motorised turning gear as per standard proven practice of the Bidder. Provide manual hand barring facility also for manually cranking the turbine in case of emergency including A-C power failure. Ensure availability of lube oil to the bearings during manual barring operation. Alternatively, Bidder can provide permanent arrangement for manual barring as per their standard practice for each unit. However, such system/arrangement shall be capable of rotating the TG rotor train independent of electrical power source like Air motor.			
1.08.00	GLAND SEALING SYSTEM FOR STEAM TURBINE and BFPDT			
1.08.01	Operation and maintenance requirement: (a) During start up and low load operation, sealing steam shall be supplied from alternate source of steam i.e. aux. steam header, along with a facility to automatically switchover arrangement from alternative source to the main source and vice-versa. The system should allow Smooth Changeover. (b) Two nos. modulating type control valves shall be provided, one discharging surplus steam to condenser or any other location as optimized by the bidder and another one for supplying extra steam to gland sealing header from steam source to maintain sealing steam header pressure at a preset value. However for the drive turbine, the requirement of modulating valve for discharging surplus steam shall be as per process requirement.			
1.09.00	STEAM ADMISSION VALVES (EMERGENCY STOP, REHEAT STOP, INTERCEPTOR STOP VALVES AND CONTROL VALVES)			
1.09.01	Design, constructional and operational requirement:			
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB SECTION-A-07 STEAM TURBINE AND AUXILIARIES SYSTEM	PAGE 2 OF 26

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(a) Provide Temporary & Permanent steam strainers for Emergency stop and Reheat Stop or control valves. In case there is no provision for temporary strainer, one set of strainers per unit shall be provided in addition to the permanent strainer. The strainers shall be arranged to permit easy inspection and cleaning. (b) Provide hydraulically operated valves, fail safe type & equipped with test device to permit complete closing of one valve at a time while the Unit is carrying load.			
1.10.00	TURBINE GOVERNING SYSTEM Provide adjustable steady state speed regulation between +3% to +8% of rated speed. Ensure dead band at rated speed and at any power output within rated output shall not exceed 0.06% of rated speed.			
1.11.00	TURBINE PROTECTIVE DEVICES (a) Emergency controller as per standard practice of bidder meeting following requirements. Bidder shall provide overspeed trip of the Unit at 110% of rated speed in case speed governor fails to limit the turbine overspeed. It shall meet the IEC-45 requirements for overspeed trip. Bidder shall provide means for testing the actual overspeed of Turbine. Further provision shall be given for testing of overspeed protection. Bidder shall provide emergency local hand trip device to facilitate manual tripping of the unit alongwith facility to trip turbine from UCB. (b) TG Protection: Advisory trips by Operator shall be avoided. All protections related to safety of turbine and/or its components and personnel shall be provided with Tripping in AUTO mode. Apart from mandatory turbine protection, these protections shall include, but not be limited to, following: a. TG Bearing temperature b. TG Shaft/bearing vibration c. Differential Expansion d. Low Main steam temperature e. Any other safety requirement as required			
1.12.00	UNLOADING DEVICE (a) Initial Pressure Regulator (1) It shall ensure turbine unloading to a preset point to run on house load in case main steam pressure falls below a predetermined value. (2) It shall be possible to adjust or bypass the initial pressure regulator from UCB at start up condition to facilitate starting with low steam pressure and during sliding pressure operation. (3) Contact to be provided for signalling the device in, "Operation" and "Reset".			
1.13.00	VACUUM BREAKER Bidder shall provide D.C operated device for rapid reduction of vacuum in condenser for turbine rotor to be brought to rest as quickly as possible.			
1.14.00	TURBINE LUBRICATION OIL SYSTEM (a) A self contained LUBRICATION oil system for each TG Unit consists of : (1) Centrifugal / gear type, Main oil pump (MOP) directly driven by Turbine as per Bidder's standard practice. In addition of above 2x100% AC Aux. oil			
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB SECTION-A-07 STEAM TURBINE AND AUXILIARIES SYSTEM	PAGE 3 OF 26

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.15.00	pumps for start up, shut down of TG unit and as standby to M.O.P. for automatic operation shall be provided. OR 2x100% AC oil pumps as per Bidder's standard practice (2) One DC motor driven emergency oil pump with sufficient capacity for meeting lube oil requirement of bearings during emergency with automatic starting on low lube oil pressure preset value. (3) 1x100% each AC & DC jacking oil pumps (if applicable for bidder design) with an interlocking not to start till lube oil pressure is established. (4) Temperature measurement device to be provided at inlet and outlet of oil and water side of the lube oil coolers. Design codes: Shell and tube type: TEMA (latest). Plate type: Pressure parts as per ASME Sec-VIII. (b) Purification System Provide permanently Connected, Continuous Oil purification system having capacity to purify 20% of total oil charge in system per hour. Purified oil shall have moisture not more than 500 PPM & max. particle size conforming to code 15/12 as per ISO 4406 or requirement of the turbine manufacturer whichever is better. The above particle size and moisture content shall be demonstrated with inlet oil quality conforming to 21/18 as per ISO: 4406 and 15000 PPM moisture respectively in one pass. All components of the oil purification system including purifier vessel, which are coming in contact with oil shall be constructed from high grade stainless steel. Type test(s): Particle size impurities test and moisture test as detailed out in the technical specification, is to be carried out on one purification system of main turbine. (c) Provide double oil piping or equivalent shielding arrangement for all high pressure lines and all pipes close to hot pipes and parts to protect against fire hazards. (d) All the piping, fittings, valves, Main Oil Tank and complete strainers including body and element shall be of stainless steel. Further all the parts of lube oil coolers (tubular or plate type) which are coming in contact of lube oil shall be of stainless steel. (1) Ensure oil return lines from bearings fitted with sight fittings, or any other device to see the flow of oil depending upon the standard proven practice of the bidder. (2) Oil supply and return lines to / from each bearing may have provision for oil flushing filters.			
	TURBINE CONTROL FLUID SYSTEM (a) Provide control fluid system for each unit consisting of : (1) Fire resistant fluid for control fluid system for all hydraulically operated valves, servo motor for turbine stop and control valves. 2x100% AC driven pumps connected to fluid reservoir alongwith hydraulic accumulators. (2) Ensure surfaces of reservoir in contact with fluid to be stainless steel, with 2x100% vapour extraction fans (if required) alongwith access ladders, platforms railings and manholes with covers on reservoir etc (If applicable). (b) Piping and other equipments/components			
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB SECTION-A-07 STEAM TURBINE AND AUXILIARIES SYSTEM	PAGE 4 OF 26

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
1.16.00	All the piping of the system coming in contact with control fluid shall be of stainless steel and any other component of the system to be preferably of stainless steel or of material compatible to control fluid depending on the standard practice of the bidder. HP-LP STEAM TURBINE BYPASS SYSTEM (a) Seat tightness of the HP and LP bypass valves shall be equivalent to tightness conforming to MSS SP61. (b) Ensure all valves (both in steam and spray water service) to be electro hydraulically operated. (c) Provide separate oil system with 100% redundant pumps, motors, accumulators and control system etc. for both HP and LP bypass systems. Accumulators shall be sized to take sufficient number of stroking operations of all actuators under a condition of loss of oil supply from the pumps. (d) Provide warming up arrangement of HP/LP bypass valves and associated piping. (e) Ensure that boiler operation is not affected in the event of loss of load on the turbine, by disposing off the steam produced in the boiler automatically by providing a quick opening device. The full stroking time of valve under quick action shall be within 2 to 3 seconds. (f) HP-LP bypass valve body shall be forged. (g) LP Bypass shall be of double stem design with separate STOP and CONTROL valves. (h) All the piping, fittings, valves, oil tanks, strainers including body and element associated with oil system of HP & LP bypass system shall be of stainless steel. (i) LP Bypass stop and control valve main plug and pilot plug area shall be sized and selected in such a way that the pressure balancing of lower and upper chamber occurs in shortest possible time without transmitting any unbalance force to the stem/spindle. Calculation for pressure balancing time and force being transmitted to the main plug stem during valve opening for each design cases of LP bypass shall be submitted by the Bidder/ LP Bypass valve supplier during detail engineering. (j) HP-LP Bypass should have the provision of removable valve seat/any other arrangement for ease of maintenance. (k) HP Bypass valves shall be designed as per degree of superheat based on Boiler-Turbine combined start-up curve i.e, degree of superheat based on Main steam pressure and Temperature at the time of HP Bypass valve opening during cold startup. For achieving degree of superheat as per approved combined start-up curve bidder shall make necessary arrangement for combination of drain lines with drain pots at the upstream of HP Bypass valves. Bidder shall provide necessary pressure and temperature measuring instruments near to HP Bypass valve for calculation of degree of superheat at upstream.			
1.17.00	PERFORMANCE REQUIREMENTS (a) Under all conditions of operation, the steam turbine generator set shall perform continuously without the noise levels of its components and auxiliaries (individually or collectively) exceeding the limits as specified under General Technical Conditions. (b) Maximum permissible vibration for auxiliaries shall conform to Zone-A of ISO10816.			
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB SECTION-A-07 STEAM TURBINE AND AUXILIARIES SYSTEM	PAGE 5 OF 26

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.18.00 1.18.01	Heat balance Diagrams: Following Heat balances complete in all respects to be computed & furnished for the conditions stipulated with units indicated in MKS system & IAPWS-IF 97 steam tables. Pressure (in ata), temperature (in deg C), enthalpy (in kcal/kg) and flow (in tonnes/hr) to be indicated at all required locations to facilitate manual checking by the Employer. Other conditions for computing heat-balances are given at Annexure-I to this sub-section. a) 105% of rated load under rated steam condition at condenser pressure 77 mm Hg (abs), with zero make up (Output guarantee) b) 100% of rated load under rated steam conditions at condenser pressure of 77 mmHg (abs) with zero make-up (Heat Rate Guarantee) c) 55% of rated load under turbine throttle main steam pressure of 150 Kg/cm2 (abs) and rated main steam temperature / rated reheat steam temp. at turbine inlet at condenser pressure of 77 mm Hg (abs) with zero make-up with one TDBFP in operation. (Heat Rate Guarantee) (d) 105% of rated load at 0% make-up, design CW temperature and CW flow (Condenser Pressure Guarantee Condition). (e) 100% of rated load under rated steam conditions at guaranteed condenser pressure with 0% make-up. f) 100% of rated load under rated steam conditions at condenser pressure of 77 mm & 89 mm Hg (abs) with 3% make-up. g) 100% of rated load under sliding pressure conditions at condenser pressure of 77 mm Hg (abs) with 3% make-up. h) 95 % of rated load under turbine throttle inlet steam conditions corresponding to Modified sliding pressure operation and rated steam temperature at condenser pressure of 77 mm Hg (abs) with 3% make-up & 1 TDBFP and 1 MDBFP in operation. i) For 80%, 60% & 50% of rated output under turbine throttle inlet steam conditions corresponding to pure sliding pressure operation and rated steam temperature at condenser pressure of 77 mm Hg (abs) 3% make-up. j) 65% of rated output under turbine throttle inlet steam conditions corresponding to modified sliding pressure at condenser pressure of 77 mm Hg (abs) with 3% make-up. k) For 40%, 30% & 20% of rated load under turbine throttle inlet steam conditions corresponding to pure sliding pressure operation at condenser pressure of 77 mm Hg (abs) with 3% make-up with all HP Heaters in service. l) Output corresponding to VWO flow under rated steam conditions at condenser pressure of 89 mm Hg (abs) with 3% make-up. m) Output (not less than 105% of rated load) corresponding to VWO flow under rated steam conditions at condenser pressure of 77 mm Hg (abs) with 3% makeup. n) HP heaters out of service (One string and both strings) under rated steam conditions at condenser pressure of 89 mm Hg (abs) with 3% make-up and maximum			
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB SECTION-A-07 STEAM TURBINE AND AUXILIARIES SYSTEM	PAGE 6 OF 26

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	continuous output not less than rated output or output corresponding to BMCR heat duty whichever is lower. o) HP-LP bypass operation under rated steam conditions with bypass valves open to full capacity and turbine on house load operation. p) HP-LP bypass operation under rated steam conditions with steam generator output of 65% of BMCR. q) Steam generator output corresponding to BMCR flow under rated steam conditions, turbine in parallel operation with HP-LP bypass with by pass open to full capacity. r) Steam Generator output corresponding to BMCR flow under rated steam condition, turbine under VVO operation, condenser pressure of 77 mmHg, 0% and 3% make up. Difference of BMCR flow and VVO steam flow through turbine shall be assumed to be drawn off from Main steam line. Same quantity of flow to be added to condenser as additional make up. s) 102 % of rated load under turbine throttle inlet steam conditions corresponding to pure sliding pressure operation and rated steam temperature at condenser pressure of 77 mm Hg (abs) with 3% make-up with overload valve in closed condition. (t) 20% of rated load under turbine throttle inlet steam conditions corresponding to pure sliding pressure operation at condenser pressure of 77 mm Hg (abs) with 3% make-up with single TDBFP in operation without opening of minimum recirculation valve. Note: – Refer annexure-I for other conditions for computing heat balance diagrams. – Any additional heat balances deemed necessary by the Employer shall be furnished. All the heat balances shall show turbine output, mechanical and electrical losses in turbine and generator and input to shaft driven auxiliaries, if any. – In case of multi-exhaust LPT configuration, the “Condenser pressure”, is the average of all the condenser pressure. HBDs requested are for equipment/system design and may or may not correspond to actual operating condition. - Bidder to compulsorily mention TG Cycle Heat Rate value for HBDs mentioned at a), b), c), d), e) and f). 1.19.00 Furnish thermal kit data for plant performance by DDCMIS. Furnish turbine clearance diagram indicating values for radial & axial clearances and leakage rate from glands. 1.20.00 Type test(s) to be conducted: Life cycle test, meridional yield rupture test and squirm test on one each of following type of metallic expansion joints: (a) Condenser neck (if applicable) (b) Cross-over pipe (largest size) (c) LPH extraction line (highest pressure and temperature) (d) LPT Gland bellows (if applicable)			
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB SECTION-A-07 STEAM TURBINE AND AUXILIARIES SYSTEM	PAGE 7 OF 26

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
2.00.00	(e) Hot-well interconnecting Bellows (If applicable) CONDENSING PLANT (a) Design manufacturing and testing as per Heat Exchange Institute, USA (latest) with proven design. Bidder to furnish thermal, hydraulic and mechanical design calculation for checking equipment capability. (b) Provision of isolating butterfly valves and expansion bellows at inlets and outlets of condenser cooling water of each half of condensers. (c) Provision of air evacuation pumps. Condenser to be designed for minimum air leakage and under normal operating conditions, the air leakage in condenser not to exceed more than 50% of design value taken for sizing of vacuum pumps. The same shall be demonstrated at site under actual operating condition failing which Bidder shall carryout necessary modifications. (d) Minimum material grade/standard has been specified for the condensing plant. However, bidder may opt for better material.			
2.01.00	Condenser (a) Easily removable/hinged type and refittable type water boxes alongwith suitable handling arrangement, if required, and provision of hinged manholes (of 460mm size) in shell, each water box and each hot well suction. (b) Water box interiors to be epoxy resin coated with suitable corrosion resistant primer of 0.25 mm minimum thickness. (c) Tubes shall be welded type stainless steel as per ASTM-A-249-TP 316L and meeting the ASME specification for general requirements for carbon ferritic alloy and austenitic alloy steel tubes SA-450 and continuous without any circumferential joint suitable for intended duty with minimum wall thickness 22 BWG. Top rows of tubes shall be extra thick. Provision for taking care of thermal expansion of tube bundle and proper drainage of tubes during shut down shall be ensured. (d) Corrosion allowance of minimum 3.2 mm for water boxes, tube plates and 1.6 mm for shell, hotwell and condenser neck. (e) Stand pipes with necessary connections for instruments, with water level gauges and isolation valves. (f) Provision of catch trough below tube sheet in hotwell for detection of water leakage into steam side alongwith conductivity measurement instrument. (g) Steam dumping device for dumping of desuperheated steam from LP bypass alongwith all accessories and instrumentation. (h) Shell material carbon steel as per ASTM-A-285 Gr.C or IS 2062 E250BR, welded construction and 16mm minimum wall thickness. Hot well of material same as shell material, shall be longitudinally divided with proper drainage provision. (i) Water box, tube plates and support plates material carbon steel as per ASTM-A-285 Gr.C or ASTM A-516 GR 70 and suitable for intended duty. Water side of tube plates coated with epoxy resin of 0.25 mm minimum thickness.			
2.01.01	Hydrostatic and Hydraulic Tests (a) The hydrostatic testing of condenser steam space shall be carried out after connecting all the pipes with the condenser along with the condenser vacuum system by filling the steam space with water 300 mm above final joint of condenser			
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB SECTION-A-07 STEAM TURBINE AND AUXILIARIES SYSTEM	PAGE 8 OF 26

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	exhaust neck to turbine. The level of hydraulic test shall be selected such that all the field welding joints are covered in the test. Any leakage detected shall be rectified immediately. (b) The water space shall be tested hydraulically alongwith the circulating water lines, after assembly of the waterbox doors. (c) After the hydraulic testing, the waterboxes tube plates and covers shall be given suitable coatings of anti-corrosive paints. The paints and painting shall meet the approval of the Employer.			
2.02.00	CONDENSER AIR EVACUATION PUMPS (a) Single/two stage liquid ring type with both stages (if two stage pumps provided) mounted on a common shaft. (b) Heat Exchangers shall be shell and tube type. Material of tube shall be stainless steel type 316 L and material of shell and tube plates as M.S. type ASTM-A285 Gr. C properly coated. Alternatively-plate type heat exchangers with SS 316 plates and 20% area margin on plates also acceptable. (b) No cavitation under all operating conditions without air ejector. (c) Noise levels should not exceed limitations as specified in Section of General Technical Requirements and vibration levels shall be Zone A of ISO 10816.			
2.02.01	Type Test(s) to be Conducted Following type tests are to be carried out on one vacuum pump. (i) Cavitation test (ii) Wet air test			
3.00.00	CONDENSER ON LOAD TUBE CLEANING SYSTEM (a) Provision of separate sponge ball type condenser on-load tube cleaning system for each half of condenser including ball circulation pumps, strainer and ball monitoring system. Sponge rubber ball type tube cleaning system designed for continuous & trouble-free operation with provision of abrasive coated balls cleaning in case of hard deposits inside tubes. (b) Provision of manual and automatic back washing system with automatic collection of balls prior to back washing. (c) Provision of ball monitoring system, which should at least consist of separate ball circulation monitor and ball oversize monitor. (d) The no. of balls in circulation should be at least 10% of nos. of condenser tubes. (e) Bidder should indicate the number of ball losses in 336 hours of continuous operation of COLTCS. (f) Provision to prevent losses of ball during normal and abnormal condition including tripping of CW pump.			
4.00.00	CONDENSATE EXTRACTION PUMP (a) Vertical, Multistage, Canister type, Centrifugal, diffuser type with double suction first stage impeller. (b) Motor bottom level			
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB SECTION-A-07 STEAM TURBINE AND AUXILIARIES SYSTEM	PAGE 9 OF 26

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Bottom of motor to be above zero meter by suitably considering the pit level and motor stool dimensions. (c) Minimum recirculation flow Individual recirculation line for each CEP shall be provided. Minimum recirculation flow requirements at design speed of the pump shall be not less than 25% of design flow or on set recirculation (discharge/suction) whichever is higher. (d) Performance curve Characteristic curve of pumps should be continuously rising type with decrease in flow and shut off head shall be between 115% to 130% of TDH at design point. (e) First stage impeller life Life due to wear due to Cavitation of first stage Impeller not less than 40,000 running hours. (f) Peripheral speed at the eye of the impeller at design speed Not to exceed 20m/sec. (g) Material The material adopted shall not be inferior to those mentioned below: (a) Suction bell/Pump casing - cast iron (b) Impeller/Wearings/Shaft/ Shaft sleeves - 12% Cr. stainless steel. (c) Canister - Fabricated mild steel. (h) Applicable Code: HIS (Latest edition) (i) STRAINERS AT CONDENSER EXTRACTION PUMP SUCTION The clear area of strainer to be Five times the inlet cross sectional area of the connecting piping. Strainer to be constructed of 11 gauge perforated stainless steel (304 grade) and lined with stainless steel (316 grade) screen. At design flow and clean condition, Pressure drop not to exceed 0.1 Kg/cm2. At design flow and 50% clogged condition, Pressure drop not to exceed 0.15 kg/cm2.			
4.01.00	Type test(s) to be conducted: NPSH (R) test on one CEP, Pressure drop test on one CEP suction strainer			
4.02.00	DRIP PUMP (IF OFFERED): Vertical, Multistage, Cannister type, Centrifugal, diffuser type. Alternatively, Horizontal, multistage centrifugal diffuser type. Bottom of motor to be above zero meter by suitably considering the pit level and motor stool dimensions. Individual recirculation line for each Drip pump shall be provided. Minimum recirculation flow requirements at design speed of the pump shall be not less than 25% of design flow or on set recirculation (discharge/suction) whichever is higher. Characteristic curve of pumps should be continuously rising type with decrease in flow and shut off head shall be between 115% to 130% of TDH at design point. Life due to wear due to Cavitation of first stage Impeller shall not be less than 40,000 running hours. Peripheral speed at the eye of the impeller at design point shall not to exceed 20m/sec. Drip pump Impeller/wearings/Shaft/ Shaft Sleeves shall have minimum 12% Cr. stainless steel.			
4.02.01	Applicable Code: HIS (Latest edition)			
	Type test(s) to be conducted : NPSH (R) test on one Drip Pump.			
5.00.00	FEED WATER HEATING PLANT			
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB SECTION-A-07 STEAM TURBINE AND AUXILIARIES SYSTEM	PAGE 10 OF 26

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	(a) Tube material stainless steel as per ASTM. A 213 Gr. TP 304/304N for seamless tubes without circumferential joints or ASTM A 688 Gr. TP 304/304N for welded tubes. Maximum content of carbon shall be limited to 0.05%. (b) Tube sheet material carbon steel as per ASTM. A516 Grade 70 or SA 350 LF-2 or SA-508 Gr 3 Cl-I and shall be welded to shell and water box. Tube support plates of common quality steel of 16mm (min) thickness. (c) Water box channels to have access openings of minimum 450 mm dia. or of elliptical shape with minimum size 450 mm x 350 mm. These shall be self sealing type and bolted design is not acceptable. (d) Corrosion allowance of 3.2 mm for each heater shell and water box. (e) Minimum material grade/standard has been specified for the Feed water heating plant. However, bidder may opt for better material. (f) Vent orifice shall be sized to pass one half percent of TMCR extraction steam flow to respective heater under TMCR conditions. (g) Stand pipes with necessary connections for instruments with water level gauges and isolation valves. (h) Proper drainage of bled steam lines to be ensured. Bidder shall provide Hydraulic/ Pneumatic power operated/ Assisted Quick closing type & ordinary NRVs for each Steam extraction line (except for extractions from LP Turbine) including steam extraction line to BFP drive turbine. For each CRH line and extractions from LP Turbine minimum one hydraulic/ Pneumatic power operated / assisted QCNRV shall be provided, except for heater mounted in condenser neck.		
5.01.00	Low Pressure Heaters and Drain Cooler Horizontal and U-tube type with integral drain cooler. Duplex type LP heater (two heaters in single casing) installed in condenser neck is also acceptable as per standard practice of the bidder. Shell of rolled steel as per ASTM A-516 Gr. 70 with SS-304 bands at cut points on shell to prevent damage against flame impingement during torch cutting. Water box channel of carbon steel as per ASTM A-516 Gr. 70 and welded to tube sheet. Tubes shall be expanded hydraulically in tube sheet. Tube shall be cold bent for fabrication. Requirement of drain cooler for heaters, installed in condenser neck and heater with drip pump for forward cascading of drains shall be as per standard practice of the bidder and cycle optimisation. If separate drain cooler is offered it shall be of straight or U-tube type.		
5.02.00	DEAERATOR (a) Horizontal/Vertical, Spray-cum-tray with integral direct contact vent condenser mounted on horizontal storage tank as a separate vessel or Spray cum tray with integral direct contact vent condenser accommodated inside Feed Storage Tank as per standard practice of bidder. In case spray type Deaerator is provided, Bidders to provide Stainless Steel cladding on internal surfaces of storage tank above Low low level to meet HEI requirements. (b) Alternatively, Spray type STORK or Equivalent with minimum two (2) spray control valves of disc type or equivalent, in order to ensure fine atomisation of incoming condensate and rapid heating up by the steam. (c) Design and construction as per ASME code for unfired pressure vessels, Section-VIII or any other equivalent code and Heat Exchange Institute Standards. (d) All pressure parts like shell and heads shall be of carbon steel as per ASTM A-516 Gr. 70. Shell plate min. thickness 15.8mm of welded construction. Nozzles shall of carbon steel as per ASTM A-105.		
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB SECTION-A-07 STEAM TURBINE AND AUXILIARIES SYSTEM PAGE 11 OF 26

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(e) Hardened 400 series stainless steel impingement plates for flashed drain inlet from HP heaters, BFP recirculation, boiler startup drains etc. (f) All water spray valves, splash plates, trays, vent condenser and other elements in contact with undeaerated water or non-condensable gases shall be of stainless steel SS-304 or SS-410. (g) Design for efficient steam distribution and deaeration of condensate under all operating conditions including VWO, 3% m.u., HP-LP bypass, one string/both strings of HPH out of service. (h) Floating pressure type. Deaerator pegging pressure during cold, warm, hot startup and during HP-LP bypass operation, shall be as optimized by the bidder and shall be suitable to ensure required deaeration and water quality required for boiler. The optimised pressure should be same during warm, hot startup conditions and HP-LP bypass operation. Deaerator pressure shall vary with load when it gets steam from turbine extraction. Design pressure & temp. shall not be less than extraction pressure or worst operating condition with sufficient margin above the same. (i) Sources for heating: (1) Extraction steam from turbine IP-LP cross over/ cross-around pipe (normal operation) or as optimized by the bidder. (2) Steam from CRH till extraction steam (normal source) pressure is available. (3) Steam from Auxiliary steam header till CRH steam pressure is available. (j) Design to withstand full vacuum and pressure decay. (k) Free carbon dioxide as measured by APH method shall be non-traceable at all loads. (l) Shell thickness corrosion allowance 3.2 mm. (m) Provision of sparger pipe and nozzle for feed water heating. (n) Provision of access platforms and ladders alongwith hand rails on deaerator and storage tank. Provision of manholes of 450 mm dia (min) on deaerator and storage tank for access to and removal of internals including trays.			
5.03.00	HIGH PRESSURE HEATERS 2X50% capacity HP heaters, horizontal and U-tube type with desuperheating, condensing and drain cooling sections. Shell of carbon steel as per ASTM-516 Gr. 70 and water box channel and channel cover as per ASTM A-266 class-II / ASTM-516 Gr. 70 / SA 533 Type B Cl 2 and shall be welded to tube sheet. Tubes to be welded to tube sheets and then hydraulically expanded.			
6.00.00	BOILER FEED PUMP			
6.01.00	(a) Construction Requirements (1) Main Pump: Horizontal, centrifugal type, multistage, outer casing barrel type with end rotor removal. (2) Booster pump: Single stage, two bearing design and double suction impeller type. Overhung impeller not acceptable. (b) Performance curve The characteristic curves of booster pump and main pump should be continuously rising type with decrease in flow and combined shut off head of main pump & booster			
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB SECTION-A-07 STEAM TURBINE AND AUXILIARIES SYSTEM	PAGE 12 OF 26

CLAUSE NO.	TECHNICAL REQUIREMENTS		
6.02.00	pump shall be in the range of 115% to 130% of combined TDH (booster pump and main pump) at design point. (c) Minimum recirculation (1) The minimum flow of the booster pump and main pump shall not be less than 25% of design flow. (2) Minimum recirculation valve with valve body designed for 40% of design flow. (3) Seat tightness of recirculation valve shall conform to MSS SP 61 (d) Motor drive start up time Motor shall be able to accelerate the pumps from standby conditions to rated pumping conditions in less than 15 seconds after receipt of starting signal while operating either singly or in parallel with other operating pump and MDBFP and associated auxiliaries to be designed for auto startup on failure of running equipments/auxiliaries. (e) Critical speed The first critical speed in water with internal clearance being 150% of new clearance shall be more than 130% of design speed. (f) First Stage Impeller life Life due to wear due to cavitation of first stage impeller not less than 40000 running hours. (g) Dry running Capable of accepting complete loss of water due to incidents such as inadvertent complete closure of suction valve and brought down to rest in controlled manner from design condition with simultaneous closure of suction valve. (h) Diametrical Clearances between periphery of impeller and inside diameter of boiler feed pump casing: Not less than 4% and 6% of impeller outer diameter for diffuser and volute type pumps respectively. (i) Thermal shock withstand capabilities The pump should be designed to withstand thermal shock encountered during the entire operating regime (normal & abnormal) of the unit. (j) Applicable Code : HIS (latest edition) Operational and maintenance requirement: (a) Warm up arrangement Suitable warm up arrangement (if required) to start the pump rapidly shall be provided. However, pump should preferably be capable of starting from any conditions without having any warm up in emergency. (b) Parallel Operation Response and Performance characteristics of BFP (MD and TD) shall be such that while operating in parallel the difference in flow handled by them and the flow		
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB SECTION-A-07 STEAM TURBINE AND AUXILIARIES SYSTEM	PAGE 13 OF 26

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
6.03.00	proportionate to their rating corresponding to the load shall not be more than 5% of flow through any one pump. (c) Emergency Lubrication of MDBFP Pressure lubrication (if necessary) of MDBFP at the time of coasting down of the motor driven boiler feed pump set in the event of AC power failure shall be arranged by Bidder. (d) Cartridge Concept The inner pump element comprising shaft, impellers, stage casings capable of being removed and replaced as a unit without disturbing feed piping in not more than 12 hours and shall be demonstrated by Bidder. Suction, discharge and interstage bleed connections need not be broken to dismantle the pumps. Mechanical Seals (a) Type : Fully cartridgised design. (b) Seal face Materials : (i) For Booster Pump: Not inferior to silicon Carbide and Carbon seal face combination (ii) For Main Pump: Superior to silicon Carbide and Carbon seal face combination like Diamond face, suitable to operate with feed water PH of 8 to 8.5 without dosing arrangement. (c) Life : Not less than 20,000 running hours between overhauls and having dry running withstand capability as specified running with the specified feedwater PH of 8 to 8.5. (d) Supporting system Each seal to be provided with 2x100% magnetic filters, 2x100% tubular coolers, Piping, Valves, Control and instrumentation etc. Each cooler to be designed with margin of 20% over worst condition of heat generated in seals. Further in case of AC power failure, seal should be able to withstand without cooling water. (e) Alternatively, bidder can also provide Main pump shaft sealing of throttle type along with all accessories, associated piping, valves & fittings, specialties, instrumentation and control etc. as per standard proven practice of the BFP manufacturer. Throttle type seal (if offered) for main pump shall meet following requirement: 1. Cold condensate injection flow should not enter the Main pump casing under any condition (including standby condition) to avoid sagging of main pump shaft. 2. Withstand capability in case of total AC power failure		
6.04.00	HYDRAULIC COUPLING (1) Type & Rating: Combined fluid Coupling/Gear box type. Adequately rated to meet the requirement of pump characteristics while operating in the range of capacities specified. (2) Material and other accessories Complete with stainless steel impellers, bearings, pillow blocks and proven thrust bearing as per bidder's standard practice for input/output with removable Covers, oil sump, duplex filters to remove all particles upto 25 microns, oil temperature and		
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB SECTION-A-07 STEAM TURBINE AND AUXILIARIES SYSTEM	PAGE 14 OF 26

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	pressure gauges, Control pump for oil regulation if provided, regulating Valves, stainless steel scoop tube, 1x100% lube oil cooler, 1x100% Working oil cooler, one portable type oil purifier per station of adequate capacity to be included to form the centralized lubrication system for MDBFP set. The specification and capacity of portable type oil purifier shall be as specified in drive turbine section.			
6.05.00	DRIVE TURBINE:			
6.05.01	Type: Dual admission type or Single admission type with an external control valve, single cylinder, condensing type.			
6.05.02	Casing : To withstand the maximum pressure and temperature likely to be subjected during normal operation and 25% over rated pressure for short term duration.			
6.05.03	Rotor: Forged steel, heat treated, accurately machined and proportioned in order to keep critical speed away from operating speed.			
6.05.04	Drive turbine stop control valve			
	(a) Stop Valves to be provided with removable stainless steel steam strainer for normal operation and one additional strainer element shall be provided for initial operation.			
	(b) Valves to be provided with removable internals to allow for steam blowing.			
	(c) Stop valves to have provision for on load testing.			
6.05.05	Turning gear			
	(a) Drive turbine to be provided with an adequately sized AC motor driven or hydraulically operated turning gear for rotation of complete TDBFP train i.e. booster pump, gear box, drive turbine and main pump while unit being started or taken out of service.			
	(b) Hand barring gear shall be provided for manually rotating the drive turbine in an emergency. The lube oil shall be made available to the bearing during such operation.			
6.05.06	Drive turbine Lubricating oil system			
	(a) Each drive turbine shall be provided with a complete lubricating oil system which shall provide lube oil for drive turbine, main pump, booster pump and couplings and shall also cater the control oil of governing system and turning gear oil requirements. The lube oil system shall consist of			
	- One AC motor driven main oil pump			
	- One AC motor driven auxiliary oil pump -			
	- An oil purification system of type as specified for Main Turbine elsewhere in the specification.			
	- One DC motor driven emergency oil pump for bearings oil requirements only.			
	- Duplex type full capacity oil filters of cartridge type with bypass facility.			
	- 2x100% AC motor driven oil vapour extractors.			
	- One full capacity AC motor driven jacking oil pump (if required).			
	(b) All the piping, fittings, valves, Main Oil Tank and complete strainers including body and element shall be of stainless steel. Further all the parts of lube oil coolers (tubular or plate type) which are coming in contact of lube oil shall be of stainless steel.			
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB SECTION-A-07 STEAM TURBINE AND AUXILIARIES SYSTEM	PAGE 15 OF 26

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	The lube oil for Main Turbine, Drive Turbine, TDBFP and MDBFP shall be kept same in view of ease of operation and maintenance.			
	(c) Type test(s) to be conducted Particle size impurities test and moisture test as detailed out for Main Turbine, is to be carried out on one oil purification system of BFP drive turbine.			
6.05.07	Codes Design of drive turbines generally in accordance with API 612 and 614 and testing in accordance with ASME PTC-6.			
6.05.08	Turbine to be designed for protection against water induction. All drains shall consist of motorised/ pneumatic drain valves with isolating valves and drain piping for connection to drain flash tank for warming up drains before and after valve seats, casing drains. Gland steam system drain, IP extraction CRH and auxiliary steam lines alongwith necessary controls.			
6.05.09	Operational Requirement (a) Drive turbine of BFP shall get normal motive steam from IP-LP crossover/cross around pipe or from a point as per optimized cycle of bidder during operation of turbine from full load to 60% EMCR load or below, if possible. (b) During low unit load conditions, turbine bypass operation, shutdown operation when extraction pressure of the normal motive steam source is insufficient to operate the drive turbine, steam from alternate source, from the same unit i.e. CRH, shall be admitted through a separate set of stop and control valves. Both sets of control valve to be controlled by electro hydraulic governing system. Bidder can offer single admission turbine with an external control valve (to be operated from the governing system). (c) An additional alternate source of steam from other unit shall be provided by the bidder for Drive turbine of BFP for cold/ hot start of boiler (in case MDBFP is inoperative). For this additional alternate source during startup, bidder may opt for the auxiliary steam supply, if the auxiliary steam parameter suits the drive turbine requirement. (d) In case bidder offer extraction steam to BFPT arrangement as per BOX-B of tender P&ID of extraction steam to BFPT then the pressure regulating valves in the CRH and Auxiliary steam line shall necessarily be electro hydraulically operated. (e) Single Drive Turbine along with corresponding TDBFP shall be capable of operating at unit load corresponding to 20% TMCR without opening of minimum recirculation valve and with FW control in AUTO mode. Corresponding Heat Balance Diagram (HBD) shall be furnished.			
6.05.10	STRAINERS AT BOOSTER PUMP AND BOILER FEED PUMP Strainer body simplex and cylindrical type. The clear area of strainer to be Five times the inlet cross sectional area of the connecting piping. Strainer to be constructed of 11 gauge perforated stainless steel (304 grade) and lined with stainless steel (316 grade) screen. At design flow and clean condition, Pressure drop not to exceed 0.15 Kg/cm2. At design flow and 50% clogged condition, Pressure drop not to exceed 0.20 kg/cm2.			
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB SECTION-A-07 STEAM TURBINE AND AUXILIARIES SYSTEM	PAGE 16 OF 26

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC																														
6.05.11	Type Test(s) to be conducted Following type tests to be carried out; (i) NPSH (R) Test on one BFP and one BP (ii) Pressure pulsation test on one BFP (iii) Axial thrust measurement on one BFP (iv) Complete strip down test of BFP which undergone above tests (v) Pressure drop test on one strainer for each type and size Bidder to ensure that after the type test, the pump is properly cleaned and dried so that during transportation there is no damage/rusting in the pump.																																	
7.00.00	EOT CRANES																																	
7.01.00	TURBINE HALL EOT CRANE: (i) RATING <table><tr><td>(a)</td><td>Capacity</td><td>AS specified elsewhere in specification</td></tr><tr><td>(b)</td><td>Auxiliary Hoist Capacity</td><td>Not less than 20 Tonne</td></tr><tr><td>(c)</td><td>Total height of crane</td><td>Top most level of crane w.r.t. the top of runway rail level shall be approximately 4.5m</td></tr><tr><td>(d)</td><td>Approximate max. full load speeds</td><td></td></tr><tr><td></td><td>- Main Hoist</td><td>1.6 m/min</td></tr><tr><td></td><td>- Auxiliary Hoist</td><td>7.5 m/min.</td></tr><tr><td></td><td>- Trolley travel</td><td>15.0 m/min.</td></tr><tr><td></td><td>- Crane travel</td><td>30.0 m/min.</td></tr><tr><td>(e)</td><td>Creep speed of main hook and auxiliary hook</td><td>10% of max. speed</td></tr><tr><td>(f)</td><td>Creep speed for cross travel and long travel</td><td>10% of the maximum speed</td></tr></table> (ii) Applicable codes (a) Design and duty of crane structure, main hoist, auxiliary hoist, cross travel, long travel in accordance with class M5 of IS: 3177 (latest edition). (b) All other structure of cranes in accordance with IS-807. (c) Main hook Ramshorn type conforming to IS-5749 (latest edition) and auxiliary hook shank type conforming to IS 15560 (latest edition) In case the load is more than 250 Tonne, Main hook (Ramshorn type) shall conform to DIN-15402 (latest edition). (iii) Bridge structure (a) Vertical deflection caused by safe working load and weight of trolley in central position not to exceed 1/900 of the span. (b) Trolley stops of spring type to be mounted independently on bridge rails to prevent trolley from running off. (iv) Buffer				(a)	Capacity	AS specified elsewhere in specification	(b)	Auxiliary Hoist Capacity	Not less than 20 Tonne	(c)	Total height of crane	Top most level of crane w.r.t. the top of runway rail level shall be approximately 4.5m	(d)	Approximate max. full load speeds			- Main Hoist	1.6 m/min		- Auxiliary Hoist	7.5 m/min.		- Trolley travel	15.0 m/min.		- Crane travel	30.0 m/min.	(e)	Creep speed of main hook and auxiliary hook	10% of max. speed	(f)	Creep speed for cross travel and long travel	10% of the maximum speed
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SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB SECTION-A-07 STEAM TURBINE AND AUXILIARIES SYSTEM	PAGE 17 OF 26																														

CLAUSE NO.	TECHNICAL REQUIREMENTS	एन टी पी सी NTPC		
	(a) Suitable buffer to be fitted to each end of carriage assembly and crab. (b) Buffers to be designed to bring the loaded crane to rest from a speed of 50% of the rated speed. (v) End trucks, wheels and axles To be designed in accordance to IS: 3177 (latest edition) (vi) Bridge and trolley drive Mechanism (a) One drive at each end of bridge. (b) One drive for trolley drive. (vii) Operator's cabin and platform (a) Open type for indoor service to be located at B-row column. Cabin shall be designed as per IS3177 so as to have unrestrictive view of load from operator's cabin. (b) The area of cabin to be 2500/1850 mm with a head room of 2000 mm. (c) A foot operated electric warning horn of double bell type suitable for 240 V AC. of noise level 95 dBA at 3.5 m. (d) One brass gong suspended outside the Cabin and operated from inside. (e) A distinct type alarm with conspicuous warning lights on either side of the crane bridge to indicate overloading of crane. (f) Adequate carbon dioxide gas cylinders of 4.5 Kg. (g) One non oscillating ventilating fan. (h) Suitable inspection cages to accommodate two persons to facilitate inspection of down shop lead. (i) Access walkways of not less than 800 mm (clear) with hand railing of height of 1100 mm along the both side of bridge girder and cross over walkways (viii) Drums To be in accordance with IS-3177 (latest edition). (ix) Wire Rope (a) Wire rope of extra flexible plough steel and of 6/36 or 6/37 construction conforming to IS: 2266 (latest edition) (x) Bearings and lubrication (a) The type of bearings for various parts as per IS:3177 (latest). (b) Bearing life not less than 10,000 working hours. (c) Centralised grease lubrication with hand operated grease pump for all bearings as per bidder's standard proven practice. (xi) Guarding (a) Suitable guard to push forward or off the rail track any object placed across. (b) Suitable guards to live electrical wirings downshop lead. (c) Other guarding as per relevant standard. (xiii) Safety (a) Suitable anti-collision device of two cranes, alongwith stoppers at both the gable ends. (b) To meet the requirements of Factories Act. (xiv) Runway/trolley Rails and rail joints			
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB SECTION-A-07 STEAM TURBINE AND AUXILIARIES SYSTEM	PAGE 18 OF 26	

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Rails to be as per relevant Indian Standard and joints to be butt welded by thermit welding or fusion welding. (xv) Brakes 2 X 100 % Brake shall be provided for each motion. Each brake for hoisting motion, cross travel, long travel etc., shall be designed as per following: Brakes to be as per IS 3177. The Capacity of hoisting motion brakes to be 150% of torque transmitted to the brake drum with full load and that of cross travel and long travel to be 125% of motor rated torque before deaerating. xvi) Storm Brakes: 2x50% storm brakes, one each at each end of the bridge, shall be provided for each crane. Storm brakes shall be designed for wind velocity as indicated in "Criteria for wind resistant design for structure and equipment", Sub-section – D-01 / Civil Works/ Part-B/ Section-VI. (xvi) Common lifting beam for generator stator a) Suitable common lifting beam for lifting generator stator by means of two cranes operating in conjunction with suitable swiveling arrangement. b) A suitable indicating device to indicate the difference in the lifts of the two cranes, which shall be limited to 500 mm shall be provided on the lifting beam. The level difference indication shall be visible from ground level. c) A limit switch shall be provided to give alarm at both the cabins to enable the crane operators to control the level difference within 500mm. The bidder shall furnish the GA drawing of the beam showing all the dimensions, constructional details, details of crane hooks connection to the beam, lifting arrangement, level difference indicating devices, etc alongwith the bid.			
7.02.00	EOT CRANES FOR BOILER FEED PUMP (if envisaged)			
7.02.01	One (1) no of Electrically operated travelling cranes (Double Girder type) for each unit with associated auxiliaries, alongwith electrical equipment, control & instrumentation as required and specified shall be provided in the BC bay for erection and maintenance of Boiler feed pump and their auxiliaries. The capacity of each crane shall be 10% over and above the heaviest component/equipment (including Drive Turbine assembly) to be handled (including lifting beam and slings etc., if provided) or 25 Tonne whichever is higher.			
7.02.02	The EOT crane shall be pendent operated. The power shall be supplied from a single electrical power supply point at a suitable location on the operation floor of pump house.			
7.02.03	The design code for EOT crane shall be IS: 3177 latest edition.			
7.02.04	However, the speed for the various motions shall be as follows:			
	Main hoist	-	1.6 m/min	
	Trolley Travel (Cross Travel)	-	4.0 m/min	
	Crane Travel (Long Travel)	-	8.0 m/min	
7.02.05	Creep speed drives shall be provided for all the motions viz. bridge motion, trolley motion and hoist motion. This shall be 10% of the rated speeds. (Creep speed to be achieved through pony motor and planetary gear box or through variable voltage variable frequency (VVVF) system. Hoist brake shall not be used for this motion).			
7.02.06	The crane shall be electrically operated, overhead travelling type. Design and duty of crane structure, main hoist, cross travel. Long travel shall be in accordance with class M5 of IS:3177 (latest edition) and shall be suitable for indoor operation.			
7.02.07	The crane shall be complete with trolley and truck, wheels and axles, Drive mechanisms, Hoisting Drums, Brakes, Creep Speed Arrangement, Lifting tackles, Buffers Electric Motors, Controls, Switch Board and cabling, horns, warning lights, Limit switches etc. Any item not			
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B		SUB SECTION-A-07 STEAM TURBINE AND AUXILIARIES SYSTEM
PAGE 19 OF 26				

CLAUSE NO.	TECHNICAL REQUIREMENTS											
7.02.08	mentioned herein but required to make the system complete for the satisfactory performance of the crane shall also be included. The main hoist, trolley travel and crane travel for each movement shall be motor driven. Proper allowance shall be made for impact and wear in the design of the crane and the factor of safety shall be as per IS: 3177 based on the ultimate strength of the materials used at design duty. The design duty of crane structure, main hoist, cross travel and long travel shall conform to class M5 of the Indian Standard IS: 3177 (latest edition) or superior. The crane as a whole shall comply with the Indian Standard IS: 3177 / IS: 807 or approved equivalent international standard (latest edition).											
7.02.09	The hoist motors shall be provided with electro-magnetic brakes / Electro Hydraulic Thrust brakes. Electro - Hydraulic Thrust brakes shall be provided for cross travel & long travel. 2 X 100 % Brake shall be provided for each motion. Each brake for hoisting motion, cross travel, long travel etc., shall be designed as per following: Brakes to be as per IS 3177. The Capacity of hoisting motion brakes to be 150% of torque transmitted to the brake drum with full load and that of cross travel and long travel to be 125% of motor rated torque before deaerating.											
7.02.10	Safe means of access shall be provided and to every place of crane where examination/maintenance of any component is involved. A platform shall extend to full length of the crane bridge on both sides of the bridge girder. The platform shall be made of checkered Steel plate. A double tire hand-rail of height 1100 mm shall be provided along the outer edge of the platform and 75mm high toe-guards shall be provided all along the platforms and wherever else required from safety consideration. The width of platform shall not be less than 800mm in width and Guard rails shall be provided on the crab side of the bridge platform.											
7.02.11	LADDERS : Necessary access ladders shall be provided for access on to crane bridge platform form the gantry girder level, from crane bridge platform to trolley platform and from operating floor of pump to gantry girder level.											
7.02.12	The lifting tackle shall consist of a safety type lower pulley block, hook, necessary sheave and flexible steel wire ropes. The lower block sheaves and ropes shall be of adequate design and size to handle the specified loads. The hooks shall be of forged steel. The main hook shall be of Ramshorn type conforming to IS:5749 (latest edition) for 50 T and above capacity and shank type conforming to IS:15560 (latest edition) for capacity lower than 50 T. The factor of safety for the rope shall be as per IS:3177. The sheaves shall be of heavy duty with deep flanges made of cast steel and shall be properly grooved to fit the rope and adequately guarded.											
7.02.13	Each crane shall be controlled individually for all its motions from the control pendent panel.											
7.02.14	Each crane shall have a permanent inscription of English on each side, readily visible from the ground level, stating the safe working loads in tonnes for both the hooks, year of manufacture, crane serial number and manufacturer's name.											
7.02.15	The vertical deflection of crane girder shall not exceed 1/800 of the span. The girder shall be of box type and construction shall ensure non-accumulation of water/oil inside the box.											
7.03.00	MAXIMUM SPAN/DEPTH RATIO FOR GIRDER: <table><tr><td>(a)</td><td>Plate girders</td><td>:</td><td>18</td></tr><tr><td>(b)</td><td>Lattice girders</td><td>:</td><td>12</td></tr></table>				(a)	Plate girders	:	18	(b)	Lattice girders	:	12
(a)	Plate girders	:	18									
(b)	Lattice girders	:	12									
7.04.00	Material <table><tr><td>(i)</td><td>Structural steel plates : rolled section</td><td>:</td><td>Mild steel, grade 'B' of IS 2062 in 100% killed, normalised and ultrasonically tested quality or high strength steel of IS 8500 as appropriate</td></tr><tr><td>(ii)</td><td>Nuts & Bolts</td><td>:</td><td>As per IS:1363, IS:1364 and IS:1367. High Tension</td></tr></table>				(i)	Structural steel plates : rolled section	:	Mild steel, grade 'B' of IS 2062 in 100% killed, normalised and ultrasonically tested quality or high strength steel of IS 8500 as appropriate	(ii)	Nuts & Bolts	:	As per IS:1363, IS:1364 and IS:1367. High Tension
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SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB SECTION-A-07 STEAM TURBINE AND AUXILIARIES SYSTEM	PAGE 20 OF 26								

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनडीपीसी NTPC
			Friction grip bolts as per IS: 3757. High Tension Friction grip nuts as per IS: 6623.	
	(iii)	Electrodes	:	Radiography quality, covered electrodes with heavy covering as per IS : 814 and relevant requirements of ASME Sec. IX and IIC. Bare Electrodes as per IS:7280 and flux wire combination as per IS : 3613.
	(iv)	Chequered plates	:	IS: 3502 (Minimum 6 mm thick O/P)
	(v)	Hand rail pipes	:	32 mm NB Medium class of IS : 1161 having top and bottom rail at height of 1050 mm and 600 mm and vertical post spacing not exceeding 1500 mm with provision of kick plate(100 mm high and 6 mm thick).
	(vi)	Crane Rails	:	As per IS : 3443.
7.05.00	Minimum thickness of Structure Members:			
	(a)	Load Carrying members:	:	8 mm
	(b)	Tubes with both ends sealed	:	4.9 mm (6 SWG)
	(c)	Tubes with unsealed ends	:	8 mm
	(d)	Chequered plate	:	6 mm O/P
8.00.00	PRECOMMISSIONING ACTIVITIES			
	The pre-commissioning activities including some of the important checks & tests for certain major equipment/ systems are mentioned under respective equipments, although it is the Contractor's responsibility to draw up a detailed sequential & systematic list of checks / tests and various activities / procedures connected with pre-commissioning of the complete facilities with all systems, sub-systems and equipment supplied and installed by him and get the same approved by the Employer.			
9.00.00	COMMISSIONING OF FACILITIES			
	Upon completion of pre-commissioning activities/test the Contractor shall initiate commissioning of facilities. During commissioning the Contractor shall carryout system checking and reliability trials on various parts of the facilities.			
	Contractor shall carry out these checks/tests at site to prove to the Employer that each equipment of the supply complies with requirements stipulated and is installed in accordance with requirements specified. Before the plant is put into initial operation the Contractor shall be required to conduct test to demonstrate to the Employer that each item of the plant is capable of correctly performing the functions for which it was specified and its performance, parameters etc. are as per the specified/approved values. These tests may be conducted concurrently with those required under commissioning sequence.			
10.00.00	NOISE LEVEL			
	In case the noise level pertaining to equipments covered under the scope exceeds the specified values, as given in relevant clause of General Technical requirement portion of Technical Specification, suitable acoustic enclosures, properly illuminated, having adequate inside space for movement (minimum 500 mm clear space on all sides from last equipment)			
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B		SUB SECTION-A-07 STEAM TURBINE AND AUXILIARIES SYSTEM
PAGE 21 OF 26				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	alongwith all accessories in order to complete the system shall be provided to achieve the specified values. The acoustic enclosures & accessories shall be designed as per internationally accepted standards and shall be subject to Employer's approval.			
11.00.00	AVAILABILITY REQUIREMENTS OF TG AND AUXILIARIES			
	The steam turbine generator unit and auxiliaries shall be designed for maximum reliability and availability, operability and maintainability particularly in respect of the following:			
11.01.00	All equipment and systems shall be of proven design, using proven materials with well established physical and chemical properties and as appropriate to the service as intended.			
11.02.00	The steam turbine generator unit and its auxiliaries shall be suitably designed and provided with required instrumentation for rapid starting, loading and unloading without causing undue vibration, distortion, differential expansion or producing excessive thermal stresses.			
11.03.00	The steam turbine generator unit alongwith auxiliaries is normally expected to operate in sliding pressure mode from rated pressure down to 40% of rated pressure in conjunction with steam generator, HP-LP bypass system and plant instrumentation and control system.			
11.04.00	All stand-by auxiliaries shall be designed for auto start up, on failure of running auxiliaries with minimum time delay and without runback on unit load.			
11.05.00	Adequate maintenance facilities shall be provided as required for assembly, disassembly, alignment work particularly in respect of HP barrel, casing, inner and outer casings, diaphragm glands, steam valves, journal bearings, thrust bearings, turbine rotors, generator rotor, particularly end rings, shaft seals, generator bearings, hydrogen coolers, water cooled condenser system, vacuum pumps, condensate extraction pumps and boiler feed pump cartridges, BFP drive turbines, regenerative feed heaters, turbine oil coolers and pumps, etc. The offer shall give details like components requiring replacement or repairs during the life cycle of the plant, meantime between failures and list of tasks to be carried out during major overhauls.			
12.00.00	TYPE TESTS			
12.01.01	The contractor shall carry out the type tests as listed in the "TYPE TEST(S) TO BE CONDUCTED" on the equipment mentioned therein. The Bidder shall indicate the charges for each of these type tests separately in the relevant schedule of BPS and the same shall be considered for the evaluation of the Bids. The type test charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the Employer's Engineer.			
12.01.02	The type tests shall be carried out in presence of the Employer's representative, for which minimum 15 days notice shall be given by the Contractor. The Contractor shall obtain the Employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.			
12.01.03	Irrespective of the requirement of conducting the type tests under this contract, the Contractor shall submit the reports of the type tests listed in the "TYPE TEST(S) TO BE CONDUCTED" and carried out within last five years from the date of bid opening. These reports should be for the tests conducted on the equipment same (model / type / size / rating) to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The			
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB SECTION-A-07 STEAM TURBINE AND AUXILIARIES SYSTEM	PAGE 22 OF 26

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
13.00.00	Employer reserves the right to waive conducting of any or all of the specified type tests under this contract, in which case the type test charges shall not be payable for the type tests waived by the Employer. All the Turbine & Auxiliaries equipments shall be designed following “Fail Safe” concept. In case of failure of Power supply like Electric power, Hydraulic pressure, Pneumatic pressure, Vacuum etc. the system should be designed in such a way that the equipment/Valves etc. shall always move/remains (as applicable) to safest position as per system requirement to ensure safety of Man and Machinery.			
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB SECTION-A-07 STEAM TURBINE AND AUXILIARIES SYSTEM	PAGE 23 OF 26

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनडीपीसी NTPC
	ANNEXURE-I Other conditions for computing heat balance diagrams: 1. Throttle steam pressure Kg/cm²(abs) 270 2. Throttle steam temperature deg. C 600 3. Reheat steam temperature deg. C To be optimized by the bidder between 600 and 610 deg.C (both values inclusive) but not less than 600 deg.C 4. Worst condenser pressure mmHg(abs) 89 5. Condenser Pressure mm Hg(abs) 77 6. Make up water (as applicable) % throttle flow 3.0 7. Quantity of steam tapped off from cold reheat line for meeting normal auxiliary steam requirement t/hr. 15 (normal) 8. Final feed water temperature optimised at 100% TMCR deg. C To be optimised by the bidder but not less than 305 deg C 9. Pressure drop in the reheat circuit (from HP turbine exhaust flange to IP turbine inlet) % of HP turbine exhaust pressure To be optimised by the bidder 10. Design pressure drop in : (i) All extraction steam lines except to the deaerating heater % of the pressure (abs) at the turbine extraction flange 5 (max)			
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB SECTION-A-07 STEAM TURBINE AND AUXILIARIES SYSTEM	PAGE 24 OF 26

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	(ii) Steam extraction line to deaerator -- do -- 8 (max) (iii) Steam extraction line to boiler feed pump drive turbine -- do -- 12 (max) Note : (1) The above mentioned values of pressure drop in reheater circuit and extraction lines shall be at the heat rate guarantee point of 800 MW output at 77 mm Hg (abs) condenser back pressure and 0% make-up. (2) During H.P./L.P. bypass operation, the source of steam supply of deaerator shall be from cold reheat line and the deaerator shall be pegged at pressure as optimized by the bidder. For heat balance diagrams and for sizing of the HP-LP bypass system, no steam shall be tapped off for any of the feed water heaters other than the deaerator. (3) The heat balances with zero percent make up shall be computed without any auxiliary steam tapped off from CRH line. Other heat balances with 3% cycle make-up shall be computed with 15 T/hr. of steam tapped off from CRH line for meeting auxiliary steam requirements of the unit. (4) The auxiliary steam drawn off from CRH line shall be treated as loss from the cycle which in turn shall be made up in the condenser hot well.. (5) The temperature of make up water shall be taken same as that of the hot well condensate under any load condition. (6) In the sliding pressure mode of operation the throttle pressure will slide down from rated pressure to a value corresponding to 40% of rated pressure. For computing heat balance for sliding pressure mode of operation at 80%, 70%, 60%, 50% & 30% of Unit rated load, rated temperature shall be used for main steam and hot reheat steam respectively. However in case the temperature control range of the steam generator is above 30% of unit rated load, the maximum temperature attainable by the steam generator shall be used for development of heat balance diagram at 30% of unit rated load. (7) Tentative figures wherever indicated are for the purpose of preparing heat balance diagrams. (8) The 3% make-up to the cycle will be 3% of the main steam flow at HP turbine inlet. For the purpose of computation of heat and mass balance with 3% cycle make-up the difference of the mass flow between the make-up and the mass of steam drawn from CRH for auxiliary steam shall be assumed to be lost from the cycle as feed water down stream of the top HP heater. (9) It may be noted that the heat balance diagrams and guarantees shall be furnished considering the quantities of water for superheater and reheater sprays with any mill combination in service to the Employer's choice. For superheater and reheater, the spray quantities used shall not exceed the limits specified elsewhere in the specification. During Performance Guarantee Testing in case the spray quantity used are at variance from the values used in the heat balance diagrams, the actual values will be used for calculation of heat rate and no correction shall be allowed.		
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB SECTION-A-07 STEAM TURBINE AND AUXILIARIES SYSTEM PAGE 25 OF 26

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	(10) However, correction on account of variation in supper heater and Reheater spray quantities with respect to values used for the purpose of guaranteed heat rate values shall be permitted only to the extent that such variations are solely attributable to the change in coal properties with respect to those specified for the design coal. Bidders shall necessarily include the correction curves for variation in superheaters and reheater spray quantities with coal properties in his bid proposal, failing which no corrections shall be permitted.		
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB SECTION-A-07 STEAM TURBINE AND AUXILIARIES SYSTEM	PAGE 26 OF 26



SUB-SECTION–A-08

POWER CYCLE PIPING

**SINGARENI THERMAL POWER PROJECT
STAGE-II (1X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC NO.:CW-CM-11159-C-O-M-001**

CLAUSE NO.	TECHNICAL REQUIREMENTS		
1.03.00	DESIGN PARAMETER SELECTION: (a.) Design parameters shall be selected based on the provisions of latest editions of ASME B31.1 and IBR 1950. While selecting the design parameters, due consideration shall be given to the maximum occasional pressure and temperature variations expected in each system during its service. However, notwithstanding anything contained in these codes, standard & regulations, following specific requirement shall also be met. (b.) The design pressure of MS piping system from super heater outlet header up to and including boiler stop valve shall not be less than the design pressure of final Super heater outlet header. (c.) The design pressure for BFP discharge piping up to and including downstream block valve at feed regulating station (FRS) shall be selected such that the minimum calculated thickness for various pipes at design temperature is sufficient for the following conditions. (i) Discharge Pressure corresponding to Turbine driven BFP trip speed at shut off head flow condition, If TDBFP characteristics is governing for calculation of boiler feed discharge piping design pressure. (ii) Discharge pressure corresponding to Motor driven BFP trip speed (frequency 51.5 Hz) at shut off head flow condition If MDBFP characteristics is governing for calculation of boiler feed discharge piping design pressure. (d.) The design pressure of complete feed water discharge piping system downstream FRS first isolation valve shall not be less than maximum of the following: (i) 1.05 times the maximum operating pressure (including BMCR condition) at BFP discharge. (ii) Pressure required at BFP discharge under lowest spring-loaded safety valve on boiler separator blowing condition. (iii) Design pressure as required by IBR / ASME. (e) The design pressure and temperature, down-stream of any pressure reducing valve up to and including the first block valve shall be the same as that at up-stream of pressure reducing valve. However, lower design pressure downstream of MS-PRDS (with temperature corresponding to isenthalpic drop across the MS-PRDS) may be considered in case bidder provides suitable nos. of safety valves between MSPRDS & block valve at downstream. (f) The piping at D/S of de-super heater, for the spray mixing length, shall be of alloy steel material. The minimum straight length of piping to be considered at downstream of de-super heater for spray mixing shall not be less than the length required for proper mixing & evaporation of spray water as recommended by respective de-super heater manufacture. First bend downstream of any de-super heater shall be provided only after de-super heater manufacturer's recommended minimum required straight pipe length for proper mixing of spray water with steam. (g) The selected piping for the spray mixing length at d/s of desuperheater / HP Bypass valve/LP Bypass valve shall be checked (as per Clause 102.2.4 of ASME B 31.1) to meet the design requirement corresponding to the temperature derived from the equivalent enthalpy method between upstream and downstream of the de-super heater valves. (h) Complete boiler feed pump recirculation piping up-to last block valve (downstream of re-circulation control valve) shall be designed for full pump shut-off head. However, if IBR/ASME calls for any provision of safety valve at the downstream of last isolation valve on recirculation piping, then the same shall be provided by bidder. (i) Cold reheat Line from High Pressure turbine exhaust up to and including CRH NRV: Selected piping for this portion of cold reheat piping shall be checked to meet the maximum temperature (tentatively 500 deg. C) to which this portion of piping is exposed under any operating condition including turbine trip case, as recommended by turbine manufacturer.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB SECTION-A-08 Power Cycle Piping
			PAGE 2 OF 19

CLAUSE NO.	TECHNICAL REQUIREMENTS															
1.04.00	MATERIAL SELECTION: Piping system shall be of carbon steel for design temperature upto & including 400 deg.C and alloy steel for design temperature above 400 deg. C.															
1.05.00	PIPE WALL THICKNESS: (a) Thickness calculation shall be made on the basis of procedure and formula given in ASME B 31.1. Thickness thus calculated shall then be checked based on the procedure and formula given in IBR. Then, based on the higher value of the two calculations (after adding manufacturing tolerance), the next heavier commercial wall thickness shall then be selected from thickness schedules (e.g. Sch.-40, Sch-80, etc.) as contained in ANSI /ASME B36.10 for OD controlled pipes and from manufactures' schedules for ID controlled pipes. However, in such cases where the calculated thickness for OD controlled pipe falls beyond the thickness corresponding to the listed schedule nos. as given in ANSI B36.10 for the pipe size, both ID and OD controlled pipes to manufactures' schedules are acceptable. (See Note below). Note: - The maximum value of allowable stress (ASME material) as given in Mandatory Appendix-A of ASME B31.1 (Allowable stress Tables) shall be used for both ASME & IBR pipe thickness calculations, unless otherwise specified elsewhere in specification. (b) To Account for losses due to corrosion, erosion etc. during the plant service life, an allowance of 1.6 mm/0.75mm shall be considered in the minimum wall thickness calculation of pipes (both alloy steel & carbon steel) as per ASME B31.1/IBR respectively. (c) The selected pipe thickness in no case shall be less than (a) Sch XS for LP Bypass downstream piping (b) Sch.80 for alloy steel & carbon steel pipes of sizes 50 Nb & below and (c) Sch. 40S of ANSI B36.19 for Stainless steel piping. (d) Further, for the piping systems likely to be subjected to two phase flow, i.e. downstream of control valves on heater drain lines etc., the selected thickness shall not be less than Sch XS or one schedule higher than the calculated thickness, whichever is higher.															
1.06.00	END CONNECTIONS: Pipes, fittings & valves in power cycle piping systems shall in general be provided with butt welding ends as per ANSI B 16.25 for sizes 65NB & above and socket welding ends as per ANSI B 16.11 for 50 NB & below. However, butt weld joints in 25 NB / 40 NB / 50 NB piping is also acceptable provided root run (with TIG welding) is followed for the butt joints. Also, in certain cases specific edge preparation on pipe welding end may be required to be done to match equipment terminals, valves, specialties, connection to flanges, etc.															
1.07.00	SPECIFICATION FOR PIPES & FITTINGS: <table><tr><td></td><td>Alloy Steel</td><td>Carbon Steel</td></tr><tr><td colspan="3">A. PIPES</td></tr><tr><td>a) Material</td><td>ASTM A335 Gr. P-91, ASTM A335 Gr. P-92 or equivalent, (See Note below) ASTM A335 Gr. P22 OR ASTM A335 Gr. P11 (See Note below)</td><td>ASTM 106 Gr. B/ ASTM 106 Gr.C [A 106 Gr. C for BFD design parameters, CRH design parameters and above. Alternate material for BFD design parameters -15NiCuMoNb5 (EN 1.6368) / ASTM A335 Grade P36 (See Note below)]</td></tr><tr><td>b)Construction</td><td>Seamless</td><td>Seamless (See Note below)</td></tr></table>					Alloy Steel	Carbon Steel	A. PIPES			a) Material	ASTM A335 Gr. P-91, ASTM A335 Gr. P-92 or equivalent, (See Note below) ASTM A335 Gr. P22 OR ASTM A335 Gr. P11 (See Note below)	ASTM 106 Gr. B/ ASTM 106 Gr.C [A 106 Gr. C for BFD design parameters, CRH design parameters and above. Alternate material for BFD design parameters -15NiCuMoNb5 (EN 1.6368) / ASTM A335 Grade P36 (See Note below)]	b)Construction	Seamless	Seamless (See Note below)
	Alloy Steel	Carbon Steel														
A. PIPES																
a) Material	ASTM A335 Gr. P-91, ASTM A335 Gr. P-92 or equivalent, (See Note below) ASTM A335 Gr. P22 OR ASTM A335 Gr. P11 (See Note below)	ASTM 106 Gr. B/ ASTM 106 Gr.C [A 106 Gr. C for BFD design parameters, CRH design parameters and above. Alternate material for BFD design parameters -15NiCuMoNb5 (EN 1.6368) / ASTM A335 Grade P36 (See Note below)]														
b)Construction	Seamless	Seamless (See Note below)														
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB SECTION-A-08 Power Cycle Piping	PAGE 3 OF 19												

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	B. FITTINGS		
	a) Material for sizes above 50 NB	ASTM A234 GR. WP91 / ASTM A182 Gr. F92 or equivalent, ASTM A234GR. WP22 OR ASTM A234GR. WP11 [See Note below]	ASTM A234 Gr. WPB with A 106 Gr.B piping and ASTM A234 Gr. WPC for A106 Gr. C piping And 15NiCuMoNb5 (EN 1.6368) / ASTM A335 Grade P36/ ASTM A234 Gr. WPC with P36 pipe material specified above. [See Note below]
	b) Material for sizes 50 NB and below	ASTM A182 Gr. F91, ASTM A182 Gr. F92 or Equivalent, ASTM A182 Gr. F22 or ASTM A182 Gr. F11 (See note below)	ASTM A105 (See note below)
	c) Basic standards	ASME B 36.10 ASME B 16.9, ASME B 16.11, ASME B 16.25 ASME B 16.28	ASME B36.10 ANSI B16.9, ANSI B16.11, ANSI B 16.25 ANSI B 16.28
	d) Construction	Seamless (Note-1)	Seamless (Note-1)
	e) Rating/Wall / Thickness	To match with that of pipe	To match with that of pipe
	Note-1: Spherical WYE-piece (made of seamless forged components) as per TRD-303 / EN 13480-3 for high temperature applications is also acceptable.		
	C. MATERIAL ANALYSIS		
	Mandatory Test Requirements and Supplementary Test requirements	(a) Mandatory requirements: All tests, as given in respective material code (other than supplementary requirements), shall be carried out as minimum. This includes the tests wherein it is specified in the respective material code that “the test is to be carried out when specified by the purchaser” or any such indication, in the material code. (b) Optional tests/ Supplementary requirements (Applicable for 15NiCuMoNb5 (EN 1.6368) / ASTM A335 Grade P36): <u>(i) Optional tests for 15NiCuMoNb5 (EN 1.6368)</u> Product Analysis (Option 3), Wall thickness measurement away from tube end (Option 15), NDT for the detection of transverse imperfection (option 8) and laminar imperfection (option 9) as indicated in EN 10216-2 and tensile test at room temperature to be done per heat as an additional test. <u>(ii) Supplementary tests for ASTM A335 Grade P36</u> S1, S2, S3, S4 & S5 as indicated in ASTM A335.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB SECTION-A-08 Power Cycle Piping	PAGE 4 OF 19



(c) Supplementary tests & Additional Requirements applicable for ASTM-A-335-P-92 or Equivalent:

For ASTM A335 Grade P 92:

1. Supplementary tests S1, S2, S3 and S4 as per ASTM A 335 will be done. However, quantum of tests shall be at least 5% of the pipes per heat or Minimum 2 pipes per heat from one end / both end of the pipe as specified in ASTM A335.
2. Supplementary requirement S5: Certificate of conformity "COC" from pipe supplier for microstructure and delta ferrite (to be maintained within 3%max. when measured as per VD TUV 1272).
3. Chemical Composition: For ASTM A335 P92 Nickel and Copper shall be limited to Ni – 0.3% max. and Cu – 0.25% max., respectively, while complying the percentage of other elements in P-92 within the prescribed limits as indicated in the applicable codes/standards for piping (pipes/fittings/ components/ valves, etc.).

For material equivalent to ASTM A335 Grade P 92:

1. All supplementary tests (or optional tests, as the case may be) as per the applicable material standard /code.
2. Certificate of conformity "COC" from pipe supplier for microstructure and delta ferrite (to be maintained within 3%max. when measured as per VD TUV 1272).
3. Additional tests, i.e. tests, if any, not covered above but are required to be done as per IBR.

NOTE:

1. The material used for main steam piping system, hot reheat piping system and other alloy steel piping systems shall be equal to or better than the following specified material unless indicated otherwise:

(a)

	Max. permissible Temperature :	Design	Material (see note-9 below)
i)	Upto & including 510 degree Celsius		Alloy steel ASTM A-335 Gr.P-11.
ii)	Upto & including 545 degree Celsius		Alloy steel ASTM A -335 Gr.P-22.
iii)	Upto & including 601 degrees Celsius. * <i>*Consequent to above design temperature limitation of 601 Deg.C for usage of ASTM-A-335-P-91 or its equivalent material, this material (i.e. ASTM-A-335-P91 or its equivalent) shall not be used or offered in Main Steam and / or Hot Reheat Piping System when rated steam temperature at turbine inlet as offered by the Bidder exceeds 593 deg.C for either main steam or Hot reheat piping or for both)</i>		Alloy steel ASTM A -335 Gr. P-91 or equivalent.
iv)	Upto & including 610 degree Celsius.		Alloy steel ASTM A -335 Gr.P-92 or equivalent.

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	(b) In case it is proposed by the bidder to use material equivalent to ASTM-A-335 P-92 for Main Steam and / or Hot Reheat Piping, Bidder shall be required to furnish a certificate of provenness of the material certifying the usage & satisfactory performance of the proposed material in Main Steam and / or Hot Reheat Piping/components for a reference plant (or applicable unit of reference plant) having rated main steam and / or Hot Reheat steam temperature at turbine inlet at least equal to or higher than the rated Main Steam and / or Hot Reheat steam temperature at turbine inlet offered by the bidder. Such reference plant(s) (or unit) should have been executed by the bidder himself or by others and should have been under operation for at least 50,000 hours or 6 years from date of commissioning of the applicable unit (of the reference plant). (c) If the Bidder offers HRH Temperature in the Specified range up to 610 deg C, Alloy Steel ASTM A -335 Gr.P-92 or equivalent shall be used for HRH Piping, up to & including 620 degree Celsius design temperature. 2. Piping material for CRH piping from HPT exhaust nozzle up to and including the Tee-off of connection of HP by Pass shall be alloy steel to ASTM A335 Gr. P92/P91/P22/P11 depending on design temperature. Fittings shall also be corresponding to ASTM A234 Gr. WP92 or ASTM A182 Gr F92/ASTM A234 Gr. WP91/WP22/WP11. 3. HP Bypass downstream piping shall be of Alloy steel to ASTM A335 P92/P91/P22/P11 depending on design temperature. Fittings shall also be corresponding to ASTM A234 Gr. WP92 or ASTM A182 Gr. F92/ASTM A234 Gr. WP91/WP22/WP11. 4. LP Bypass downstream piping shall be of ASTM A335 P91/ ASTM A691 Gr.91 or ASTM A335 P22 /ASTM A691 Gr. 2¼Cr. CL-21/22 and fittings shall be ASTM A234 Gr. WP91/WP22, depending on design temperature. The fittings shall correspond to ASTM A234 with Grade corresponding to the pipe material. Single seam welded construction fittings are preferred with A691 piping. However, all requirements as per ASME B31.1 including the requirements given in mandatory Appendix-D, IBR & respective material code shall be fully complied with, in respect of welded fittings. 5. EFW Pipes as per ASTM A672 Gr. B60, CLASS-12/21/22 are acceptable for carbon steel piping of sizes 500Nb & above if the design pressure and design temperature are such that it calls for pressure rating of ASME 300 class or below. However, in such cases where the main piping is of seamless construction, all branch/tap-off from it shall also be of seamless construction irrespective of the pipe size. (For CEP discharge Piping system and CRH piping systems/parameters only seamless construction as specified above at 1.07.00 is acceptable). 6. Bends in BFP-T Exhaust Piping to condenser shall be of alloy steel of A691-2¼Cr.CL-21/22 or A691-1¼Cr. CL-21/22. 7. EFW pipes as per ASTM A691 Gr.2-1/4 Cr. Class 21/22 (up to design temperature 545 degree) are acceptable for alloy steel piping of sizes 500Nb & above if the design pressure and design temperature are such that it calls for pressure rating of ASME 300 class or below. (For CRH piping/parameters only seamless construction as specified above is acceptable). Further, in such cases where the main piping is of seamless construction, all branch/tap-off from it shall also be of seamless construction irrespective of the pipe size. 8. The materials for fittings with above-said ASTM A672/A691 piping shall correspond to ASTM A 234 with Grade corresponding to the pipe material. Welded construction fittings are also acceptable with A672/A691 piping provided that all requirements for welded fittings as per ASME B31.1 including the requirements given in mandatory Appendix-D, IBR & respective material code shall be fully complied with. Single seam welded construction fittings are preferred with A691/672 piping. 9. Materials for pipe components, valves, fittings, bends etc. shall be corresponding to the piping material, unless specified otherwise.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB SECTION-A-08 Power Cycle Piping	PAGE 6 OF 19

CLAUSE NO.	TECHNICAL REQUIREMENTS																																																																																												
1.08.00	10. For Boiler Feed Discharge piping / re-heater Attenuation piping, material conforms to 15NiCuMoNb5 (EN 1.6368)/ASTM A335 Grade P36 are acceptable as an alternate material to the specified material ASTM A106 Grade C. subject to meeting the following conditions: (a) Material for stubs, laterals, Boss etc. which are to be welded on to the main pipe of material 15NiCuMoNb5 (EN 1.6368)/ ASTM A335 Grade P36 shall corresponds to either the pipe material or ASTM A105. (b) Valves body shall be of forged construction and material shall corresponds to (15NiCuMoNb5 (EN 1.6368)/ ASTM A335 Grade P36) or A105. (c) Maximum permissible operating temperature for the material shall not exceed 310 deg. C. (d) The contractor / sub-contractor should have experience in fabrication & welding of feed water piping / re-heater Attenuation piping (as the case may be) with 15NiCuMoNb5/ASTM A335 P36. 11. The contractor/sub-contractor should have experience in fabrication and welding of Main Steam piping with the material of the pipe offered & specified above for the service.																																																																																												
	SPECIFICATION FOR VALVES A) Cast / Forged Steel Valve (Gate/Globe/Check 65 NB size & above)																																																																																												
	<table><tr><th rowspan="2">Sl. No.</th><th rowspan="2">Description</th><th colspan="2">Carbon Steel</th><th colspan="2">Alloy Steel</th><th rowspan="2">Stainless Steel</th></tr><tr><th>600 Lbs & below</th><th>Above 600 Lbs</th><th>600 Lbs & below</th><th>Above 600 Lbs</th></tr><tr><td>1.0</td><td>Basic Standard</td><td colspan="5">ANSI B16.34 or equivalent</td></tr><tr><td>2.0</td><td>Construction</td><td colspan="5"></td></tr><tr><td>a</td><td>Bonnet/Cover</td><td>Bolted type</td><td>Pressure Seal</td><td>Bolted type</td><td>Pressure seal</td><td>Bolted Type</td></tr><tr><td rowspan="4">b</td><td>Disc</td><td colspan="5"></td></tr><tr><td>Globe valves</td><td colspan="5">Throttling type plug</td></tr><tr><td>Check valves</td><td colspan="5">Tilting / swing type</td></tr><tr><td>Gate valves</td><td colspan="5">Solid/flexible wedge below 100 NB Flexible wedge for 100 NB & above</td></tr><tr><td>c</td><td>Seat</td><td colspan="5">Integral type / Welded Type</td></tr><tr><td>3.0</td><td>Material</td><td colspan="5"></td></tr><tr><td>a</td><td>Body & Bonnet Cover</td><td>ASTM 216 Gr. WCB (Refer note below)</td><td>ASTM 216 Gr. WCC (Refer note below)</td><td colspan="2">ASTM A 217 Gr. WC6 ASTM A217Gr. WC9 ASTM A 217Gr. C12A ASTM A182 Gr. F91 ASTM A182 Gr. F92 or equiv. (Refer Note below)</td><td>ASTM A351 CF8/CF8M</td></tr><tr><td>b</td><td>Stem</td><td colspan="4">13% chrome steel ASTM-A-182 Gr.F6a / ASTM A 564 Type 630 H 1150 D / ASTM A 565 GR 616 / ASTM A 565 GR 660 / A479 Type 410 / A479 Type 431/ A479 Type XM-19 /16Cr-Ni-Mo (Ohtaron) or better.</td><td>ASTM 182 F316/ F304</td></tr><tr><td>c</td><td>Hinge pin(for check valves)</td><td colspan="4">13% chrome steel ASTM A-182 Gr F6a</td><td>ASTM 182 F316/F304</td></tr></table>	Sl. No.	Description	Carbon Steel		Alloy Steel		Stainless Steel	600 Lbs & below	Above 600 Lbs	600 Lbs & below	Above 600 Lbs	1.0	Basic Standard	ANSI B16.34 or equivalent					2.0	Construction						a	Bonnet/Cover	Bolted type	Pressure Seal	Bolted type	Pressure seal	Bolted Type	b	Disc						Globe valves	Throttling type plug					Check valves	Tilting / swing type					Gate valves	Solid/flexible wedge below 100 NB Flexible wedge for 100 NB & above					c	Seat	Integral type / Welded Type					3.0	Material						a	Body & Bonnet Cover	ASTM 216 Gr. WCB (Refer note below)	ASTM 216 Gr. WCC (Refer note below)	ASTM A 217 Gr. WC6 ASTM A217Gr. WC9 ASTM A 217Gr. C12A ASTM A182 Gr. F91 ASTM A182 Gr. F92 or equiv. (Refer Note below)		ASTM A351 CF8/CF8M	b	Stem	13% chrome steel ASTM-A-182 Gr.F6a / ASTM A 564 Type 630 H 1150 D / ASTM A 565 GR 616 / ASTM A 565 GR 660 / A479 Type 410 / A479 Type 431/ A479 Type XM-19 /16Cr-Ni-Mo (Ohtaron) or better.				ASTM 182 F316/ F304	c	Hinge pin(for check valves)	13% chrome steel ASTM A-182 Gr F6a				ASTM 182 F316/F304
	Sl. No.			Description	Carbon Steel		Alloy Steel		Stainless Steel																																																																																				
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c	Seat	Integral type / Welded Type																																																																																											
3.0	Material																																																																																												
a	Body & Bonnet Cover	ASTM 216 Gr. WCB (Refer note below)	ASTM 216 Gr. WCC (Refer note below)	ASTM A 217 Gr. WC6 ASTM A217Gr. WC9 ASTM A 217Gr. C12A ASTM A182 Gr. F91 ASTM A182 Gr. F92 or equiv. (Refer Note below)		ASTM A351 CF8/CF8M																																																																																							
b	Stem	13% chrome steel ASTM-A-182 Gr.F6a / ASTM A 564 Type 630 H 1150 D / ASTM A 565 GR 616 / ASTM A 565 GR 660 / A479 Type 410 / A479 Type 431/ A479 Type XM-19 /16Cr-Ni-Mo (Ohtaron) or better.				ASTM 182 F316/ F304																																																																																							
c	Hinge pin(for check valves)	13% chrome steel ASTM A-182 Gr F6a				ASTM 182 F316/F304																																																																																							

CLAUSE NO.	TECHNICAL REQUIREMENTS							
	Sl. No.	Description	Carbon Steel		Alloy Steel		Stainless Steel	
			600 Lbs & below	Above 600 Lbs	600 Lbs & below	Above 600 Lbs	400 Lbs & below	
	d	Disc and seat ring (heat treated & hardened)	ASTM A216 Gr. WCB Minimum Hardness 250 BHN Refer note below)	ASTM A216 Gr. WCC (Refer note below)	ASTM A217 Gr.WC6 ASTM A217 Gr.WC9 ASTM A217 GrC12A ASTM A182 F91 ASTM 182 F92 or equivalent		ASTM 182 F316/F304	
	e	Back seat/stem guide Bushing	13% Chromium Steel ASTM A 182, Gr. F6a with stellite hard facing				ASTM 182 F316/ F304	
B) Forged Steel Valves (50 mm NB & below - Gate/Globe/Check)								
	Sl. No.	Description	Carbon Steel		Alloy Steel		Stainless Steel	
	1.0	Design Standard : ANSI B16.34 or equivalent						
	2.0	Construction						
	a	Bonnet/cover	Bolted type for 600 / 800 lbs, Seal welded type for 900 lbs and above				Seal welded/ Bolted type for 600/800Lbs. Sealed welded above 800lb	
	b	Disc:						
		Gate	Solid wedge type					
		Globe	As per manufacturing std					
		Check	Piston lift					
	c	Seat	Integral type					
	3.0	Material						
	a	Body & Bonnet Cover	ASTM A-105		ASTM A-182 Gr. F11 ASTM A-182 Gr. F22 ASTM A-182 Gr. F91 / F92 or equivalent (Refer Note below)		ASTM 182 F316/304	
	b	Stem	13% chrome steel ASTM-A-182 Gr.F6a / ASTM A 564 Type 630 H 1150 D / ASTM A 565 GR 616 / ASTM A 565 GR 660 / A479 Type 410 / A479 Type 431/ A479 Type XM-19 /16Cr-Ni-Mo (Ohtaron) or better.				ASTM 182 F316/304	
	c	Disc and seat ring	ASTM A105 hard faced with stellite minimum hardness 350 HB		ASTM A182 Gr. F22 ASTM A 182 Gr F91/F92 or equivalent ASTM A 182 Gr F11 /hard faced with stellite minimum hard ness 350 HB		ASTM 182 F316/304 hard faced with stellite Minimum hardness 350 HB	
C) Angle Globe Valve								
			Alloy Steel		Carbon steel			
		Design Standard	ANSI B16.34 or equivalent		ANSI B16.34 or equivalent			
		Material:						
		Body &	A182 Gr.F11/F22/F91/F92 or		A105 or better			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE			TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001			SUB SECTION-A-08 Power Cycle Piping		PAGE 8 OF 19

CLAUSE NO.	TECHNICAL REQUIREMENTS																																																																																									
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				PAGE 9 OF 19																																																																																						

CLAUSE NO.	TECHNICAL REQUIREMENTS						
	S. NO	DESCRIPTION	SAFETY VALVE		RELIEF VALVE	BF VALVE	
			ALLOY STEEL	CARBON STEEL			
			SEAT RING: ASTM A182 F316 / F316L				-EPT/BUNA-N/ Neoprene for water service -EPT/EPDM for steam service
			NOZZLE:				
			ASTM A182 F316 / F316L	A105 with 17% Cr (hard faced) or better			
	6.4	Spindle guide	17% chrome steel or monel, heat treated and hardened to minimum hardness 250 HB				
	6.5	Spring	Stainless steel /Tungsten steel / Chromium alloy	Chromium alloy		--	
	6.6	Retainer Rings and internal bolts Etc	--	--	--	SS 304	
	6.7	Bearing	--	--	--	Sleeve type, self lubricated	
	NOTES: 1. Valves shall be tested in accordance to ANSI B 16.34. However, for butterfly valves, the requirements of AWWA C-504, C516 shall also be met including POD test (where POD test results of representative valve is not available). 2. All gate and globe valves shall be with outside screw and yoke with rising stem. However, for Valves sizes 2"and below Bidder may provide rising wheel design valve also. 3. Gate valves below 100 NB shall be solid wedge / flexible wedge type, valves of size 100 NB and above shall be of flexible wedge type. However, for sizes 100 mm NB and above and with class above 600, parallel slide valves are also acceptable. 4. Stem for all valves shall be heat treated and hardened. Gland packing for gate and globe valves shall be alloy steel/SS wire reinforced graphite with stem corrosion inhibitor. 5. Minimum differential hardness between seat and other disc material shall be 50 HB in case of 13% chrome hardened with heat treatment of steel. 6. Valve closure test shall be as per ANSI B16.34 and MSS-SP-61. 7. Specification for valve actuators shall be as indicated in C&I and electrical Subsection. 8. Valves of size 65 NB and above shall have butt welded ends as per ANSI B16.25 and Valves 50 NB and below shall have socket weld ends as per ANSI B16.11. However, butt weld end (as per ANSI B 16.25) is also acceptable for valves sizes 25 NB / 40 NB / 50 NB on corresponding size of piping having thickness schedule 80 & above. 9. Locking arrangement, wherever specified shall be of non-detachable type. 10.All bolts and nuts shall be at least ASTM A-193 Gr. B 7 and ASTM A-194 Gr. 2H respectively. 11.Valves 50NB and below shall be globe type unless otherwise specified elsewhere. 12.Safety valves with Pressure Class 400 LBS and below shall be spring loaded with weld end / flanged End inlet, pop up type. 13.Safety valves with Pressure Class above 400 LBS shall be spring loaded with weld end inlet, pop up type. 14.For valves (all sizes) coming on A335 P92 or equivalent pipeline, body material shall be ASTM A182 F92 or equivalent and of forged construction. 15.Materials of valve trim shall be suitable for the design parameters. 16.Forged valve body construction in lieu of Cast valve body construction is also acceptable. However, material (ASME forged grade) shall correspond to the specified valve material/pipe material. 17.The valve body material shall be corresponding to the pipe material, unless specified otherwise. 18.Unless otherwise agreed, all valves shall be fitted with the spindle in upright position.						
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB SECTION-A-08 Power Cycle Piping	PAGE 10 OF 19		

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.09.00	19.The minimum inside diameter for valves shall be as per requirements of ASME B16.34. For valves beyond the listed sizes & rating in Table-A of non-mandatory Appendix-A of ASME B16.34, the minimum diameter of valve flow passage shall not be less than 90% of pipe inside diameter. However, reduced port valves are also acceptable for sizes 65NB and below.			
	STRESS ANALYSIS: 1) Flexibility/stress analysis for power cycle piping systems shall be as per the requirement of ASME B31.1/IBR. Contractor shall ensure that flexibility analysis also calculates the deflection in all directions (translational/rotational) to enable design & solution of hanger/support system. 2) Besides the flexibility /stress analysis, steam hammer analysis & dynamic analysis shall also to be performed wherever required to study the effects of fast closure of steam admission valves and safety valve blowing etc. Requirements of additional restraints/snubbers to take care of these effects shall be established and such restraints / snubbers shall be provided by the contractor. The contractors shall also analyze the effects of safety valve reactions, seismic & wind loads and provide adequate support to take care of the same. 3) Cold pulling is not permitted. The contractor shall so design the piping systems that there will be no requirements of cold pulling for meeting allowable reaction/stress values.			
1.10.00	DRAINS & VENTS: (a.) All high points in piping system shall be provided with vents. All low points shall be provided with drains. Provisions of drains on steam piping shall be as per ASME code TDP-1. Drain lines shall be adequately sized so as to clear condensate in the line and prevent water hammer and damage to turbine due to water induction. All piping shall be sloped towards the system low point such that slope is maintained in both hot and cold condition. (b.) For all Power cycle piping systems, minimum inside diameter of drainpipe selected shall not be less than 19mm. (c.) All drain, vent, air release, sampling and instrument root lines in piping system with design pressure 40 Kg/cm2 (g) and above or with temperature above 350 deg.C or with vacuum service shall be provided with two(2) valves in series (i.e double valved).			
1.11.00	HYDROSTATIC TEST OF PIPES (IBR & NON-IBR): 1) At pipe manufacturers shop, all mother pipes shall be hydro tested at a pressure as specified in IBR as minimum. However, non-destructive testing in lieu of the hydro test is also acceptable as permitted by IBR-1950. 2) At pipe manufacturers shop, all fabricated/ completed pipes shall be hydro tested at a pressure as specified in IBR as minimum. However, in lieu of this hydro test, non-destructive testing of weld joints etc. as permitted by IBR-1950 in such cases is also acceptable. 3) On completion of installation/erection, all power cycle piping systems shall be hydro tested in accordance with the requirements of the Indian Boiler Regulations/ASME B31.1, as applicable. The detailed schemes and procedure for carrying out hydraulic testing shall be prepared and furnished to employer by the contractor. However, for such systems where it is practically not possible to do hydro tests, NDT as called for in ANSI B31.1 & IBR in lieu of hydro test shall also be acceptable. Requirement of IBR shall be met as a minimum for IBR piping. Hydraulic test shall be considered successful only on certification to that effect by the concerned inspecting authority as per the provision of the IBR and the Project Manager.			
1.12.00	SPECIFIC REQUIREMENTS: PIPES AND FITTINGS 1. Manufacturing tolerances on pipe diameter and thickness shall be as per ASTM A-530/ A999M, as applicable.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB SECTION-A-08 Power Cycle Piping	PAGE 11 OF 19

CLAUSE NO.	TECHNICAL REQUIREMENTS				
1.13.00	2. Bend thinning allowance shall be provided for all bends as per the recommendations of ASME B 31.1. However, bidder/contractor shall ensure that the minimum wall thickness at any point in the finished bend shall not be less than the calculated minimum straight pipe wall thickness. 3. Instrument tubing upto and including the root valves and all line drains & vents shall be generally of the same pipe material as that of the main pipe on which they are located unless & until specified otherwise elsewhere. 4. Elbows shall be generally of long radius type. 5. Bends shall be made in accordance with PFI-ES-24/ISO/other internal standards. 6. Wherever ASTM 106 Gr. B/Gr. C or A - 105 material are used the maximum carbon content shall be limited to 0.30% (Max.). 7. All stubs welded to the pipe including welded thermo wells and instrument source tapings shall be installed on the pipe prior to stress relieving. 8. Wherever metered bends are used, the thickness of the pipe from which they are fabricated shall conform to the requirement of regulation 361 (c) of IBR. The angle between axes of adjoining pipe section shall not exceed 22.5 degree. 9. Non-destructive examinations for butt welds of NPS 50mm and for welded branch connections of branch size over 100mm NPS shall be as specified elsewhere. For smaller sizes, the mandatory minimum requirement for Non-destructive examination for welds shall be as per table 136.4 of ANSI B 31.1 for non IBR piping and as per regulation 360 of IBR or table 136.4 of ANSI B 31.1, whichever is more stringent, for piping under purview of IBR.				
	SPECIFIC REQUIREMENTS: VALVES AND SPECIALITIES 1) For all globe and check valves, the direction of flow shall be clearly stamped on the body of the valve and all valves shall be provided with proper name plates indicating complete information about the valves. 2) All globe valves shall be capable of being closed against the design pressure. 3) All gate and globe valves shall have bonnet-back seating arrangement or similar arrangement as per manufacturer's standard proven practice. 4) All gate, globe and check valves shall be designed for reconditioning seating surfaces and replacement of stem and disc without removing the valve body from the line. 5) Manual gear operators shall be provided to open/close the valve against the maximum differential pressure across the valve such that the effort required to operate the valve does not exceed 35 kgf. 6) Valves of 65 mm Nb & above with rising stem shall be provided with position indicator/ visual indication either through plastic stem covers or through metallic stem covers. 7) All gate, and globe valves of size 50 mm and below in vacuum service shall have extra deep gland packing without requiring water gland sealing. All gate and globe valves of size 65 mm Nb and above in vacuum services shall have adequately deep gland packing and shall be equipped with lantern rings to admit pressurized water for gland sealing. 8) Where floors and extension spindle arrangements is required for valves, the height of floor stand shall be about one meter from the floor/platform. 9) Integral bypass shall be provided with motor operation if main valve is motor operated.				
1.14.00	STEAM TRAPS AND STRAINERS Steam traps shall be of inverted bucket/thermo static type with integral or separate Y-type strainers. All Y-type strainers shall have stainless steel screen of not more than 20 mesh size. Screen open area shall be at least four (4) times the pipe cross sectional area. Traps shall have stainless steel internals.				
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB SECTION-A-08 Power Cycle Piping	PAGE 12 OF 19

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.00.00	SPECIFICATION FOR HANGERS/SUPPORTS			
2.01.00	Design, selection and Manufacture of Hangers/Supports shall conform to ASME B 31.1, MSS-SP-58, MSS-SP-89.			
2.02.00	Rod hanger rigid supports shall generally be used for supporting piping where the cold to hot vertical movement at pipe support point is practically zero or negligible.			
2.03.00	Where hanger rod angularity exceeds 4 degrees from cold to hot position (at rated parameters), the hanger and structural attachments shall be offset in the cold position in such a manner that the hanger rod shall be within 4 degree in hot position unless otherwise specified.			
2.04.00	The Contractor shall furnish detailed arrangement sketches for each support, restraints, anchor, etc. The sketches shall include the key plan, support identification no., bill of quantities, design load, operating load, spring stiffness, amount of pre-compression, centre line elevation of pipe, spring box position/orientation, aux. steel structure arrangement details, etc.			
2.05.00	SPRING HANGERS			
	(a.) Constant load hangers shall generally be used when vertical displacement exceeds 40 mm or where the supporting effort variation of available variable spring exceeds 25%.			
	(b.) Constant load hanger shall be of moment-coil-spring counter balanced design or cam & spring type. Variable spring hangers shall be of helical spring design. Spring hanger/ assembly shall be constructed such that complete release of piping load is impossible in case of spring mis-alignment or failure.			
	(c.) Constant load hanger shall have a minimum field adjustment range of 15% of the load. The total travel for constant load hangers shall be design travel plus 20% but in no case shall the difference between total travel and design travel be less than 25 mm. The supporting effort variation throughout the travel range of constant load hangers shall not exceed 6%.			
	(d.) Variable spring hangers shall have supporting effort variation of not more than 25% throughout the total travel range. Available travel reserve for Variable Hanger shall be 5mm minimum in travel direction.			
	(e.) All springs shall remain under compression throughout their operating regime and never under tension.			
	(f.) Spring hangers shall have provision for locking the hangers in any position of the travel.			
	(g.) Spring hangers shall be adjusted to the cold position before shipment and locked in that position. The cold and hot position shall be clearly marked on the travel indicator scales.			
	(h.) All spring hangers shall be locked before performing the hydro test. The locking shall be removed before the line is placed under operation.			
	(i.) Spring Hangers shall be provided with stainless steel strip with embossed scale for readings.			
	(j.) Spring hangers/supports shall be selected from NTPC approved spring hanger/support manufacture's Catalogue, meeting NTPC Technical specification requirements. While selecting the spring rating/size, the spring data & guidelines for selection as given in the catalogue shall be followed.			
2.06.00	SNUBBERS			
	1. Snubbers shall be designed to allow normal movement of pipe due to thermal expansion and shall require minimal maintenance.			
	2. The rated load/nominal load of selected snubber shall not be less than 1.25			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB SECTION-A-08 Power Cycle Piping
PAGE 13 OF 19				

CLAUSE NO.	TECHNICAL REQUIREMENTS				
2.07.00	times of the maximum calculated load on the Snubber. 3. Snubber shall have convenient means for determining rod extension. 4. Axes of snubbers/ restraints shall be parallel to the direction of the expected reaction force in operating condition. 5. Construction of snubbers: At least piston & Cylinder (which is in contact with fluid) shall be made of stainless-steel material (SS 304 or better). Non-stainless-steel parts of snubbers exposed to atmosphere shall be provided with proper corrosion protection. 6. Supporting Structure of the Snubbers shall be designed to withstand twice the rated load of the snubber.				
	SPECIFIC REQUIREMENTS: HANGERS & SUPPORTS 1) Each rod of a double rod hanger support shall be designed for the full hydro test load coming on the double rod hanger assembly. 2) Hanger support rods of less than 10 mm diameter for supporting pipes of 50 Nb and smaller and less than 12 mm diameter for supporting pipes of 65 mm Nb and larger, shall not be used. 3) Bolted pipe clamps shall have a minimum thickness of 5 mm for weather protected locations and 6 mm for locations exposed to weather. 4) Anchors, guides and restraints shall be capable of withstanding the forces and moments due to thermal expansion and dynamic effects. 5) All sliding surfaces of supports and restraints shall have teflon lining/graphite lining/ other suitable material as per good engineering practice on one surface coming in contact with stainless steel lining on the other surface. 6) All pipe hangers/supports shall be designed to carry static load/dead weight, Operating load, test medium/hydro load and dynamic/occasional loads (as applicable). 7) All hanger components/supports on flash tanks and piping which are connected to condenser nozzles located below the level of LP turbine blade tip and subjected to hydrostatic load shall be designed for full hydro load also to enable flood test of condenser with the pipes connected to condenser in installed position. 8) Hangers support tag no. shall be marked on all pipe hangers/supports, restraints and anchor assemblies. The design loads, hot and/or cold loads shall be stamped on respective constant and variable springs. 9) All pipe hangers & supports shall be designed to carry the weight of the piping, fittings, thermal insulation, self-weight of the hanger assembly & medium transported or test medium, whichever is heavier. In addition, all rigid rod hangers and variable spring shall be designed to carry the operating load in hot condition. The supports shall also be designed to take care of the occasional/dynamic loads. 10) Testing and Inspection: a) All shop tests shall be conducted in accordance with ANSI standards and other applicable codes/standards. b) Each Constant load hanger shall be tested before delivery to ensure that the variation in supporting capacity provided through specified range does not exceed 6%. c) Each variable load spring hangers shall be tested before delivery for its spring stiffness.				
3.00.00	MATERIAL TEST AND ANALYSIS All materials shall be furnished in strict accordance with the applicable codes. All sources of materials shall be disclosed and relevant test certificates giving precise details of identification of material for the physical and chemical properties shall be submitted to the Employer/Project Manager.				
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB SECTION-A-08 Power Cycle Piping	PAGE 14 OF 19

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.00.00	SPECIFIC REQUIREMENTS: FABRICATION			
	1) All dissimilar material piping connections shall be subjected to the prior acceptance and approval of the Employer/Project Manager. Direct welding of P91 & other higher grade material to lower grade alloy steel or carbon steel shall be avoided by introducing suitable transition piece. 2) Access holes for radiography at shop for piping requiring 100% radiography shall be provided only if the area to be radio graphed is not accessible from pipe ends. Access holes for field radiography shall be provided. 3) Where examination of bends indicates that wall thinning has resulted in thickness less than the minimum specified, repair by weld deposition shall be allowed only where the length of the affected area is 150 mm or less as measured along the outside arc of the bend. Repairs in excess of this amount shall not be allowed. All repairs shall be carried out only after approval of the Employer. 4) Branch connections shall conform to the requirements of ASME B 31.1. All branch connection welds shall be full penetration welds, except as permitted by ASME B31.1/IBR. 5) When 'C' clamps are tack welded to the pipe for the purpose of alignments of a joint, preheating for the tack welding shall be performed if the main joint adjacent to it to be preheated as per the requirements of this specification, otherwise preheating for the tack weld may be omitted. After the joint is completed, all tack welds shall be removed flushed with the adjacent surface of pipe by chipping and/or grinding. The areas where 'c' clamps were attached shall be subjected to stress relieving as required. 6) Cutting/welding/edge preparation and re-welding required for blanking, temporary piping connection and/or for replacements by spool pieces including reinstallation of components/piping systems after chemical cleaning/steam blowing/hydraulic testing shall be the responsibility of contractor 7) Where welded pipe and fittings are used, the longitudinal weld seams of adjoining sections shall be staggered by 90 deg. 8) Elbows shall be generally of long radius type 9) Bends for piping of sizes 65mm Nb and above shall be made hot and for piping of sizes 50mm Nb and below may be made cold. 10) Bends shall be made in accordance with PFI-ES-24/ISO/other international standards. Bends shall be supplied with the minimum tangents except where the piping layout necessitates shorter lengths in which case the tangents shall be suitably reduced after the bending operation to suit the requirement of the piping layout. 11) Heat treatment of bends shall be done as per material specification. 12) All bends 65mm Nb and larger shall be ultrasonically examined as per PFI-ES-20. 13) All material that are bent, forged or formed shall be subject to heat treatment after the forming operation as required by the original material specification. For alloy steel materials the preferred heat treatment process is full annealing.			
5.00.00	SPECIFIC REQUIREMENTS – ERECTION			
	1) Where control valves, flow nozzles, orifices, thermo wells and other piping appurtenances are to be installed, they shall be installed only after steam blowing and chemical cleaning operation. After the completion of the steam blowing/chemical cleaning the contractor shall cut spool pieces of required length and install the components.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB SECTION-A-08 Power Cycle Piping	PAGE 15 OF 19

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	 2) Field run piping shall be erected only after completion of erection of all other piping system, structures and equipment unless otherwise approved/directed by the Employer/Project Manager. 3) The hydrostatic testing of the piping system shall be done after proper installation of all permanent hangers/supports. Spring hangers shall be locked during hydrostatic test. Prior to steam blowing all hangers which had been locked for the hydrostatic testing shall be unlocked. 4) Use of backing rings not permitted for welding /jointing pipes 5) All gaskets shall be asbestos free material and suitable for the service application 6) The setting and logging of all supports, restraints/limit stop, spring hangers, etc. is the responsibility of the contractor. The initial setting on all hangers and supports and clearance on restraints and limit stops shall correspond to the design cold values. The Contractor shall check all readings after completion of erection of piping system and application of insulation and carry out readjustment as necessary to be in line with the design cold values. After satisfactory setting of all hangers/restraints, hanger readings/clearances shall be logged by the contractor in proper format and a joint protocol be made. 7) The contractor shall monitor the behavior of all hangers, supports, restraints etc. during the initial stages of plant operation. When the piping system(s) have attained their rated temperature the contractor shall log, hanger readings, snubber deflections, restraints / limits stop clearances, as specified elsewhere. 8) Wherever there is possibility of ingress of rain water through floor/ceiling opening at points where any pipe passes through floor/ceiling suitable weather protection hood shall be provided.		
6.00.00	SPECIFICATION FOR CHEMICAL CLEANING OF PIPING SYSTEMS AND EQUIPMENTS 1) It is intended to chemically clean the following piping systems and equipments. (a) Boiler feed piping system (b) Heater drains piping (c) Main condensate piping (d) Extraction steam piping (e) Reheater spray piping (f) H.P. Heaters (g) L.P. Heaters (h) Deaerator (i) Gland steam cooler (j) Drain cooler (k) Any other equipment in contractor's scope to be cleaned through chemical cleaning as per the procedure prepared by contractor and approved by employer during detail engineering. Note: In case chemical cleaning is not to be performed as per the standard practice of the bidder for any of the above-said equipment under bidder's scope, then suitable alternate measures are to be mutually discussed & agreed during detailed engineering after award. 2) Bidder shall submit along with the offer his usual procedures and practices for chemical cleaning of the piping and equipment specified. The Bidder shall submit all schematics; write up, details of chemicals to be used etc. and detailed procedures he intends to follow. These schematics and procedures shall be subject to the approval of the Employer. 3) All the piping systems and equipment listed above shall be water flushed before introducing chemicals. Water flushing will be followed by alkaline cleaning, acid cleaning and passivation. Hand cleaning of the interiors of all vessels which are included in the cleaning operation. Upon completion of each stage of cleaning, the waste products shall be drained and transferred to the waste treatment basins (in bidder scope). The Contractor shall then		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB SECTION-A-08 Power Cycle Piping
			PAGE 16 OF 19

CLAUSE NO.	TECHNICAL REQUIREMENTS			
7.00.00	supply and add the necessary chemicals to the basin to neutralize all waste solutions and rinses generated by the cleaning process, and arrange for its disposal to an area to be indicated by the Employer/Project Manager.			
	SPECIFICATION FOR STEAM BLOWING OF PIPING SYSTEMS 1. The following piping systems shall be cleaned through steam blowing operation Contractor shall submit their recommended procedure for steam blowing operation of these piping systems along with scheme/ layout/ drawings giving step by step procedure for performing steam blowing of each these piping systems to the Employer. 1) Main steam 2) Hot reheat 3) Cold reheat 4) HP bypass & LP bypass 5) complete auxiliary steam piping system including unit header & station header 6) Main Turbine gland sealing system 7) Boiler Feed Pump Drive Turbine gland sealing system 8) Steam line feeding turbines of boiler feed pumps. 9) Steam lines to Deaerator 10) Any other piping systems in contractor's scope to be cleaned through steam blowing (as finalized during detailed engineering). Note: Boiler Feed Pump Drive Turbine exhaust to condenser shall be cleaned at site after erection as per standard practice of contractor subject to approval of employer. 2. Steam blowing shall include design, engineering, fabrication, supply and installation of all temporary piping, valves, fittings including quick actuating valves (for puffing purposes), supports, blanking plates, blanking inserts, blow out & blow through tools, spools, target plates, instruments, controls, Thermal insulation and all other accessories and services required to complete the cleaning process. 3. Steam blowing shall also include reinstatement of cleaned piping systems and dismantling/removal of all temporary piping, equipment and materials from site. All temporary piping, valves, equipment and materials shall be taken back by the contractor upon satisfactory completion of cleaning, and shall be removed from the Employer's premises. 4. Cleanliness of system shall be checked by means of test plates (target plates) made of suitable materials as specified elsewhere in this technical specification for pre-commissioning/commissioning (sub-section A-29). The steam blowing termination criteria / acceptance target plate condition will also be as specified in pre-commissioning/commissioning chapter (sub-section A-29).			
8.00.00	FLASH TANKS 1) The flash tanks and accessories shall be designed, manufactured and tested in accordance with ASME Boiler and pressure vessels (B&PV) codes (latest) and other applicable ANSI standards referenced in the above codes. 2) The flash tanks shall be adequately sized to take care of the total drains in the complete power cycle piping system. There shall be sufficient margin to accommodate the possible variation in drain quantities as well as flash steam. It shall be vertical, cylindrical design and of welded construction with torispherical or hemispherical heads complete with access ladders for access to the instruments (if required), valves, main holes, a full length level indicating gauge glass complete with protective rods, isolation valves and drains, Temperature indicators and temperature switches, supports, etc.. 3) Minimum design pressure and temperature for the flash tanks shall be full vacuum & 3.5 Kg/cm2 (g) and 210 degC respectively.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB SECTION-A-08 Power Cycle Piping	PAGE 17 OF 19

CLAUSE NO.	TECHNICAL REQUIREMENTS			
9.00.00	4)	The minimum thickness of the vessels including corrosion allowance shall not be less than 8 mm. Corrosion allowance shall be 3.0 mm.		
	5)	In case the spray is in manifold, the material for the flash tank manifolds shall conform to ASTM A335 Gr. P22 or better and its thickness shall not be less than SCH 100 of ANSI B36.10 irrespective of temperature of the fluid handled.		
	6)	Schedule of Materials		
		Shell and Head	ASTM A 285 Gr.C	
		Wear Plate/Baffle	ASTM A 285 Gr.C	
		Nozzle Neck	ASTM A 106 Gr. B	
		Manhole nozzle flange and cover	ASTM A 285 Gr.C	
		Couplings	ASTM A 105	
		Bolts and studs	ASTM A 193 Gr. B7	
		Nuts	ASTM A 194 Gr. 2 H	
	Gaskets	Spiral wound SS 316 with graphite		
	However, the material as per ASTM A 516 Gr. 60 or IS 2062 Gr. B shall also be acceptable subject to the relevant codes / standards permitting so for the design parameters of various flash tanks.			
	SPECIFICATION FOR METALLIC EXPANSION JOINTS			
	1)	The design, material, construction, manufacture, inspection, testing and performance of the expansion joints shall comply with the currently applicable requirement of EJMA, Boiler and Pressure Vessel Code Section III, ANSI B-31.1 and all statutes, regulations and safety codes.		
	2)	The bellow shall be hydraulically or roll formed from perfect cylinders of single ply / multi ply, 304 grade stainless steel. It shall have internal sleeves of the same material as the bellows and installed with sufficient clearance to allow full rated deflection.		
	3)	Type test of Metallic Expansion joints		
		Following tests (Type tests) shall be carried out for metallic expansion joints as per the procedures given in EJMA.		
		a) Life Cycle Test		
		b) Meridional yield-rupture testing		
		c) Squirm testing		
	4)	For the purpose of carrying out type tests; metallic bellows shall be grouped based on the parameters as given below. The bellows conforming to same combination of these parameters shall constitute one group. Type test shall be carried out on one or more bellows (as required) for the successful completion of all the type tests specified above.		
	I.	Material of bellow: Based on material of bellow, bellows shall be categorized into three categories namely Carbon steel, stainless steel (E.g. SS304, 316, 321etc.) & High alloy steel (E.g. Inconel).		
	II.	Profile of convolutions: Each profile shall be considered as separate category (e.g. U profile, V profile & Lyra profile etc.).		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		
		SUB SECTION-A-08 Power Cycle Piping		
		PAGE 18 OF 19		

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	III. Dimension of bellows: Based on the size, the categories shall be as under: - Nominal diameter of metallic expansion joints up to and including 800mm NB. - Nominal diameter of metallic expansion joint greater than 800mm NB up to & including 1600 NB. - Nominal diameter of metallic expansion joint greater than 1600mm NB up to & including 2400 NB. - Each size above 2400mm NB shall be a separate category. IV. Design pressure: Based on the design pressure, bellows shall be categorized as under: - Design pressure from full vacuum up to 5 kg / sq.cm (g). - Design pressure above 5 kg / sq.cm (g) and up to 10 kg / sq.cm (g) with or without vacuum. (5) Number of cycles For the life cycle test, the number of test cycles shall be minimum 10,000 cycles. Other tests for metallic expansion joints shall be carried out as per the approved QP / QA Section. Further, other terms and conditions for type test shall be as specified elsewhere in the specification.			
10.00.00	Testing Requirements: The detailed testing requirements for power cycle piping and its components are given in the subsection for Quality Assurance (QA). The requirements pertaining to testing given in this subsection if in variance with that given in QA subsection, then the more stringent of the two shall be followed.			
11.00.00	Cleaning and Protection & Marking a) All fabricated piping shall be cleaned as per relevant SSPC cleaning technique/practice such that both inside and outside surfaces of the piping. After cleaning outside surface shall be coated with enamel or other protective paint and internally with a water-soluble preservative. The weld end preparation shall be coated with deoxyalumina be paint and protected adequately. Use of grease or oil, other than light grade mineral oil is not allowed. Following cleaning and preservation, the fabricated sections shall be covered, boxed, capped, or others shielded from further contamination or corrosion. b) All piping shall be marked clearly and legibly at the shop with its identifying pipeline description and piece no. as per the appropriate component or spool piece fabrication drawing.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB SECTION-A-08 Power Cycle Piping	PAGE 19 OF 19



SUB-SECTION–A-09

LOW PRESSURE PIPING

**SINGARENI THERMAL POWER PROJECT
STAGE-II (1X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC NO.:CW-CM-11159-C-O-M-001**

CLAUSE NO.	TECHNICAL REQUIREMENTS																																								
	<u>LOW PRESSURE PIPING</u>																																								
1.00.00	EQUIPMENT SIZING CRITERIA																																								
1.01.00	All the piping systems and equipment supplied under this package shall be designed to operate without replacement and with normal maintenance for a plant service life of 30 years and shall withstand the operating parameter fluctuations and cycling which can be normally expected during this period.																																								
1.02.00	For all Low-Pressure piping systems covered under this specification, sizing and system design shall be to the requirements of relevant codes and standard indicated. In addition to this, requirements of any statutory code as applicable shall also be taken into consideration.																																								
1.03.00	Inside diameters of piping shall be calculated for the flow requirements of various systems. The velocities for calculating the inside diameters shall be limited to the following: a) Water Application <table><tr><th colspan="2"></th><th colspan="3">Water Velocity in m/sec</th></tr><tr><th></th><th>Pipe Size</th><th>Below 50 mm</th><th>50-150 mm</th><th>200 mm & above</th></tr><tr><td>(a)</td><td>Pump suction</td><td>-----</td><td>1.2-1.5</td><td>1.2-1.8</td></tr><tr><td>(b)</td><td>Pump discharge and recirculation</td><td>1.2-1.8</td><td>1.8-2.4</td><td>2.1-2.5</td></tr><tr><td>(c)</td><td>Header</td><td>-----</td><td>1.5-2.4</td><td>2.1-2.4</td></tr></table> Pipeline under gravity flow shall be restricted to a flow velocity of 1 m/sec generally. WILLIAM & HAZEN formula shall be used for calculating the friction loss in piping systems with the following "C" value: <table><tr><td>(i)</td><td>Carbon steel pipe</td><td>100</td></tr><tr><td>(ii)</td><td>Ductile Iron.</td><td>140</td></tr><tr><td>(iii)</td><td>Rubber lined steel pipe</td><td>120</td></tr><tr><td>(iv)</td><td>Stainless steel pipe</td><td>100</td></tr></table> For calculating the required pump head for pump selection, at least 10% margin shall be taken over the pipe friction losses and static head shall be calculated from the minimum water level of the tank/ sump/ reservoir from which the pumps draw water. (b) Compressed Air Application Compressed air 15.0 m/sec.						Water Velocity in m/sec				Pipe Size	Below 50 mm	50-150 mm	200 mm & above	(a)	Pump suction	-----	1.2-1.5	1.2-1.8	(b)	Pump discharge and recirculation	1.2-1.8	1.8-2.4	2.1-2.5	(c)	Header	-----	1.5-2.4	2.1-2.4	(i)	Carbon steel pipe	100	(ii)	Ductile Iron.	140	(iii)	Rubber lined steel pipe	120	(iv)	Stainless steel pipe	100
		Water Velocity in m/sec																																							
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(iii)	Rubber lined steel pipe	120																																							
(iv)	Stainless steel pipe	100																																							
1.04.00	The pipes shall be sized for the worst (i.e. maximum flow, temp. and pressure values) operating conditions.																																								
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION- A-9 (LOW PRESSURE PIPING)																																					
PAGE 1 OF 20																																									

CLAUSE NO.	TECHNICAL REQUIREMENTS																																				
1.05.00	Based on the inside diameter so established, minimum thickness calculation shall be made as per ANSI B 31.1 OD. Manufacturing allowance shall be added to minimum calculated thickness and next higher standard thickness of pipes shall than be selected as per ANSI B 36.10/IS-1239 Heavy grade/IS-3589/ASTM-A-53/API-5L/ANSI B36.19 as the case may be. Alternatively, manufacturers standard thickness can also be accepted subject to that such thickness shall be equal to or more than the minimum calculated thickness after considering manufacturing allowance. Selected thickness then shall be checked for vacuum loading criterion as per the guidelines given in AWWA-M-11. However, in no case, the selected Thickness for various pipe sizes shall be less than the specified thickness as given below for indicated Pipe Sizes including intermediate sizes as well: <table><tr><th>Pipe Size in NB</th><th>Specified Thickness in mm</th></tr><tr><td>200 NB</td><td>6 mm</td></tr><tr><td>250 NB</td><td>6 mm</td></tr><tr><td>300 NB</td><td>6 mm</td></tr><tr><td>350 NB</td><td>6 mm</td></tr><tr><td>400 NB</td><td>6 mm</td></tr><tr><td>450 NB</td><td>6 mm</td></tr><tr><td>500 NB</td><td>6 mm</td></tr><tr><td>600 NB</td><td>6 mm</td></tr><tr><td>700 NB</td><td>7 mm</td></tr><tr><td>800 NB</td><td>8 mm</td></tr><tr><td>900 NB</td><td>10 mm</td></tr><tr><td>1000 NB</td><td>10 mm</td></tr><tr><td>1100 NB</td><td>10 mm</td></tr><tr><td>1200 NB</td><td>12 mm</td></tr></table>							Pipe Size in NB	Specified Thickness in mm	200 NB	6 mm	250 NB	6 mm	300 NB	6 mm	350 NB	6 mm	400 NB	6 mm	450 NB	6 mm	500 NB	6 mm	600 NB	6 mm	700 NB	7 mm	800 NB	8 mm	900 NB	10 mm	1000 NB	10 mm	1100 NB	10 mm	1200 NB	12 mm
Pipe Size in NB	Specified Thickness in mm																																				
200 NB	6 mm																																				
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1100 NB	10 mm																																				
1200 NB	12 mm																																				
1.06.00	Corrosion allowance of 1.6 mm will be added to the calculated thickness being considered (except stainless steel piping).																																				
1.07.00	Bend thinning allowance/manufacturing allowance etc. shall be as per the requirement of the design code provision.																																				
1.08.00	Material of construction for pipes carrying various fluids shall be as specified elsewhere.																																				
1.09.00	Compressed air pipe work shall be adequately drained to prevent internal moisture accumulation and moisture traps shall be provided at strategic locations in the piping systems.																																				
1.10.00	Depending upon the size and system pressure, joints in compressed air pipe work shall be screwed or flanged. The flange shall be welded with the parent pipe at shop and shall be hot dip galvanized before dispatch to site. Alternatively, the flanges on GI pipes may be screwed-on flanges also.																																				
1.11.00	Threaded joints shall be provided with Teflon sealant tapes.																																				
1.12.00	Following types of valves shall be used for the system/service indicated.																																				
	SYSTEM	TYPES OF VALVES																																			
		Butterfly	Gate	Globe	Check	Ball	Plug																														
	Water	x	x	x	x	x																															
	Air		x	x	x	x																															
	Drains & vents		x	x	x																																
	Fuel oil (if any)		x	x	x	x	x																														
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001			SUB-SECTION- A-9 (LOW PRESSURE PIPING)		PAGE 2 OF 20																														

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.13.00	Recirculation pipes along with valves, breakdown orifices etc. shall be provided for important pumping systems as indicated in respective process and instrumentation diagrams (P&IDs). The recirculation pipe shall be sized for minimum 30%design flow of single pump operation or the recommended flow of the pump manufacturer whichever is higher.			
2.00.00	TECHNICAL SPECIFICATION			
2.01.00	GENERAL			
	Specific technical requirements of low-pressure piping, fittings, supports, valves, specialties and tanks etc. have been covered under this Sub-section. It includes details pertaining to design and material of construction for piping, fittings, valves, equipment, etc. cleaning/surface preparation application of primer and painting on over ground piping. It also includes detailed technical requirement of laying underground/buried piping including water proofing/anti corrosive protection. It also covers design, engineering, manufacturing, fabrication, technical details of piping, valves, specialties, piping hangers / supports, tanks etc.			
2.02.00	Pipes and fittings			
2.02.01	All low-pressure piping systems shall be capable of withstanding the maximum pressure in the corresponding lines at the relevant temperatures. However, the minimum thickness as specified in the following clauses and or respective codes for pipes and fittings shall be adhered to. The bidder shall furnish the pipe sizing/ thickness calculation as per the criteria mentioned above under LP piping equipment sizing criteria of this Technical Specification.			
2.02.02	Piping and fittings coming under the purview of IBR shall be designed satisfying the requirements of IBR as a minimum.			
2.02.03	Supporting arrangement of piping systems shall be properly designed for systems where hydraulic shocks and pressure surges may arise in the system during operation. Bidder should provide necessary protective arrangement like anchor blocks/anchor bolt etc. for the safeguard of the piping systems under above mentioned conditions. The requirement will be, however, worked out by the contractor and he will submit the detailed drawings for thrust/anchor block to the Employer. External, and internal, attachments to piping shall be designed so as not to cause flattening of pipes and excessive localized bending stresses.			
2.02.04	Bends, loops, off sets, expansion or flexible joints shall be used as required in order to prevent overstressing the piping system and to provide adequate flexibility. Flexibility analysis (using software packages such as Caesar-II etc.) shall be carried out for sufficiently long piping (straight run more than 300M).			
2.02.05	Wherever Bidder's piping coming under this specification, terminates at an equipments or terminal point not included in this specification, the reaction and the thermal movement imposed by bidder's piping on equipment terminal point shall be within limits to be approved by the Employer.			
2.02.06	The hot lines shall be supported with flexible connections to permit axial and lateral movements. Flexibility analysis shall be carried out for pipelines which have considerable straight run as indicated above and necessary loops/ expansion joint etc. shall be provided as may be necessary depending on layout.			
2.02.07	Piping and fittings shall be manufactured by an approved manufacturer of repute. They should be truly cylindrical of clear internal diameter, of uniform thickness, smooth and strong, free from dents, cracks and holes and other defects.			
2.02.08	For rubber lined ERW pipes, beads shall be removed for pipe size 80 NB and above.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION- A-9 (LOW PRESSURE PIPING)
PAGE 3 OF 20				

CLAUSE NO.	TECHNICAL REQUIREMENTS																					
2.02.09	Inspection holes shall be provided at suitable locations for pipes 800 Nb and above as required for periodic observations and inspection purposes.																					
2.02.10	At all intersection joints, it is Contractor's responsibility to design and provide suitable reinforcements as per the applicable codes and standards.																					
2.02.11	For large size pipes/ducts, at high point and bends/change of direction of flow, air release valves shall be provided as dictated by the system requirement and operation philosophy & tripping conditions of pumping system. Sizing criteria for air release valves shall be generally on the basis of valve size to pipe diameter ratio of 1:8. Requirement shall be decided as per relevant code.																					
	Transient analysis /surge analysis wherever specified and required shall be conducted in order to determine the location, number and size of the Air-Release valve on certain long distance/high volume piping systems, if applicable within the scope of work of the package.																					
2.03.00	Material																					
2.03.01	Alternate materials offered by Bidder against those specified. shall either be equal to or superior to those specified. The responsibility for establishing equality or superiority of the alternate materials offered rests entirely with the Bidder and any standard code required for establishing the same shall be in English language.																					
2.03.02	No extra credit would be given to offers containing materials superior to those specified. Likewise, no extra credit would be given to offers containing pipe thickness more than specified.																					
2.03.03	All materials shall be new and procured directly from the manufacturers. Materials procured from traders or stockists are not acceptable.																					
2.03.04	All materials shall be certified by proper material test certificates. All material test certificates shall carry proper heat number or other acceptable references to enable identification of the certificate that certifies the material.																					
2.03.05	Material of construction for pipes carrying various fluids shall be as follows:																					
	<table><tr><th>Sl No</th><th>Type of Fluid</th><th>Material</th></tr><tr><td>1.</td><td>i) Ordinary Water (Raw Water, Clarified Water, etc.) ii) Equipment cooling water including Both primary & secondary circuit (DMCW pH corrected & ACW drain water)</td><td>IS-2062 Gr.-E-250B/ASTM A-36/ASTM A-53 type 'E' Gr. B/IS-3589 Gr. 410 /IS-1239 Heavy.</td></tr><tr><td>2.</td><td>i) Demineralised water, ii)Alkaline solution (ECW system chemical dosing)</td><td>Stainless Steel to ASTM A312, Gr. 304 welded for sizes 65 mm NB and above. Stainless steel to ASTM A312, Gr. 304 sch.40s seamless for sizes 50mm and below</td></tr><tr><td>3.</td><td>i) Drinking (potable) water ii)Compressed air (Instrument & service air)</td><td>ASTM A-53 type E Gr. B galvanized/ IS 1239 Gr heavy galvanized/IS 3589 Gr 410 galvanized. Galvanized shall be to IS- 4736 or equivalent.</td></tr><tr><td>4.</td><td>(Condensate) spill water</td><td>ASTM A 106 Gr. B</td></tr><tr><td>5.</td><td>Effluents from Neutralization pit</td><td>MSRL</td></tr></table>				Sl No	Type of Fluid	Material	1.	i) Ordinary Water (Raw Water, Clarified Water, etc.) ii) Equipment cooling water including Both primary & secondary circuit (DMCW pH corrected & ACW drain water)	IS-2062 Gr.-E-250B/ASTM A-36/ASTM A-53 type 'E' Gr. B/IS-3589 Gr. 410 /IS-1239 Heavy.	2.	i) Demineralised water, ii)Alkaline solution (ECW system chemical dosing)	Stainless Steel to ASTM A312, Gr. 304 welded for sizes 65 mm NB and above. Stainless steel to ASTM A312, Gr. 304 sch.40s seamless for sizes 50mm and below	3.	i) Drinking (potable) water ii)Compressed air (Instrument & service air)	ASTM A-53 type E Gr. B galvanized/ IS 1239 Gr heavy galvanized/IS 3589 Gr 410 galvanized. Galvanized shall be to IS- 4736 or equivalent.	4.	(Condensate) spill water	ASTM A 106 Gr. B	5.	Effluents from Neutralization pit	MSRL
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION- A-9 (LOW PRESSURE PIPING)																		
PAGE 4 OF 20																						

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.03.06	In water lines, pipes up to 150mm Nb shall conform to ANSI B36.10/ASTM-A-53, Type-E Gr. B /IS:1239 Gr. Heavy and minimum selected thickness shall not be less than IS:1239 Grade Heavy except for demineralised water, drinking water and condensate spill lines.			
2.03.07	Pipes of above 150mm Nb shall be to AWWA-C200/ANSI B 36.10/ASTM A-53/IS 3589 Gr.410. Pipe to be fabricated by the bidder shall be rolled and butt welded from plates conforming to ASTM A-53 type 'E' Gr. B/IS 2062 Gr. E-250B/ASTM-A-36. However, larger pipes, i.e. 1000mm Nb and above shall be made from plates conforming to ASTM A 36/IS 2062 Gr. E-250B and shall meet the requirements of AWWA-M-11 (for deflection & buckling criteria considering water filled pipe as well as vacuum condition that may prevail during transient/surge conditions, truck-load, rail-load and weight density for compacted soil or any other load as the case may be).			
2.03.08	In demineralised water service, the pipes up to 50 Nb shall be of stainless-steel ASTM A 312, Gr. 304 sch. 40 Seamless. These shall be socket welded. The material for pipe from 65mm NB up to and including 400 NB shall be to ASTM A 312, Gr. 304 (welded). In no case the thickness of fittings shall be less than parent pipe thickness. The size for these pipes shall be to ANSI B 36.19, and greater than minimum thickness required after considering manufacturing allowance. Bidder/Contractor shall note that pipes offered as per a particular code shall conform to that code in all respects i.e. Dimension, tolerances, manufacturing methods, material, heat treatment, testing requirements, etc. unless otherwise mentioned elsewhere in the specification.			
2.03.09	Instrument air, Plant (service) air lines and Drinking water lines shall be to ASTM A 53 type E grade B/ANSI B 36. 10/IS 3589, Gr. 410 / IS: 1239 Heavy (in case thickness calculated is more than gr. Heavy, ANSI B 36.10 Schedule numbers shall be followed) and galvanized to IS 4736 or any equivalent internationally reputed standard. The material of the pipes shall be to ASTM A 53 type 'E' Gr. B / IS: 3589, Gr. 410 / IS: 1239 Gr. Heavy. The fittings shall be of either same as parent material or malleable iron to IS-1879 (galvanized).			
2.03.10	Spiral welded pipes as per API-5L/IS-3589 are also acceptable for pipe of size above 150 NB. However minimum thickness of the pipes shall be as elaborated in above clauses.			
2.03.11	Condensate lines shall be to ASTM A 106 Gr. B and dimension to ANSI B 36.10 schedule "standard" as minimum to be maintained.			
2.03.12	If carbon steel plates of thickness more than 12 mm are used for manufacture of pipes, fittings and other appurtenances, then the same shall be control-cooled or normalized as the case may be following the guidelines of the governing code.			
2.04.00	Field routed pipes:			
2.04.01	Pipelines of NB 50 size and below are regarded as field run piping. It is Bidder's responsibility to plan suitable layouts for these system insitu. Bidder shall prepare drawings indicating the layout of field run pipe work. These drawings shall be approved by Project Manager to the installation of the field run pipe work. Based on these approved layouts the Bidder shall prepare the BOQ of field run pipes and submit to Employer for approval.			
2.05.00	Slope/Drains and Vents			
2.05.01	Suitable slope shall be provided for all pipelines towards drain points. It is Bidder responsibility to identify the requirements of drains and vents, and supply the necessary pipe work, valves, fittings, hangers and supports etc. As per the system requirement low points in the pipelines shall be provided with suitable draining arrangement and high points shall be provided with vent connections where air or gas pockets may occur. Vent for use during hydrostatic test shall be plugged after the completion of the test. Vent shall not be less than			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION- A-9 (LOW PRESSURE PIPING)
PAGE 5 OF 20				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	15mm size. Drains shall be provided at low points and at pockets in piping such that complete drainage of all systems is possible. Drain shall not be less than 15mm for line size up to 150mm, not less than 20mm up to 300mm and not less than 25mm for 350mm to 600mm pipes and not less than 50mm for 600mm and above pipes. Material for drain and vent lines shall be compatible with that of the parent pipe material.			
2.05.02	Air piping shall be sloped so that any part of the system can be drained through the shut-off drain valve or drain plugs.			
2.06.00	Pipe Joints In general, all water lines 65mm NB and above, are to be joined generally by butt welding except the locations where valves/fittings are to be installed with flanged connections and 50mm and below by socket welding unless mentioned otherwise specifically. All air lines shall be of screwed connection and rubber lined pipes of flanged connections.			
2.06.01	Screwed Joints (a) Threading of pipes shall be carried out after bending, heat treatment etc. If not possible, threading may be done prior to these operations but proper care should be taken to protect them from damage. Threads shall be to ANSI B 2.1 (taper) NPT / ANSI B1.20.1 (taper) NPT / IS: 554 unless specified otherwise. (b) Galvanized pipe shall generally be joined by screwing into sockets. The exposed threaded portion on the outside of the pipes shall be given a zinc silicate coating. Galvanized pipes shall not be field joined by welding for protection of Galvanising Zinc layer. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before jointing. For galvanized pipe sizes above 150 mm NB, screw & socket jointing as per ASTM-A-865 shall be employed for both pipe-to-pipe and pipe-to-fitting jointing. For pipe to fitting connection since no direct threading can be done on the fittings (supplied as per ASTM-A-234 Gr. WPB and ANSI B-16.9) necessary straight pipe lengths acting as match pieces shall be welded to the fitting at both ends and subsequently the free ends of the straight lengths shall be threaded as per ASTM A-865 for jointing with main pipe. Once welding of fittings with match pieces and threading of free ends of match pieces are over, the entire fabricated piece shall be galvanized, or in case match pipes and fittings are already galvanized before the above mentioned fabrication then suitable application of Zinc-Silicate paste adequately at the welded surface (both in side & outside) after welding, along with the nascent threaded metal portions at both free ends given the same application of Zinc Silicate paste. Alternatively, flanged jointing may be employed for pipe sizes 100 NB and above. However, the bidder shall ensure the galvanized pipe joints do not fail during hydro test. (c) Teflon tapes shall be used to seal out screwed joints and shall be applied to the male threads only. Threaded parts shall be wiped clean of oil or grease with appropriate solvent if necessary and allowing proper time for drying before applying the sealant. Pipe ends shall be reamed, and all chips shall be removed. Screwed flanges shall be attached by screwing the pipe through the flange and the pipe and flange shall be refaced accurately. (d) For pipe sizes from 350 mm NB to 550 mm NB (including 350 NB & 550 NB) the GI pipes shall be of flanged connection. However, the pipes after welding of flanges shall be completely galvanized. All the welded surfaces whether inside or outside shall be coated with zinc-silicate paste. Seal welding of flanges will be permitted only when any flange is leak-prone during hydro testing. (e) For pipe sizes 600 mm NB and above, the GI pipes shall be of welded connection followed by application of zinc silicate coating at welded surfaces both inside and			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION- A-9 (LOW PRESSURE PIPING)	PAGE 6 OF 20

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	outside the pipe, except for the last blank/blind flange, or, equipment connection where application of zinc-silicate paste after welding cannot be done due to inaccessibility of the inside welded surface and where galvanic protection has been impaired due to welding of pipe-to-pipe joint. Thus, the last erection joint shall be flanged joint.			
2.06.02	Welded Joints (a) For making up welded joints (butt weld or socket weld) the welding shall be performed by manual shielded metal arc process in accordance with the requirements specified elsewhere in the spec. Any welder employed for carrying butt welding shall be qualified as per ASME section IX for the type of joints he is going to weld. Jointing by butt weld, or socket weld shall depend upon the respective piping material specifications.			
2.06.03	Flanged Joints (a) Flanged connections for pipes are to be kept to the minimum and used only for connections to vessel, equipments, flanged valves and other fittings like strainer/traps/orifices etc. for ease of connection and maintenance etc. Rubber lined pipes shall be flange joined only. (b) All flanged valves intended for installation on steel piping system, shall have their flanges drilled to ANSI B 16.5 (or equivalent) and according to the pressure class stated in their respective piping material specification. (c) Drilling on flanges of flanged valves must correspond to the drilling of flanges on the piping system on which the valves are installed.			
2.07.00	Bends / elbows / mitre bends / Tees / Reducers & other fittings			
2.07.01	For pipe fittings such as elbows (long radius), reducers, tees, etc. the material shall be to ASTM-A-234 Gr. WPB/ASTM-105 up to 300 NB. For pipe fittings above 300 NB, the fittings may be fabricated conforming to parent pipe material. Provision of compensation pads shall be kept as per ANSI B 31.1. The fitting shall conform to the dimensional standard of ANSI B-16.9/ 16.11. Further branching in pipes for sizes 65nb and above is also acceptable (ANSI B 31.1). However, for pipes up to 150 NB, pipe fittings may be supplied with material and dimension conforming to IS 1239 in case parent pipes also conform to IS 1239.			
2.07.02	For pipe size 350Nb and above mitre bends may be used for all pipes except rubber lined pipes. However, mitre bends are also acceptable for rubber lined pipes above 1200 NB. The bend radius shall be 1½ times the nominal pipe diameter. 90 deg. bends (mitre) shall be in 4 pieces (3 cuts) and 45 deg. mitre bends shall be in 3 pieces 22½ deg. Fabrication of mitre bends shall be as detailed in BS 2633/BS534.			
2.07.03	For pipes, above 1200 NB, reducer and tees shall be to dimensional standard of AWWA-C-208.			
2.07.04	Stainless steel fittings shall conform to either ASTM-A-182 Gr. 304 or ASTM-A-403 Grade WP. 304 Class-S, for sizes up to and including 50 mm NB, i.e. the fittings shall be of seamless construction. However, for stainless fittings above 50 mm NB, the same shall conform to ASTM-A-403 Gr. WP 304 Class W i.e. the fittings shall be of welded construction strictly in accordance with ASTM-A-403.			
2.07.07	In no case, the thickness of fittings shall be less than the thickness of parent pipe, irrespective of material of construction.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION- A-9 (LOW PRESSURE PIPING)	PAGE 7 OF 20

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.08.00	Flanges			
2.08.01	Flanges shall be slip on type or weld neck type. Welding of flanges in tension is not permitted.			
2.08.02	All flanges and-flanged drilling shall be to ANSI B 16.5/BS EN-1092 / AWWA C-207 of relevant pressure/temperature class. Flanges shall be fabricated from steel plates conforming to ASTM A 105/IS 2062 Gr. E-250B. However stainless-steel flanges shall be fabricated from SS plates to ASTM-A-240, Gr. 304 or equivalent.			
2.09.00	Specific technical requirement of laying buried pipe with anti-corrosive treatment			
	The pipe in general shall be laid with the top of the pipe minimum 1.0 (one) meter below finished general ground level.			
2.09.01	Trenching			
	(a) The trench shall be cut true to the line and level and shall follow the gradient of the pipeline. The width of the trench shall be sufficient to give free working space on each side of the pipe. Trenches shall conform to IS 5822 or any international standard.			
2.09.02	Preparation and cleaning of piping			
	(a) The pipeline shall be thoroughly cleaned of all rust, grease, dirt, weld scales and weld burrs etc. moisture or other foreign matter by power cleaning method such as sand or grit blasting, power tool cleaning, etc. Grease or heavy oil shall be removed by washing with a volatile solvent such as gasoline. Certain inaccessible portions of the pipeline (which otherwise not possible to be cleaned by power cleaning methods) may be scrubbed manually with a stiff wire brush and scrapped where necessary with specific permission of the Project Manager.			
	(b) On the internal surface for pipes 1000 Nb and above, a coat of primer followed by a hot coal-tar enamel or coal tar epoxy painting (cold) shall be applied.			
2.09.03	Coating and wrapping/ Anti corrosive Protection Coal tar tape			
	a. Buried piping shall be coated and wrapped, as per specification, after completion of welded and/or flanged connections, and after completion and approval of Hydro testing. Materials to be used for coating and wrapping of underground pipelines are:			
	(1) Coating primer (coal tar primer)			
	(2) Coating enamel (coal tar enamel)			
	(3) Wrapping materials.			
	All primer/coating/wrapping materials and methods of application shall conform to IS: 10221 except asphalt/bitumen material. Materials (primer/coating/wrapping) as per AWWA-C-203 are also acceptable.			
	Protective coating shall consist of coal tar primer, coal tar enamel coating, glass fiber, tissue inner wrap followed by glass fiber or coal tar impregnated Kraft outer wrap or finish coat.			
	Number of coats and wraps, minimum thickness for each layer of application shall be as per IS-10221. Number of. Coats and wraps shall be decided based on soil corrosivity / resistivity as indicated in IS-10221. Soil data-for this purpose shall be made available.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION- A-9 (LOW PRESSURE PIPING)
PAGE 8 OF 20				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Total thickness of completed coating and wrapping shall not be less than 4.0 mm. b. Alternatively, the anti-corrosive protection for buried pipes can consist of anti-corrosive protection Coal-tar tapes. Material and application of tapes shall conform to IS 15337 or equivalent. These-tapes shall be applied hot over the cold coal tar primer in steps of 2mm thickness so as to cover the spiral edges of the first tape by the application of second tape. The total nominal thickness of the finished protective coating shall be 4.0 mm.			
2.09.04	Trench bed preparation and back filling Prior to lowering and laying pipe in any excavated trench, the bottom of the trench may require to be back filled and compacted (or as the case may be) to provide an acceptable bed for placing the pipe. Bed preparation in general shall be as per IS: 5822.			
2.09.05	laying of galvanized steel (GI) pipes All the joints shall be screwed with socket or flanged. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before jointing Threaded portion on either side of the socket joint shall be applied with Zinc silicate paste. All the provisions for trenching' bed preparation' laying the pipe application of primer' coating' wrapping with tapes and back filling etc. as indicated for "laying of buried piping" and " anti-corrosive protection for buried piping" are applicable for buried galvanized steel (GI) pipes also.			
2.10.00	Cleaning and flushing			
2.10.01	All piping shall be cleaned by the Bidder before and after erection to remove grease, dirt, dust, scale and welding slag.			
2.10.02	Before erection all pipe work, assemblies, sub-assemblies, fittings, and components, etc. shall be thoroughly cleaned internally and externally by blast cleaning or by power driven wire brushes and followed by air-blowing. However, for pipe sizes below 100nb the pipes may be cleaned internally by compressed air blowing as an alternative to internal blast cleaning. The brushes shall be of the same or similar material as the metal being cleaned. Cleaning of Galvanized pipes shall be done by air blowing only.			
2.10.03	After erection, all water lines shall be mass flushed with water. The cleaning velocities in water lines shall be 1.2-1.5 times the operating velocities in the pipelines.			
2.10.04	All compressed air pipe work shall be cleaned by blowing compressed air.			
2.11.00	Specification for hangers and supports			
2.11.01	All supports and parts shall conform to the requirement of power piping code ANSI B 31.1 or approved equivalent.			
2.11.02	The maximum spans of the supports of straight length shall not exceed the recommended values indicated in ANSI B 31.1.			
2.11.03	At all sliding surfaces of supports suitable arrangement is to be provided to minimize sliding friction.			
2.12.00	Design/Construction/Material Particulars of Gate/ Globe /Check /Butterfly / Ball / Air release /Float valves / Moisture Traps.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION- A-9 (LOW PRESSURE PIPING)	PAGE 9 OF 20

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.12.01	GENERAL (a) All valves shall have indicators or direction clearly marked on the hand-wheel so that the valves opening/closing can be readily determined. (b) Special attention shall be given to operating mechanism for large size valves with a view to obtaining quick and easy operation ensuring that a minimum of maintenance is required. (c) The valves coming in vacuum lines shall be of extended gland type and/or water sealed. (d) The actuator-operated valves shall be designed on the basis of the following: (1) The internal parts shall be suitable to support the pressure caused by the actuators. (2) The valve-actuator unit shall be suitably stiff so as not to cause vibrations, misalignments, etc. (3) All actuator-operated valves shall be provided with hand operated gearing mechanism also. (4) All actuators operated valves shall open/ close fully within time required by the process. (e) Valves coming under the purview of IBR shall meet IBR requirements. (f) All valves shall be provided with embossed name plate giving details such as tag number, type, size etc. (g) Wherever required valves shall be provided with chain operator, extension spindles and floor stands or any other arrangement approved by employer so that they can be operated with ease from the nearest operating floor. Wherever necessary for safety purpose locking device shall be provided. Further, necessary small platforms for facilitating easy valve operation shall be provided by the contractor wherever necessary in consultation with project manager within the bid price at no extra cost to employer			
2.12.02	VALVE BODY MATERIAL Valve body material for various services shall be as follows: Valve body material for water application like Secondary circuit auxiliary cooling water of ECW system, Raw water, Ash water make-up, service water, clarified water, DM cooling water (pH corrected) , drinking water etc. shall be cast iron for sizes 65NB and above; gun-metal for sizes 50 Nb and below. For compressed air application, valve body material shall be cast carbon steel or forged carbon steel for sizes 65 mm NB & above and Gun metal / Forged Steel for sizes 50 NB and below. DM water: SS body and disc along with SS internals. However for butterfly valves, Cast Iron /Ductile Iron/SG iron/carbon steel body and disc with elastomer lining are also acceptable. Condensate: Cast Carbon Steel / Forged Carbon Steel.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION- A-9 (LOW PRESSURE PIPING)	PAGE 10 OF 20

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.12.03	The design, material, construction, manufacture, inspection, testing and performance of valves shall comply with all currently applicable statutes, regulations and safety codes in the locality where the valves will be installed. The valves shall conform to the latest editions of applicable codes and standards as mentioned elsewhere. Nothing in this specification shall be construed to relieve the Bidder of his responsibility. Valves in general shall conform to the requirements of the following standards.			
	Standards and Codes			
	AWWA-C-504	Rubber seated butterfly valves.		
	BS-5155/EN-593	Cast iron and steel body butterfly valves for general purpose.		
	IS-778	Gun-metal gate, globe and check valves for general purpose.		
	BS-5154	Copper alloy globe/globe stop and check and gate valves for general purpose.		
	IS-780	Sluice valves for water works purpose (50-300 mm size)		
	IS-2906	Sluice valves for water works purpose (350-1200 mm size)		
	IS-5150	Cast iron wedge and double disc gate for general purpose.		
	BS-5152	Specification for cast iron globe valves.		
	BS-5153	Cast iron check valves for general purpose.		
	IS-5312	Swing check type reflux (non-return) valves.		
	ANSI B 16.34	Standard for valves.		
	API-594	Standard for Dual-check valves.		
	API-600	Steel gate valves.		
	ANSI-B-16.10	Valves face to face and other relevant dimension.		
	API-598	Valves inspection test.		
2.12.04	End Connections			
	The end connections, shall comply with the following:			
	Socket welding (SW) - ANSI B 16.11			
	Butt Welding (BW) - ANSI B 16.25.			
	Threaded (SC) - ANSI B 2.1			
	Flanged (FL) - ANSI B 16.5& AWWA-C-207 (steel flanges), ANSI B 16.1 (Cast Iron flanges).			
2.13.00	Gate/Globe/Check Valves			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION- A-9 (LOW PRESSURE PIPING)	PAGE 11 OF 20

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(a) All cast iron body valves (gate, globe and non-return) shall have flanged end connections; (screwed ends for Ductile D.2NI body valves are not acceptable). (b) All steel and stainless-steel body valves of sizes 65 mm and above shall have flanged or butt welding ends. Valves of sizes below 65mm shall have flanged or socket welded ends. Compatibility of welding between valve body material and connecting pipe material is a pre-requisite in case of butt-welded joints. (c) All gun metal body valves shall have screwed ends. (d) All flanged end valves / specialties shall be furnished along with matching counter flanges, fasteners, gaskets etc. as required to complete the joints. (e) Gate/slucice valves shall be used for isolation of flow. All gate valves shall be of the full-way type, and when in the fully open position, the bore of the valve shall not be constricted by any part of the gate. Gate valves shall be of the solid/elastic or articulated wedge disc. Gate valves shall be provided with the following accessories in addition to other standard items: (1) Hand wheel (2) Position indicator (for above 50 mm NB valve size) (3) Draining arrangement wherever required. (f) Globe valves shall be used for regulation purposes. They shall be provided with hand wheel, position indicator, draining arrangement (wherever required) and arrow indicating flow direction. Preferably, the valves shall be of the vertical stem type. Globe valves shall preferably have reduced or spherical seating and discs shall be free to revolve on the spindle. The pressure shall preferably be under the disc of the valve. However, globe valves, with pressure over the disc shall also be accepted provided (i) no possibility exists that flow from above the disc can remove either the disc from stem or component from disc (ii) manual globe valves can easily be operated by hand. If the fluid load on the top of the disc is higher than 40-60 KN, bypass valve shall be provided which permits the downstream system to be pressurized before the globe valve is opened. (g) Check valves shall be used for non-return service. They shall be swing check type or double door (Dual plate) check type with a permanent arrow inscription on the valve body indicating the fluid flow direction. In long distance pipes lines with possibility of surge-occurrence, dual plate check valves are preferable for its spring-controlled opening /closing of flaps/doors against flow reversals. However, dual plate check valves shall not be used for sizes more than 600mm NB. (h) For bore greater than 2" the valves must be swing check type or dual plate check type suitable for installation in all positions (vertical and horizontal); (i) For bore smaller than or equal to 2" the valves must be of the piston type to be installed, in horizontal position. (j) All gate and globe valves shall be provided with back seating arrangement to enable online changing of gland packing. The valves shall be preferably outside screw & yoke type.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION- A-9 (LOW PRESSURE PIPING)	PAGE 12 OF 20

CLAUSE NO.	TECHNICAL REQUIREMENTS				
2.13.01	(k)	All gate and globe valves shall be rising stem type and shall have limit switches for full OPEN and full CLOSED indication wherever required. This will include motor-operated valves also wherever required. In such cases the limit switches shall form an integral part of the valve. Stop-gap arrangement in this respect is not acceptable.			
	(l)	All valves except those with rising stems shall be provided with continuous mechanical position indicators; rising stem valves shall have only visual indication through plastic/metallic stem cover for sizes above 50 mm nominal bore.			
	(m)	For CI gate, globe and check valves wherever thickness of body/bonnet is not mentioned in the valves standards, thickness mentioned in IS- 1538 for fitting shall be applicable.			
	MATERIAL OF CONSTRUCTION (GATE/GLOBE/CHECK VALVE)				
	(a)	The materials shall generally comply with the following:			
	(1)	Cast Steel Valves			
		Body & bonnet	ASTM A 216 Gr. WCB/ ASTM A 105		
		Disc for non-return Valves	ASTM A 216 Gr. WCB/ ASTM A 105		
		Trim.	ASTM A 182 Gr. F6 or Equivalent		
	(2)	Stainless steel valves			
	Body & Bonnet	SS 304			
	Disc	-do-			
	Trim.	SS 316			
(3)	Cast iron valves				
	Body & bonnet	BS 1452 Gr. 14/ IS-210 Gr. FG 260			
	Seating surfaces and rings	13% chromium steel/ 13% Chrome overlay			
	Disc for non-return valves	BS 1452 Gr. 14/IS-210 Gr FG 260			
	Hinge pin for non-return valves	AISI 316			
	Stem for gate globe valves	13% chromium steel or Equivalent			
	Back seat	13 % chromium steel / 13% Chrome overlay			
(4)	Gun Metal valves				
	Body and bonnet	IS 318 Gr. 2/ Equivalent Standard			
	Trim.	-do-			
(b)	Cast iron body valves shall have high alloy steel stem and seat.				
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION- A-9 (LOW PRESSURE PIPING)	PAGE 13 OF 20

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.14.00	(c)	Material for counter flanges shall be the same as for the piping.		
	(d)	Forged carbon steel & Forged stainless-steel valves are also acceptable in place of Gun metal valves.		
		Air Release Valve		
2.15.00	(a)	The air release valves shall be of automatic double air valve with two orifices and two floats. The float shall not close the valve at higher air velocities. The orifice contact joint with the float shall be leak tight joint.		
	(b)	The valve shall efficiently discharge the displaced air automatically from ducts/pipes while filling them and admit air automatically into the ducts/pipes while they are being emptied. The valve shall also automatically release trapped air from ducts/pipes during operation at the normal working pressure.		
	(c)	Body material of automatic air release valves shall comply generally with BS 1452 Gr. 14/IS: 210 Gr. FG 260. and spindle shall conform to high tensile brass.		
	(d)	Air release valves shall not have any integral isolation device within them. Each Air release valve shall be mounted, preceded by a separate isolation gate/ butterfly valve.		
		Butterfly valves		
2.15.01		Design/Construction		
2.15.02	(a)	The valves shall be designed for the design pressure/temperature of the system on which it is installed and in accordance with AWWA-C-504, EN-593 or any other approved equivalent standard latest edition. Fabricated steel (IS: 2062 GR. E-250B) butterfly valves instead of cast iron body valves are also acceptable for size above 300 mm Nb diameter.		
	(b)	The valves shall be suitable for installation in any position (horizontal/vertical etc.) and shall be generally of double-flanged construction. However, for sizes 600 NB and below the valves of Wafer construction are also acceptable		
	(c)	Valves-350Nb and above shall have pressure equalizing bypass valves, wherever system parameters warrant the same.		
	(d)	Valves-200Nb and above shall also be provided with gear operator arrangement as a standard practice suitable for manual operation. Manual operation of valve shall be through gear arrangement having totally enclosed gearing with hand wheel diameter and gear ratio designed to meet the required operating torque It shall be designed to hold the valve disc in intermediate position between full open and full closed position without creeping or fluttering. Adjustable stops shall be provided to prevent over travel in either direction.		
		Limit and torque switches (if applicable) shall be enclosed in water tight enclosures along with suitable space heaters for motor actuated valves, which may be either for On-Off operation or inching operation with position transmitter.		
		Material of Construction (Butterfly Valves)		
		Materials and other design details shall be as indicated below:		
	(a)	Cast Iron Butterfly Valves		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION- A-9 (LOW PRESSURE PIPING)
				PAGE 14 OF 20

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.15.03	Body & Disc	ASTM A48, Gr. 40 with 2% Ni / IS: 210. Gr. FG-260, with 2% Ni / SG iron BSEN 1563, Gr EN GJS-400-15 with 2%Ni and epoxy coated		
	Shaft	BS 970 431 S: 291 / EN 57, or AISI-410 or AWWA-permitted shaft material equivalent to EN-57/AISI-410 or better.		
	Seat ring	18-8 Stainless steel		
	Seal	Nitrile Rubber		
	(b) Stainless Steel Butterfly Valves			
	Body & Disc	SS 304		
	Shaft	SS 316		
	Seat Rings	EPT/BUNA-N/Neoprene		
	(c) Carbon steel Butterfly Valves			
	Body & Disc	ASTM A 216, Gr. WCB		
	Shaft	SS 304		
	Disc & Seat Rings	EPT/BUNA-N/Neoprene		
	(d) Elastomer lined Butterfly Valves			
	Body & Disc	ASTM A48, Gr. 40 / IS: 210. Gr. FG-260 / SG Iron (ductile iron) IS 1865 Gr 400-15 or BSEN 1563, Gr EN GJS-400-15 / ASTM A 216, Gr. WCB with elastomer lining.		
	Shaft	SS 316		
2.15.03	Proof of Design Test (Type Test) for Butterfly Valves			
	Proof of Design (P.O.D.) test certificates shall be furnished by the bidder for all applicable size-ranges and classes of Butterfly valves supplied by him, in the absence of which actual P.O.D. test shall be conducted by the bidder.			
	All valves that are designed and manufactured as per AWWA-C-504 / AWWA-C-516 shall be governed by the relevant clauses of P.O.D test in AWWA-C-504/AWWA-C-516. For Butterfly valves, designed and manufactured to EN-593 or equivalent, the P.O.D. test methods and procedures shall generally follow the guidelines of AWWA-C-504 in all respect except that Body & seat hydro test and disc-strength test shall be conducted at the pressures specified in EN-593 or the applicable code. Actuators shall also meet requirements of P.O.D. test of AWWA-C-504/AWWA-C-516.			
2.16.00	Float operated valves			
	(a) Valve shall automatically control the rate of filling and will shut off when a predetermined level is reached and close to prevent over flow on pre-set maximum water level. Valve shall also open and close in direct proportion to rise or fall of water level.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION- A-9 (LOW PRESSURE PIPING)
PAGE 15 OF 20				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(b) DESIGN AND CONSTRUCTION FEATURES The following design and construction feature of the valve shall be the minimum acceptable. (c) Valves shall be right-angled or globe pattern. (d) Valves shall be balance piston type with float ball. (e) Leather liner shall not be provided. (f) The body and cover material shall be cast iron conforming to ASTM-A 126 Grade 'B' or IS: 210 Grade 200 or equivalent, and Float shall be of copper with epoxy painting of two (2) coats. (g) Valves shall be suitable for flow velocities of 2 to 2.5m/sec. (h) The valves shall have flanged connections.			
2.17.00	Tanks and Accessories			
2.17.01	The designer and manufacturer of storage tanks shall comply with and obtain approval of all currently applicable statutory regulations and safety codes in the locality where the equipment will be installed. The tanks shall conform to IS 803/IS804/IS 805/ IS 2825/ API 650/ IS 4049/ IS 4682 (part-I) and IS 4864 to 4870/ ASME B & PV code Sec.-VIII as the case may be.			
2.17.02	DESIGN AND CONSTRUCTION			
	(a) Design of all vertical atmospheric storage tanks containing water, acid, alkali and other chemical shall conform to IS:803 & API 650. (b) Design of all horizontal atmospheric storage tanks containing water, acid, alkali and other chemicals shall generally conform to IS:2825 as regards to fabrication and general construction taking care of combined bending, shear & hoop stresses developed due to supporting arrangement. (c) Tank shall be made from mild steel plates to BS 4360/IS-2062 Gr.E-250B (or equivalent) for ordinary wafer application when it is not corrosive in nature. (f) Tank shall be provided with suitable supporting joints. All vessels shall be provided with lifting lugs, eye bolts etc. for effective handling during erection. (j) Tanks shall be provided with float operated level indicators / level gauges / level transmitters and level switches, as required, with complete assembly. Suitable flanged pads for level switches mounting shall also be provided. The level indicator can be top or side mounted as the case may be. (k) In addition to inlet and outlet nozzles, the tanks shall be provided with vents, overflow, drain nozzles complete for various connections on tanks. Overflow lines from storage tanks is to be routed to the nearest surface drains. For tanks containing DM water, alkaline water or power cycle water the vent to atmosphere shall be through carbon-di-oxide absorber vessel suitably mounted on the tank. CO2 absorber vessel shall be provided with the initial fill of chemicals. (l) Tanks shall have suitable stairs/ladders on inside and outside of the tanks, manholes / inspection cover as required and also platform suitably located. (m) Tank supporting arrangement as approved by Employer shall be provided with all plates/angles/joints/flats and supporting attachment including lugs, saddles, legs etc. (o) Tank fabrication drawing and design calculations shall be approved by the Project Manager.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION- A-9 (LOW PRESSURE PIPING)	PAGE 16 OF 20

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.17.03	Corrosion protection			
	(a)	A corrosion allowance, applicable to surface in contact with corrosive media, when required after thorough cleaning by blast cleaning preceded by wire brushing shall be taken into consideration.		
	(b)	Manholes shall be provided for easy access into the vessels. The size shall be minimum 500 mm and will be with cover plate, nuts bolts, etc. to ensure leak tightness at the test pressure.		
	(c)	Each tank shall be provided with drilled cleats welded to the tank for electrical grounding. Material of cleats shall be same as that of the shell.		
	Sl. No.	Description	Tech. Particulars	
	1.00	CONDENSATE STORAGE TANKS		
	1.01	Number required	one for each unit	
	1.02	Capacity of each tank (Effective)	450 Cu. m (for 800MW units)	
	1.03	Size (Dia. & Height)/Plate Thickness	8.6mX7.2m minimum, Shell & Roof plate Thickness 8mm and Base plate thickness 10mm	
	1.04	Type and pressure class	Vertical, cylindrical, atmospheric	
	1.05	Material of construction	MS- (IS-2062 Gr. B or equivalent) as per specified code, 8mm thickness (minimum)	
	1.06	Location	Outdoor	
	1.07	Overflow, drain, vent and Sample connection (piping &valve)	required	
	1.08	Level Indicator		
		a) Number	One for each tank	
	b) Type	Mechanical float type with dial type indicator (Guide wire, Float and Housing of Stainless steel - 316 Gr. construction)		
1.09	Manhole (minimum 500mm size)	Two (2)-one on shell and the other on roof		
1.10	Special Fittings			
	a) Hydraulic Seal of	Required		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION- A-9 (LOW PRESSURE PIPING)	PAGE 17 OF 20

CLAUSE NO.	TECHNICAL REQUIREMENTS																								
	Overflow/Drain <table><tr><td>b)</td><td>Additional nozzle Connection</td><td>number and size to be indicated to successful Bidder</td></tr><tr><td>c)</td><td>Nozzle connection for Instrument/spare</td><td>Three (3) nos. for each tank</td></tr><tr><td>d)</td><td>CO2 Absorber for vent (not to be kept on roof of tank, but to be kept on ground level)</td><td>required</td></tr><tr><td>e)</td><td>Outside stair case (spiral)</td><td>required</td></tr><tr><td>f)</td><td>Inside Ladder</td><td>Required</td></tr><tr><td>g)</td><td>Draw off sump</td><td>required</td></tr><tr><td>h)</td><td>Root valve for level Transmitter</td><td>Root valves for two (2) nos. level transmitter for each tank Required</td></tr></table> -----				b)	Additional nozzle Connection	number and size to be indicated to successful Bidder	c)	Nozzle connection for Instrument/spare	Three (3) nos. for each tank	d)	CO2 Absorber for vent (not to be kept on roof of tank, but to be kept on ground level)	required	e)	Outside stair case (spiral)	required	f)	Inside Ladder	Required	g)	Draw off sump	required	h)	Root valve for level Transmitter	Root valves for two (2) nos. level transmitter for each tank Required
b)	Additional nozzle Connection	number and size to be indicated to successful Bidder																							
c)	Nozzle connection for Instrument/spare	Three (3) nos. for each tank																							
d)	CO2 Absorber for vent (not to be kept on roof of tank, but to be kept on ground level)	required																							
e)	Outside stair case (spiral)	required																							
f)	Inside Ladder	Required																							
g)	Draw off sump	required																							
h)	Root valve for level Transmitter	Root valves for two (2) nos. level transmitter for each tank Required																							
2.18.00	RUBBER EXPANSION JOINTS																								
2.18.01	All parts of expansion joints shall be suitably designed for all stresses that may occur during continuous operation and for any additional stresses that may occur during installation and also during transient condition.																								
2.18.02	The expansion joints shall be single bellow rubber expansion joints. The arches of the expansion joints shall be filled with soft rubber.																								
2.18.03	The tube (i.e. inner cover) and the cover (outer) shall be made of natural or synthetic rubber of adequate hardness. The shore hardness shall not be less than 60 deg. A for outer and 50 deg. A for inner cover.																								
2.18.04	The carcass between the tube and the cover shall be made of high quality cotton duck, preferably, square woven to provide equal strength in both directions of the weave. The fabric plies shall be impregnated with age resistant rubber or synthetic compound and laminated into a unit.																								
2.18.05	Reinforcement, consisting of solid metal rings embedded in carcass shall be provided.																								
2.18.06	Expansion joints shall be complete with stretcher bolt assembly. The expansion joints shall be suitable to absorb piping movements and accommodate mismatch between pipe lines.																								
2.18.07	The expansion joints shall be of heavy duty construction made of high grade abrasion-resistant natural or synthetic rubber compound. The basic fabric for the ' duck' shall be either a superior quality braided cotton or synthetic fiber having maximum flexibility and non-set characteristic.																								
2.18.08	The expansion joints shall be adequately reinforced, with solid steel rings, to meet the service conditions under which they are to operate.																								
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION- A-9 (LOW PRESSURE PIPING)																					
PAGE 18 OF 20																									

CLAUSE NO.	TECHNICAL REQUIREMENTS												
2.18.09	All expansion joints shall be provided with stainless steel retaining rings for DM water application and IS 2062 Gr E-250B galvanized steel retaining rings for ordinary water for use on the inner face of the rubber flanges, to prevent any possibility of damage to the rubber when the bolts are tightened. These rings shall be split and beveled type for easy installation and replacement and shall be drilled to match the drilling on the end rubber flanges and shall be in two or more pieces.												
2.18.10	The expansion joints shall have integral fabric reinforced full-face rubber flanges. The bolt on one flange shall have no eccentricity in relation to the corresponding bolt hole on the flange on the other face. The end rubber flanges shall be drilled to suit the companion pipe flanges. The flanges shall be as per ANSI B 16.5. For higher sizes, not covered under ANSI B 16.5, the same shall be as per AWWA.												
2.18.11	All exposed surfaces of the expansion joint shall be given a 3 mm thick coating of neoprene. This surface shall be reasonably uniform and free from any blisters, porosity and other surface defects.												
2.18.12	Each control unit shall consist of two (2) numbers of triangular stretcher bolt plates, a stretcher bolt with washers, nuts, and lock nuts. Each plate shall be drilled with three holes, two for fixing the plate on to the companion steel flange and the third for fixing the stretcher bolt.												
2.18.13	Each joint shall have a permanently attached brass or stainless steel metal tag indicating the tag numbers and other salient design features.												
2.18.14	Bidder to note that any metallic part which comes in contact with DM /corrosive water shall be of Stainless Steel material.												
2.18.15	Life cycle test for RE Joints of Condenser CW Inlet Outlet lines: Life cycle test certificates shall be furnished by the bidder for each type and size of RE joints supplied by the Bidder, in the absence of which actual Life cycle test shall be conducted on one rubber expansion joint of each type and size.												
2.19.00	STRAINERS												
2.19.01	Simplex type The strainers shall be basket type and of simplex construction. The strainer shall be provided with plugged drain/blow off and vent connections. The free area of the strainer element shall be at least four (4) times the internal area of the connecting pipe lines. The strainer element shall be 20 mesh. Pressure drop across the strainers in new condition shall not exceed 1.5 MCW at full flow. Wire mesh of the strainers shall be suitably reinforced, to avoid buckling under operation. Strainer shall have screwed blow off connection fitted with a removable plug. The material of construction of various parts shall be as follows: <table><tr><td>(a)</td><td>Body</td><td>IS: 318, Gr. 2 up to 50 mm Nb, and IS: 210 Gr. FG 260 above 50 mm Nb. (For DM water/ -Body: AISI 316 or equivalent)</td></tr><tr><td>(b)</td><td>Strainer Element</td><td>Stainless steel (AISI 316)</td></tr><tr><td>(c)</td><td>End connection</td><td>Screwed up to 50 mm Nb, and Flanged above 50 mm Nb</td></tr></table>				(a)	Body	IS: 318, Gr. 2 up to 50 mm Nb, and IS: 210 Gr. FG 260 above 50 mm Nb. (For DM water/ -Body: AISI 316 or equivalent)	(b)	Strainer Element	Stainless steel (AISI 316)	(c)	End connection	Screwed up to 50 mm Nb, and Flanged above 50 mm Nb
(a)	Body	IS: 318, Gr. 2 up to 50 mm Nb, and IS: 210 Gr. FG 260 above 50 mm Nb. (For DM water/ -Body: AISI 316 or equivalent)											
(b)	Strainer Element	Stainless steel (AISI 316)											
(c)	End connection	Screwed up to 50 mm Nb, and Flanged above 50 mm Nb											
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION- A-9 (LOW PRESSURE PIPING)	PAGE 19 OF 20									

CLAUSE NO.	TECHNICAL REQUIREMENTS							
2.19.02	Duplex type							
	(a) The strainers shall be basket type and of duplex construction. The strainer shall be provided with plugged drain/blow off and vent connections. The free area of the strainer element shall be at least four (4) times the internal area of the connecting pipe. The mesh of strainer element shall be commensurate with the actual service required. Pressure drop across the strainer in new condition shall not exceed 4.0 MWC at full flow. (b) Wire mesh (if applicable) of the strainers shall be suitably reinforced. The material of construction of various parts shall be as follows. <table><tr><td>Body</td><td>IS: 318, Gr. 2 up to 50 mm Nb, and IS:210, Gr. FG 260 or ASTM-A-515 Gr. 75/IS-2062 Gr. E-250B and internally epoxy-painted above 50 mm NB.</td></tr><tr><td>Strainer element</td><td>Stainless steel (AISI 316)</td></tr><tr><td>End connection</td><td>Screwed up to 50mm Nb, and Flanged above 50 mm Nb. Gasket shall be of full face type</td></tr></table> (c) The strainer will have a permanent stainless steel tag fixed on the strainer body indicating the strainer tag number and service and other salient data. (d) The size of the strainer and the flow direction will be indicated on the strainer body casting. (e) Thickness of the strainer element should be designed to withstand the pressure developed within the strainer due to 100% clogged condition exerting shut-off pressure on the element.			Body	IS: 318, Gr. 2 up to 50 mm Nb, and IS:210, Gr. FG 260 or ASTM-A-515 Gr. 75/IS-2062 Gr. E-250B and internally epoxy-painted above 50 mm NB.	Strainer element	Stainless steel (AISI 316)	End connection
Body	IS: 318, Gr. 2 up to 50 mm Nb, and IS:210, Gr. FG 260 or ASTM-A-515 Gr. 75/IS-2062 Gr. E-250B and internally epoxy-painted above 50 mm NB.							
Strainer element	Stainless steel (AISI 316)							
End connection	Screwed up to 50mm Nb, and Flanged above 50 mm Nb. Gasket shall be of full face type							
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION- A-9 (LOW PRESSURE PIPING)					
			PAGE 20 OF 20					



SUB-SECTION-A-11

CONDENSATE POLISHING UNIT

**SINGARENI THERMAL POWER PROJECT
STAGE-II (1X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC NO.:CW-CM-11159-C-O-M-001**



CLAUSE NO.

TECHNICAL REQUIREMENTS

CONDENSATE POLISHING UNIT

1.00.0

GENERAL

1.01.00

The Condensate Polishing Plant (CPP) shall treat the condensate of the Turbine-Generator (TG) Unit (Stage-III) of the Power station.

1.02.00

The proposed schematic arrangement of the Condensate Polishing Plant has been shown in the relevant Tender Drawing (P&ID). The Contractor shall propose the complete system including regeneration facilities as per their standard design and as elaborated in this specification meeting the basic functional and minimum requirements. Arrangement of piping and valves shown in Tender drawings are for guidance only.

1.03.00

The Condensate polishing Plant shall consist of one (1) set of Condensate Polishing Unit (CPU) for TG unit inside TG Building and a regeneration system.

1.04.00

The influent and effluent headers of CPU, will be connected to an automatic bypass line(s) to be provided by Contractor. On high pressure signal across the service vessel, the automatic control valve(s) in the bypass line(s) shall open, bypassing the service vessel(s).

1.05.00

Make-up water to the turbine cycle will be added to the condenser hot well as required. The analysis of the cycle makeup water (DM Water) is exhibited in the specification elsewhere.

1.06.00

The Condensate Polisher Service vessels, blowers etc. will be located indoor near the unit. Regeneration system equipment shall be kept under shed and one-meter height parapet wall shall be provided around this shed. Effluent re-circulation/disposal pumps, Bulk chemical storage tanks, unloading transfer pumps and DM water storage tanks for regeneration system etc. shall be kept in open area.

2.00.00

SALIENT DESIGN DATA

2.01.00

The design flow (through working vessels) for condensate polishing plant shall be the corresponding condensate flow of TG unit at VWO (Valve wide open) condition at 3% cycle make-up.

2.02.00

The following dissolved solids concentration and conditions shall be used as a basis of design for the condensate polishing system. The ionic concentrations indicated below are as such.

	Influent	Effluent
Ammonia ppb	150	--
Total solids, ppb	100	20
Silica, ppb	30	5 (refer Note 1 below)
Iron, ppb	50	5
Sodium, ppb	10	2
Chloride, ppb	10	2
Ph	8.5-9.0	--
Effluent conductivity after removal of ammonia and amines (micro mhos/cm) at 25°C.	--	0.1 or less

Note: 1. Silica value shall be 7 ppb as per resin supplier recommendations in case the temperature of the condensate is 50°C & above.



CLAUSE NO.	TECHNICAL REQUIREMENTS									
2.03.00	However, the Contractor to check and reduce the ionic concentrations at the effluent based on their requirement. Under the above operating and design flow through the polisher units, the un-ammoniated resins shall not reach “ammonia break-point” in less than 30 days (720 hrs) of continuous operation while maintaining the above effluent quality. Whenever specific conductivity starts increasing from 0.1 micro mhos/cm in the effluent, it is deemed that “ammonia break point” is reached. The effluent values indicated above shall be the maximum values.									
2.04.00	In addition to the dissolved solids, the influent condensate shall also contain some quantities of suspended solids (crud) derived from the corrosion of water and steam carrying pipelines, turbine condenser and steam side of the feed water heater. Normally this concentration will not exceed about 25 ppb and the Polisher beds shall provide sufficient filtering action to restrict the effluent crud content to less than 5 ppb & same shall be guaranteed. During start up conditions, quality of the influent may deteriorate to – <table><tr><td>TDS, ppb</td><td>2000 maximum</td></tr><tr><td>Silica, ppb</td><td>150 maximum</td></tr><tr><td>Crud, ppb (mostly black oxide of Iron)</td><td>1000 maximum</td></tr></table>				TDS, ppb	2000 maximum	Silica, ppb	150 maximum	Crud, ppb (mostly black oxide of Iron)	1000 maximum
TDS, ppb	2000 maximum									
Silica, ppb	150 maximum									
Crud, ppb (mostly black oxide of Iron)	1000 maximum									
2.05.00	For design purposes, average crud loading shall be considered as 500 ppb. Under such conditions, total crud content of the effluent shall not exceed 150 ppb. However, the Contractor to check and reduce the crud content at the effluent based on their requirement.									
2.06.00	Influent water qualities as indicated in the above clauses are minimum only. Contractor to check the same and higher values, if felt by them, shall be considered in the design so as to meet the specified effluent quality.									
2.07.00	The bed cross section shall be such that the velocity of condensate through it, shall not exceed 2 m/min at the design flow rate. Internal diameter of the service vessels (excluding the rubber lining) of cylindrical type shall be selected meeting the above-mentioned velocity criteria. For vessels of spherical shape, where the bed cross section vary, the diameter (excluding the rubber lining) of the vessel shall be selected considering velocity not exceeding 1.75 m/min. The effective depth of the mixed resin bed in the condensate polisher service vessels shall not be less than 1100 mm. Uniform bead size of resin should be provided for better separation of resins and better performance.									
2.08.00	At the design flow rate, the pressure drop across the polisher service vessels with clean resin bed shall not exceed 2.1 kg/cm². This pressure drop shall include losses due to entrance and exit nozzles, distributors, under drains, resins, and the effluent resin traps. Maximum pressure drop under dirty conditions will be restricted to 3.5 kg/cm² including the pressure drop across effluent resin traps.									
2.09.00	Cation resins shall be regenerated by technical grade hydrochloric acid to IS:265 (concentration 30-33% by volume) and anion resins by sodium hydroxide, rayon grade to IS:252 available as 48% lye or as flakes. In no case, the regeneration levels cannot be lower than the values indicated below: <table><tr><td>a) Cation resin</td><td>:</td><td>125 kg of 100% HCl per cubic meter of resin</td></tr><tr><td>b) Anion resin</td><td>:</td><td>160 kg of 100% NaOH per cubic meter of resin.</td></tr></table>				a) Cation resin	:	125 kg of 100% HCl per cubic meter of resin	b) Anion resin	:	160 kg of 100% NaOH per cubic meter of resin.
a) Cation resin	:	125 kg of 100% HCl per cubic meter of resin								
b) Anion resin	:	160 kg of 100% NaOH per cubic meter of resin.								
2.10.00	Rinse water outlet header of condensate polishing unit shall be provided with a pressure reducing station with isolating valves, suitably designed to enable the water entry to the condenser hot well which is operating under vacuum. The pressure reducing station shall consist of either a pressure reducing valve from design pressure of service vessel to condenser vacuum or a combination of orifice plates to reduce pressure from design pressure of service vessel to 2 kg/cm² and a pressure reducing valve from 2 kg/cm² to condenser vacuum. While calculating pump head, 10% margin (minimum) shall be considered on the value of friction losses. Pipe friction loss sprehall be calculated as per William-Hazen formula and “C” value to									
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION A - 11 CONDENSATE POLISHING UNIT	PAGE 2 OF 15						



CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.00.00	be adopted shall be as described elsewhere in the Technical Specification. Pump recirculation with a regulating valve shall be provided for all the pumping system. All the design parameters at clause no 2.00.00 of above shall be guaranteed. The effluent quality, the design flow, design service length, chemical consumption for regeneration and the pressure drop across the resin bed in clean and dirty conditions at rated design flow shall be guaranteed by the Contractor.		
4.00.00	SYSTEM REQUIREMENT		
4.01.00	The regeneration process offered by the contractor/its sub-vendor, shall be of Proven Design and shall essentially be the same process by virtue of which the contractor/its sub-vendor is qualified and shall give resin-separation compatible with the desired effluent quality. Documentary evidence shall be submitted by the contractor/its sub-vendor to the employer to establish this requirement during detailed engineering stage, if required.		
4.02.00	The contractor shall include inert resin in the system if they feel that it helps in better resin separation.		
4.03.00	In case, after separation of resins, there are undesired contaminant resins, the Contractor shall provide a system either to eliminate this cross contamination of resins or to nullify the detrimental effect of entrapped resins to the effluent quality.		
4.04.00	Ion-Exchange Resins a) The resins shall be in the form of spherical beads. Base of the ion-exchange resins shall be a copolymer of styrene and divinyl benzene forming a macroporous or macrorecticular structure. Other details are as follows: Cation : Strong acid, with sulfonic acid functional group. Anion : Strong base, with quanternary ammonium (type I) functional group. Inert : Nonionic, compatible with the above resin types. Cation resins shall be supplied in hydrogen form and Anion resins shall be supplied in hydroxide form. Cation Resin of gel type may also be offered meeting the criteria as mentioned below in d) (iv). b) <u>Physical Properties:</u> (i) Particle size: The resins shall be in the form of spherical beads. All resins, when wet screened with U.S. standard sieves, shall pass through a No.14 sieve not more than 2% shall be retained on a no. 16 sieve, and not more than 2% shall pass through a no. 40 sieve. The particle sizes and densities shall be carefully controlled to facilitate clear separation between the resins during regeneration process. (ii) Bead Strength: The average force required to fracture individual beads of cation resins in hydrogen form, anion resins in hydroxide form, and the inert resins, shall exceed 350 grams. Not more than 5% of the beads tested in each batch shall get fractured by forces less than 200 grams. c) <u>Chemical Properties:</u> (i) Total wet volume ion-exchange capacities in equivalents/liter shall not be less than the following: Cation in hydrogen form : 1.7		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION A - 11 CONDENSATE POLISHING UNIT
			PAGE 3 OF 15

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.05.0	Anion in hydroxide form : 0.8 (ii) The resins shall contain a minimum of metallic and organic impurities consistent with good processing. The processing procedure will include rinsing the resins with demineralized water before packing, so that further rinsing will not be required before use. Foreign objects in the resins shall constitute a basis for its rejection. (iii) Cation-Anion resin ratio shall be 1.5 parts cation to 1.0-part anion by volume. In case the contractor's process require any non ionic resin the same shall represent at least 10% of the bed volume, but not less than 15 cm of the bed depth in the resin separation tank of the external regeneration facility. (iv) The resins shall be of reputed manufacturer with adequate past record of successful service for not less than 3 years in similar application. d) The resin shall be suitable for the condensate temperature that may be achieved in all operating regimes of TG cycle. However, the anion resin shall be suitable for a temperature of 60°C.			
	Condensate Polishing Units Condensate polishing unit of TG unit shall consist of the following: 1) Condensate polisher vessels complete with condensate inlet and outlet connections, pre-filters, connections for resin transfer to and from the vessels, bed support-cum-under drain system, inlet water distributors, air distribution arrangement for resin mixing, all fittings and appurtenances etc. as specified and as required. 2) External resin traps at the outlet of each of the polisher vessels, designed for in-place manual back washing. 3) Condensate inlet and outlet headers for each installation with pipe connections to the condensate polisher vessels. 4) Resin transfer headers and pipelines connecting the external regeneration facility to the condensate polisher vessels of each installation. 5) Rinse water outlet headers from condensate polisher vessels of each installation upto the condenser hot well. 6) All necessary valves and fittings for the installations with actuators necessary for their remote operation. These shall include suitable fool-proof arrangement to prevent accidental over pressurization of the resin transfer pipeline and regeneration facilities connected to it, which are designed for pressure much lower than that of the polisher service vessels. 7) A common drain header for the condensate polisher service vessels of each unit up to the hot well. 8) All necessary drains, vents, and sampling points, with valves as specified and as required. 9) Gland sealing water piping for the valves in the rinse water line. 10) Emergency bypass between the condensate influent and effluent headers with its automatic valve, isolation valves on both sides and controls. 11) Two (2) nos. (2x100%) (1W+1S) capacity oil free type, air blowers to supply necessary air for mixing the resins in the service vessels for TG unit CPP. 12) Complete instrumentation, controls etc. for automatic operation. 13) Operating pressure for service vessels shall be normal operating pressure of condensate extraction pump. Service vessel design pressure shall be equal to shut off pressure of condensate extraction pump plus 5% margin.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION A - 11 CONDENSATE POLISHING UNIT	PAGE 4 OF 15



CLAUSE NO.	TECHNICAL REQUIREMENTS		
4.06.00	c) Design temperature of service vessel and their internals/appurtenances shall take care of all operating regimes including HP-LP bypass operation and minimum 70 deg C. Process design temperature shall be based on all operating regimes of TG cycle and minimum 52 deg C. However, short term excursion of temperature upto 60 deg C is also expected. d) Emergency bypass system: 1) The condensate polisher service unit shall be provided with an automatic bypass system for the condensate polisher on the condensate inlet and outlet headers of the unit with a set of control valve with its isolation valves on the upstream and downstream sides of the control valve. 2) In the event of excessive pressure differential between the condensate inlet and outlet headers, this control valve will open automatically to bypass requisite quantity of condensate to prevent this pressure differential from exceeding a preset limit when all vessels/ two vessels/one vessel/no vessel is in operation. 3) Either 2x50% capacity valves or 1x100% control valve to achieve proper control under all operating conditions is to be provided. 4) Complete instrumentation and controls required to complete the system, shall also be installed. 5) The isolation valves may be provided with operators for manual operation. The entire system shall be designed for an internal pressure of at least the design pressure of service vessels and for a maximum condensate flow of not less than total design flow of all the working service vessels. 6) The control system shall be so designed that the control valve is able to bypass 33% or 50% of rated flow (based on offered vessel configuration) when any of the service vessel is out of service, 67% or 100% (based on offered vessel configuration) of flow when two vessels are taken out of service and 100% of flow when all the service vessels are out of service. External Regeneration Facility (Regeneration Plant) a) The Contractor shall propose the complete system including regeneration facilities as per their standard design and as elaborated in this specification meeting the basic functional and minimum requirements. One (1) facility for regeneration of the ion-exchange resins from the condensate polishers of the turbo-generator unit shall be provided utilizing three (3) tank concepts and consisting of: 1) Resin Separation & Cation Regeneration Vessel (1 sets). 2) Anion Resin Regeneration Vessel (1 sets). 3) Mixed Resin storage vessel (1 sets). 4) Resin injection hopper, complete with a water ejector system for resin make-up. Resin injection hopper shall be sized to handle upto 150 litre of as received new resins. 5) All internals, fittings, and appurtenances for these vessels. Common waste effluent header with one resin trap designed for in-place manual backwashing. 6) Two (2) nos. (2x100%) Oil free type air blowers with electric motor drives, for supplying all the process air required for cleaning of the resins and their regeneration processes.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION A - 11 CONDENSATE POLISHING UNIT	PAGE 5 OF 15



CLAUSE NO.

TECHNICAL REQUIREMENTS

The acid and alkali dosing equipment for regeneration of condensate polishing resins shall be mounted on skid, which shall consist of at least the following:

- 1) Positive displacement type metering pumps with electric motor drive; two (2x100%) for dosing hydrochloric acid (30% conc.) and two (2x100%) for dosing sodium hydroxide solution.
- 2) All necessary suction and discharge piping for these pumps including all strainers, valves and fittings as required, upto the mixing tee with the diluent water.
- 3) Diluent water supply separately, for acid and alkali, each provided with an automatic on off valve, a throttling valve for setting of flow, a local flow indicator, and a mixing tee where the chemicals get injected into the water stream.
- 4) A hot water tank with electric immersion heater.
- 5) Two (2) acid measuring tanks each of adequate capacity to hold chemical for 125% of one regeneration.

All the equipment, piping etc. shall be assembled on two (2) structural steel skids one (1) for acid and one (1) for alkali dosing equipment. The Contractor shall supply all anchor bolts, foundation plates, sleeves, nuts, inserts etc. to be embedded in concrete for these equipment skids. Each equipment skid shall be provided with suitable lifting lugs, eye bolts etc. to facilitate erection and maintenance. Suitable control philosophy is to be developed & finalized by the bidder and its sub-vendor based on the regeneration system offered.

5.00.00

TECHNICAL REQUIREMENTS OF EQUIPMENTS

5.01.00

Bulk Acid & Alkali Storage Tanks

Description / Data	Acid Storage tanks	Alkali Storage Tanks
Numbers	Two (2)	Two (2)
Dimensions (Diameter, length & thickness)	————As per BS: 2594 —————	
Useful capacity	Each tank to store 15 days requirement	
Type & pressure class	Horizontal, with dished (Torospherical) ends	Atmospheric
MOC	————Mild Steel (as specified) —————	
Internal Painting/ lining	————Rubber lining (4.5 mm thick) —————	
External painting	----As specified elsewhere----	
Concentration	30-33% HCl	48% NaOH
Accessories	Vent, overflow, drain, sample connections, fume absorbers, manholes (2), Operating platforms etc.	



CLAUSE NO.

TECHNICAL REQUIREMENTS

5.02.00

Acid & Alkali Unloading Pumps (applicable if included in scope of supply)

Description / Data	Acid Unloading Pumps	Alkali Unloading Pumps and Alkali transfer cum recirculation pumps
Numbers	Two (2) (1W+1S)	Two (2x100%) Unloading pumps & Two (2x100%) Alkali transfer pumps
Type	Horizontal, Centrifugal	
Pump Speed	Maximum 1500 rpm	
Capacity & head (min.)	---As required---	
Liquid to be handled	30-33% HCl	5 to 50% NaOH
MOC	Polypropylene or equiv. for HCl	SS-316
Reinforced Rubber hoses	Minimum two (2) nos. of size 80 mm NB & Min. 10 m with isolation valves	
Accessories	--Coupling Guards, drain plug, Vent valve, Suction hoses, isolation valves, Y-type strainers etc. as required as per manufacturer's standard--	

5.03.00

Chemical Preparation Tanks

Chemical Tanks	Alkali Preparation Tank	Alkali Day Tank	Acid Measuring Tank
Numbers	One (1)	One (1)	Two (2)
Type	-Vertical Cylindrical, with dished end at bottom; Atmospheric-		
Useful capacity	Minimum 10 Cum	--Each tank shall be adequate to hold chemical for 125% of one regeneration--	
MOC	——M.S. with 4.5 mm thick rubber lining inside ——		
External protection	———— As specified elsewhere —————		
Accessories	Vent, Overflow, Drain connection, motor driven stirrer (only for alkali preparation & day tanks), Dissolving basket in SS-316 construction (only for alkali preparation tanks), fume absorber etc. as required as per manufacturer's standard.		



CLAUSE NO.

TECHNICAL REQUIREMENTS

5.04.00

DM Water Pumps

Description / Data	DM Water (for Resin Transfer) pumps	DM Water (for Regeneration) pumps
Numbers	Two (2x100%)	Two (2x100%)
Type	Horizontal, Centrifugal	
Pump Speed	Maximum 1500 rpm	
Capacity & head (min.)	---As required---	
MOC		
i) Casing & Impeller	ASTM A 351 CF 8M	
ii) Wearing rings	As per manufacturer's Standard	
iii) Shaft	SS 316	
iv) Shaft sleeves	SS 410	
v) Mechanical seal	As per manufacturer's Standard	
Accessories	--Coupling Guards, Drain plug, Vent valve, Suction hoses, isolation valves, Y-type strainers etc. as required as per manufacturer's standard--	

5.05.00

Dosing Pumps

Description / Data	Acid	Alkali
Numbers	Two (2x100%)	Two (2x100%)
Type	Simplex positive displacement hydraulically operated diaphragm type	
Whether suction strainer required	Yes	
Accessories	---As required---	
Pressure dampeners	Two	
External safety relief valve (in addition to in-built safety valve)	Two	Two
Maximum pump stroke speed	100 per minute	
MOC		
i) Liquid End (Pump Head, Valve, valve housing, valve spring etc.)	PVC	AISI:316
ii) Shaft	Hardened steel EN 8 (BS:970)	

5.06.00

Pre Filter (Cartridge Filter)

- a. Number : Two (2) x 50% for the TG unit CPP.
- b. Type : Back washable
- c. Design Code : ASME SEC-VIII DIV I
- d. Mesh size : 20 micron/proven design
- e. MOC of Cartridge : Polypropylene/ proven design



CLAUSE NO.	TECHNICAL REQUIREMENTS		
5.07.00	Hot Water Tank (for alkali) For heating of alkali diluent water, 2x50% electrical heating coil in a tank of mild steel rubber lined construction shall be provided. The capacity of tank shall be minimum 20% higher than the maximum water demand. This tank shall be provided with burn out protection, pressure relief valve, level transmitters/switches, temperature indicator etc. The heater shall be controlled by the temperature switches provided on the tank.		
5.08.00	Activated Carbon Filter (For Alkali) Rated flow of the filter shall not be less than the design capacity of the alkali transfer-cum recirculation pump, and the maximum velocity through the filter for this flow shall not exceed 12 meters/hour. Depth of the filter material shall not be less than 1 meter. The activated carbon shall be of good quality suitable for removal of odor, chlorine, and dissolved organic substances. Suitable free board shall be provided over the filtering medium below the backwash outlet nozzle and in straight portion of vessel to facilitate backwashing. The inlet distribution (preferably header-lateral type) and under drain collecting system (header-lateral/strainer-on-plate) shall be so designed as to give uniform distribution and flow without channeling and obstruction.		
5.09.00	Air Blowers Each blower shall be complete with motor, V-belt drive with belt guard, inlet filter/silencer, flexible couplings, and discharge snubber, all mounted on a single base.		
5.10.00	DM Water storage tanks for Condensate polishing Plant Two (2) numbers of DM Tanks of vertical cylindrical type in MS construction internally painted with epoxy shall be provided. The design features of the tanks & accessories shall be as per IS: 803. However, minimum thickness of shell plate, bottom plate and roof plate shall be 8 mm, 10 mm, and 6 mm receptively. The tanks shall be provided with CO ₂ absorber and overflow seal pit. Effective capacity of each tank shall be equivalent to 1.5 times the DM water required for one (1) regeneration operation of working vessels of the TG unit including resin transfer operations from Condensate Polishing Plant to regeneration plant and regeneration plant to Condensate Polishing Plant and for preparation of chemicals for one (1) regeneration of working vessels of the TG unit. However, the capacity of each DM water storage tank shall be 600 Cum minimum. Water inlet pipe shall lead up to the bottom of DM tanks (preferably through perforated pipe) to avoid turbulence/agitation.		
5.11.00	Effluent Neutralisation System Neutralising pit of RCC construction with acid/alkali resistant tiles shall be provided to receive drains from the regeneration. If separate pit is envisaged for Condensate Polishing Plant, contractor shall design the system so that pit shall be provided in two (2) sections and each section shall have a holding capacity of 1.5 times the waste effluent from each regeneration of each vessel. For disposal of neutralized effluent pumping, pumps shall be provided. Proven agitation system like air agitation/venturi mixing shall be provided, in addition to recirculation from pumps. <i>Note: If CPU regeneration facility is located in DM Regeneration area, a common Effluent Neutralisation system for CPU and DM Regeneration system may be provided. However, total requirement of N-pit for DM and CPU regeneration shall have a holding capacity of 150% of waste effluent generated from one regeneration of complete stream of cation, anion, MB and CPU service vessel.</i>		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION A - 11 CONDENSATE POLISHING UNIT PAGE 10 OF 15



CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.12.00	The waste recirculation/disposal pumps shall conform to the following technical requirements: Effluent re-circulation cum-disposal pumps: a) Number : Three (3) numbers (1W+1S+1Maint. standby) b) Type : Horizontal centrifugal single stage with priming system c) Minimum Capacity and total head of each pump : Suitable to pump the total volume of one section in 8 hours (Minimum 50 Cu.m/hr). Head to suit the requirement d) Suction condition : Suction from priming chamber e) Casing & Impeller material : Rubber lined/ FRP lined, CI IS: 210 FG 260 f) Shaft material : SS-316 g) Number of priming chambers : Two (2) Dosing of acid, alkali and lime shall also provide to neutralized effluents before disposal along with all piping, valves etc. including lime solution preparation facilities for neutralization. One (1) number of lime tank of SS construction of effective capacity of minimum 2 m³ shall be provided with dissolving basket, agitator, platform/ladder, manhole, overflow/drains etc. <i>Note: If CPU regeneration facility is located in DM Regeneration area, common Effluent re-circulation cum-disposal pumps for CPU and DM Regeneration system may be provided. Backwash water (from filters) & rinse waste (from exchangers) water collection & recycling system shall also be provided as specified.</i> Waste water generated during resin transfer: The DM water used for resin transfer operations shall be collected in a RCC pit with solvent free epoxy coating in regeneration area having holding capacity 1.5 times the capacity of DM water required for transferring the resins or 50 m³ (min) and the same shall be pumped CT basin for recycle/re-use by means of two (2) 2x100% of waste water recycle pumps. The material of construction of pumps shall be SS-316.			
	Piping a) Contractor shall design, supply, and erect the piping between the service units and the common external regeneration facility, for transferring the exhausted and regenerated resins as required. b) All outdoor piping shall be laid above ground and generally laid in pipe trestles including crossing of road/pipe/cable trenches if any. Piping between chemical tanks area and regeneration area etc. may be laid on pedestals if layout permits. c) The resin transfer pipeline arrangement shall have minimum number of bends, avoiding any sharp bends which cause segregation of the mixed resins, and pockets where the resins can get trapped. Suitable observation ports shall be provided in all critical areas to enable the operator to monitor completeness of the resin transfer operations. All necessary arrangements for venting and draining of the pipeline shall be provided. d) The resin transfer pipeline shall be sized for a flow velocity of between 2.3 - 3.0 m/s. For other service, design criteria in piping shall be generally in line with design philosophy described elsewhere in Technical Specification. e) Remotely operated valves suitably interlocked with the plant operation, shall ensure that the resins get transferred to and from only the particular service vessel which has been selected by the operator. f) All lined vessel connections and connections in unlined vessels (25 NB and larger) shall be flanged to ANSI 125 lb class except the Polisher service vessels which shall be ANSI 300 lb class. Flat face flanges shall be used throughout. Nozzle material shall be ASTM A-106 Gr.B. Sch.80 pipe for all vessels. All flanged connections shall be supplied			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION A - 11 CONDENSATE POLISHING UNIT	PAGE 11 OF 15

CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.13.00	complete with matching counter flanges, nuts, bolts and full-face gaskets. All the pipelines in service vessels area where pressure may attain same as service vessel shall be designed for 300 lb class (minimum). g) MOC for piping: 1) Pipes handling DM Water and Resin transfer pipeline shall be of stainless-steel type 304 Sch-40 (minimum). 2) Pipeline handling Alkali shall be of stainless-steel type 316 Sch.10 (minimum). 3) Piping for Acid service (HCl) shall be of carbon steel Polypropylene lined/MSRL/CPVC as per ASTM F441 (Sch.80). 4) Piping for air service shall be of hot dip galvanized (heavy grade) steel. 5) Piping for condensate near condenser Polisher service unit shall be of seamless carbon steel ASTM A-106 Gr B all welded construction with 300 lb flange connection or higher class as per requirement. 6) Pipe handling wastewater during resin transfer shall be of stainless-steel type 304 Sch.40 (minimum).			
	Valves 1) The isolation valves on the resin transfer line shall be of eccentric plug type/ball valve (full bore type) of Stainless steel construction (SS-316). 2) Emergency bypass control valve shall be of double flanged/lugged wafer butterfly type. Isolation valves of wafer (lugged) type butterfly valves (resilient material seated, to ensure bubble-tight shut off) shall be provided on the upstream and downstream sides of the control valve. The material of construction of valves handling condensate in service vessel area shall be SS-316. Seat/seat rings should be of Teflon/titanium back up rings. Seal shall be of Teflon or equivalent. 3) Isolation Valves handling Alkali, Ammonia etc. shall be of diaphragm type in SS-316 construction. 4) Isolation Valves handling Acid (HCl) shall be of diaphragm type in MSRL (Mild steel Rubber lined) or CPVC construction. 5) Isolation Valves handling DM water shall be Butterfly or gate or globe type and shall be of SS - 304 construction. 6) Non-return valves shall be constructed of SS-304 for DM Water & SS-316 for alkali. For Hydrochloric acid, non-return valve shall be dual plate/swing check/lift ball check type of suitable material or as per manufacturer's standard practice. 7) All valves in service vessels area where pressure may attain same as service vessel shall be designed for 300 lb. class minimum.			
5.14.00	Pressure Vessels & Miscellaneous Items a) All pressure vessels shall be designed and constructed in strict accordance with the ASME code Section VIII or acceptable equivalent international standard. Suitable mill tolerances shall be considered for determining the thickness of the shells and dished ends. A minimum thinning allowance of 2 mm shall be considered for the dished ends of torospherical type. b) Pressure vessel ends shall be of dished design and constructed by forging, pressing or spinning process. Spherical vessels for CPU service vessels are acceptable. Conical or flat ends shall not be accepted. All the atmospheric vessels shall be at least 6 mm thickness. c) All pressure vessels shall be fabricated from carbon steel plates to SA-515/516 Gr. 70 and lined internally. The lining shall be of rubber having a hardness of 65 (+/-) 5			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION A - 11 CONDENSATE POLISHING UNIT	PAGE 12 OF 15



CLAUSE NO.

TECHNICAL REQUIREMENTS

- (3) Isolation from service.
- (4) Resin Transfer from CPU vessel to Regeneration plant.
- (5) Resin Transfer from Regeneration plant to CPU vessel
- (6) Rinse mode.

Each mode or operation is described as below:

f) Standby Mode:

- (1) Among the vessels, any one of the vessels may be selected in this mode.
- (2) Under this mode, the vessel, which was regenerated in previous cycle and filled with regenerated resin, shall be kept ready for next Service cycle.
- (3) The selection of any vessel for Standby mode shall be initiated by operator and there shall be indication about the details such as "Condition of the resin; Whether it is filled with regenerated resin or exhausted resin, whether the standby vessel has undergone rinse cycle or not, date and time of receipt of regenerated resin and completion of rinse cycle etc.

g) Service mode:

- (1) Service flow rate for each polishing vessel shall be monitored. During periods of low condensate flow the operator may select to remove one of the vessels from service by a manually initiated automatic sequence.
- (2) High differential pressure across the influent and effluent headers will cause an alarm and bypass system shall be initiated as described elsewhere in this section.
- (3) By observing the individual vessel flow indicators, or conductivity at vessel outlet the operator can determine which vessel is contributing most to the pressure drop and is in need of resin cleaning.
- (4) Cation conductivity indicators shall monitor the polishing system influent and effluent streams as well as the discharge of each service vessel. A high influent conductivity alarm will alert the plant operator that a problem condition such as air or condenser cooling water leakage has occurred. An alarm at the power station main control room shall also be initiated. A high effluent header or service vessel conductivity alarm will alert the operator to the need for regeneration of a polishing vessel.
- (5) When the vessel under Service mode is ready for regeneration, the operator shall change the same into "Isolation mode" in the panel. Subsequently the "Standby vessel" shall be selected for "Service mode" from the OWS/control panel. The selection shall follow, required sequences such as pressurization of the vessel, checking of the effluent quality and putting the vessel in service on satisfactory effluent quality.
- (6) The differential pressure (DP) across the inlet and outlet headers of CPU services vessels shall be measured and the bypass control valve will also modulate as per the DP. The bypass system shall also be actuated upon high condensate temperature.

e) Isolation from Service:

Normally "Service Vessel" once exhausted shall be isolated from service till the "Resin Transfer" operation is initiated. In addition, provision to be kept for isolation of one or all the vessels from service if required by operator from the panel.



CLAUSE NO.	TECHNICAL REQUIREMENTS			
6.03.00 7.00.00 7.01.00	f) <u>Resin Transfer from CPU vessel to Regeneration plant</u> (1) When a vessel in a service mode needs regeneration as stated above, the resin transfer from the particular vessel to the regeneration plant shall be initiated from the panel of the condensate polishing plant. (2) The transfer of resin from the service vessel shall include operations such as isolation of the service vessel, hydraulic transfer of the resin to the external regeneration system (resin separation vessel) and the complete drain down of the service vessel. (3) The sequence of "Resin Transfer" operation shall be initiated from the Control system in panel of CPP and shall be controlled in the regeneration Panel. (4) The completion of the operation shall be exhibited in the panel. g) <u>Resin Transfer from Regeneration Plant to CPU Vessel</u> (1) When the regeneration is completed in the regeneration plant, the resin shall be transferred to the empty vessel of Condensate Polishing plant. (2) This shall be initiated by the operator from the control panel of condensate polishing plant of the unit from which resin was transferred to the regeneration plant in previous service. Provision shall also be kept to transfer the regenerated resin to any of the empty vessel of the CPP of the TG unit if required. (3) The transfer of resin from the regeneration plant shall include operations such as hydraulic transfer of the resin and the complete drain down of the water. (4) The sequence shall be initiated from the panel of CPP and shall be controlled in the regeneration Control Panel. (5) The completion of resin transfer operation shall be exhibited in both the Control panels. h) <u>Rinse mode</u> (1) After transfer of regenerated resin from the regeneration plant to the empty condensate polisher vessel, this rinse cycle shall be initiated from the Control system of the respective unit so that the vessel may be rinsed and kept ready for next service cycle. (2) The rinse mode shall be a manually initiated full automatic sequence. This sequence shall include the rinse down step using condensate at a suitable rate until the unit effluent quality is acceptable for boiler feed water. Prior to rinsing, the resin shall be given air scrub by means of air blowers provided near the CPP. (3) The effluent quality shall be determined by conductivity monitoring of the rinse water outlet, which is returned to the condenser hotwell for recycle. (4) Cation conductivity values shall be monitored and interlocked to prevent advancing of the automatic sequence until the rinse down is complete. (5) The completion of rinse operation shall be annunciated in the panel so that the rinsed vessel may be selected for "Standby mode" or "Service mode" as per requirement. Interlocks All interlocks for safe operation of the plant shall be provided. The contractor shall submit the complete details of the system offered by him during detailed engineering. PAINTING Painting shall conform to the requirements specified in the chapter titled "Surface Preparation & Painting"			
	SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION A - 11 CONDENSATE POLISHING UNIT	PAGE 15 OF 15



SUB-SECTION-A-12

SURFACE PREPARATION & PAINTING

**SINGARENI THERMAL POWER PROJECT
STAGE-II (1X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC NO.:CW-CM-11159-C-O-M-001**

CLAUSE NO.	TECHNICAL REQUIREMENTS		
1.00.00	Specification of surface preparation & painting		
1.01.00	Surface preparation methods and paint/primer materials shall be of the type specified herein. If the contractor desires to use any paint/primer materials other than that specified, specific approval shall be obtained by the contractor in writing from the employer for using the substitute material.		
1.02.00	All paints shall be delivered to job site in manufacturers sealed containers. Each container shall be labelled by the manufacturer with the manufacturer's name, type of paint, batch number and colour.		
1.03.00	Unless specified otherwise, paint shall not be applied to surfaces of insulation, surfaces of stainless steel/nickel/ copper/brass/ monel/ aluminum/ hastelloy/lead/ galvanized steel items, valve stem, pump rods, shafts, gauges, bearing and contact surfaces, lined or clad surfaces.		
1.04.00	All pipelines shall be Colour coded for identification as per the NTPC Colour-coding scheme, which will be furnished to the contractor during detailed engineering.		
1.05.00	SURFACE PREPARATION		
1.05.01	All surfaces to be painted shall be thoroughly cleaned of oil. Grease and other foreign material. Surfaces shall be free of moisture and contamination from chemicals and solvents.		
1.05.02	The following surface preparation schemes are envisaged here. Depending upon requirement any one or a combination of these schemes may be used for surface preparation before application of primer. SP1 Solvent cleaning SP2 Application of rust converter (Ruskil or equivalent grade) SP3 Power tool cleaning SP4 Shot blasting (shot blasting shall be used as surface preparation method for hot worked pipes prior to application of primer) SP4* Shot blast cleaning/ abrasive blast cleaning to SA21/2 (near white metal) 35-50 microns SP5 Shot blasting/ abrasive blasting. SP6 Emery sheet cleaning/Manual wire brush cleaning.		
1.06.00	APPLICATION OF PRIMER/PAINT		
1.06.01	The paint/primer manufacturer's instructions covering thinning, mixing, method of application, handling and drying time shall be strictly followed and considered as part of this specification. The Dry film thickness (DFT) of primer/paint shall be as specified herein.		
1.06.02	Surfaces prepared as per the surface preparation scheme indicated herein shall be applied with primer paint within 6 hours after preparation of surfaces.		
1.06.03	Where primer coat has been applied in the shop, the primer coat shall be carefully examined, cleaned and spot primed with one coat of the primer before applying intermediate and finish coats. When the primer coat has not been applied in the shop, primer coat shall be applied by brushing, rolling or spraying on the same day as the surface is prepared. Primer coat shall be applied prior to intermediate and finish coats.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION - A-12 SURFACE PREPARATION & PAINTING
			PAGE 1 OF 8

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.06.04	Steel surfaces that will be concealed by building walls shall be primed and finish painted before the floor is erected. Tops of structural steel members that will be covered by grating shall be primed and finish painted before the grating is permanently secured.			
1.06.05	Following are the Primer/painting schemes envisaged herein: PS3 - Zinc Chrome Primer (Alkyd base) by brush/Spray to IS104. PS3* - Zinc Chrome primer (Alkyd base) by dip coat. PS4 - Synthetic Enamel (long oil alkyd) to IS2932. PS5 - Red Oxide Zinc Phosphate primer (Alkyd base) to IS 12744 PS9 - Aluminum paint to IS 2339. PS9* - Heat resistant Aluminum paint to IS-13183 Gr.-I (for temperature 400 degC – 600 degC), IS-13183 Gr.-II (for temperature 200 degC- 400 degC and IS-13183 Gr.-III (for temperature upto 200 degC) PS13 - Rust preventive fluid by spray, dip or brush. PS14 - Weldable primer-Deoxaluminate or equivalent. PS16 - High Build Epoxy CDC mastic `15'. PS17 - Aliphatic Acrylic Polyurethane CDE134, %V=40.0(min.) PS18 - Epoxy based TiO2 pigmented coat PS19 - Epoxy Zinc rich primer (92% zinc in dry film (min.), %VS=35.0(min.) PS-20 - Epoxy based finish paint			
1.06.06	All weld edge preparation for site welding shall be applied with one coat of weldable primer.			
1.06.07	For internal protection of pipes/tubes, VCI pellets shall be used at both ends after sponge testing and ends capped. VCI pellets shall not be used for SS components and composite assemblies.			
1.06.08	SG membrane walls and other Flue gas swept pressure part surfaces shall be applied with appropriate primer for protection of surfaces during transit, storage and erection.			
1.06.09	a) All un-insulated equipments, pipes, valves etc. covered in sub-section A-07 (Steam Turbine & Auxiliary system) shall be painted with paint not inferior to Epoxy resin based paints with minimum DFT of 150 microns. The paint shall be applied in three stages i.e. primer, intermediate and finish coats in following manner: ▪ Primer coat – Epoxy based zinc phosphate ▪ Intermediate - Epoxy based TiO₂ pigmented coat ▪ Finish coat - Epoxy based finish coat/Two pack polyurethane coat b) Equipment, pipes etc. with high temperature shall be painted with heat resistant aluminum paint (to be selected based on the service condition of component as per IS-13183). Two coats of paint shall be applied with total DFT 40 microns. c) Surface preparation before painting shall be carried out according to requirement indicated in this sub-section and international standard.			
1.06.10	A)	Specification for the application of Epoxy coating for internal protection of DM tank & other vessels/tanks (as applicable) shall be as follows:		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION - A-12 SURFACE PREPARATION & PAINTING	PAGE 2 OF 8

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Primer : One coat of unmodified epoxy resin along with polyimide hardener. Paint : Two (2) coats unmodified epoxy resin along with Aromatic adduct hardener. Total thickness of primer and paint should not be less than 400 microns. B) Specification for application of chlorinated Rubber paint for external protection vessel, tanks, piping, valves & other equipments shall be as follows: i) For Indoor vessel, tanks, piping, valves & other equipments: (a) Surface preparation shall be done either manually or by any other approved method. (b) Primer coat shall consist of one coat of chlorinated rubber based zinc phosphate primer having minimum DFT of 50 microns. (c) Intermediate coat (or under coat) shall consist of one coat of chlorinated rubber based paint pigmented with Titanium dioxide with minimum DFT of 50 microns. (d) Top coat shall consist of one coat of chlorinated rubber paint of approved shade and colour with glossy finish and DFT of 50 microns. Total DFT of paint system shall not be less than 150 microns. ii) For Outdoor vessel, tanks, piping, valves & other equipments: (a) Surface preparation shall be blast cleared using non-siliceous abrasive after usual wire brushing, which shall conform to Sa 2-1/2 Swiss Standard. (b) Primer coat shall consist of one coat of epoxy resin based zinc phosphate primer having minimum DFT of 100 microns. (c) Intermediate coat (or under coat) shall consist of epoxy resin based paint pigmented with Titanium dioxide with minimum DFT of 100 microns. (d) Top coat shall consist of one coat of epoxy paint suitable pigmented of approved shade and colour with glossy finish and DFT of 75 microns. Additionally finishing coat of polyurethane of minimum DFT of 25 microns shall be provided. The paint may be applied in one coat, in case high built paint is used, otherwise two coats shall be applied. Total DFT shall not be less than 300 microns.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION - A-12 SURFACE PREPARATION & PAINTING	PAGE 3 OF 8

1.06.11 Primer/Painting Schedule

Sl. No	Description		Surface Preparation	Primer Coat			Intermediate Coat			Finish Coats			Total Min. Painting DFT (Microns)	Colour Shade
				Type of Primer	No. of Coats	Min. DFT / coat (Microns)	Type of coating	No. Coats	Min. DFT/ Coat (Microns)	Type of coating	No. Coats	Min. DFT/ Coat (Microns)		
A) Power Cycle Piping														
1.	All insulated Pipings, fittings/ components, Pipe clamps, Vessels/Tanks, Equipments etc.		SP3/SP4	PS9*	1	20	-	-	-	PS9*	1	20	40	As per NTPC Colour shade/ coding scheme
2.	All un-insulated Pipings, fittings/ components, Pipe clamps, Vessels/Tanks, Equipment etc.	Design temperature < or equal to 60°C	SP3/SP4	PS 5	2	25	-	-	-	PS 4	3 \$	35 \$	155 \$	
		Design temperature above 60°C- 200°C	SP3/SP4	PS 9*	1	20	-	-	-	PS9*	1	20	40	
		Design temperature > 200°C	SP3/SP4	PS9*	1	20	-	-	-	PS9*	1	20	40	
3	Constant Load Hanger (CLH) and Variable Load Hanger (VLH)		SP4*	PS19	1	40	-	-	-	PS17	1	30	70	

4	Piping hangers / supports (other than (3) above. (un-insulated)		SP3/SP5	PS5	2	25	-	-	-	PS4	2	25	100	
	Valves													
5.	Cast/Forged	Design temperature < or equal to 60 degC #	SP3/SP5	PS5	2	35	-	-	-	PS4	2	25	120	
		Design temperature above 60 degC	SP3/SP5	PS9*	1	20	-	-	-	PS9*	1	20	40	
6.	All auxiliary Structural Steel components for pipe supports	Outside TG building and in SG envelope	SP4*	Inorganic Ethyl Zinc Silicate	1	75	PS18	1	75	a) Epoxy coat	2	35	250	
										b) Final coat of paint PS17	1	30		
		Within TG building	SP4*	-do-	1	35	PS18	1	35	a) Epoxy coat	2	25	150	
										b) Final coat of paint PS17	1	30		

7.	Weld Edges	SP6 (Hand cleaning by wire brushing)	PS13 (Weldable primer)	1	25	-	-	-	-	-	-	25	
1. \$ - The first 2 finished coats (total min.DFT of 70 microns) shall be done at shop and the 3rd finish coat (min.DFT 35 Microns) shall be applied at site. 2. For valves below 65NB and temperature upto and including 540 DegC, Parkerizing/zinc phosphate corrosion resistant coating as per ASTM F1137 is also acceptable in lieu of Aluminum paint. 3. For corrosion protection of threaded hanger rods and variable spring cages, electro galvanizing in full compliance to minimum Corrosion category C3 as per EN ISO12944 is also acceptable. 4. For spring cages, 2 coats of 30 µm (min) zinc-rich epoxy resin primer with zinc content> 80 weight% in dry film followed by 2 coats of 30 µm (min) top coat of Acrylic resin Co-polymerisate with a total combined minimum DFT of 120µm is also acceptable in lieu of above specified paint scheme. 5. For corrosion protection, all inner parts of the hangers (CLH/VLH) shall be at least in full compliance to Corrosion category C3 as per EN ISO12944. 6. # - For Cast/forged valves upto & including design temperature 60Deg.C, Aluminium painting as per IS-13183 Gr-3 or better with total DFT 40Micron is also acceptable.													
B) Steam Generator & Auxiliaries:													
1	All surfaces with temperature 95°C or less and which are insulated	SP3/SP4	PS 5	2	30	-	-	-	PS 4	2 \$	20 \$	100 \$	
2	All surfaces with temperature above 95°C and which are insulated	SP3/SP4	PS9*	1	20	-	-	-	PS9*	1	20	40	

Note: 1) SG membrane walls and other Flue gas swept pressure part surfaces shall be applied with appropriate primer for protection of surfaces during transit, storage and erection.

2) Painting specification for all other exposed steel surfaces not covered above shall be same as that given in Civil Sub-section, Part-B, Section VI for corrosion protection of steel structures.

C) LOW PRESSURE PIPING

1	All Piping, fittings / components, valves, Equipments etc.	SP3/SP5	PS3/ PS5	2	25	PS 4	1	30	PS 4	2	35	150	As per NTPC Color shade/ coding scheme.
2	Stainless steel surface, Galvanized steel surface and gun metal surface.	No Painting											
3	On the internal surface for pipes 1000 Nb and above	A coat of primer followed by hot coal-tar enamel or coal tar epoxy painting (cold) shall be applied.											

D) Fire Detection & Protection System, Compressed air system and Air-conditioning & Ventilation System

For Fire Detection & Protection System, Surface preparation and painting of Fire Water Storage Tanks, all Steel Surfaces (external) exposed to atmosphere (outdoor & indoor installation), Deluge Valves, Alarm Valves, Foam monitors, Water monitors, Foam Proportioning equipments, Foam makers, etc. should be as per the Part-B, Sub Section-A-18, Fire Detection & Protection System

For Air Conditioning System, Surface preparation and painting of all the steel surfaces (external) exposed to atmosphere (outdoor & indoor installation), centrifugal fans – Casing etc. should be as per the Part-B, Sub Section-A-17, Air Conditioning System.

For Ventilation System, Surface preparation and painting of all the steel surfaces (external) exposed to atmosphere (outdoor & indoor installation), centrifugal fans – Casing etc. should be as per the Part-B, Sub Section-A-17, Ventilation System.

For compressed air system, Surface preparation and painting of all the steel surfaces should be as per the Part-B, Sub Section--A-16 compressed air system.

E) ESP												
1	All surfaces with surface temperature 95°C or less (with or without insulation)	SP3/SP4	PS3/ PS3*	1	25	-	-	-	PS 4	1	30	55
2	All surfaces with surface temperature above 95°C (with or without insulation)	SP3/SP4	PS5	2	30	-	-	-	-	-	-	60

General Notes (Applicable for all above points A to E)

- i) Painting specification for all surfaces with surface temperature 95°C or less (un-insulated) that are not covered above shall be same as that given in Civil Sub-section, Part-B, Section-VI for corrosion protection of steel structures.
- ii) Painting specification for inside surfaces (such as inner surfaces of ducts/ tanks/ mills/ dampers/ ESP etc.) that are not covered specifically in above clauses, shall be provided with 2 coats of suitable primer i.e. PS5/ PS9 (Total DFT 60/40 micron) based on the temperature.

F) FGD System

- (i) Surface preparation shall be blast cleaned conforming to Sa 2-1/2 Swiss Standard.
- (ii) Primer coat shall consist of epoxy resin based zinc phosphate primer having minimum DFT of 100 microns.
- (iii) Intermediate coat (or under coat) shall consist of epoxy resin based paint pigmented with Titanium dioxide with minimum DFT of 100 microns.
- (iv) Top coat shall consist of one coat of epoxy paint suitable pigmented of approved shade and colour with glossy finish and DFT of 75 microns.
Additionally finishing coat of polyurethane of minimum DFT of 25 microns shall be provided.



SUB-SECTION–A-13

THERMAL INSULATION

**SINGARENI THERMAL POWER PROJECT
STAGE-II (1X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC NO.:CW-CM-11159-C-O-M-001**

CLAUSE NO.	TECHNICAL REQUIREMENTS		
1.00.0	THERMAL INSULATION		
	a) For all Piping / SG / TG systems and the equipment with surface operating temperature of 60 deg.C and above, thermal insulation shall be applied for heat conservation and/or personnel protection such that the temperature of protective cladding shall not exceed 60 deg.C. Insulation thickness shall be calculated based on the following design data & methodology:		
	Design ambient temperature	40 Deg.C for inside and 45 Deg.C for outside the Main plant building.	
	Maximum cladding temperature	60 Deg.C	
	Wind speed	0.5m/sec. for inside and 0.25m/sec for outside the Main plant building	
	Emissivity of cladding	0.2	
	Pipe/Equipment wall temp.	Maximum operating temperature.	
	Thickness calculation	As per ASTM C-680 (Latest edition) or equivalent	
	Thermal insulation shall also be provided for piping systems where it is expected that occasional rise in fluid temperature during operation exceeds 60 deg.C,		
	Upstream of all drain lines and the lines connected to steam traps, shall be insulated up to and including isolating valve for heat conservation. Rest of such lines drain lines and other lines such as safety valve discharges, vents, etc. shall be insulated for personnel protection.		
b) Insulating materials should conform to the following requirements:			
i) The minimum insulation thickness, however, shall not be less than 75 mm for Steam Generator surfaces and 25 mm for other surfaces. Also refer as specified at clause no 1.00.00 b (ii) of this chapter. Material and application of insulation material, protective cladding, wire mesh etc. shall also be conforming to latest edition of following Codes: IS: 8183, IS: 3677, IS: 3144, IS: 14164, IS: 280, ASTM-B 209.			
Physical requirements — Following shall be met by testing as per relevant clauses of IS: 3144.			
a) Shot content	5% by weight (maxm.), size of any shot not to exceed 5 mm in diameter (size details, as applicable, shall be as per referred standard.).		
b) Bulk density	To comply with Table 2.01.00 below.		
c) Weight gain by moisture absorption	2% (maxm.)		
d) Sulphur Content	Not exceeding 0.6%		
e) Alkalinity	7-10 pH		
f) Maximum oil content	Not exceeding 0.3% by weight		
g) Total carbon content	Not exceeding 0.3% by weight		
h) Settlement	Nil (When tested as per Cl. 22 of IS:3144)		
i) Handability	Fully handable, without any lump formation and disintegration of material		
j) Loss of weight after combustibility test	Not exceeding 5% by weight		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE			
TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001			
Sub-Section -A-13 THERMAL INSULATION			
PAGE 1 OF 9			

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	In addition to requirements of as specified above, the Mineral wool shall: (a) Pass standard combustibility test both immediately after application and after subjected to maximum operating temperature for not less than 100 hrs. (b) Not suffer permanent deterioration as a result of contact with moisture due to condensation and shall be free from objectionable odor. (c) Not cause corrosion of the surface being insulated or of cladding on it under normal site conditions. (d) Not suffer any quality deterioration under specified service conditions (both cold/hot face temp.) of use. (e) Not contain asbestos in finishing materials of insulation in any form (ii) Insulation mattress/section shall be supplied in thickness of 25, 40, 50, 60, 65 and 75 mm. Insulation of higher thickness shall be made up in multiple layers using mattress/slabs of thickness specified above. However, if the required thickness is such that by using above mattress/slabs the calculated thickness is not achieved, the mattress/slabs in increment of 5 mm shall be acceptable for outer layers. The min. thickness however, shall not be less than 25 mm and number of layers shall be minimum and innermost layer shall be thickest. c) INSULATION (STEAM TURBINE AND BFP) (a) The HP cylinder, IP cylinder, steam chest and interconnection piping, crossover / cross-around piping, such parts of LP cylinder as considered necessary, and all associated piping and valves shall be efficiently insulated with inner thermal insulating materials. In case the noise limit as specified elsewhere in the specification is exceeded, the insulated portion of the steam turbines shall be covered with fabricated steel cover, provided with suitable anti-drumming and sound pressure attenuating material inside. The insulation and steel covering should be so designed and erected as to provide easy accessibility to parts requiring frequent inspection. (b) The thermal insulation for the turbine casing shall preferably be insulated by preformed ceramic mattress blankets conforming to IS15402 or equivalent. These mattresses are fixed over the casing and held in position by metallic washers fastened to the MS rod welded to the casing. To meet the thickness requirements, multiple layers of mattresses may be applied. Alternatively, bidder may apply turbine insulation as per their standard practice i.e. sprayed insulation produced by projecting specially prepared mineral wool along with a fine liquid spray. However, the casing parting plane shall necessarily be provided with blanket type insulation. The bidder may apply complete spray type or complete blanket type or combination of both of above as per their standard practice. These blankets shall consist of high temperature felted mineral insulation fully enclosed in wire inserted asbestos free cloth for temperature exposure to 445°C to 595°C. A single layer of blanket shall not be more than 75 mm thick. Voids around the blankets should be avoided. However, unavoidable voids shall be filled with loose mineral wool.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	Sub-Section -A-13 THERMAL INSULATION	PAGE 2 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(c) Nuts and other exposed portions of the casing and valve flanges shall be suitably insulated for minimum heat loss. (d) Suitable stainless steel lugs shall be tack welded on turbine casing to support the insulation. In places where welding is not permitted, suitable alternative arrangement shall be provided by the Contractor. The design of the support shall be so as to involve minimum number of lugs. (e) The thermal insulation designed, furnished and installed by the Contractor shall be such that the following items of performance shall be guaranteed, and the specific design and application features adopted shall be so as not to exceed the stipulated limits in temperature differentials. The Employer shall have the option to have any random check of specimen as per his choice, to establish conformity to guaranteed particulars: (1) The difference in temperature between upper and lower metallic parts of HP and IP casings in the zone of governing stage/ steam admission shall not be more the 40 °C during cooling of the casing. (2) The difference in metallic temperatures of upper and lower halves of both H.P. and I.P. casings, during normal operating conditions shall not be more than 15 °C. (f) Applicable Standards: 1. IS15402 Ceramic mattress insulation 2. IS - 9742 Sprayed mineral wool thermal insulation. 3. IS - 5696 Loose mineral wool. 4. IS - 3677 Unbonded slag wool for thermal insulation. 5. IS - 8183 Lightly bonded mineral wool for thermal insulation. 6. IS - 7413, IS - 3144, IS - 9482 (g) The use of asbestos in any form for insulation and elsewhere is not permitted. The insulating material and cladding material shall be as per the tables of material given below:			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		Sub-Section -A-13 THERMAL INSULATION
				PAGE 3 OF 9



2.01.00 Insulation Materials

	Type # 1	Type # 2	Type # 3	Type # 4	Type # 5	Type # 6
Type	Lightly resin Bonded mineral wool	Lightly resin bonded mineral wool	Resin bonded mineral wool preformed pipe section	Resin bonded glass wool preformed pipe section	Calcium silicate preformed block type	Ceramic Fiber
Apparent Density	120-150 Kg/M ³	100 Kg/M ³	140-150 kg/M ³	60-80Kg/M ³	200-250Kg/m ³	128 Kg / m ³
Mtl. Standard	IS:8183	IS:8183	IS:9842	IS:9842	IS:8154	IS : 15402
Applicable Service	Piping system & equipment with operating temp. in range of 400-500 deg.C	Piping system & equipment with operating temp. in range of 60-400 deg.C	Piping system of 350 NB and below with temp. in range of 60 – 500 deg. C	Piping system of 350 NB and below with operating temp. in range of 60-400 deg.C	Piping system & equipment with operating temp. in range of 400 – 500 deg. C	Piping system & equipment with operating temp 500 deg. C and above. (except Vent and drain Lines). [See Note: 1& 2 below]
Testing Requirement	As per IS:8183	8183	IS:9842	IS:9842	IS:8154	IS : 15402

Note: (1) For piping systems with operating temperature 500 Deg. C and above, the first (innermost) 75 mm thickness shall be of ceramic fiber Insulation followed by subsequent layers of mineral wool/LBM.

Thickness of Ceramic fiber and LBM is to be calculated layer wise considering the first layer of ceramic fiber **insulation followed** by mineral wool/LBM of appropriate thickness to reach cladding surface temperature 60 Deg. C or less)

- (2) For drains & vent lines with operating temperature 500 Deg C and above either Lightly resin Bonded mineral wool or ceramic fiber or combination of ceramic fiber & LRBM of suitable thickness as per approved calculation can be provided.

SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	Sub-Section -A-13 THERMAL INSULATION	PAGE 4 OF 9



2.02.00 Cladding Material & Accessories shall be as specified here under.

S.No.	Item	Basic Specification	Description
1.	Cladding	Aluminum ASTM B-209-1060 temper H14 or IS:737 Gr.19000/H2	Thickness of sheathing (a) 18SWG (1.219mm) for diameter for insulated surface 450 mm and above and for flat surfaces (b) 20 SWG (0.91 mm) for diameter of insulated surface 150 mm and above up to 450 mm. (c) 22 SWG (0.71 mm) for diameter of insulated surface 150 mm and below. (d) 16 SWG ribbed Aluminum for Steam Generator outer casing
2.	Binding & lacing wire	Galvanized Steel wire to IS: 280 for temp. below 400°C and stainless to IS:6528 for temp above 400°C	20 SWG for all insulation interface temperature
3.	Straps & Bands	(i) Aluminum where interface temperature are below 400 deg. C (ii) Stainless steel where temperatures are above 400 deg. C	Band shall be 20 mm wide and 0.6 mm thick for securing Aluminum Sheathing anodized aluminum bends shall be used.
4.	Screws	Stainless steel	Self-tapping, cheese headed
5.	Hexagonal wire mesh	(i) Galvanized steel wire to IS: 280 mesh for interface temperature up to 400 deg. C. (ii) Stainless steel wire for temperature above 400 deg. C	Wire mesh netting shall be 10 to 13 mm aperture at least 0.56mm diameter wire. Wires used for stitching/tying the hexagonal mesh facing with the insulation mattress shall be minimum 0.4 mm thick.

CLAUSE NO.	TECHNICAL REQUIREMENTS		

CLAUSE NO.	 TECHNICAL REQUIREMENTS		
	I. For the Steam Generator furnace, if provided with skin casing and the super heater, reheater and economizer casings where water cooled walls are involved, a first covering of refractory material shall be applied to the external tube surfaces before the application of any further heat resistant insulating material II. The access doors and inspection doors in the Steam Generator shall be lined with refractory material. The access doors in other portions of the Steam Generator shall be insulated in a similar manner corresponding to any casing, flue-ducts or air, ducts where such openings and access doors occur. III. While applying mineral wool blanket insulation: (a) Provide expended metal or hexagonal wire mesh on both sides for single layer mattress and on first layer in case of multilayer insulation. Subsequent layers of multilayer insulation to have only one side wire netting. (b) The edges of adjacent blankets to be leased together, by appropriate lacing wire as per as specified at clause no 2.02.00 of this chapter. (c) Any gap between joints between insulation layers shall be filled by loose mineral wool confirming to IS 3677. (d) All insulation to be secured by 1.63 mm diameter wire netting over blankets with ends of wire tightly twisted, and pressed in to insulation surface. (e) Impelling pins shall be placed on centers not exceeding 300 mm. IV. Air & Flue Gas ducts with external stiffeners shall have first layer of insulation between the stiffeners and a second layer of insulation over stiffeners so that stiffeners are also insulated and a level surface is achieved. Other requirements are same as given in as specified at clause no 21.10.00 of this chapter. V. Penthouse Insulation Arrangement: Penthouse vertical wall shall be insulated from outside. Alternately, insulation material inside penthouse shall be protected by SS sheet cladding. Similarly, the upper deck sheet of pent house shall also be insulated from outside only. The flat surface of deck sheet shall be insulated by calcium silicate blocks/pourable/castable refractory only. Alternately, outer casing shall be provided over upper deck sheet insulation. 10) Testing and Guarantee for insulation: 1. All tests, as per the applicable material standards and as specified shall be carried out in accordance with the methods prescribed. Employer shall have the right to witness any or all of the tests conducted by the contractor at the shop or laboratory. 2. The Contractor shall guarantee that if on actual measurement the specified maximum insulation surface temperatures are exceeded, the contractor shall either replace the insulation with a superior material or provide additional insulation thickness at no extra cost.		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI PART-B	Sub-Section -A-13 THERMAL INSULATION	Page 8 of 9

CLAUSE NO.	TECHNICAL REQUIREMENTS		
2.04.00	Refractories		
2.04.01	The refractory material shall comply with relevant Indian Standards. The refractory selected shall ensure perfect sealing, and shall have good thermal cycling properties allowing quick startup/shut down of Steam Generators.		
2.04.02	The refractory material shall (a) Have high bulk density and minimum moisture content, (b) Be capable of withstanding service temperature of 1700 degree Celsius. (c) Be resistant to slagging products due to coal, and to impurities of oil like V₂O₅, Fe₂O₃, K₂O₂, Na₂O etc. and to erosion due to fly ash. (d) Be chemically inactive towards alkalis, iron, silica etc. shall pose no health hazard to working personnel, and shall not have any explosive properties. (e) Have sufficient strength to withstand forces generated in Steam Generator, without any rupture or damage.		
2.04.03	Application of refractory shall be such that: (a) To ensure perfect sealing, easy maintenance, minimum time for application. (b) To ensure minimum number of joints, all the joints to be filled and tightly packed with loose powder of same material. (c) Selection of Refractory shall consider the applied stress, stress distribution and expansion allowance. (d) Refractories shall have good thermal cycling properties to ensure quick start up and shut down of Steam Generators.		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI PART-B	Sub-Section -A-13 THERMAL INSULATION
			Page 9 of 9



SUB-SECTION-A-14

WATER TREATMENT PLANT

**SINGARENI THERMAL POWER PROJECT
STAGE-II (1X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC NO.:CW-CM-11159-C-O-M-001**

CLAUSE NO.	TECHNICAL REQUIREMENTS			
				
	WATER TREATMENT PLANT			
1.00.00	General	This Chapter describes the system description, minimum Technical Requirements of the Water Treatment plant and associated equipment. The minimum technical requirements for plant and equipment shall include, but not be limited to the following:		
1.01.00	System description	1) The Pre-treatment plant would be designed to remove suspended/colloidal matter in the raw water. Pre-treatment plant shall be provided for Circulating water system (PT-CW System). The plant shall consist of clarifiers for PT-CW system. The clarified water shall be used as make-up to CW system either by pumping or by gravity. Clarified water makeup shall be used for various systems like Air conditioning & ventilation system, FGD system, Service water etc. and any other system as envisaged by the bidder in design. CW blow down water shall be used for Ash handling system, FGD system and any other system as envisaged by the bidder in design. Service water provision for CHP dust suppression system shall also be kept. Filtered water from Existing Gravity Filters shall be used in DM plant. The filtered water shall be used in DM plant to produce demineralized water of specified quality. A common chemical house shall be provided to store chemicals, dosing equipment etc. Chemical house and Filter house shall be RCC buildings. 2) CW Chlorination system (Chlorinator-evaporator sets) and PT Chlorination system (Chlorinator sets) are envisaged near CW pump house. The Chlorination systems shall be provided with chlorine ton containers, instrumentation, Chlorine leak detectors etc. Complete chlorination plants shall be located indoor. Chlorine leak absorption system as plant emergency measure shall be provided for the Chlorination plants to neutralize chlorine leakage from the plant. Chlorination Building shall be a RCC construction. 3) The contractor shall provide Ion exchange-based DM plant. The capacity of DM plant shall be sized to meet the makeup water requirement of the steam cycle, make up water to close circuit equipment cooling water (ECW) system, stator water cooling system etc. and any other requirements as envisaged by the Contractor. DM Plant shall be kept under steel shed open from side. Existing DM plant regeneration shall be used for the new DM stream also. Pump houses shall be envisaged under steel shed unless otherwise specified. 4) Wastewater Treatment System & ZLD: An effluent management scheme for the plant consisting of collection, treatment, maximum recycle & reuse shall be adopted by the contractor to optimize the make-up water requirement and minimizing various plant effluent water, and for meeting and maintaining the Zero-liquid discharge (ZLD) of the plant. The contractor shall provide a detailed scheme and write-up for the Zero liquid discharge to be envisaged for the plant during detailed engg. The minimum technical requirements shall include, but not be limited to the following: a) Treating the service water effluents from various plant areas in ETP and treated service water from Treated Water Tank/CMB used for recycling/re-use in plant. The effluent waste from DM Plant etc. to be neutralized and pumped to Ash slurry sump/tank.(as per requirement and capacity of existing N-pit). Power cycle blow down shall be recycled to condenser with provision for recycling the same to the CW system with suitable quenching arrangement. b) Coal laden water in the plant shall be treated in settling ponds and decanted water recycled/reused in Coal handling plant suitably. Coal settling ponds and treatment plant shall be designed suitably to receive and treat excess storm water mixed with coal laden water and supernatant water recycled to CW channel, with provision for diverting the treated supernatant water to storm water		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTIONA - 14 WATERTREATMENT PLANT	PAGE 1 OF 33

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	drain & Waste service water to be treated in ETP. Lime, alum, and suitable synthetic flocculent dosing to be envisaged to increase the settling rate of suspended solids. The pH of treated supernatant water is expected to be acidic in nature (pH: 2.8-7.8) and required to be neutralized prior to discharge in CW channel, storm water drain & ETP with required lime dosing facilities. The clarifier sludge shall be dewatered using the Filter press for dried coal particles to be reused. c) Waste water from Existing stage-I AVGF and CMB alongwith Excess CW blowdown, storm water (in rainy season), excess service water shall be treated in LET plant. Minimum requirements of the Employer, and the equipment, and systems for the ZLD system are specified in various parts of the specification, which shall in no way relieve the Contractor of his responsibilities to meet all ZLD compliance of the plant.			
2.00.00	General design requirement of PT systems 1) The hydraulic circuit of the complete Pre-treatment plant shall be designed in such a way that Water from aerator shall flow by gravity up to the clarified water storage tank (for PT-CW) under various flow rates up to maximum flow. The system shall be designed with Top water level in the Clarified water storage tank as (+) 4.5 M from the FGL or higher. Maximum water level in the filtered water reservoirs shall not exceed the local FGL. Hydraulics of the Complete PT system shall be designed to take an occasional over loading of 20% over the design flow. 2) All the clarifiers shall be designed to operate simultaneously. PT plant shall be designed such that following units can be bypassed if required a) Any one clarifier/two clarifiers/all clarifiers of PT-CW system b) Existing Clarifier PT-DM system c) Interconnection of Clarifiers of various system(s). 3) Pre-treatment Plant should be designed to run continuously. 4) The various units of PT plant like Aerator, Stilling chambers, Clarifiers, inlet channels, Chemical house first floor, Gravity filter operating floor, Clarified water tank etc. shall be interconnected by at least 1 M wide walkway at appropriate elevations with hand-railing on both sides and pathway at ground level as required by Employer. 5) Raw water temperature varies seasonally from 10 deg C to 36 deg C. 6) Cascade aerators shall be designed based on the surface flow rate of not less than 0.03 m²/m³/hr. The velocity of water rise through the stilling chamber shall be 0.05 m/sec and volume of stilling chamber shall have a retention time of 1 minute. 7) The Chemical unloading pumps area shall be provided with a kerb wall and the kerbed area shall also be provided with Acid proof lining. Suitable dyke wall/barrier shall also be given in between chemical tanks to avoid any kind of mixing.			
2.01.00	Reactor Clarifier unit 1) The unit shall be designed with a minimum retention time of 90 minutes in the settling zone. Larger retention time may be provided to meet the equipment guarantee. 2) The overall area of the unit shall be based on an average flow velocity not more than 3 m³/m²/hr. Weir loading shall not exceed 300 m³/m/day. For uniform overflow over weirs, triangular notches (saw tooth weir) shall be provided as necessary. 3) Clear width of the bridge shall not be less than 1200 mm. All the Reactor Clarifiers shall be equipped with full bridge. 4) Design of the sludge removal system should be such as to reduce loss of water during sludge blow off within 3% of rated flow.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTIONA - 14 WATERTREATMENT PLANT	PAGE 2 OF 33

CLAUSE NO.	TECHNICAL REQUIREMENTS							
2.02.00	5) The clarifier periphery (all around) shall have sufficient width (minimum 850 mm) to have an easy walkway for general inspection. The walkway shall be provided with handrails along with periphery access (staircase) at least from two (2) locations with platforms and hand railing for the clarifiers for good approach. Permanent ladder shall also be provided (not rungs) for approaching the sludge pipeline valves for maintenance.							
	6) The sludge valves shall be operatable from the top of the sludge chamber through head stock and extended spindle arrangement.							
	Chemical House							
	1) The storage rooms shall have suitable bins/partitions sufficiently large to accommodate for lime and alum. The chemical house shall have sufficient unloading space, wide corridors for movement of chemicals, office, toilet etc. as required.							
	2) In the first floor of chemical house, all chemical preparation tanks and dosing equipment shall be located. Suitable staircases, walkways, platforms etc. shall be provided to have clear access to different units.							
	3) Quick lime (purity of 75% CaO) shall be dissolved in the slaking tanks and the resultant slurry (about 10% W/V) from the slaking tanks shall be transferred to the lime solution preparation tanks by the lime slurry transfer pumps. The lime solution dosing system shall be of re-circulating type.							
	4) Alum solution preparation tanks and dosing equipment shall be sized for a continuous alum dosage of 70 ppm considering the clarifiers to be operating at the maximum capacity.							
	5) Operating platforms shall be provided for all the structures such as Aerators, Stilling chambers, Clarifiers, Sludge chamber etc. along with step ladders and hand railings. All the sumps, tanks, reservoirs, and other water retaining structures shall be provided with approach ladders (i.e. step ladders with hand railing) from operating platforms/ground level.							
	6) All the metallic parts of equipment of Pre-treatment plant (PT) and effluent treatment plant (ETP) which are embedded in concrete or in contact with water shall be painted with three coats of bitumastic heavy duty paint over a coat of primer to prevent corrosion unless otherwise specified and total thickness shall be 400 microns.							
	7) All the other parts of the PT Plant and ETP shall be painted with one coat of primer and three coats of chlorinated rubber paint and total thickness shall be 200 microns. The concrete parts encountering water shall be painted with three (3) coats of bitumastic heavy-duty paint of 400 microns thick.							
8) All the tanks shall be provided with vent, overflow, drain and sample connections. Effective capacity for chemical tanks & water retaining structures/ tanks/sumps means the capacity between the bottoms of the overflow nozzle to the top of the outlet nozzle. Outlet nozzle center line shall be kept at least 200 mm from the Invert Level of the Chemical tanks /Water retaining structures /Tanks/Sumps. A minimum free board of 300 mm shall be provided in all the water retaining structures of Pre-treatment plant and Effluent treatment plant above the maximum water level at design flow condition/overflow level.								
9) Maximum operating speed of all the pumps shall be limited to 1500 rpm or less unless specified otherwise.								
10) Various equipment in the PT Plant will be sized for the following minimum Chemical Dosing Requirements:								
	<table><tr><td>a)</td><td>Alum</td><td>70 mg/litre on 100% basis</td></tr><tr><td>b)</td><td>Lime</td><td>30 mg/litre on 100% basis</td></tr></table>	a)	Alum	70 mg/litre on 100% basis	b)	Lime	30 mg/litre on 100% basis	
a)	Alum	70 mg/litre on 100% basis						
b)	Lime	30 mg/litre on 100% basis						
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTIONA - 14 WATERTREATMENT PLANT PAGE 3 OF 33						

CLAUSE NO.	TECHNICAL REQUIREMENTS												
	11) For all pumps, while calculating the pump head, 10% margin shall be considered on friction losses. 12) The maximum support length in meters for MS pipe shall be as follows <table><tr><td>a)</td><td>Pipe dia (mm)</td><td>1200</td><td>1000</td><td>800</td></tr><tr><td>b)</td><td>Span (meters)</td><td>12</td><td>10</td><td>10</td></tr></table> For pipe sizes less than 800 NB, span shall be provided as per ANSI B31.1	a)	Pipe dia (mm)	1200	1000	800	b)	Span (meters)	12	10	10		
a)	Pipe dia (mm)	1200	1000	800									
b)	Span (meters)	12	10	10									
3.00.00	Other design and construction features												
3.01.00	Aerator & Stilling Chamber												
	The aerator shall be of stepped design and shall allow water to flow downward after spreading over inclined thin sheets and the turbulence is secured by allowing the water to pass through a series of steps and baffles. The chlorine dosing shall be done in the stilling chamber before and after aerator by using diffusers of proven design.												
3.02.00	Clarifiers												
3.02.01	The clarifier shall be solid contact reactor type with integral variable speed impeller/ turbine to internally re-circulate water and sludge at adjustable rate to produce consistent water quality at varying hydraulic load and turbidity.												
3.02.02	The Clarifiers shall be provided with following features: 1) The sludge blanket shall be suspended and maintained in the lower portion. The clarifier unit shall be circular, central feed type with concentric recirculation zone (rapid mixing), reaction zone (slow mixing) and clarification zone in RCC construction. Clarifiers shall be provided with radial launders. 2) Bridge type rake arm and suitable equipment such as turbine/ impeller shall be provided for internal sludge recirculation. 3) The design of the turbine/impeller shall be such as not to break the flocs during recirculation. 4) Suitable mechanism for varying the recirculation rate shall also be provided such that the reactor clarifier shall be capable of operating at varying hydraulic load and turbidity with consistent effluent quality. 5) The bottom of clarifier shall be sloped towards the center and mechanically driven sludge scraper and collector shall be used to remove the settled sludge down the sloping bottom to the central sludge area. Rubber squeezer pads shall be provided on sludge scraper and skimmer. 6) Sludge removal system design shall consist of central sludge area with rotating pickets and back flush arrangement for proper control of sludge accumulation at the bottom. Suitable scum collecting arrangement shall be provided in the clarifying section for removal of floating debris, foam etc. if possible. The scraper shall consist of blades which are inclined to the radius in the opposite direction to that of the floor scraper. 7) The rake bridge and agitators shall be constructed of structural steel and suitably braced to provide rigidity. 8) Sludge blow off shall be affected by the static head of water in the clarifier unit. Main sludge disposal line, which includes a blow-off valve, shall drain sludge to the sludge disposal pump sump. This is an intermittent operation. Continuous sludge disposal line												
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTIONA - 14 WATERTREATMENT PLANT	PAGE 4 OF 33									

CLAUSE NO.	TECHNICAL REQUIREMENTS												
3.03.00	consists of telescopic standpipe, the top of which is maintained at a desired elevation to ensure trickle flow of water or sludge water mixture to the sludge sump. 9) Suitable sampling connections from the various levels and zones of clarifier and at the outlet shall be provided for performance monitoring. 10) Each of the clarifier shall be provided with a gate at the outlet for isolation of any of the clarifier for maintenance.												
	Overflow & drain disposal system The overflow & drains from the various chemical tanks and floor wash drains shall be led to the PT Plant clarifier sludge sump. The overflow & drains from structures and piping handling clear raw water, clarified water and filtered water in the Pre-treatment plant such as Stilling chamber, Inlet chamber shall be led to the filter backwash sump. The overflow & drains from the filtered water reservoir, filtered water sump etc. shall be led to the filter backwash sump. Overflow from filtered water overhead tank shall be led to the inlet channel of Gravity Filters of PT-DM. Concrete sewerage pipe/Hume pipe shall not be used for any of the drain disposal system.												
	PT Plant Clarifier sludge disposal system One (1) number sludge pit, in twin sections shall be provided to collect the sludge from all the clarifiers/tube settlers/lamella periodically. The sludge shall be transferred to the ash slurry tank/sump by means of sludge transfer pumps. Each section of the pit shall be provided with agitation by recirculation (jetting nozzles) system and air agitation system. Two (2) numbers air blowers shall be used for the air agitation system of the sludge pit.												
	Clarified Water/Other Storage Tanks The water tank shall be provided with access rungs and dewatering pits.												
3.04.00	Waste Service Water Treatment System Hydraulics of the plant shall be such as to take an occasional overloading of 20% of the design flow rate.												
3.05.00	a) Design Conditions for tube settlers/lamella clarifiers: <table><thead><tr><th></th><th><u>Inlet quality</u></th><th><u>Outlet quality</u></th></tr></thead><tbody><tr><td>i)</td><td>Turbidity 500 NTU (max)</td><td>10 NTU (max)</td></tr><tr><td>ii)</td><td>Oil content 50 ppm (max)</td><td>5 ppm (max)</td></tr></tbody></table>					<u>Inlet quality</u>	<u>Outlet quality</u>	i)	Turbidity 500 NTU (max)	10 NTU (max)	ii)	Oil content 50 ppm (max)	5 ppm (max)
	<u>Inlet quality</u>	<u>Outlet quality</u>											
i)	Turbidity 500 NTU (max)	10 NTU (max)											
ii)	Oil content 50 ppm (max)	5 ppm (max)											
3.06.00	b) Wastewater collection Sump & Pumping scheme 1) Service water effluents (after floor washing etc.), other plant effluents etc. having high-suspended solids require treatment for removal of total suspended solids (TSS). 2) The minimum technical requirements for waste service water system (WSWS) shall include, but not be limited to: a) Collection sump(s) in different areas/clusters, b) Waste service water sump (WSWS) c) Tube settlers/Lamella clarifiers (2x100%) d) Oil skimmer (2x100%) Oil centrifuge (2x100%) e) Pumps, (n+1) f) Chemical storage, handling, and dosing equipment etc. 3) The treated water shall be reused/recycled suitably in plant like in service water etc. A Waste service water sump (WSWS) shall be provided for collection of service water effluents from various areas/clusters. Waste service water transfer pumps shall be installed in WSWS to pump waste service water to Tube settlers/Lamella clarifiers.												
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTIONA - 14 WATERTREATMENT PLANT									
PAGE 5 OF 33													

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	4) Chemical dosing (Alum & lime) shall be provided for these Tube settlers/Lamella clarifiers in the chemical house. 5) The treated water form Tube settlers/Lamella clarifiers shall be led to Treated water tank/Central monitoring basin (CMB) of twin sections of RCC construction. Provision for diverting clarified water to service water tank shall be provided. Capacity of each section shall be suitable for storing 60 minutes of discharge from one Tube settler/lamella clarifier. Service water transfer pumps shall be provided for plant service water network etc. 6) Oil skimmer(s) shall be provided in the waste service water sump so that oil impurities floating on the sump is skimmed and collected in a tank located over ground. Facility shall be provided to collect free oil to a MS oil drums of 200 liters capacity. Trolley mounted oil centrifuge of suitable capacity shall be provided to collect and purify the oil of the Waste Service Water System. c) Tube Settler/Lamella Clarifier 1) The tube settler/Lamella Clarifier (counter flow or cross flow type) with flash mixer and Flocculation Chamber at its upstream (all RCC), with minimum 1-minute storage for flash mixer and 10-minute storage for flocculation chamber at the design flow rate. Design of the sludge removal system should be such as to reduce loss of water during sludge blow off within 5% of rated flow. Design flow velocity shall be not more than 5 m³/hr/m². Minimum side water depth of the unit is 4 M. 2) The cross-sectional area of each tube shall be such that the effective hydraulic diameter is 60 mm (min). The material of tube pack shall be UV inhibited virgin PVC. In case of plate type separator, the plates shall be made of GRP (glass reinforced plastic). The resin for the manufacturing of GRP plates shall be orthophthallic type. 3) The length of the tubes/plates through which the water flow shall not be less than 1.5 m, the tubes/plates shall be inclined by 50-80 deg. angle to the horizontal. 4) Sludge removal system shall be designed to thicken the sludge to minimum 2% consistency before disposing from separator bottom, angle of inclination of sludge hopper shall be minimum 55° to horizontal plane. 5) Walkway (bridge) and platform to approach all the internals shall be provided. Clear width of the bridge shall not be less than 1200 mm. Suitable walkway around periphery of tube settler/clarifier with hand-railing, access ladder with platform, hand railing to be provided. Suitable water jet arrangement shall be provided. All the pipelines carrying the sludge shall be provided with flushing connection. Separate pumps and piping shall be provided.		
3.07.00	Coal Handling Plant Run-Off Water Treatment System 1) The settling ponds shall be designed to take care of flow conditions which may occur during the rainstorm. Interconnection shall be provided between the ponds such that flexibility of selecting any pond remains. 2) The exit for run-off water from the settling pond shall be such that the short-circuiting of water is avoided. For this purpose, water shall be allowed to traverse under a breast wall located about 5 meters ahead of outlet side of the pond. 3) Runoff water from coal slurry settling pond would be led to a sump and pumped (2x100%) for re-use in Coal handling plant and as well as treated in clarifier (1x100%) for recycle/reuse in CW system. Provision for diverting treated supernatant water to storm water drain & WWSWS with pumps (2x100%) and isolating valves in the lines. 4) Adequate steps/stairs to be provided in coal settling pond for manual cleaning of pond.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTIONA - 14 WATERTREATMENT PLANT	PAGE 6 OF 33

CLAUSE NO.	TECHNICAL REQUIREMENTS	
4.00.00	Demineralisation plant (DM plant)	
	The minimum technical requirements equipment shall include, but not be limited to the following:	
4.01.00	General requirement 1) All the vessel internals of activated carbon filters, ion-exchanges units, and degasser units such as inlet distributor, regenerant distributor, under drain system etc. shall be of proven design. 2) All valves used with vessels shall be suitably arranged in the front in accessible position, for manual operation in case of emergency. The valves under automatic operation of DM Plant shall be operated pneumatically by diaphragm actuator. 3) All dematerializing streams shall be designed to run continuously at its rated capacity and simultaneously under parallel operations. 4) Suitable permanent flushing connections shall be provided for all pipelines carrying acid and alkali. 5) The pipelines which are immersed inside the drain trench or in Neutralization pits shall be rubber lined to a height of at least 600 mm from the maximum liquid level apart from internal rubber lining. 6) All the external parts of equipment of complete DM Plant shall be painted chlorinated rubber paint unless specified otherwise. 7) The unloading pumps area shall be provided with a kerb wall and the kerbed area shall also be provided with Acid proof lining. Suitable dyke wall/barrier shall also be given in between chemical tanks to avoid any kind of mixing. 8) Suitable sampling points shall be provided for ACF, all Ion exchange units of DM plant.	
5.00.00	Design and construction features	
5.01.00	Activated Carbon Filters (ACF) 1) Design and Fabrication of the vessel should be according to subsection titled "Pressure & Storage vessel" of Part-B of this Technical Specification. 2) The activated carbon shall be of good quality suitable for removal of odor, chlorine, and dissolved organic substances. 3) Suitable (at least 75%) free board shall be provided over the filtering medium below the backwash outlet nozzle and in straight portion of vessel to facilitate backwashing. 4) The inlet distribution (preferably header-lateral type) and under drain collecting system (header-lateral/strainer-on-plate) shall be so designed as to give uniform distribution and flow without channeling and obstruction.	
5.02.00	Ion Exchange Units 1) Design and Fabrication of the vessels should be according subsection titled "Pressure & Storage vessel" of Part-B of this Technical Specification. 2) Under drainage system shall be header lateral or strainer-on-plate type. The inlet distribution system shall preferably be header lateral type. Material of construction shall be mild steel with rubber lining (MSRL) and rubber covered (RC).	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTIONA - 14 WATERTREATMENT PLANT
PAGE 7 OF 33		

CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.02.01	3) The regenerant distributor and middle collector shall be mild steel rubber lined inside and rubber covered outside. All internal studs /nuts/washers shall be of AISI 304 L for alkali service and of suitable MOC for acid service. 4) At least 100% free board shall be provided over resin bed below the backwash outlet nozzle and in straight portion of vessel to allow for expansion during backwashing and for addition of extra resin, if required. 5) All the Ion Exchangers shall be provided with two additional nozzles for hydraulic transfer of resin as and when necessity arises. The nozzle shall be provided with manual valves of 100 mm NB. 6) Each exchanger unit shall be provided with resin traps on treated water outlet line. Resin traps shall also be provided both on the backwash and regenerant outlet lines. Flow measuring instrument shall also be provided at the regenerate outlet of preceding unit in case of thorough fare regeneration.			
	Surface Flow Rate for Ion –exchangers 1) The following shall be maximum surface flow rates for the various Ion-Exchangers at the design capacity. i) Cation unit – 35 m³/hr/m² (for both weak and strong Cation) ii) Anion unit – 35 m³ hr m² (for both weak and strong Anion) iii) Mixed bed unit – 40 m³/hr/m². 2) In case of both weak and strong Ion-exchange units (for Cation and/or Anion unit), the surface flow rate for the strong ion exchange unit(s) only may be increased as indicated below, in case the bidder/its sub-vendor has adequate experience of designing Demineralisation plants of such higher surface flow rate: Maximum surface flow rate: - i)Strong Cation unit – 40m³/hr/m². ii)Strong Anion unit – 40 m³/hr/m².			
	5.03.00 Regeneration System Existing regeneration system in stage-I units shall be used for regeneration of stage-II ion exchange resins also. Necessary interconnection to be provided by the bidder. DM stream to be designed considering existing Regeneration system.			
5.05.00	Exchange Resin 1) Cation and anion resin shall be of reputed make and proven type and must have been in use in demineralising plants capable of producing water of quality as specified or better, for a period of not less than three (3) years. 2) Cation and anion resin charge shall consist of material properly selected washed, processed and graded to provide the guaranteed capacity and life and shall have adequate abrasion resistance during its guaranteed life. 3) The cation exchanger resin used in the strong cation unit and mixed bed exchanger shall be strongly acidic, high capacity polystyrene resin in the bead form. 4) The anion exchanger resin used in strong anion unit & mixed bed shall be strongly basic, high capacity resin (Type-I) in bead form to the satisfaction of the Engineer. The anion resin shall be able to withstand a temperature of 60 deg. C (minimum) continuously. Type-II anion resin shall not be accepted. Strong Base Anion resin (or weak base Anion in case of hookup) shall be MACROPOROUS type only.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTIONA - 14 WATERTREATMENT PLANT
PAGE 8 OF 33				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.06.00 5.07.00 5.08.00 5.09.00 5.09.01 6.00.00	5) Each stream shall be provided with independent headers from the outlet of Activated carbon filters. However, suitable inter-connecting lines, valves shall be provided at outlet/inlet of each unit to facilitate the changeover. 6) Bidder shall design the DM water chains in such a way that any chain can be regenerated without the necessity of other chain being put into operation. Degasser System Degasser tower shall be designed to reduce dissolved CO₂ in treated water to the level as indicated in the guarantees. Blowers shall be provided to remove CO₂ from water. Each tower shall be provided with a storage tank to store degassed water. Polishing UF Commercially proven hollow-fiber, high volume pressurized type UF membranes of Polysulfone, Poly Vinylidene Di Fluoride (PVDF) with spiral glass outer wraps shall be supplied. Gross maximum design flux rate shall not be more than 60 l/m²/h. Filtration direction may be either Out-to-In or In-to-Out. Minimum design UF recovery shall be at least 92% of the influent with a colloidal silica rejection of not less than 99.5%. Maximum Membrane pore size shall be 10000 Dalton MWCO (Molecular weight cut off). Safety and Protection Automatic safety shower units consisting drench shower and eye bath shall be provided near regeneration area & chemical storage area to provide adequate spray of water to protect operating personnel against any chemical hazard. The shower shall receive supply of water from the filtered water system and will be actuated by standing on platform beneath the showers through mechanical linkage. Wastewater Neutralizing Arrangement Bidder shall design the demineralising plant in such a way that the regenerant effluent from cation and anion units and from the mixed bed unit are self neutralising. Provision shall however be made to dose acid, alkali, and lime to neutralise the effluent, whenever required. Sump & Trenches of wastewater Wastewater from all vessels namely Activated Carbon Filter, Cation, Anion and Mixed Bed exchangers will be led into individual sumps near each vessel. Bidder shall provide measuring orifice board into the sump. Wastewater after being metered through the orifice board, will be led by gravity into trench, suitably lined and finally to the neutralising pit. The backwash wastewater from Activated Carbon Filters and Rinse wastewater generated during regeneration of the DM stream shall be routed through separate effluent channel (acid/alkali proof tile lined) and shall be terminated in Backwash/ Rinse Wastewater sump. The Backwash/ Rinse Wastewater sump shall be lined with acid/alkali proof tile. The backwash water recycling/reused in Clarifier of Pre-treatment Plant. Control & operation of the DM plant 1) The control & operation of various systems described below is indicative only and the actual control & operation philosophy shall be finalized with during detailed engineering based on which the control logic is to be built by the contractor in DDCMIS. Complete DM Plant operation shall be through mimics on OWS/LVS The sequence startup mode (Automatic, semi-automatic and operator guided mode) shall be provided shall be of the following types			
	SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		
		SUB-SECTIONA - 14 WATERTREATMENT PLANT		
		PAGE 9 OF 33		

CLAUSE NO.	TECHNICAL REQUIREMENTS 				
	2) In case of failure of control system, the DM plant valves shall be operated manually by means of manual operator of solenoid valves (as well as by hand wheel of valves) locally. 3) Acid and alkali unloading pumps, agitators of alkali preparation tanks & day tanks and alkali transfer pumps shall have provisions of local start also. 4) Complete stream shall be isolated automatically from SERVICE in case any of the following take place and an alarm displayed. 5) Differential conductivity of the effluent is less or totalised flow and sodium leakage from the cation is high. Conductivity of the effluent or totalised flows from anion is high. Conductivity or silica content of the effluent or totalised flow from mixed bed is high. 6) The operation of alkali/acid inlet valves at ejectors shall be interlocked with the availability of dilution water in the respective ejectors. 7) Common conductivity meter shall be employed for measuring conductivity in the effluent line and rinse lines for anion and mixed bed exchangers. During rinsing of anion and mixed bed unit, the respective analyzer shall be connected to rinse line automatically, in the end of the rinse cycle. 8) During rinsing of mixed bed unit, the analyzer of silica shall automatically be connected to the stream which is under regeneration to ascertain the completion of rinsing operation. 9) Only one stream shall be regenerated at a time. However, all the streams can be put to service simultaneously. The alkali diluent heater shall be controlled by measuring the temperature of water in the heater. 10) For all the pumps, blowers etc. which form part of the automatic operation, facilities through control system shall be provided for Auto/remote manual/Local mode selection wherever specified. Wherever standby equipment is provided, selection of the same shall be possible from the control system. The selected standby equipment shall start automatically in case of failure of working equipment. For, other drives which are not involved in continuous running or automatic operation, facilities through control system shall be provided for remote/local selection. 6.01.00 Backwash pit and pumping scheme 1) At a specific water level in the sump, selected pump(s) shall start, and backwash wastewater shall be recycled back to the clarifiers. Upon reaching predetermined low level, one of the operating pumps shall be stopped and further reduction in level shall result into stoppage of all the operating pumps. 2) The pit level shall be available to operator and in case of very high level, the operator shall be alerted to avoid starting of backwash/rinse operation so that the pit does not overflow. 6.02.00 Neutralization pit and pumping scheme 1) At a specific water level in the sump, selected pump (s) shall start, and backwash wastewater shall be recycled back to the pit and after achieving desired pH level, the wastewater shall be pumped out to Ash slurry sump. Upon reaching predetermined low level, operating pumps shall be stopped and further reduction in level shall result into stoppage of all the operating pumps. 2) The pit(s) level status shall be available to operator and in case of very high level; the operator shall be alerted to avoid starting of regeneration operation so that the pits do not overflow.				
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; text-align: center;"> TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001 </td> <td style="width: 50%; text-align: center;"> SUB-SECTIONA - 14 WATERTREATMENT PLANT </td> </tr> <tr> <td colspan="2" style="text-align: right;"> PAGE 10 OF 33 </td> </tr> </table>	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTIONA - 14 WATERTREATMENT PLANT	PAGE 10 OF 33	
TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTIONA - 14 WATERTREATMENT PLANT				
PAGE 10 OF 33					

CLAUSE NO.	TECHNICAL REQUIREMENTS			
7.01.00 7.02.00 7.03.00	CHLORINATION PLANT CW & PT CHLORINATION 1) Chlorine dosing (PT-Chlorination) shall be provided at the upstream and downstream of stilling chamber of PT system. For controlling organics in circulating water system, Chlorine dosing (CW-Chlorination) shall be provided. The chlorination plant for CW system shall consist of the following : - Chlorine ton containers and accessories such as isolation valves and safety accessories, and supporting brackets with roller trunnions. - Chlorine manifold consisting of straight lengths of pipe, fittings, isolation valves, automatic shut-off valves, liquid expansion chambers fitted with rupture etc. pressure indicator, temperature indicator, pressure switch, alarms etc. - Electrically heated water bath type evaporator - Strainer in chlorine gas line - Pressure reducing and shut-off valve in chlorine gas line. - Chlorinator with integral pressure regulating valve, flow regulating device, flow indicator complete with sensing element, vacuum regulating valve, pressure-vacuum relief valve, ejector etc. - Chlorinated water diffuser and mixing system. - Power water supply system. - Instrumentation, including chlorine residual analyser, control panels, etc. - Safety and supervisory instruments. - Suitable lifting, handling and weighing devices. - Chlorine (leakage) gas absorption system. The chlorination plant for Pre-treatment Plant shall however have the following minimum system components: - Chlorine ton containers and accessories such as isolation valves and safety accessories, and supporting brackets with roller trunnions. - Chlorine manifold consisting of straight lengths of pipe, fittings, isolation valves, automatic shut-off valves, pressure indicator, temperature indicator, pressure switch, alarms etc. - Chlorine gas withdrawal shall preferably be 100% under vacuum from source i.e. tonner. - The chlorinator shall comprise of major components viz. vacuum regulator, control unit and injector. Pressure reducing valve ahead of vacuum regulator may also be accepted provided it is the manufacturer's standard. - In case of vacuum regulator design it shall be directly mounted on the tonner. The vacuum regulator shall directly reduce the chlorine tonner pressure to a vacuum. In case of pressure reducing valve design, the chlorine gas pressure shall be reduced to an acceptable limit. - The vacuum regulator shall contain a built-in trap and filter for removal of impurities from chlorine gas. In gas of pressure reducing valve design, an external filter for removal of impurities shall be provided. - The control unit shall essentially contain rotameter, control valve and differential regulating valve. The control unit shall be either wall mounted or frame mounted design. - Chlorinated water diffuser and mixing system. - Power water supply system. - Instrumentation, including chlorine residual analyser, control panels, etc. - Safety and supervisory instruments. - Suitable lifting, handling and weighing devices. - Chlorine (leakage) gas absorption system.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTIONA - 14 WATERTREATMENT PLANT	PAGE 11 OF 33	

CLAUSE NO.	TECHNICAL REQUIREMENTS		
8.00.00	DESIGN REQUIREMENT & CONSTRUCTION		
8.01.00	Ton Container & Accessories a) The chlorine ton-containers shall be provided to store chlorine in liquid vapour phase. b) Two (2) numbers of eductor pipes shall be provided, each terminating into an isolating valve of 25mm (nominal) size. Valve shall be as per IS:3224 & BS:341 Part-I. One eductor tube will be used for chlorine gas withdrawal while the other shall deliver liquid chlorine. c) Each chlorine ton-container shall be placed on two (2) nos. metallic brackets, each provided with two (2) roller supports. These brackets will be mounted on civil foundation. d) Each chlorine ton-container shall be placed on the roller supports in such a way that the isolating valves are in vertical line. The upper valve shall deliver gas discharge. The lower valve shall deliver liquid chlorine. e) Each ton container shall be provided with approved colour band for identification of its content as recommended by Indian Explosive act. f) The roller supports shall be of CI frame and SG Iron rollers with bronze bushings. Frame shall be protected with a coat of primer and three coats of chlorinated Rubber paint. Roller, bush, shaft, pins and circlips shall be cadmium plated. g) The chlorine tonner, container and auxiliary ton container valve shall be of approved design by the chief Controller of Explosives or Chlorine institute and each of the item supplied shall be stamped / approved by Chief Controller of Explosives.		
8.02.00	Pressure reducing valve Spring loaded chemically inert diaphragm type pressure regulating valve shall be mounted external to the chlorinator in the chlorine gas supply line. By provision of this pressure regulator, the chlorinator shall be subjected to less gas pressure during operation. All flange sealing should be done by lead gasket.		
8.03.00	Expansion Chamber Expansion chambers shall be provided in all pipelines carrying liquid chlorine which may become stagnant due to closure of isolating valves. The expansion chamber shall be sized for a minimum 20% of the piping volume in which it will be installed. Connection to the chamber shall be through a rupture disc. Suitable pressure switch shall be provided to initiate a high pressure alarm.		
8.04.00	Vacuum Regulating Valve Vacuum regulating valve shall be spring loaded, chemically inert diaphragm type. The valve shall reduce the chlorine gas pressure to vacuum in case of all vacuum chlorination system, this valve shall be designed for direct mounting on the chlorine tonner.		
8.05.00	Evaporator a) Electrically heated constant temperature water bath type evaporator shall be provided to vapourise liquid chlorine into gas from the further feeding into the chlorinator in case of chlorination plant for CW System. The evaporator shall comprise a coil surrounded by water bath heated with electrical immersion heaters. The heaters shall be mounted external to the water bath. However, direct heating may also be acceptable provided if it is the standard practice of the supplier. The heating element shall be 3 phase 415 V, 50 HZ. The chlorine liquid inlet connection can be made at the top or bottom. b) Hot water bath shall be vented to atmosphere. It shall have provision for incorporating the electrical heaters. Minimum water level shall be maintained automatically by a solenoid valve. Drain plug shall be provided for maintenance. Water level indicator and overflow line shall be provided.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTIONA - 14 WATERTREATMENT PLANT
			PAGE 12 OF 33

CLAUSE NO.	TECHNICAL REQUIREMENTS			
8.08.00	Injector The injector shall be made of corrosion resistant material and shall be light in weight. In the injector, pressure water shall create vacuum near the venturi and upto the vacuum regulator valve. Chlorine gas thus transmitted upto the injector under vacuum shall thoroughly be mixed with water. The injector shall be provided with check valve assembly (built in or externally provided as per the manufacturer standard) to prevent injector water from flooding the control unit. A drain relief valve shall be preferred for back-up measure of flooding protection.			
8.09.00	Chlorinated Water diffuser & mixing system a) Chlorinated water should be led from the injector to the point of application via pipeline. b) Diffuser should be constructed of rubber lined perforated steel tubes/HDPE. c) Diffusers should be located in strategic locations so that effective mixing of chlorine solution takes place with water to be treated. All diffusers should be located well below the lowest water level so the these are never exposed to atmosphere. d) All fittings, brackets, etc. to locate the diffusers shall be of rubber lined steel construction.			
8.10.00	Power Water Supply system to Ejector a) Source of water available to meet the requirements of power water supply is identified in the tender drawings. b) Horizontal centrifugal pumps shall be provided to pump water to required pressure to the ejectors of the respective chlorination system. The capacity and head of pumps shall be selected in such way that required vacuum and solution concentration are achieved. Each chlorinator shall have separate pump. c) Supply line to each chlorinator shall be provided with flow control valve and flow indicator for equal distribution of water.			
8.11.00	Piping and Accessories for chlorine duty a) In case of pressure reducing system the chlorine gas pressure pipe connecting the tonner to the valve shall be of annealed copper with cadmium plating. b) Polypropylene or PVC or similar material shall be used for chlorine gas duty operating under vacuum. c) Liquid and gas chlorine line operating in pressure shall be seamless carbon steel schedule 80. No flange joints are allowed in the pressure line. d) Piping handling chlorine shall be as simple as possible with minimum number of screwed joints. Piping shall be well supported and adequately sloped to allow drainage. Low spots shall be avoided. Suitable allowances shall be provided for pipe expansion due to change in temperature. e) For chlorinated water service, rubber line steel shall be used. f) Valves for liquid and gas service on the chlorine supply side of the installation shall be approved design of the Chlorine Institute, USA or BS:5351.			
9.00.00	MATERIAL OF CONSTRUCTION Selection, defect free manufacture of fully chemically inert material for chlorine handling duty shall be the main criterion. Following material of construction of construction is preferred for the chlorination plant. Pressure regulating valve Body : Ebonite, PVC or ABS Internals : Chemically inert material. Strength of the material shall be checked for the duty envisaged. Vacuum regulating valve Body : Ebonite, PVC or ABS Internals : Chemically inert material.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTIONA - 14 WATERTREATMENT PLANT	PAGE 14 OF 33

CLAUSE NO.	TECHNICAL REQUIREMENTS			
10.00.00	Rotameter Body : Borosilicate glass, Pyrex glass Internals : Glass, ceramic kynar with lead insert (if required), monel or hastelloy			
	Control Unit Cabinet Body : PVC, polyster plastic reinforced fibre glass			
	Injector Body : PVC, Ebonite, ABS			
11.00.00 11.01.00	SAFETY & SUPERVISORY EQUIPMENTS			
	a) Gas Masks: Required number of (as mentioned in Data sheets) of gas masks and air breathing equipment shall be installed inside a cabinet at a suitable location of chlorination plants. Each of the equipment shall be provided with face mask, carrying plate, carrying harness, pressure reducing valve, pressure gauge, demand valve with coupling, tool kit, refillable air cylinder (suitable for a duration of forty minutes) etc. The equipment shall be approved Chief Controller of Explosives (india) and as per relevant BIS code and shall have warning signal at low pressure to alert the user. Canister type gas masks are not acceptable. b) Chlorine Leak detectors: i) Leak detectors shall be provided in the chlorination plant. These detectors shall be provided to react quickly to the presence of chlorine in the ambient air in such a way that the sensor responds within two seconds upto 1 ppm by volume. ii) The detector sensors shall consist of an electrode system connected to wall mounted control box. The alarm levels shall be adjustable from the control box on stepless basis from 0-5ppm. Each detector/cell shall accompany with control box which shall incorporate visual (by L.E.D) and audible alarm, indication lamp for power supply, cell/detector failure due to empty electrolyte detector cell dry, cable interruption etc. iii) Each of the cell shall be supplied with electrolyte sufficient for 2 years operation .Complete cabling from cell to control box shall be supplied along with each detector. v) The detector shall be suitable for operation upto the maximum temperature of 50 deg C and enclosure class shall be IP-55. vi) Number of chlorine detectors shall be selected based on the chlorine area to the protected; however it shall not be less than the quantity indicated in the Data Sheets. vii) Repeat audio-visual alarm shall be exhibited from chlorine leak detector in the control panel as required. LIFTING & HANDLING DEVICES Electric monorail hoists of three (3) tonne capacity each shall be provided for the CW system chlorination plant and PT chlorination plant. This shall be supplied complete with load indicator, which shall be suspension type with minimum capacity of 3000 Kg. scale shall have tare adjustment so that amount of chlorine in the ton-container can be read directly. Scale shall also have a crane hook with 360 deg. swivels.			
	CHLORINE LEAK ABSORPTION SYSTEM			
	System Description			
	a) The chlorine leak absorption system for both CW system and PT system shall evacuate leaked chlorine from chlorine tonners/evaporators located in CW chlorination plant, neutralise the same in an absorption tower and release chlorine free air to the atmosphere.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTIONA - 14 WATERTREATMENT PLANT	PAGE 15 OF 33

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	b) The chlorine leak absorption system shall comprise of: i) Split FRP hood-both lower portion of hood & upper portion of hood shall be provided for all the connected tonners as shown in relevant tender drawings. ii) One chlorine sensor shall be provided for a set of two tonner/ three tonners as shown in relevant tender drawings and the same shall sense the leakage of chlorine through the detector associated with the sensor. iii) Outlet hose/pipe with isolation dampers from the lower portions of the hoods connected to the absorption tower through FRP ducting. Provision for sucking leaked chlorine gas from evaporator rooms through an FRP duct (Suction piece) to the above mentioned FRP ducting. iv) Absorption tower, with caustic solution tank of capacity as mentioned in Data Sheets, made of FRP, with manhole, caustic solution inlet, water supply inlet, drains, caustic solution outlet, caustic recirculation inlet, chlorine gas inlet, air outlet, etc. v) Outlet air duct of FRP construction from the absorption tower to blowers. The leak absorption system for CW and PT chlorination systems is shown in the tender drawings.			
11.02.00	System Operation and Control Philosophy			
11.02.01	For CW System In the event of leakage in chlorine tonner, the chlorine leak sensor shall sense the leakage and start the absorbent recirculation pump, blower and open the motorised damper at blower inlet alongwith audiovisual alarms. In case of chlorine leakage in adjoining areas, such as chlorinator/evaporator rooms etc, the detectors provided in these areas shall sense the leak and give audio-visual alarms. The blower and pump shall then be started and the damper at blower shall be opened automatically. Essentially, the whole absorption unit shall be under vacuum as soon as the blowers are under operation. The absorbent recirculation pumps, however, are interlocked with a low level switch in the caustic solution tank and will not start if the level of absorbent is low. In that case, the level switch will give an alarm. The leaked chlorine gas is brought to the absorption tower. In the absorption tower, leaked chlorine shall meet counter currently the caustic soda solution. The chlorine gas shall be neutralised in the tower and chlorine free air shall be released to the atmosphere.			
11.02.02	For PT System (if separate leak absorption system is envisaged) The operation is similar to the description given above for CW System except that the leaked chlorine gas shall be led to Caustic Solution through diffusers.			
11.03.00	Design Basis All the equipment in the system shall be sized for absorption of one (1) tonner of chlorine liquid leaking out from a tonner within one hour. Blower capacity shall be selected considering passing of air through the gap between the hood and tonner and as well opening size of suction piece in other rooms. As all the connected tonners and suction pipe are interconnected to a single FRP ducting, entry of air through all such openings shall be considered for design calculation of capacity of Blowers.			
11.04.00	The major requirements of the leak-absorption system for CW system and PT system chlorination plant shall consist of the following: a) Split type FRP hoods : b) Chlorine leak sensors for all the chlorine ton containers as shown in tender drawings and in other areas as mentioned in Data sheets. c) 2x100% capacity, blowers with drive motors including couplings, basedplates, anchor bolts etc. and drive accessories. d) One (1) number, absorption tower with PVC packing (rasching rings) and ducting. e) One (1) number, 6 Cu M capacity (minimum) caustic solution tank.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTIONA - 14 WATERTREATMENT PLANT	PAGE 16 OF 33

CLAUSE NO.	TECHNICAL REQUIREMENTS				
11.05.00	f) 2x100%, absorbent circulating pumps with drive motors including couplings, base-plates, anchor bolts etc and drive accessories. g) Interconnecting FRP ducting, piping, fittings, valves, isolation dampers and specialties. h) Supports, brackets, clamps, bolts for complete ducting, piping, fittings, valves etc under bidder's scope. i) All drain pipes with valves from all equipment, piping upto the nearest drainage system. j) Instrumentation as necessary for safe, efficient operation of the plant. k) Multipoint gas detector unit(s) with requisite number of sensor modules in control unit. The major requirements of the leak-absorption system for PT system (if separately identified in the tender drawing) chlorination plant shall consist of the following: a) Split type FRP hoods b) Chlorine leak sensors/detectors for all the chlorine ton containers as shown in tender drawing and in other areas as mentioned in Data sheets. c) Blowers, along with required piping, fittings, valves, isolation dampers and specialties as shown in the tender drawing. . d) Interconnecting FRP ducting upto diffusers in the Caustic solution tank e) One (1) number, 6 Cu M capacity (minimum) caustic solution tank. Supports, brackets, clamps, bolts for complete ducting, piping, fittings, valves etc g) All drain pipes with valves from all equipment, piping upto the Owner's nearest drainage system,. h) Instrumentation as necessary for safe, efficient operation of the plant.				
12.00.00	INSTALLATION a) Chlorine pipe lines joints shall be flanged or welded. If threaded joints are required, extreme care shall be taken to obtain clean sharp thread, two or three cuts may be necessary to produce the desired perfect thread. Cut pipe shall be reamed after threading and the threads shall be washed with trichlorethylene to remove cutting oils. Linseed oil and white lead is recommended a pipe dope. For permanent joints, Teflon tapes shall be used. All remanats must be removed before joints are remade wherever teflon tape is used. b) During erection, cutting oil grease and other foreign materials inside pipe lengths and fittings shall be removed. New valves or other equipment received jn an oily condition shall be dismantled and cleaned before use. c) Chlorine pipeline and valves after installation shall be hydraulically tested at 40 Kg/cm2 (g) for leak tightness or tested with nitrogen or dry air to a pressure of 25 Kg/cm2 (g). d) Drying of pipe line & valves shall be done by passing steam though lines from the high end allowing condensate and foreign matter to drain out. Steaming shall be continued until the pipeline is thoroughly heated and no further debris blown out. Steam supply shall then the disconnected and the pipeline is dried by passing air [dew point (-) 40 deg. C] through the hot pipeline. Steam or nitrogen/air shall not be made available by Employer. e) After drying, the system shall be filled with dry air at 10 Kg/cm2 (g) and tested for leaks by application of soap water on the outside of joints. Small quantities of chlorine gas shall then the introduced in the pipe line, test pressure built up with air and tested for chlorine leakage. f) Vent from each chlorinators shall be carried to the outside atmosphere without manifolding and traps to safe area. The vents of the chlorine pressure reducing valve and steam vapour vents of vaporator shall be manifolded to be taken outside the building.				
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTIONA - 14 WATERTREATMENT PLANT	PAGE 17 OF 33	

CLAUSE NO.	TECHNICAL REQUIREMENTS			
28.00.00	CHEMICAL STORAGE & DOSING SYSTEM a) Chemical tank which is proposed to be used for storage, preparation and supply of chemicals at any instant shall be selectable through control system. b) Unloading operation for Acid, Ferric chloride and Alkali transfer pump from tankers shall be done manually through local start/stop push buttons near the pumps. Operator shall supervise unloading and transfer operation by manually adjusting the valves. Preparation, mixing and transfer of alkali from flakes to bulk storage tanks shall be manual by local/start operation of agitators & respective pumps c) Transfer operation of Acid, Alkali and Ferric chloride from bulk shall be possible automatically operated through control system and as well as manually local start/stop push buttons near the pumps. d) Mixing tanks agitators for the Alkali and Coagulant shall be automatically started and stopped (after set duration) through control system or manually through local start/stop push buttons. Mixing tank agitators for the Anti scalant, Anti oxidant and coagulant aid shall be started using the local push button station for solution preparation and shall be stopped using a timer & dilution water to fill up the tank shall be manual. e) All metering pumps shall have an electronic stroke positioner and controller with a minimum 10:1 range, with a micrometer indicator reading from 0 to 100% and zero stroke – zero signal cut-off switch. Stroke positioner shall signal from the remote process controller for adjusting the positioner setting. Stroke positioner shall be equipped with a “no flow” or “zero stroke” auxiliary contact for external control. Stroke controllers shall have a power on/off switch, auto/manual signal select switch, dosage set point scaling potentiometer, manual dosage set point toggle switch, and input signal/stroke length indication meter and selector switch. The stroke controller shall be mounted in the control panel. Diaphragm failure detector shall be used to signal the metering pump diaphragm failure. f) The metering pumps are controlled from the following control programs / interlocks:- 1) Coagulant and coagulant aid dosing pumps shall be started and stopped by the pre-treatment program and the feed adjustment shall be made in control system through pumps stroke controller, depending feed flow to clarifiers. 2) Acid and alkali dosing pumps for pH Control shall be started and stopped by the RO plant program and the feed adjustment shall be stroke controller, by the pH control program. 3) Anti-scalant and anti-Oxidant dosing pumps shall be started and stopped by the RO plant program and the feed adjustment shall be through stroke controller, depending on the number of RO streams operating and the RO feed rate. 4) Acid and Alkali dosing pumps of regeneration system of MB ion exchanger units and associated opening & closing dilution water valves shall be started / stopped by the regeneration sequence logic.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION A - 14 WATERTREATMENT PLANT	PAGE 19 OF 33	

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	5) In addition to the remote controlling facility, all the metering pumps shall be provided with local start / stop facility. Option for local / remote control shall be selected through OWS of the control system g) As mentioned in general control philosophy, all the pump operation shall be interlocked with the level in the tanks from which chemical is drawn or level of the tanks to which the chemicals are transferred or unloaded as the case may be. Operation of standby pump(s), upon tripping of working pumps shall be automatic.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTIONA - 14 WATERTREATMENT PLANT
		PAGE 20 OF 33

CLAUSE NO.	TECHNICAL REQUIREMENTS				
29.00.00	DATA SHEETS				
	Pre-treatment plant				
	NO	DESCRIPTION	PT-CW System	Coal Slurry settling System (CSSP)	
	I	Aerator, Stilling chamber and Inlet channel			
	II –A)	Aerator/Stilling Chamber	PT-CW System	Coal settling System (CSSP) (Stilling Chamber)	
	1)	Design Flow (min.)	2100m³/hr.+ 3% for sludge	1300 m³/hr + 3% for sludge	
	II-	CLARIFIERS			
	1)	Type	----- Circular Reactor type -----		
	2)	Design Flow of each clarifier (Net output) (minimum)	1750 m³/hrx2 nos clarifiers	1300 m³/hr	
	3)	Reaction Turbine	With variable frequency drive as per Manufacturer's Standard		
	4)	Clarifiers Scrappers			
		a) Number	-----One (1) assembly per Clarifier-----		
		b) Material of construction	----- Mild steel with rubber inserts ----- (with bitumastic paint protective coating)		
		c) Drive	Slow speed Motor driven through reduction gear unit or variable frequency drive as per manufacturer's standard		
	30.00.00	Clarified Water Storage Tank /Sludge / Backwash Water Pit/Sump			
I		Clarified Water Storage Tank/Distribution Chamber (Above Ground)			
1)		Effective Capacity (retention time)	Minimum 15 mins.		
III		Sludge pit/sump & pump house (common)			
1)		Number of Sludge pit	One (1) in two (2) sections		
2)		Effective capacity of each section	Not less than 200 Cu.m		
IV		Backwash water Pit/Sump & pump house			
1)		Number of pits	One (1) in two (2) sections		
2)		Effective capacity each section	Not less than 200 Cu.m		
3)		Material of Construction	RCC with Acid alkali proof lining		
31.00.00	Pumps (Vertical/Horizontal/Metering)				
	A. Vertical Sump Pumps				
	NO	Application	Sludge, Wastewater, Back washing		
	1)	Service of duty	----- Continuous, Outdoor -----		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTIONA - 14 WATERTREATMENT PLANT	PAGE 21 OF 33

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	A. Vertical Sump Pumps		
	NO	Application	Sludge, Wastewater, Back washing
	2)	Type of pump	-----Non-clog ----
	3)	Type of Discharge	---- Above Floor discharge -----
	4)	Type of impeller	----- Open -----
		Suction condition	----- Submerged -----
	5)	Minimum Water level	-----By Bidder -----
	6)	Maximum Water level	--- Local Finished Grade level----
	7)	Operating floor level	----Minimum 500 mm above FGL-
	8)	Type of shaft coupling	-----Flexible / Rigid -----
	9)	Material of Construction	
		Suction Bell /Casing	2.5 % Nickel Cast Iron, IS: 210 Grade FG 260; S-0.1% max. P-0.15% max.
		Impeller	ASTM A351 CF8M
		Shaft	----- SS-410 -----
		Column pipe & Discharge pipe	IS:2062 (minimum thickness 8 mm) with 2 coats of epoxy coating inside & outside.
		Shaft enclosing tube (if applicable)	-----do -----
		Bolts & nuts	SS
		Base plate and Soleplate	CS (Minimum 10 mm thick)
	B. Vertical Turbine (Wet pit) Type Pumps		
	NO	Application	Coal Decanted Water
	1)	Service of duty	-----Continuous, Outdoor -----
	2)	Type of pump	Non-pull out type.
	3)	Type of Discharge	-----Above Floor discharge -----
	4)	Type of impeller	-----Closed / Semi-open -----
		Suction condition	-----Submerged -----
	5)	Minimum Water level	----- By Bidder -----
	6)	Maximum Water level	-Local Finished Grade Level (FGL)
	7)	Sump Invert level	----- As per design-----
	8)	Operating floor level	---Minimum 500 mm above FGL ---
	9)	Type of shaft coupling	-----Flexible / Rigid -----
	10)	Material of Construction	
	i)	Suction Bell	2.5%NiCl; IS: 210 Gr. FG 260; S-0.1%& P-0.15% max.
ii)	Casing/Bowl	2.5%NiCl; IS: 210 Gr. FG 260; S-0.1%& P-0.15% max.	
iii)	Impeller	ASTM A 351 CF8M	
iv)	Wearing rings (if applicable)	---As per manufacturer's Std --	
v)	Impeller Shaft, Pump & line shaft	-----SS ASTM A 276 Gr. 410. -----	
vi)	Shaft bearings	As per manufacturer's standard	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTIONA - 14 WATERTREATMENT PLANT
			PAGE 22 OF 33

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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	2)	Material of Construction	RCC	
	3)	Effective Capacity each section (minimum)	250 Cu.m	
	B CHLORINATION PLANT /EQUIPMENT			
	I)	Chlorine Ton Containers	CW– Chlorination	PT-Chlorination
	1)	Number	12	8
	2)	Chlorine capacity in each Ton Containers	----- Not less than 900 Kg -----	
	3)	Mounting arrangement	Chlorine tonner mounted on two numbers of metallic brackets each provided with two (2) roller supports	
	II)	Evaporators (For CW System)		
	1)	Number required	3 Nos.	Not Applicable
	2)	Type	Electrically heated constant temperature water bath type	Not Applicable
	3)	Capacity	120 Kg/hr	Not Applicable
	4)	Material of Construction		
		i) Vaporiser Body	Seamless steel tubes as per ASTM – 106 Gr. B	Not Applicable
		ii) Flanges	IS : 2002 Gr. 'B'	Not Applicable
	5)	Cathodic protection system to protect water bath tank and outside of evaporator	Required	Not Applicable
	6)	Hydraulic Test Pressure for vaporiser	40 Kg / cm ²	Not Applicable
	7)	Electrically interlocked shut off valve at the gas discharge line from evaporator	Required	Not Applicable
	8)	One (1) No Control cubicle containing necessary contactors, fuses, ammeters	Mounted near the evaporator	Not Applicable
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTIONA - 14 WATERTREATMENT PLANT PAGE 25 OF 33

CLAUSE NO.	TECHNICAL REQUIREMENTS 																																																																		
	and other instruments for each evaporator. III) Strainers <table border="0"> <tr> <td>1)</td><td>Number required</td><td>Two (2x100%) for each Chlorinator (1 W+1 S)</td><td>Two (2x100%) for each Chlorinator (1 W+1 S)</td></tr> <tr> <td>2)</td><td>Capacity</td><td>100% each</td><td>100% each</td></tr> </table> IV) Chlorinators <table border="0"> <tr> <td>1)</td><td>Number required</td><td>Three (3) (2 W + 1 S)</td><td>Two (2) 1 W + 1 S)</td></tr> <tr> <td>2)</td><td>Capacity of each Chlorination</td><td>120 Kg/hr</td><td>30 Kg/hr</td></tr> <tr> <td>3)</td><td>Type</td><td colspan="2">----Vacuum operated solution feed type--</td></tr> <tr> <td>4)</td><td>Inlet chlorine pressure reducing valve</td><td>Required</td><td>Required</td></tr> <tr> <td>5)</td><td>Chlorine feed rate adjuster</td><td>Required</td><td>Required</td></tr> <tr> <td>6)</td><td>Automatic pressure vacuum relief valve</td><td>Required</td><td>Required</td></tr> </table> V) Chlorinated Water Diffuser & Mixing System <table border="0"> <tr> <td>1)</td><td>Chlorinated water supply point</td><td>CW pump house fore bay and individual CW pump sumps</td><td>Before aerator, in the stilling chambers</td></tr> <tr> <td>2)</td><td>Location of diffusers</td><td colspan="2">----Well below minimum water level ----</td></tr> <tr> <td>3)</td><td>Material of construction</td><td colspan="2">---Rubber lined perforated Steel tubes --</td></tr> </table> VI) Hoist <table border="0"> <tr> <td>1)</td><td>Type</td><td colspan="2">Electrically operated</td></tr> <tr> <td>2)</td><td>Number and Capacity</td><td>One (1)</td><td>One (1)</td></tr> <tr> <td></td><td></td><td colspan="2">Each of 2 Ton capacity with lifting beams & load indicator.</td></tr> </table> VII) Weighing Scale <table border="0"> <tr> <td>1)</td><td>Type</td><td colspan="2">Electronic type</td></tr> <tr> <td>2)</td><td>Number & Capacity</td><td colspan="2">Two (02) Number; 2 Tonne each</td></tr> </table>			1)	Number required	Two (2x100%) for each Chlorinator (1 W+1 S)	Two (2x100%) for each Chlorinator (1 W+1 S)	2)	Capacity	100% each	100% each	1)	Number required	Three (3) (2 W + 1 S)	Two (2) 1 W + 1 S)	2)	Capacity of each Chlorination	120 Kg/hr	30 Kg/hr	3)	Type	----Vacuum operated solution feed type--		4)	Inlet chlorine pressure reducing valve	Required	Required	5)	Chlorine feed rate adjuster	Required	Required	6)	Automatic pressure vacuum relief valve	Required	Required	1)	Chlorinated water supply point	CW pump house fore bay and individual CW pump sumps	Before aerator, in the stilling chambers	2)	Location of diffusers	----Well below minimum water level ----		3)	Material of construction	---Rubber lined perforated Steel tubes --		1)	Type	Electrically operated		2)	Number and Capacity	One (1)	One (1)			Each of 2 Ton capacity with lifting beams & load indicator.		1)	Type	Electronic type		2)	Number & Capacity	Two (02) Number; 2 Tonne each	
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
	VIII)	Chlorine Leak Absorption System	CW-Chlorination	PT-Chlorination	
	1)	Type	-----AUTOMATIC-----		
	2)	Blowers			
		i) Number	2 nos. (1W + 1S)	2 nos. (1W+1S)	
		ii) Type	-----Centrifugal-----		
		iii) Fluid Handled	Air with chlorine gas/Caustic solution		
		iv) Location	-----Outdoor----- --		
		vi) Capacity & discharge pressure	-----As required ----- (refer Design Basis specified elsewhere)		
		vii) Material of construction	Blower internals i.e. casing, impeller, shaft etc. shall be FRP lined to protect against corrosion		
	3)	Absorbent Circulating Pumps			
		i) Number	2 Nos. (1W + 1S)	2 Nos. (1W + 1S)	
		ii)Type	-----Horizontal Centrifugal Type----- --		
		iii) Fluid Handled	---Sodium Hydroxide (20% Conc.)---		
		iv) Location	-----Outdoors-----		
		v) Capacity (minimum) and Head	20 M³/hr; Head to suit system requirement		
		vi) Material of Construction			
		a) Casing	SS ASTM A 351 GR CF8M		
		b) Impeller	SS ASTM A 351 GR CF8M		
		c) Shaft	SS 410		
		d) Shaft Sleeve	SS 410		
	4)	Caustic Solution Tank			
		i) Number	One (1)	One (1)	
		ii) Type	Cylindrical conform to ASTM 3199/BS -4994		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTIONA - 14 WATERTREATMENT PLANT	
				PAGE 27 OF 33	

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	iii) Useful Capacity 6 Cu.M or capacity required of to neutralize one ton of chlorine whichever is maximum iv) Material -----FRP + PP----- v) External Protection -----As specified in Specification----- --- vi) Vent, Overflow, drain connection ----- Required ----- vii) Dissolving basket ----- AISI-316 ----- 5) Absorber Tower i) Number One (1) One(1) ii) Type Cylindrical conform to ASTM 3199/BS -4994 iii) Resin Isophthalic type suitable to corrosion resistant to sodium Hydroxide (20% Concentration) & Moist chlorine vapour iv) Reinforcement material -----Glass fibre Class C----- 6) Isolation Dampers i) Type ----Manual / Electric motor actuated---- ii) fluid Handled Moist air chlorine mixture/Air caustic solution mixture iii) End Connection -----Flanged----- iv) Location ----Motorised dampers – outdoor---- -- -----Manual damper – inside----- v) Material of Construction i) Casing, Disc, Shaft and Pins/ Keys -----To suit fluid handled----- ii) Bearings -----Teflon----- iii) Disc Seal ----Asbestos – impregnated Teflon---- -- 7) Hood for Ton Container i) Type of material -----FRP----- -		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTIONA - 14 WATERTREATMENT PLANT	PAGE 28 OF 33

CLAUSE NO.	TECHNICAL REQUIREMENTS																																																																																																																												
33.00.00	ii) Quantity		One hood per container in two halves for all the connected containers as shown in the tender drawing																																																																																																																										
	IX) Safety & Supervisory Equipments																																																																																																																												
	1)	Number of Gas Masks & air breathing equipments required	6 sets for CW system 4 sets for PT System																																																																																																																										
	2)	Number of Chlorine Sensors																																																																																																																											
	a) For Connected Cylinders (integrated with Chlorine leak absorption system)		Refer tender drawing titled "Schematic diagram of Chlorination Plant".																																																																																																																										
	b) For Other areas																																																																																																																												
	i) Tonner Storage (Unconnected)		Minimum 2 nos																																																																																																																										
	ii) Evaporators & Chlorinators area		Minimum 1 no for each room																																																																																																																										
	3)	Emergency Kits																																																																																																																											
	Numbers Required		Four (4) numbers along with flexible hose of 50M (approx.)																																																																																																																										
Ion exchanger unit (Cation exchangers, Anion exchangers and MB units)																																																																																																																													
<table><tr><td>A</td><td colspan="2">DM plant streams</td><td colspan="3"></td></tr><tr><td>1)</td><td>Stream Capacity</td><td colspan="4">90Cum/hr</td></tr><tr><td>B</td><td colspan="2">Activated Carbon Filter</td><td colspan="3"></td></tr><tr><td>1)</td><td>Type</td><td colspan="4">Vertical shell type with dished ends</td></tr><tr><td>2)</td><td>Number of units per stream</td><td colspan="4">One (1)</td></tr><tr><td>3)</td><td>Design Flow per unit (Net)</td><td colspan="4">90 Cum/hr.</td></tr><tr><td>4)</td><td>Period between two successive back wash (Design)</td><td colspan="4">24 hours</td></tr><tr><td>5)</td><td>Design surface flow at design flow (maximum)</td><td colspan="4">15 m³/hr./m²</td></tr><tr><td>6)</td><td>Design Pressure of Vessel (minimum)</td><td colspan="4">8 Kg/Sq.cm (g)</td></tr><tr><td>7)</td><td>Filter Media / Resin</td><td colspan="4">Activated Carbon</td></tr><tr><td>8)</td><td>Minimum bed depth of filter media/ Resin</td><td colspan="4">1200 mm</td></tr><tr><td>9)</td><td>Supporting material for the fill</td><td colspan="4">Graded gravel</td></tr><tr><td>10)</td><td>Shell & dished end material</td><td colspan="4">Mild Steel as per specified code</td></tr><tr><td>11)</td><td>Internal painting</td><td colspan="4">Epoxy Paint</td></tr><tr><td>12)</td><td>External painting</td><td colspan="4">Chlorinated Rubber Paint</td></tr><tr><td>13)</td><td>Number of Manhole per Vessel</td><td colspan="4">Minimum Two (2)</td></tr><tr><td>14)</td><td>Number of Sight windows with minimum clear width of 75 mm</td><td colspan="4">Minimum Two (2)</td></tr><tr><td rowspan="2">C</td><td rowspan="2">Ion exchanger units</td><td colspan="2">Cation Unit</td><td colspan="2">Anion Unit</td><td rowspan="2">Mixed Bed unit</td></tr><tr><td>Weak</td><td>Strong</td><td>Weak</td><td>Strong</td></tr><tr><td>1)</td><td>Type</td><td colspan="5">Vertical shell type with torispherical dished ends</td></tr></table>						A	DM plant streams					1)	Stream Capacity	90Cum/hr				B	Activated Carbon Filter					1)	Type	Vertical shell type with dished ends				2)	Number of units per stream	One (1)				3)	Design Flow per unit (Net)	90 Cum/hr.				4)	Period between two successive back wash (Design)	24 hours				5)	Design surface flow at design flow (maximum)	15 m³/hr./m²				6)	Design Pressure of Vessel (minimum)	8 Kg/Sq.cm (g)				7)	Filter Media / Resin	Activated Carbon				8)	Minimum bed depth of filter media/ Resin	1200 mm				9)	Supporting material for the fill	Graded gravel				10)	Shell & dished end material	Mild Steel as per specified code				11)	Internal painting	Epoxy Paint				12)	External painting	Chlorinated Rubber Paint				13)	Number of Manhole per Vessel	Minimum Two (2)				14)	Number of Sight windows with minimum clear width of 75 mm	Minimum Two (2)				C	Ion exchanger units	Cation Unit		Anion Unit		Mixed Bed unit	Weak	Strong	Weak	Strong	1)	Type	Vertical shell type with torispherical dished ends				
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CLAUSE NO.	TECHNICAL REQUIREMENTS						
	2)	Number of Streams	One(1)	One(1)	One(1)	One(1)	One(1)
	3)	Number of units per DM stream	-----One (1) -----				
	4)	Design Flow per unit (Net) in m³/h	90		90		90
	5)	Guaranteed Effluent Quality	Refer Subsection-IV of Part-A of Technical Specification				
	6)	Period between two (Design) successive regenerations in hours	12		12		108
	7)	Net output between two successive regenerations in m³	1080		1080		9720
	8)	Design surface flow at design flow (maximum)	As specified elsewhere				
	9)	Resin	Weakly Acidic Carboxylic Group	Strongly acidic, high capacity polystyrene resin in bead form	Tertiary Ammonia Group	Strong base, Type-I, high capacity polystyrene resin in bead form	Strongly acidic and Strongly basic Type-I resins. Both resins of high capacity polystyrene resins in bead form.
	10)	Resin Depth					
	a)	Minimum bed depth of Resin for Counter current regenerated vessels over bed plate/header lateral.	----- 1000 mm -----				-----
	b)	Minimum bed depth of filter Resin for Co-current regenerated vessels over bed plate/header lateral.	----- 800 mm -----				-----
	c)	Minimum (Total) bed depth of Resin	-----				1000 mm
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE			TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTIONA - 14 WATERTREATMENT PLANT		PAGE 30 OF 33

CLAUSE NO.	TECHNICAL REQUIREMENTS			
			Balance Courses – 8 mm	
	6)	Bottom Plate Thickness (min.)	10 mm	
	7)	Roof Plate Thickness (min.)	6 mm	
	8)	Internal Protection	Solvent free epoxy coating	
	9)	External painting	Epoxy Paint	
	10)	Manholes	Minimum 2 numbers (one on the shell and other on the roof)	
	11)	Accessories	a) Staircase & platform b) Vent, Overflow and drain connections c) Overflow seal d) CO ₂ absorbers in vent line e) e) Hand railing on the roof of the tank all around the tank	
	12)	Additional nozzle connections	a) Minimum Two (2) Numbers one of 250 NB size & another of 150 NB size at bottom level (for suction). b) Minimum Two (2) numbers one of 150 NB size & another of 100 NB size at the top level (for future filling)	
	40.00.00	Design features of “Pressure and Storage Vessels” 1) Design of all pressure vessels shall conform to ASME Section VIII or acceptable equivalent standard. Design pressure shall be the maximum expected pressure to which the vessels may be subjected to plus 5% additional margin. Maximum expected pressure for vessels placed in the discharge line of pumps shall be based on the shut-off head of the pumps plus static head at pumps suction if any. For all other pressure vessels, design pressure shall be at least 8 Kg/cm ² (g). 2) Design of all vertical cylindrical atmospheric storage tanks containing water, acid, alkali, and other chemicals shall conform to IS: 803. 3) Design of all horizontal cylindrical atmospheric storage tank containing water, acid, alkali, and other chemicals shall conform to BS: 2594. 4) Design temperature of all pressure vessels and storage tanks shall be 10 deg. C higher than the maximum temperature that any part of the vessel/tank is likely to attain during operation. In case, tank is subjected to vacuum, the same shall be taken care in designing the tank. 5) The design of DM water storage tanks (Vertical type) shall conform to IS: 803. Supporting frame where required shall be in accordance with IS: 800. The tank shall be "Non-pressure" fixed roof type with atmospheric vents. 6) All vessels/tanks without inside rubber lining shall have a corrosion allowance of minimum 2 mm and mill allowance (minimum 0.3 mm) for shell and dished ends. Thinning allowance of 2 mm (minimum) shall be considered for dished end. 7) All the atmospheric tanks shall have sufficient free board above the “Level High”/ “Normal Level” as the case may be. The overflow level shall be kept at least 20 cm or 10% of vessel height above the “Level High”/“Normal Level” for all the tanks except for the DM tanks for which a minimum height of 300 mm shall be provided over the “High Level”. Further, a minimum 100 mm free board shall beprovided above the top of overflow level to the bottom of roof of the tank. Wall thickness of atmospheric tanks shall not be less than 6 mm. 8) Vessels coming under preview of IBR shall be designed accordingly. 9) Material of Construction i) The pressure vessels shall be fabricated from carbon steel plates conforms to SA 515 Gr.70 or SA 516 Gr. 70 if the pressure vessels are designed as per ASME Section VIII.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTIONA - 14 WATERTREATMENT PLANT	PAGE 32 OF 33



SUB-SECTION–A-15

CW SYSTEM

**SINGARENI THERMAL POWER PROJECT
STAGE-II (1X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC NO.:CW-CM-11159-C-O-M-001**

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	(A) CW Pumps This Chapter describes the System description, Basic Design Criteria and Minimum Technical Requirements of the Circulating Water (CW) System and associated equipment. The minimum technical requirements and equipment shall include, but not be limited to the following:		
1.01.00	System description CW system shall be Re-circulating type with Cooling Tower. The unit shall be provided with its own dedicated cooling tower and CW System. Water from CW sump will be pumped out into steel lined concrete ducts. The duct shall be connected to the pump discharge flange through a carbon steel pipe, hydraulically actuated butterfly valve, expansion joint and distance piece (if applicable). From the ducts, steel pipes shall carry water to and from the condenser. The outlet pipes from condenser shall be joined to ducts which shall lead hot water up to the base of cooling tower. From base of the cooling tower, steel pipes shall take water up to the hot water distribution system of the cooling tower. The cold water shall flow back to the CW sump through open channel by gravity. Intake duct from the CW pumps to the condenser and discharge duct from condenser to cooling tower shall be provided. Clarified water would be given as make up water to CW system from the Water Pre-treatment Plant. The CW blow down water shall be used for filling of Fire water tank, Ash Handling system, FGD process water, CHP Dust suppression and any other requirement envisaged by the bidder and as per system requirements. Provision shall be provided for excess CW blow down water to the Central monitoring basin of Effluent Treatment plant. Chlorine di-oxide shall be dosed in the fore-bay of CW pump house as a biocide agent. The common re-circulation line shall be led up to the CW channel through an inching type Butterfly valve which shall be provided with a motor actuator. CW pumps shall be located in CW pump house with shed.		
1.02.00	General design & construction requirements of CW pumps 1) The pump shall be directly driven by a constant speed squirrel cage induction motor coupled with suitable coupling and shall be designed for 25 years of life to withstand the seismic loads as specified elsewhere in specification. 2) The "suction specific speed required" i.e. specific speed calculated with NPSH required, shall not exceed 12,000 (US Units). 3) The system suction specific speed (i.e. specific speed calculated with NPSH available) shall not be greater than 8500 US units at minimum water level. Pump speed shall be based on the above suction specific speed available. "Net Positive Suction Head (NPSH) Required" shall be less than "NPSH Available" during all operating conditions including run-out condition. 4) The pumps shall have stable head capacity characteristic continuously rising towards shut off conditions. The design shall ensure equal load sharing among the pumps operating in parallel. All pumps shall be identical having identical characteristic curves and shall be capable of running in parallel continuously without any restrictions. The pump shall operate satisfactorily in single pump operation as well as in parallel with all other working pumps. Pumps shall be able to operate satisfactorily and continuously at run out capacity conditions as determined with the help of system resistance curve. 5) The pump and motor (complete assembly) should be designed for withstanding the run-away speed attained with reverse rotation caused by reverse flow continuously even when all the remaining pumps are in operation. Necessary speed switches to detect reverse rotation shall be provided with indicator. 6) The system resistance curves shall be provided to indicate the approximate system resistance for each Unit. Range of operation of pumps shall be so selected that it can accommodate the following modes of operation at maximum water level in sump (Run-out Condition) and as well as at minimum water level in sump.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001 SUB SECTION-A-15 CW SYSTEM PAGE 1 OF 40			

CLAUSE NO.	TECHNICAL REQUIREMENTS																																												
	PART- 1 TECHNICAL REQUIREMENTS OF CW PUMPS (VERTICAL WET PIT TYPE) 1.00.00CODES AND STANDARDS 1.01.00The design, manufacture, inspection, and testing shall comply with all currently applicable standards. 2.00.00DESIGN AND CONSTRUCTION REQUIREMENTS 2.01.00Design Criteria 2.01.01The pumps shall be vertical, constant speed, wet pit, mixed flow design, with single stage impeller, suitable for continuous heavy duty with flanged discharge connection. The pumps shall be suitable for handling water having chemical analysis and turbidity as per specifications requirements. 2.01.02Suitable arrangement shall be provided to take care of the discharge hydraulic thrust due to an untied expansion joint. However, for above floor discharge, thrust block assembly is not acceptable. 2.01.03The length of shaft & column sections shall not exceed 3.0 meters. The column pipe shall have a wall thickness of not less than 12 mm. 2.02.00Constructional Features 2.02.01The materials used in construction of the various components shall not be inferior to those given below: <table><tr><td>a.</td><td>Suction Bell & Casing</td><td>ASTM A 351 CF8M</td></tr><tr><td>b.</td><td>Casing Liner</td><td>Stainless steel</td></tr><tr><td>c.</td><td>Impeller, Impeller Guide (if applicable)</td><td>Austenitic stainless-steel ASTM A743 / CF8M</td></tr><tr><td>d.</td><td>Wearing rings</td><td>Stainless steel of suitable grade as per manufacturer's proven practice.</td></tr><tr><td>e.</td><td>Pump & Line shaft</td><td>Hardened stainless steel conforming to ASTM A276 Gr.410</td></tr><tr><td>f.</td><td>Shaft coupling & Shaft Sleeve</td><td>Stainless steel type 410, ASTM A276, Heat treated & hardened</td></tr><tr><td>g.</td><td>Line shaft bearing</td><td>Cutless rubber with bronze retainer/Thordon type bearing.</td></tr><tr><td>h.</td><td>Bearing guide spider</td><td>Fabricated Steel</td></tr><tr><td>i.</td><td>Column Pipe</td><td>Fabricated Steel as per IS-2062 with 2 coats of epoxy coating</td></tr><tr><td>j.</td><td>Shaft Enclosing Tube (If Applicable) etc.</td><td>Fabricated Steel as per IS-2062</td></tr><tr><td>k.</td><td>Thrust pads</td><td>Carbon steel with white metal lining</td></tr><tr><td>l.</td><td>Fasteners</td><td>Stainless steel AISI type 316 for fasteners in contact with water. Others shall be of high-tension carbon steel.</td></tr><tr><td>m.</td><td>Gaskets</td><td>Wire Reinforced Rubber Gasket / Neoprene rubber / Compressed asbestos fibre (CAF)</td></tr><tr><td>n.</td><td>Gland packing</td><td>Impregnated teflon</td></tr></table>			a.	Suction Bell & Casing	ASTM A 351 CF8M	b.	Casing Liner	Stainless steel	c.	Impeller, Impeller Guide (if applicable)	Austenitic stainless-steel ASTM A743 / CF8M	d.	Wearing rings	Stainless steel of suitable grade as per manufacturer's proven practice.	e.	Pump & Line shaft	Hardened stainless steel conforming to ASTM A276 Gr.410	f.	Shaft coupling & Shaft Sleeve	Stainless steel type 410, ASTM A276, Heat treated & hardened	g.	Line shaft bearing	Cutless rubber with bronze retainer/Thordon type bearing.	h.	Bearing guide spider	Fabricated Steel	i.	Column Pipe	Fabricated Steel as per IS-2062 with 2 coats of epoxy coating	j.	Shaft Enclosing Tube (If Applicable) etc.	Fabricated Steel as per IS-2062	k.	Thrust pads	Carbon steel with white metal lining	l.	Fasteners	Stainless steel AISI type 316 for fasteners in contact with water. Others shall be of high-tension carbon steel.	m.	Gaskets	Wire Reinforced Rubber Gasket / Neoprene rubber / Compressed asbestos fibre (CAF)	n.	Gland packing	Impregnated teflon
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			PAGE 4 OF 40																																										

CLAUSE NO.		TECHNICAL REQUIREMENTS						
		<table><tr><td>o.</td><td>Ladder, Platform & related accessories</td><td>Fabricated Steel as per IS-2062</td></tr></table>	o.	Ladder, Platform & related accessories	Fabricated Steel as per IS-2062			
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2.02.02		Bearing lubrication						
		Complete forced water lubrication system shall be provided for each pump.						
2.02.03		Column, Shaft and Shaft Sleeves						
		The pump column shall be provided with flanged joints to permit easy disassembly. The line shaft coupling shall be of muff type or approved equivalent. Shaft sleeves shall be provided below the bearings to protect the shaft from wear. Suitable locking arrangement shall be provided for all bolted connections.						
2.02.04		Stuffing Box						
		Gland packing shall be provided at the top of the line shaft. Shaft sleeves shall be provided at the stuffing box. The packing glands shall be split type to facilitate re-packing of the stuffing boxes.						
2.02.05		Wearing Rings						
		Replaceable wearing rings/casing liners shall be provided in impeller and casing. The diametrical clearance between casing and impeller at the wearing ring(s) when the pump is new shall not be less than 1.2 mm.						
2.02.06		Base Plate						
		Each pump shall be provided with a heavy structural steel base plate.						
2.02.07		Vibration limits						
		The vibration limits of the pump set when measured at location at motor end / <i>as indicated in HIS</i> shall not exceed 100 microns (maximum).						
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-15 CW SYSTEM				
				PAGE 5 OF 40				

CLAUSE NO.	TECHNICAL REQUIREMENTS																	
	PART- 2 TECHNICAL REQUIREMENTS OF CW PUMPS (CONCRETE VOLUTE/ METALLIC VOLUTE WITH CONCRETE ENCASEMENT)																	
1.00.00	CODES AND STANDARDS																	
1.01.00	The design, manufacture, inspection, and testing shall comply with all currently applicable standards.																	
2.00.00	DESIGN AND CONSTRUCTION REQUIREMENTS																	
2.01.00	Design Criteria																	
2.01.01	The CW pumps shall be of concrete volute/ metallic volute with concrete encasement, concrete draft tube, vertical shaft, constant speed, single entry, centrifugal or mixed flow design, with single stage impeller, suitable for continuous heavy duty.																	
2.01.02	The motor shall be mounted on the operating floor which is above maximum water level.																	
2.01.03	The pump shall have a flanged discharge connection. Further, the pumps shall be provided with the following parts as per the standard practice of the manufacturer: Concrete Volute or metallic Volute, Concrete Draft tube or metallic draft tube embedded in concrete, A casing cover bolted to the upper part of the pump, A replaceable type sealing wearing ring bolted on to the suction part, Anchor bolts on the embedded parts, Steel set ring/ puddle flanges anchored in concrete and locked with reinforcements on the discharge side. Embedded parts (cast or fabricated) in the concrete (i.e. cut water, suction part and upper part) shall be suitable for the quality of water being pumped.																	
2.02.00	Constructional Features																	
2.02.01	For concrete volute type design, the suction draft tube and pump volute casing shall be of cast-in-situ concrete construction. The draft tube and volute construction with prefabricated concrete elements are also permissible. For Metallic Volute type design, the Volute and the draft tube can either be cast steel/cast iron or fabricated carbon steel construction as per the standard practice of the manufacturer. The metallic draft tube shall be embedded on concrete.																	
2.02.02	The inner side of the pre-cast elements must be smooth & have a high degree of water tightness and shall confirm to following: <table><tr><td>a)</td><td>Reinforcing Steel</td><td>Fe-415 conforming to IS:1786</td></tr><tr><td>b)</td><td>Concrete Quality</td><td>M25 / M30 conforming to IS:456-2000</td></tr><tr><td>c)</td><td>Cement</td><td>As per Civil Works sub-section</td></tr><tr><td>d)</td><td>Concrete cover</td><td>Minimum 50mm inner side and minimum 25mm outside</td></tr><tr><td>e)</td><td>Wall thickness</td><td>According to structural calculation. Minimum 125 mm</td></tr></table>			a)	Reinforcing Steel	Fe-415 conforming to IS:1786	b)	Concrete Quality	M25 / M30 conforming to IS:456-2000	c)	Cement	As per Civil Works sub-section	d)	Concrete cover	Minimum 50mm inner side and minimum 25mm outside	e)	Wall thickness	According to structural calculation. Minimum 125 mm
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2.02.03	Cast iron trays of anchor bolts at suction side with steel anchors for suction wear ring and One steel foundation ring on discharge side for fixing the discharge wear ring must be integral part of the prefabricated elements.																	
2.02.04	Final finishing of the surface of the draft tube and volute shall be carried out by the bidder with epoxy paint or mortar so as to meet the surface finish as required by the pump manufacturer.																	
	Materials of Construction																	
<table><tr><td>SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE</td><td>TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001</td><td>SUB SECTION-A-15 CW SYSTEM</td><td>PAGE 6 OF 40</td></tr></table>				SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-15 CW SYSTEM	PAGE 6 OF 40											
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CLAUSE NO.	TECHNICAL REQUIREMENTS																																						
	Material & construction of the pump & column shall be such as to resist corrosion & erosion and give a long and satisfactory life to the plant. The materials used in construction of the various components shall not be inferior to those given below: <table><tr><td>a)</td><td>Casing and draft tube</td><td>Cast in situ concrete / Pre-cast concrete elements for concrete volute type pumps OR Cast steel/Cast iron or Fabricated carbon steel for metallic volute type pumps</td></tr><tr><td>b)</td><td>Impeller</td><td>Austenitic stainless-steel ASTM A743/CF 8M grade or Equivalent.</td></tr><tr><td>c)</td><td>Wearing rings</td><td>Stainless steel of suitable grade as per manufacturer's proven practice.</td></tr><tr><td>d)</td><td>Pump shaft</td><td>Hardened stainless steel conforming to ASTM A 276 Grade 410</td></tr><tr><td>e)</td><td>Shaft sleeve</td><td>Stainless steel ASTM A276 grade 410 hardened as per manufacturer's proven practice.</td></tr><tr><td>f)</td><td>Cut water</td><td>Ni resist Cast Iron</td></tr><tr><td>g)</td><td>Casing cover</td><td>Fabricated steel or 2% Ni cast Iron, D2 type</td></tr><tr><td>h)</td><td>Shaft coupling</td><td>Stainless steel ASTM A 276 grade 410.</td></tr><tr><td>i)</td><td>Bearing</td><td>Babbited with oil lubrication.</td></tr><tr><td>j)</td><td>Bolts, nuts, and lock washers</td><td>Stainless steel AISI type 304 coming in contact with water and others of high-tension carbon steel.</td></tr><tr><td>k)</td><td>Gland packing</td><td>Impregnated Teflon.</td></tr><tr><td>l)</td><td>Stuffing box housing</td><td>IS: 210 grade 260, 2% Ni C.I.</td></tr></table>			a)	Casing and draft tube	Cast in situ concrete / Pre-cast concrete elements for concrete volute type pumps OR Cast steel/Cast iron or Fabricated carbon steel for metallic volute type pumps	b)	Impeller	Austenitic stainless-steel ASTM A743/CF 8M grade or Equivalent.	c)	Wearing rings	Stainless steel of suitable grade as per manufacturer's proven practice.	d)	Pump shaft	Hardened stainless steel conforming to ASTM A 276 Grade 410	e)	Shaft sleeve	Stainless steel ASTM A276 grade 410 hardened as per manufacturer's proven practice.	f)	Cut water	Ni resist Cast Iron	g)	Casing cover	Fabricated steel or 2% Ni cast Iron, D2 type	h)	Shaft coupling	Stainless steel ASTM A 276 grade 410.	i)	Bearing	Babbited with oil lubrication.	j)	Bolts, nuts, and lock washers	Stainless steel AISI type 304 coming in contact with water and others of high-tension carbon steel.	k)	Gland packing	Impregnated Teflon.	l)	Stuffing box housing	IS: 210 grade 260, 2% Ni C.I.
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2.02.08	Wearing Rings & Shaft Sleeves Replaceable wearing rings/ liners shall be provided between impeller and casing. The suction wearing ring /liner shall be bolted in a holder which shall be grouted in concrete with non-shrinking mortar.–During grouting of this ring, the top section shall be grouted with two pack moulding mass of synthetic resin, minimum layer thickness 3 mm to provide watertight finish. The diametrical clearance between casing and impeller wearing ring(s) when the pump is new shall not be less than 1.2 mm. Casing wearing ring at suction shall be held in a metallic carrier grouted in concrete and wearing rings shall be removable from the carrier. Suitable shaft sleeves shall be provided between the shaft and impeller to protect the shaft.																																						
2.02.09	Sealing Arrangement A mechanical seal or stuffing box with packing flushed with water shall be provided in line with the standard practice of the manufacturer. A seal flushing system shall be provided which will supply the glands with flushing water both during pump start-up / shutdown and while the pump is running. The seal flushing water shall be filtered by the provision of 2x100% basket type strainers with isolation valves for each pump set. Bidder shall make necessary arrangement for proper drainage of the seal area by providing drainage pumps. Mechanical seal (if provided) of cartridge construction type, shall be of approved design. 2x100% capacity seal water pumps shall be provided for each CW pump.																																						
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-15 CW SYSTEM																																				
			PAGE 7 OF 40																																				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.02.09	Journal Bearings The guide bearings for CW pump shall be of journal bearing type with babbit lined bronze bearing sleeve located as close to the impeller as possible. The guide bearing & thrust bearing shall be protected against water splashes and gland packing leaks. The bearings housing shall be of axially split design and designed to exclude the ingress of dust and water and shall have suitable provision for breathing and be adequately sealed to prevent leakage of oil. It shall be out of water, cooled & lubricated by self-circulated oil. The bush bearings (if provided) shall be lubricated with filtered pump fluid.			
2.02.11	Pump Shaft The shaft shall be designed to transmit the maximum rated power at the pump operating speed and shall be of ample stiffness to minimize deflection of the shaft during starting conditions or any other operating condition. Where the pump shaft is exposed to water (i.e.) to effects of corrosion, it shall be adequately protected by replaceable sleeves.			
2.02.12	Lubrication System Material of construction of Cooling coils if fitted shall be of Stainless steel. All associated pipe work shall be of stainless steel. Required level sensors shall be provided for measurement/interlock & alarm purpose.			
2.02.13	Gland Drainage Four (4) numbers of drainage pumps (draining for the gland area) shall be provided in the CW pump house. The minimum capacity of each pump shall be 50 m³/hr & the corresponding head shall not be less than 10 MWC.			
2.02.14	Manhole Each pump shall be equipped with an inspection manhole (Minimum diameter of 1000 mm) with steel cover plate at discharge side. Suitable access provision shall be made for the manhole from the operating floor.			
2.02.15	Vibration limits The maximum vibration limits of the pumps set when measured at locations as indicated in HIS shall not exceed 25 microns.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-15 CW SYSTEM
PAGE 8 OF 40				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.00.00	PART- 3			
	TECHNICAL REQUIREMENTS OF ELECTRO-HYDRAULIC ACTUATORS			
	DESIGN CRITERIA			
	a. Each electro-hydraulic actuator shall be provided with its own power pack. Each actuator shall consist of a double acting cylinder, control cabinet and accessories to cater for following operational requirements. 2) In the closed position the valve shall be held closed by a substantial counterweight or by any other mechanical device. Valve shall remain open during normal running of the pump. 3) A limit switch be provided (set at about 3 deg from open position) to sense the creeping. Switch shall start the oil pump and return the valve to the fully open position. 4) When the valve is fully open and electric supply in the valve control system fails the butterfly valve shall remain open while the CW pump continues to deliver water. 5) In case of any fault causing pump motor trip the corresponding butterfly valve shall start closing at a fast rate initially and thereafter at a slow rate. The emergency closing facilities shall be duplicated each with its own solenoid valve in the hydraulic circuit. 6) Provision for local manual operation shall be made. A locking device shall be provided. 7) The hydraulic controls for each valve shall be housed in independent cabinet located on an operating floor near the valve. This shall consist of pumping unit, oil tank, and accumulator of adequate capacity to hold the valve disc at any position and to prevent any surge including disc flutter during valve travel and to fully open position. Accumulator will also have enough capacity for one cycle (open & close operation) of operation without external electric AC power. The hydraulic power pack will consist of all its associated equipment/system. 8) The electrical controls shall be housed in the common control panel (local) for CW pumps or in a separate panel. Reversible starters for the valves shall also be provided. 9) Each butterfly valve shall have four limit switches, each capable of being set of at any point between full open to full close position. In addition, one more extra limit switch to be set at an intermediate position shall be provided. each limit switch shall have 2 NO and 2 NC contacts. Limit switch enclosure shall conform to NEMA 4 x standard. 10) Each butterfly valve shall have Two nos. non-contact type 24 V DC 4-20 mA output position transmitters.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-15 CW SYSTEM
PAGE 9 OF 40				

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	 (B) COOLING TOWERS - INDUCED DRAFT (MECHANICAL)		
1.00.00	GENERAL This specification covers the design, engineering, manufacture, shop fabrication, testing at works, transportation to site, unloading and storage at site, fabrication at site, Installation, testing and commissioning of induced draught RCC/ Pultruded FRP cooling towers for power plant cooling system.		
2.00.00	CODES AND STANDARDS		
2.01.00	The design, manufacture, inspection, and testing shall comply with all currently applicable standards. The equipment shall also conform to the latest applicable British/American standards. The equipment shall conform to the latest edition of the following standards: - i) Cooling Tower Institute Publications. ii) BS 4485-Specification for Water Cooling Towers.		
2.02.00	CODES AND STANDARDS FOR FRP COMPONENTS The design of FRP components of cooling tower shall comply with the requirements stipulated in CTI STD- 131, CTI STD -137, and CTI ESG-152. The cooling tower and its components shall be designed to withstand the most onerous loading case / combination resulting from the various loading cases / combinations stipulated in CTI ESG 152. All material properties, stresses and their reduction factors, deflection criteria, material service factors, connection details and their tolerances etc., as applicable as per CTI codes CTI STD- 131, CTI STD -137, CTI ESG-152, shall be so considered such that the cooling tower and its components withstand the severest temperatures in the place of installation and application and serve a reasonably long life not less than CTI indicated life expectancy.		
3.00.00	DESIGN REQUIREMENTS / CRITERIA		
3.01.00	Each cooling tower shall be complete with tower, basin, foundations and mechanical equipment as described below. The tower shall be of single inlet or double inlet, cross flow or counter flow type with type of fill as specified in technical data sheets. The tower shall be of induced draught type with the fan located on top of the tower.		
3.02.00	The cooling tower shall be designed to meet the duty conditions as specified in this tender specification. Employer may get the verification and review of contractor's design done through third party (who can be employer's consultant/reputed designer/ National or International Technological Institute/National or International body on cooling tower & it's components), if required (during detailed engineering). All necessary data/ details/ drawings shall be provided by the contractor to get the same carried out.		
3.03.00	Number of operating cells in the cooling tower shall not be less than eight (8). Bidder shall provide spare cells (Minimum four (4) per tower) in the cooling tower in case of one tower per Unit configuration and minimum two (02) numbers per tower in case of two tower per Unit configuration to facilitate maintenance without affecting the tower performance.		
3.04.00	3The water distribution basin and piping system shall be so designed that when any two cells (other than standby cells) are out of operation for maintenance etc. the remaining cells shall be capable of handling the full quantity of water as indicated in technical data sheet.		
3.05.00	3All cells of the tower shall be identical. Thermal design of the cooling towers shall be such that the guaranteed performance is met without operating spare cells.		
3.07.00	For counter flow tower the area covered by the projected circle at 45 deg. angle from the fan cylinder opening on the drift eliminator plan area shall not be less than 80% of the drift eliminator plan area.		
3.08.00	The layout of the cooling tower in the plant area and the wind rose is indicated in the drawings titled "General Layout Plan". The Bidder shall examine the proposed layout of the tower and accordingly determine the recirculation, which must be taken into consideration		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001 SUB SECTION-A-15 CW SYSTEM PAGE 10 OF 40			

CLAUSE NO.	TECHNICAL REQUIREMENTS																				
3.10.00	for the purpose of design of the tower to ensure that the design parameters of the tower are maintained when all the cooling towers in the plant are operating simultaneously. Bidder must apply a correction factor to the design wet bulb ambient temperature to accommodate the recirculation effect. Minimum value of this recirculation correction factor shall be as given in technical data sheets.3.09.00 The length of the cooling tower shall be decided based on plant layout to be optimized by the bidder. Thermal Design Criteria The thermal design of cooling towers shall fulfil following design criteria. Sensible heat of evaporated water shall be taken into consideration in the thermal design of the cooling tower. The air flow requirement shall not be less than that worked out by the formula given below: GH = L(TI-T2) + EvT2 Where <table><tr><td>L</td><td>=</td><td>Water flow rate in kg/hr.</td></tr><tr><td>TI</td><td>=</td><td>Water inlet temperature to the tower in deg C.</td></tr><tr><td>T2</td><td>=</td><td>Water outlet temperature to the tower in deg C.</td></tr><tr><td>EV</td><td>=</td><td>Evaporation loss in kg/hr at ambient RH</td></tr><tr><td>G</td><td>=</td><td>Air flow rate in kg/hr.</td></tr><tr><td>H</td><td>=</td><td>Change in enthalpy of air in kcal/kg.</td></tr></table>			L	=	Water flow rate in kg/hr.	TI	=	Water inlet temperature to the tower in deg C.	T2	=	Water outlet temperature to the tower in deg C.	EV	=	Evaporation loss in kg/hr at ambient RH	G	=	Air flow rate in kg/hr.	H	=	Change in enthalpy of air in kcal/kg.
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3.11.00	Calculations justifying the selected airflow and evaporation loss shall be enclosed with the bid. International/National standard table of properties of air shall be used and a copy of the table clearly indicating the standard used shall be enclosed with the bid.																				
3.12.00	The bidder shall furnish in his bid the following: i) Heat balance calculations and air requirements for cooling tower as per format given elsewhere. ii) Available tower characteristics (KaV/L - as a function of air & water rates, fill geometry, hot water temperature, air velocity etc.) based on field performance tests. The relationship shall be of general form of equation given below and shall include values of the constants “C” and “n”. The equation shall cover range of L/G values from at least 20% above to at least 20% below design. KaV/L = C(L/G)n The bidder shall also submit an equation and / or curve defining the demand requirement at design approach, range and wet bulb temperature. The design L/G value shall be identified. iii) Various pressures drop in the air circuit of the cooling tower to arrive at discharge pressure of fan. iv) Calculations for arriving at the design power consumption. v) Calculations for pumping head in the format given in elsewhere. vi) Tower Performance curves (for both ambient and inlet WBT.) Bidders may note that the calculations/curves specified above must be enclosed with the offer without which bids run the risk of rejection. In case, these calculations are based on the collaborator's design, then these calculations should be duly vetted by collaborator. The Bidder shall show/explain and prove the validity and the basis of procedures and methods used in the calculations.																				
3.13.00	The tower configuration shall be such that it shall offer minimum restriction to air flow.																				
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-15 CW SYSTEM																		
			PAGE 11 OF 40																		

CLAUSE NO.	TECHNICAL REQUIREMENTS																																																
3.14.00	To ensure uniform and stable distribution of entering air, the velocity pressure ratio shall not be less than 5 (Five). Velocity pressure ratio is defined as the ratio of system pressure drop (i.e. from air inlet to the drift eliminator) to the velocity pressure at the inlet. For counter flow towers, the velocity at air inlet shall be calculated based on the clear air entry area available in vertical plane at the inner face of cooling tower wall. For purpose of calculating the velocity pressure ratio, the air velocity shall be computed considering the total airflow entering the individual cell and the total gross inlet air area of the individual cell. This will be calculated independently for each cell and the value calculated for each cell shall not be less than 5. For towers provided with over-dimensioned cold-water basin, the inlet air area shall be computed considering the water level in the cold-water basin at normal water level.																																																
3.15.00	The exit air velocity of the fan recovery stack outlet shall not be less than 6m/s.																																																
3.16.00	Maximum air Inlet velocity should be 5m/s.																																																
4.00.00	Constructional Features Wood/timber shall not be used as construction material in any part of the cooling tower. Bidder may offer MOC of components different than that specified below based on his proven practices, however allowing of such MOC shall be under employer's discretion.																																																
<table><tr><th rowspan="2">SN</th><th rowspan="2">Component Description</th><th colspan="2">Material of Construction</th></tr><tr><th>RCC IDCT</th><th>FRP IDCT</th></tr><tr><td>1</td><td>Hot water header</td><td colspan="2">MS to IS:2062 (around cooling tower)</td></tr><tr><td>2</td><td>Hot water distribution pipes for counter-flow tower</td><td colspan="2">PVC (IS 4985 Class 3) / GRP / HDPE (IS 4984 PN6, Grade PE 80)/ as per Bidder's proven practice</td></tr><tr><td>3</td><td>Hot water basin for cross flow</td><td>RCC</td><td>Pultruded FRP</td></tr><tr><td>4</td><td>Cooling tower shell/ structure</td><td>RCC</td><td>Pultruded FRP</td></tr><tr><td>5</td><td>Cooling tower basin</td><td colspan="2">RCC (Refer Civil specifications)</td></tr><tr><td>6</td><td>Drift Eliminators</td><td colspan="2">PVC</td></tr><tr><td>7</td><td>Louvers</td><td colspan="2">Bidder's proven practice</td></tr><tr><td>8</td><td>Fill</td><td colspan="2">PVC/ PP/ as per Bidder's proven practice</td></tr><tr><td>9</td><td>Fill supports</td><td colspan="2">SS:316 grid</td></tr><tr><td>10</td><td>Fan blades</td><td colspan="2">Fiber glass reinforced polyester/ Epoxy (hollow cast)</td></tr></table>				SN	Component Description	Material of Construction		RCC IDCT	FRP IDCT	1	Hot water header	MS to IS:2062 (around cooling tower)		2	Hot water distribution pipes for counter-flow tower	PVC (IS 4985 Class 3) / GRP / HDPE (IS 4984 PN6, Grade PE 80)/ as per Bidder's proven practice		3	Hot water basin for cross flow	RCC	Pultruded FRP	4	Cooling tower shell/ structure	RCC	Pultruded FRP	5	Cooling tower basin	RCC (Refer Civil specifications)		6	Drift Eliminators	PVC		7	Louvers	Bidder's proven practice		8	Fill	PVC/ PP/ as per Bidder's proven practice		9	Fill supports	SS:316 grid		10	Fan blades	Fiber glass reinforced polyester/ Epoxy (hollow cast)	
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-15 CW SYSTEM																																														
			PAGE 12 OF 40																																														

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	SN	Component Description	Material of Construction	
			RCC IDCT	FRP IDCT
	11	Fan Hub	Heavily Galvanized M.S	
	12	Fan Deck	RCC	Pultruded FRP
	13	Drive shaft and coupling	Stainless steel conforming to AISI 304 or Carbon fiber Composite material with SS 304 couplings.	
	14	Base frame and base plate for gear box and motor/ Torque Tube Support	Heavily Galvanized MS	
	15	Stair case	RCC	Pultruded FRP
	16	Recovery Stack	RCC	Pultruded FRP/ GRP
	17	Stop logs	Refer civil specifications.	
	18	Any other hardware such as fasteners, clamps, supports etc. in direct contact with water	SS 316	
	19	Any other mild steel parts used in cooling tower or its vicinity	Heavily galvanized (610 gm/m ²) in accordance with IS:2629 with corrosion resistant protective coating Surface preparation in accordance with IS:6129	
	20	Hand Rails	Refer civil specifications.	Deck Level – Pultruded FRP Others – Refer civil specifications.
	21	Misc. Structure(s)	Refer civil specifications.	
	22	Nozzles/ Splash cups	PVC/ PP/ Gun metal as per IS:318 Gr. VI	
23	Cladding Sheets	RCC	FRP	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-15 CW SYSTEM	PAGE 13 OF 40

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.02.00	Pultruded FRP structural components The Pultruded FRP structural members shall be proven for use in Cooling Towers application. Documentary evidence about past experience of parties in respect of design, manufacture, supply, erection & satisfactory operation of Pultruded structure shall be submitted to the employer.			
4.02.01	Manufacturing Process a) Pultrusion: The process of pulling continuous forms of reinforcing materials, such as glass-fiber rovings, glass-fiber mats and various surfacing veils through a bath of liquid resin. The mass of fully wetted-out material then continues to a performer and directly into a heated forming and curing die where a chemical reaction is initiated which causes the thermosetting resin to harden and the composite structural shape is formed. An optional method of cure is to pass the wetted-out composite through a radio frequency (RF) preheated. The RF preheat initiates the cure process prior to entering the heated forming die. This process is particularly useful for heavy section processing. The hardened (or cured) shape is cooled in line by water or air and then enters a pulling device where continuous pulling is maintained. Both caterpillar type and reciprocating pullers are used in pultrusion. Upon exiting the puller, the composite structural shape is cut to the desired length. b) Definition of terms relative to pultrusion can be found in ASTM D-883 and ASTM D- 3918. c) Other forms or combinations of reinforcements such as carbon fiber, aramid fiber, etc. can also be utilized when different mechanical and physical properties are required. Specific mechanical and physical properties should be negotiated between the pultrusion supplier and cooling tower.			
4.02.02	Design Temperature For members in cooling towers which are subjected to extended periods of operation in temperatures greater than 77°F, the pultrusion suppliers published allowable design values for flexural and compressive loads shall be reduced to account for reduced properties at the higher temperatures. These correction factors are published in Table II of CTI STD-137. For Type IV products, pultrusion suppliers are to supply the cooling tower manufacturer with temperature-moisture correction factors. All structural components for the tower should be selected to account for maximum expected hot water temperature including any upset conditions as a minimum (i.e., maximum hot water temperature +10°). This will account for the possible the effects of fan off operation, tower idle in hot weather and load excursions. A statement indicating the design temperature should be included as part of the cooling tower manufacturer's proposal.			
4.02.03	Materials a) Glass fiber-reinforcements may be either continuous roving's, continuous strand mats, woven or non-woven fabrics, uni-directional fabrics or combinations of these. Glass fibers shall be made for A, C, E or S-type glass. Other reinforcements may be specified for custom applications. b) The resin grade shall either be a Grade I isophthalic polyester resin or Grade 3 vinyl ester resin as per Section 4.2 of CTI Std. 137. The resin may contain additives for various purposes such as flame retardancy. UV stabilization, pigmentation or smoke reduction. These additives should be selected so as to add to the overall performance of the product without affecting the structural properties, chemical resistance an/or longevity of the part. c) Surfacing veils shall be used to improve surface appearance, assistance in chemical resistance, improved weatherability and to prevent glass fibres from coming to the surface as a result of wear or UV attack. Surfacing veils are thin tissue-type products incorporated during the pultrusion manufacturing operation as the outermost surface			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-15 CW SYSTEM
PAGE 14 OF 40				

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	layer of non-resinous material. All exterior surfaces of Pultruded members shall have a minimum surface veil of 10mil and shall have UV inhibitors to protect against UV degradation. Heavier surface veils may be provided on supplier's discretion. The final degree of UV protection is a function of the total manufactured thickness of the surfacing veils and/or surface coatings. Glass fibres exposed during fabrication process and/ or installation shall be gel coated and sealed to prevent wicking.		
4.02.04	Physical Properties Physical properties should be in line with CTI specifications, CTI-STD-137. Moreover, the pultruded FRP structural components shall be fire retardant with the resin composite having a flame spread rating less than 25 as per ASTM E 84 standards.		
4.02.05	Mechanical Properties from Coupons Minimum mechanical properties (taken from coupons) shall be as per CTI specifications CTI-STD-137.		
4.02.06	Applicable Documents a) CTI STD-137: Fiberglass Pultruded Structural Products for use in Cooling Towers b) CTI STD-152: Structural Design of FRP components c) ASTM D-4385 Practice for Classifying Visual Defects in Thermosetting Reinforced Plastic Pultruded Products. d) ASTM D-3647 Practice for Classifying Reinforced Plastic Pultruded Shapes According to Composition. e) ASTM D-3917 Specification for Dimensional Tolerance of Thermosetting Glass-Reinforced Plastic Putlrudded Shapes. f) ASTM D-3918 Definitions of Terms Relating to Reinforced Plastic Pultruded Products.		
4.02.07	Ultraviolet exposure test for 300 hours to be carried out at reputed third party laboratory once as per ASTM G-154 and Impact resistance test before & after UV exposure shall be conducted as per ASTM D-256. This will be applicable to Pultruded as well as moulded FRP components.		
4.02.08	FRP tower shall be with proper sealing/isolation between cells to avoid short circuiting of air between adjacent cells of Cooling Tower and ensure that there is no reverse rotation of fan.		
4.03.00	Cooling Tower Basin and Shell Structure The material of cooling tower basin and super structure shall be as mentioned above. The depth of basin shall be at least 1.0 m from normal water level with free board of at least 0.3 m above maximum water level unless otherwise indicated in relevant tender drawing. The Velocity of water at the outlet of the cooling tower should not exceed 1 (one) m/sec. If required, the basin may be suitably depressed to meet this requirement.		
4.04.00	Cold Water Basin Drainage Arrangement Cold water from the basin shall flow by gravity to cooling water channel through the outlet channel.		
4.04.01			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-15 CW SYSTEM
			PAGE 15 OF 40

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.04.02	Provision shall be made to completely drain the basin. For this purpose, the basin floor shall slope towards the drain sump in the Cooling Tower as shown in the relevant tender drawing. Water shall flow from the drain sump into an external sludge sump through a 300 mm NB GRP pipe 12mm thick and a gate valve of size 300mm NB with extended spindle. Two sludge sumps shall be provided for each tower. The sludge sump shall be at least 2m x 2m plan area and minimum 2.5m deep. One number sludge disposal pump of capacity 150 cum/hr and suitable head shall be supplied for each sludge sump. Sludge Pumps can be of fixed type or submersible type with proper handling arrangement.			
4.05.00	Inlet Louvers The water loss in the inlet air openings shall be prevented with provision of adequate number of louvers of proper slope, width and spacing or alternatively by over dimensioning the cold-water basin by minimum 1.0 meter all-around. Louvers, if provided, must be properly designed to give uniform distribution of air with minimum pressure drop and must be able to withstand the corrosive atmosphere.			
4.06.00	Cooling Tower Fill and Fill Supports 1) The fill shall be of non-clogging type fills like modular splash/trickle grid/turbo splash or splash type fills like V-bar splash/splash grid and easily installable. The fills shall be adequately supported to prevent sagging and damage. The tower shall be levelled so that water will be uniformly distributed over the fills and does not cause channeling. The splash type fills shall be placed horizontally. 2) The non-clogging type fills shall be in modular form. These fills are to be mechanically assembled without any use of adhesives. Assembling by other proven method is also acceptable. The fill shall be freely rested, and bottom supported to prevent any sagging and damage. 3) The fill material shall promote a high rate of heat transfer, provide low resistance to air flow and maintain uniform water and air distribution throughout the fill volume. The fill material shall be highly resistant to deterioration and shall be fire retardant. PVC/PP fill, shall be of proven quality. The make and its properties shall be subject to Employer's approval. Bidder shall furnish details of PVC/PP fill regarding fire-retarding properties, ageing effect, vibration caused by water and wind effects. The property of PVC/PP fill shall be in line with CTI 136: 2010. 4) In case of PVC/PP fill, the material should be ultra violet ray stabilized and only virgin PVC/PP material should be used. 5) The type of fill to be supplied for this package shall be of proven design. Necessary supporting data for this shall be enclosed along with the bid. 6) Preferably, the fill shall not be extended into the air inlet area. In case the bidder's standard design calls for such an arrangement, then field performance test results of towers with comparable fill arrangement supplied by the bidder duly certified by the user shall be furnished along with the bid to establish the design. 7) Type Test of PVC/PP Material In addition to the routine tests specified in this Technical specifications, ultra-violet exposure for 500 hours on the PVC/PP material shall be carried out for this contract once as per ASTM-G155, Test Method 3 and Impact resistance test before and after UV exposure shall be conducted as per ASTM D-256. The above type test shall be carried out by the Contractor at reputed third-party laboratory. Offered fills shall be tested by an independent reputed laboratory approved by NTPC to validate thermal characteristic and pressure drop correlation of the offered fill. In case the bidder has their own established test facility where such tests have been conducted for other reputed clients in the past, the same is also acceptable subject to owner's approval.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-15 CW SYSTEM	PAGE 16 OF 40

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.07.00	Test bed shall have fill height same as the offered fill height. During testing water and air loading as well as the air velocities shall be maintained same as the duty conditions and in the range of performance guarantee conditions for which tower is designed.			
	Inlet Water Distribution System 1) General Requirements: The hot water distribution system of the tower shall be designed to ensure uniform distribution to all operating cells and also to all areas in a cell. For cross flow type of towers a minimum free board of 50 mm shall be provided with the standby cell not in service. Each cell shall be able to operate independently. Suitable valves for isolation of any cell for any maintenance or repair work and to regulate the flow of water to individual cells shall be provided. The water shall be discharged throughout the plan area of the packing. For counter flow towers sufficient headroom (minimum 1.8M) shall be provided between the water distribution system and drift eliminator for inspection and maintenance. Fill cone down spray/up spray water distribution system should be provided so that there is no interference between the nozzle exit and top of fill. 2) Special requirements of distribution Nozzles: i. The Nozzles shall be arranged in a uniform pattern with proper distance to produce 15% overlapping of the individual sprays. ii. Selected nozzle characteristics like ‘Head vs Flow’ and ‘Head vs Spread area’ at three or four distances from nozzle bottom to fill top shall be furnished based on the ‘Single nozzle test’ and ‘Four nozzle test’. Previous test reports are to be furnished covering all tests along with the offer. In case the test was not conducted in the past, the above tests shall be carried out in presence of the Employer. iii. Single Nozzle Test: The nozzle shall be placed at the bottom of the overhead tank. The head in the tank can be maintained at different head of 0.1 m, 0.2 m and 0.3 m by adjusting the inlet flow. The water spread area for different heads and flow can be measured with the help of spread measuring instrument (scale) in LHS and RHS. iv. Four Nozzle Test: The nozzle shall be placed at the bottom of tank. The water-collecting compartment shall be placed at the bottom and center of spray nozzles. For different head, the quantity of water collected in the collecting compartments for 30 seconds/ 60 seconds shall be measured and this shall be verified with the design prediction/ assumption. v. Nozzle connection with internal hot water distribution pipes shall be preferably by fasteners. Fasteners shall be of stainless steel. Push on fit type connection is not acceptable. 3) Specific Requirements for cross flow towers: The hot water distribution basin shall be provided with a suitable cover to avoid direct sun rays falling on the distribution trough/basin to minimize algae growth and to prevent choking of distribution nozzles. The covers provided shall be easily openable for inspection and maintenance of the distribution system. 4) Specific Requirements for counter flow towers: All distribution pipe work shall be adequately supported. The pipe supports shall accommodate thermal movement while ensuring the pipe joints do not fail when subjected to pressure surges. The Bidder shall submit the details of the proposed method of supporting			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-15 CW SYSTEM	PAGE 17 OF 40

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	 distribution system. The design calculations for sizing of the system shall be furnished by the Bidder for Employer's approval during detailed engineering stage. 5) Specific Requirements for Pultruded FRP Cooling Towers: Each riser pipe in case of Pultruded FRP Cooling Towers shall be connected to the Cooling Tower shell through a rubber expansion joint of the diameter same as that of the riser pipe and meeting the requirement of REJ as specified elsewhere in this specification.		
4.08.00	Drift Eliminators The drift eliminators shall be designed to keep the drift loss to a maximum of 0.001% of total water in circulation. The drift eliminators shall be of profile type and gluing is not allowed. The air pressure drop across the eliminators shall be kept to a minimum by providing proper number of airflow direction changes across the eliminators. The water collected in the eliminators shall be returned to the tower basin and shall not mix with the discharge air system. HOT WATER PIPING, VALVES, ACCESSORIES Main header shall be branched into two (02) nos. for feeding to each section of cooling tower. Main header shall be branched into two (02) nos for feeding to each section of cooling tower. Two (02) nos motor operated inching type butterfly valves of suit-able size shall be provided in branch pipe of each cool-ing tower. These valves shall be in the horizontal section of hot water piping and shall be overground. After branch header isolation valves, the hot water pipe running along the air inlet side of CT shall be under-ground with suitable wrapping & coating.		
4.09.00	Recovery stack Recovery stack shall be of proper shape to improve the fan performance. The height of the stack shall be sufficient to recover the velocity and discharge the humid air to a sufficiently high level to minimize recirculation. The maximum efficiency of the stack for velocity recovery to be considered for calculation of fan power consumption shall be 75%. No credit shall be given during bid evaluation for efficiency of the stack for velocity recovery beyond the specified efficiency. In case, Fan power consumption figure (quoted by the bidder) is derived considering higher velocity recovery, the same shall be corrected for evaluation purpose. A minimum clearance between the stack and fan blades shall be maintained along the entire periphery of the stack to prevent the rubbing of fan blades while rotating.		
4.10.00	Fan Deck		
4.10.01	Fan deck shall act as an access platform for the mechanical equipment.		
4.10.02	Adequate access for roof deck, fan deck, distribution level, and drift eliminators shall be provided. For counter flow towers there shall be provision for access to water distribution level of each cell from tower roof deck or through stair case provided at each cased face of the tower. Walkways with platforms and suitable hand and knee rails and toe guards shall be provided inside towers.		
4.10.03	Handrails shall be provided all around the periphery of the cooling tower fan deck. Pipes shall be of 32 NB (Medium class). Handrails provided elsewhere should also conform to the above specification.		
4.11.00	Internal Walkways For Cross Flow Towers: Walkways with permanents and suitable hand rails shall be provided inside the towers. The drift eliminators shall be easily accessible from these walkways. One door at each cased face of the tower shall be provided.		
4.12.00	Staircase For access up to the top (roof) of the cooling tower, two numbers of staircases one at each face of the tower shall be provided for cooling tower. The staircases shall be constructed		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-15 CW SYSTEM
			PAGE 18 OF 40

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
4.13.00	adequately away from the face of cooling tower in order to prevent splashing of water on the stairs. Gearbox The fans shall be motor driven through suitable reduction gear. Flexible coupling shall be provided both at motor and reducer to minimize the effect of misalignment on account of any setting and/or warping. Flexible couplings should be pin and bush type. The support structure of the reduction gear shall be rigid. The reduction gear shall be heavy-duty type suitable for installation in outdoor and humid environment. The gear drive shall be of spiral bevel or worm type and the reduction may be accomplished in either single stage or multi stages.		
4.13.01	The gearbox shall be of proven design. Design rating of the gear box shall be arrived at after considering a suitable service factor (minimum 3.0) on motor rating. In selecting the gear box design rating the thermal derating effects at 50 degree C shall also be considered. Gearbox thermal rating shall be calculated considering max. Operating Gearbox Oil temperature which should be at least 5 deg C lower than the Permissible Gearbox Oil temperature. Detailed gear box sizing calculation shall be furnished for Employer's approval during detailed engineering. In no case, the design thermal rating of the gear box shall be less than 125% of the name plate kW rating of the selected drive motor. Also, the mechanical rating shall be checked so that minimum 25% margin is available at Pull Out Torque of the motor.		
4.13.02	The piping for oil level gauge/dipstick and thermometer shall be arranged in such a way that oil can be drained and refilled from outside the stack. This pipe shall have proper supports at frequent intervals and shall be insulated. Further, a breather connection shall be provided in the gear box. The breather provided shall be such that it prevents moisture from entering the gear box. The breather arrangement and details of oil seals shall be to Employer's approval. Oil temperature gauge should be located outside the cell through a capillary tube, which is connected to gear box stub.		
4.13.03	The gear box design should be such that the temperature of oil shall be within the manufacturer's recommended limits during all operating conditions.		
4.13.04	The gear boxes shall utilize non-hygroscopic oil for lubrication so that its lubricating properties are not lost if contaminated with water vapor.		
4.13.05	Each gear box shall be provided with a base plate. The vibration measurement sensors shall be mounted on the gear box. Vibration probe should not be mentioned on the inspection cover of the gearbox.		
4.13.06	Bidder shall furnish the maximum temperature that the lube oil can withstand and shall guarantee the maximum value of lube oil temperature when the gear reducer is in operation.		
4.13.06	Offered gearbox (minimum one no.) shall be tested at full load at manufacturer's own or any third party testing facility to demonstrate its thermal performance.		
4.14.00	Drive shaft The drive shaft shall be of tubular construction. The design of the shaft shall take into consideration a factor of safety of 2 (minimum) over the torque to be transmitted at design duty conditions. The fan shaft shall be designed in such a way that the first critical speed shall be at least 120% of the operating speed of the shaft. Shaft design requiring intermediate bearings are not acceptable. The beams at fan deck level should be designed based on dynamic analysis. The bearings shall be of proven design and shall be suitable for operation in the humid condition prevalent in the fan stack. The minimum life of bearing shall not be less than 30,000 working hours. The drive shaft design shall be such that the fan blades should not be damaged in case of shaft failure. In case of Carbon fiber composite material, drive shaft shall have the following additional requirements.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-15 CW SYSTEM	PAGE 19 OF 40

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	 1) Shaft flanges shall be preferably of Carbon fiber composite material. 2) Bonding between shaft and shaft flange shall be done by a proven method. 3) The Carbon fiber composite material should be ultra violet ray stabilized.		
4.15.00	Fans		
4.15.01	Induced draught fans of suitable capacity shall be provided. Fans shall be axial/propeller type with blades, which can be adjusted so that pitch can be altered +/- 5 deg. from the normal setting. For adjusting the fan blades, graduated stop marks with suitable locking arrangements shall be provided on the hub so that all the blades can be set to the same angle accurately. The fan blades shall be easily removable. These shall be of aerofoil section and shall provide uniform air velocity from hub to tip with low noise and vibration. Fan shall be manufactured as per the processes listed below: i) Hand Moulded Seamless FRP fan blades using ballooning method. The method of hand moulding with parting plane is not acceptable. ii) Hand moulded FRP fan blades with PU foam core and hot forming. iii) Pultruded FRP fan blades.		
4.15.02	Stack shall be provided to eliminate air turbulence in the throat area. Blades, shanks and hubs shall be suitably insulated to prevent electrolytic corrosion.		
4.15.03	The number of blades shall not exceed twelve (12) and the blade tip velocity shall not exceed 65 m/Sec. Each fan shall be driven by an electric motor.		
4.15.04	Fans to be supplied for this package shall be of proven design and make and shall be subject to approval of Employer.		
4.15.05	Fan for each cooling tower cell shall be sized (fan design point at test block) to have at least 5% margin on flow and min 10% margin on total head over and above the maximum cooling tower fan air flow and total head required (cooling tower fan duty point), to meet the specified / guaranteed cooling tower performance. Bidder shall submit detailed cooling tower fan calculation, characteristic curves etc. for the fan sizing as per the above.		
4.15.06	A scaled down model test of the fan offered shall be carried out by the contractor at the fan supplier test facility or at any other identified/recognized fan test facility to establish the rated parameters such as efficiency, power consumption etc. of the fan. Scale of model shall be minimum 1:10. The test should be carried out prior to start of manufacturing of the fan and shall be conforming to requirement of ANSI/AMCA A 210 or equivalent code.		
4.16.00	FAN MAINTENANCE FACILITIES		
4.16.01	For maintenance of drive equipment (Fan, motor, gear reducer, etc.) following arrangements shall be furnished.		
4.16.02	Each cell of cooling tower shall be provided with a monorail. In addition 3 numbers of manually operated chain pulley blocks along with travelling trolley for each of the cooling towers shall be provided. The capacity of the hoist shall be such as to be able to lift the heaviest portion of the fan motor assembly, but in no case less than 2.0 MT. Out of these specified numbers of monorail hoists, one will be used to lift equipment from ground level to tower top and accordingly the lift shall be provided. Balance two numbers of hoists shall be used for handling equipment for two (2) numbers of cells simultaneously during maintenance. The lift of these two (2) hoists shall be selected accordingly. In addition to the above a hand trolley which is sized to carry the heaviest and largest single piece of equipment shall also be provided for the cooling tower. This trolley will be used on the fan deck to transport equipment from each cell to and from the end of tower where the monorail hoist is located to lift equipment from ground level to tower top. For cross flow type of tower care shall be taken so that the equipment to be lifted does not need to be carried over the distribution basin.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001 SUB SECTION-A-15 CW SYSTEM PAGE 20 OF 40			

CLAUSE NO.	TECHNICAL REQUIREMENTS		
4.16.03	Suitable platforms/ scaffoldings (for at least 2 fans) for doing maintenance work in situ for gear reducer, fan and motor shall also be provided in addition to permanent walkways as specified elsewhere in the specification. Alternative arrangements are also acceptable, if the arrangement provided is adequate to carry out maintenance on at least two cells of the tower simultaneously. In such a case, the complete equipment for easy removal of equipment from fan flume and bringing it down to ground level shall be furnished. The arrangement proposed shall be clearly brought out in the offer by the bidder.		
4.17.00	FAN MOTOR Each electric motor shall be provided with a base plate and a base frame. Fan motor shall have at least 10% margin over the maximum power requirement of the fan when the fan is operating at its test block condition and at 50 deg. C ambient temperature as required at gear box input end.		
4.18.00	STOPLOG GATE AND HANDLING FACILITY For isolation of the cold-water basin of the tower, groove for steel stop log gate shall be provided in the cold-water outlet channel of each tower. Number of stop logs to be supplied by bidder shall be as mentioned in the civil section. The minimum thickness of skin plate shall be 8 mm. The structural design of the stop log gate shall generally conform to relevant IS codes. The gate shall be painted with corrosion resistant paint- To handle the stop log gate a monorail beam at sufficient height shall be provided across each cold-water channel. A hand operated chain pulley block with travelling trolley of adequate capacity to handle the stop log gate shall be provided for each tower. The capacity of the hoist however shall in no case be less than 125% the weight of the stoplog gate.		
4.19.00	Torque Tube Support (in case of Pultruded FRP Tower) The torque tube support shall be designed to stabilize the fan within the fan cylinder and maintain constant alignment between the motor and gear reducer. The pipe, heavy angles and plates shall be hot dip galvanized after assembly. It shall be properly fastened to the structure.		
5.00.00	MISCELLANEOUS		
5.01.00	Necessary stub connections for pitot tube shall be provided in the hot water header of cooling tower for measurement of flow. Any special equipment tools and tackles required for the successful completion of the Performance & Guarantee Test shall be included by the bidder in his scope.		
6.00.00	TESTS AT SITE After Installation at site, the complete systems/equipment will be operated at site to show satisfactory performance as required by the applicable clauses of the specification. Further, all piping shall be hydraulically tested at site.		
7.00.00	PG Test		
7.01.00	Bidder shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in these specifications.		
7.02.00	The cold water temperature as specified in technical data sheets shall be guaranteed for the design conditions of CW flow, range, ambient WBT specified in technical data sheet and design power consumption indicated by the bidder.		
7.03.00	COOLING TOWERS The test circulating water flow shall be corrected for change in test fan power consumption as compared to the design fan power consumption using the cube root formula. "Predicted cold water temperature" shall then be arrived at from the guaranteed cold water temperature		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-15 CW SYSTEM
			PAGE 21 OF 40

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	by correcting the same for the test conditions of range, ambient conditions and corrected circulating water flow using the performance curves furnished by the contractor. In case the “Test cold water temperature is higher than the “Predicted cold water temperature”, Employer reserves the right to reject/accept the tower after assessing the liquidated damages. The liquidated damages for not meeting the guarantee(s) have been specified elsewhere.			
7.04.00	The performance test of one of the Cooling Tower shall be carried out by the Contractor through CTI approved/listed testing agency in presence of Employer. The testing agency proposed by the Contractor shall be approved by the Employer. The tower to be tested through CTI testing agency shall be decided / chosen by Employer. For the balance cooling towers, the demonstration performance test shall be conducted as per the same approved PG Test procedure by the contractor himself or by experienced reputed third party. In no case, the thermal performance of these towers should be less than that of the tower tested by CTI agency. In case it is found to be less, the contractor shall take appropriate measures and correct the tower to improve its performance at least up to the level of performance of tower tested by CTI agency, failing which the contractual obligation will not be completed. The data logged in the data logger shall be given to EMPLOYER in soft form for reference immediately after the test, which should be readable in EMPLOYER computer. In case, any software is required, the same shall be supplied to employer without any extra cost to employer. The CTI agency shall simultaneously submit their final report to both Contractor as well as the client (EMPLOYER).			
7.05.00	To ascertain the fulfillment of Guarantees of the Cooling Towers, the test results of the tower tested through CTI approved testing agency shall be considered for PG test evaluation and based on the test result, the liquidated damage if applicable shall be levied for all the Cooling Towers.			
7.06.00	The indicative PG test procedure to be followed as per PG test procedure chapter.			
8.00.00	CONTROL & OPERATION PHILOSOPHY			
8.01.00	This control write-up/ operation philosophy details the control / operation requirements of cooling tower fans as a general guideline only and the contractor shall furnish his proposed philosophy during detailed engineering for approval of the Employer.			
8.02.00	Modes of Operation: The fans can be started in SOLO mode or in GROUP mode. The selection for individual and Group operation shall be made from OWS. Further, any of the fan can be put either in STANDBY mode or NOT IN STANDBY mode. (i) Group Mode START In Group Mode: On receipt of the GROUP START command from OWS, all pre-selected fans (except for the fans selected as "STANDBY") would start sequentially one after another after pre-defined time gap between start of the fans. STOP in GROUP Mode: On receipt of the GROUP STOP command from OWS, all the running fans will be tripped simultaneously. GROUP STOP command will have priority over and already executing GROUP START command. (ii) SOLO Mode: In the OWS, for each individual FAN, a separate START/STOP Button will be provided. The START button will be enabled only when the SOLO mode is selected. A fan can be started in SOLO mode immediately by pressing the START button. The fan can be stopped either by pressing the STOP push-button (of the corresponding Fan) or GROUP STOP button.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-15 CW SYSTEM
PAGE 22 OF 40				

CLAUSE NO.	TECHNICAL REQUIREMENTS		
8.03.00	Interlock and Protection Following are the Start-up permissive for the fans: 1. MCC Healthy 2. Oil Level Not Very Low 3. Emergency PB not pressed 4. Gear box oil Temperature not high Following are the protections for Fan tripping: 1. Oil Level Very Low 2. Emergency PB Pressed 3. Vibration Very High 4. Motor Overload 5. Gear box Temperature very high Control System shall issue OPEN/CLOSE command for Electrical Breaker operation and monitor status. Necessary interlocks finalized during detailed engineering shall be implemented. The close status of butterfly valves and the ON/ OFF /TRIP status of fans shall be indicated in OWS. Operator shall be alerted through audio visual indication during the condition when the fan of any cell is ON and the corresponding cell isolation valve is closed or vice-versa.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-15 CW SYSTEM	PAGE 23 OF 40

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(C) EQUIPMENT COOLING WATER SYSTEM			
1.00.00	BRIEF DESCRIPTION OF SYSTEM			
1.01.00	The cooling system for TG, SG & station auxiliaries shall be of closed-circuit type with passivated demineralized (DM) water in the primary circuit. Water tapped off from CW System would be used in the secondary circuit for cooling the primary circuit DM water. Hence all materials of construction used in primary and secondary side of the auxiliary cooling system should be suitable for the water quality. The scheme shall be as per relevant tender drawing listed in Part E of the technical specification. The minimum technical requirements and equipment shall include, but not be limited to the following:			
2.00.00	SYSTEM DESIGN (UNIT AUXILIARIES)			
2.01.00	In the primary circuit a set of Demineralized cooling water (DMCW) pumps shall discharge cooling water through plate type heat exchangers (PHE). The outlet header from plate heat exchangers shall be suitably branched off to supply cooling water to auxiliary coolers. No booster pumping system shall be provided in the primary system by the bidder. Outlet from these auxiliary coolers shall be connected back into a common return header and led back to the suction of DMCW pumps to complete the closed loop primary cooling circuit.			
2.01.01	Following coolers/auxiliaries shall be cooled by ECW System (Unit Auxiliaries) of TG System. (a) Generator hydrogen coolers. (b) Turbine lube oil coolers. (c) Turbine control oil coolers. (d) Generator seal oil coolers. (e) Stator water coolers. (f) Generator slip ring coolers. (g) Sampling coolers /SWAS coolers (as applicable) in the scope of the Bidder (if any) (h) Water cooled electric motors. (i) BFP turbine oil coolers. (j) Hydraulic couplings of BFP. (k) Condensate Extraction (CEP) bearing oil coolers. (l) Any other unit auxiliary coolers envisaged by the contractor			
2.01.02	Following coolers of SG System (Unit auxiliaries) and station auxiliaries shall be cooled by ECW System. (a) ID Fans coolers. (b) FD fans Coolers. (c) PA fans Coolers. (d) Air Pre-heater Coolers. (e) Water Cooled access doors. (f) Scaffold doors. (g) Circulating Water pumps coolers. (h) Water cooled electric motors. (i) Sampling coolers /SWAS coolers (as applicable) in the scope of the Bidder (if any) (j) Flame monitoring cameras. (k) SWAS. (l) Coolers of mills and mill gear boxes. (m) Steam Coil Air Pre-Heater (SCAPH) (n) Motors of Circulating water pumps. (o) Coolers of Station Auxiliaries like Instrument & Plant (Service) Air Compressors, Compressors of Mill reject handling system, Compressors of Ash handling system, FGD & SCR system, etc			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-15 CW SYSTEM	PAGE 24 OF 40

CLAUSE NO.	TECHNICAL REQUIREMENTS															
	(p) Any other unit/station auxiliary coolers under bidder's scope not covered above.															
2.02.00	For the primary cooling circuit, an overhead (ECW) tank shall be provided by the bidder. Outlet of this tank shall be connected to the closed-circuit return header.															
2.03.00	The pH of DM water in the closed loop shall be continuously monitored and controlled at around 9.5. The control shall be achieved by dosing sodium hydroxide in ECW/DM water overhead tank & header.															
2.04.00	Normal Make up to the closed loop primary circuit from the discharge of DM water transfer pumps located in DM plant and emergency make up from the discharge of condensate transfer pumps shall be given to overhead storage tank.															
2.05.00	The secondary cooling water system (common for TG & SG system) shall operate in parallel to the condenser and shall receive water through a tapping on the CW inlet line to the main condenser. This water will be further pressurized by auxiliary cooling water pumps and fed through the plate type heat exchangers back to the CW discharge line of the main condenser.															
2.06.00	Self-Cleaning Filters To prevent fouling on the secondary circulating water side of the PHE, self-cleaning type filters with an automatic backwash arrangement to facilitate cleaning of the choked filter while the pumps are in operation, shall be provided by the bidder on the circulating water inlet header to the PHEs. Backwashing shall be actuated and controlled either according to differential pressure and /or by timer.															
3.00.00	CONSTRUCTION FEATURES															
3.01.01	The general design and construction features of various pumps of the Equipment cooling Water System shall be as per the Annexure 1 titled " General Specification for Horizontal Pumps " enclosed with this sub-section.															
3.01.02	Specific features of pumps, plate type heat exchangers and other equipment of ECW system shall be as follows: A) Pumps (primary side & secondary side) 1) The pumps shall be of horizontal centrifugal type provided with closed type impeller and axial split casing. 2) The pumps shall be designed as per requirements of Hydraulic Institute Standards (HIS), USA. 3) The pumps shall have stable head- capacity characteristic with head rising continuously towards the shut off. The shut off head of the pump shall be in the range 115-130% of the rated head. The power characteristics shall be of non-overloading type. 4) The pumps shall be suitable for continuous operation and shall operate satisfactorily in the range 40% to 120% of the rated flow. 5) The pump shall be driven by constant speed squirrel cage induction motor with speed not exceeding 1500 rpm (synchronous). <table><tr><th>SN</th><th>Description</th><th>Primary Cooling Water Pumps</th><th>Secondary Cooling Water Pumps</th></tr><tr><td>1</td><td>Casing</td><td>ASTM A 351 CF8M</td><td>2.5% Ni Cl, IS 210 Gr FG 260</td></tr><tr><td>2</td><td>Impeller</td><td>ASTM A 351 CF8M</td><td>Bronze to IS 318 Gr. I/II or SS 316/ ASTM A 351 CF8M</td></tr></table>				SN	Description	Primary Cooling Water Pumps	Secondary Cooling Water Pumps	1	Casing	ASTM A 351 CF8M	2.5% Ni Cl, IS 210 Gr FG 260	2	Impeller	ASTM A 351 CF8M	Bronze to IS 318 Gr. I/II or SS 316/ ASTM A 351 CF8M
SN	Description	Primary Cooling Water Pumps	Secondary Cooling Water Pumps													
1	Casing	ASTM A 351 CF8M	2.5% Ni Cl, IS 210 Gr FG 260													
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-15 CW SYSTEM	PAGE 25 OF 40												

CLAUSE NO.	TECHNICAL REQUIREMENTS																							
5.00.00	<table><tr><td>3</td><td>Shaft</td><td>SS 316</td><td>EN-8 (BS-970)</td></tr><tr><td>4</td><td>Shaft Sleeve</td><td>SS 410</td><td>SS 410</td></tr><tr><td>5</td><td>Impeller Wearing rings</td><td>SS 316</td><td>High leaded bronze to IS-318 Gr. V / SS 316 in case of SS impeller</td></tr><tr><td>6</td><td>Lantern ring</td><td>SS 316</td><td>Bronze</td></tr><tr><td>7</td><td colspan="3">All fasteners of SS 316 grade</td></tr></table>				3	Shaft	SS 316	EN-8 (BS-970)	4	Shaft Sleeve	SS 410	SS 410	5	Impeller Wearing rings	SS 316	High leaded bronze to IS-318 Gr. V / SS 316 in case of SS impeller	6	Lantern ring	SS 316	Bronze	7	All fasteners of SS 316 grade		
	3	Shaft	SS 316	EN-8 (BS-970)																				
	4	Shaft Sleeve	SS 410	SS 410																				
	5	Impeller Wearing rings	SS 316	High leaded bronze to IS-318 Gr. V / SS 316 in case of SS impeller																				
	6	Lantern ring	SS 316	Bronze																				
	7	All fasteners of SS 316 grade																						
	B) Plate type Heat Exchangers 1) The heat exchangers shall be of plate type with single pass design. 2) The heat transfer plates shall be of SS-316 of thickness not less than 0.6 mm and the thickness of pressure and frame plates shall be as per ASME Sec. VIII Div. I. 3) The corrosion allowance for carbon steel parts of the heat exchanger which are in direct contact with water such as support plates, nozzles shall be 1.6 mm (minimum). 4) All the plates shall be tested by light box/ vacuum/ air chamber test as per manufacturer's standard practice. 5) Double sealing arrangement shall be provided for sealing at outer edges and around ports to avoid intermixing of fluids. 6) Guide rail shall be IS-2061 with stainless steel cladding and Tightening rods shall be as per IS-1367 or equivalent. Nozzle flange gasket shall be 3 mm wire inserted Red Rubber.																							
	C) Piping, Valves /Tanks Construction features of Piping, Valves and tanks shall be as per the sub-section titled "Low Pressure Piping" of this Technical specification.																							
	D) Self Cleaning Filters Body of filter shall conform to IS:210 GR FG-260 or ASTM-A-515 GR 75 / IS-2062 and internally painted with epoxy. Strainer shall be SS-316.																							
	E) ECW (DM water) overhead tank The overhead DM make- up tank shall be Horizontal dished end type of MS construction with plates conforming to IS 2062/ ASTM A 36 and minimum thickness of shell shall be 6 mm, epoxy coated or rubber lined (4.5 mm). Accessories such as vents, overflow and drain, CO2 absorber for vent, seal for overflow, manhole & staircase, level indicator, level transmitter and level switch etc. shall be provided. Design standard shall be ASME Boiler and Pressure Vessel code section-VIII/IS:2825 (Class 3).																							
F) Alkali dosing tank Alkali preparation/ dosing tank (Vertical cylinder, dished bottom) shall be provided for gravity feed of alkali solution to overhead DM tank and suction piping of ECW system. The tank shall be of MSRL (MS plates to IS 2062 & 6 mm thick with 4.5 mm thick rubber lining) or SS (6 mm thick) construction with SS 316 basket, SS-316 agitator etc. Alternatively, dosing system comprise of one no. alkali preparation/ dosing tank along with 2x100% dosing pumps in SS 316 construction for dosing of alkali solution may be provided.																								
CONTROL / OPERATION PHILOSOPHY 1) Complete Operation and Control shall be provided as described in relevant Subsections of Control & Instrumentation System.																								
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-15 CW SYSTEM	PAGE 26 OF 40																				

CLAUSE NO.	TECHNICAL REQUIREMENTS		

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	(D) CW CHEMICAL TREATMENT		
1.00.00	The minimum technical requirements and equipment shall include, but not be limited to the following: a) Complete Sulphuric acid handling, storage, unloading and dosing system. b) Chemical day tanks shall be of MSRL construction with stirrer (SS/FRP lined) and Chemical adding facility from top. Dosing pumps compatible with handling of the chemicals shall be provided. c) Acid (H₂SO₄) tanks shall be MS construction, horizontal, with dished (Toro spherical) ends. d) The design C.O.C of the CW System shall be 5.0 (minimum) for design of Chemical Treatment program. Contractor shall include chemicals required (other than H₂SO₄, HCl & NaClO₂) for passivation of metals during commissioning also. Chemicals required after a major shutdown for re-commissioning the system shall also form part of the bidder's scope of supply. e) Design of all vertical and horizontal cylindrical atmospheric storage tanks containing water, acid, alkali, and other chemicals shall conform to IS: 803 and BS: 2594 respectively. However, dished ends shall be of Tori spherical type.		
2.00.00	The bidder shall perform the performance & guarantee test regarding the performance of chemical treatment program for complete CW system to meet the guarantees. The performance guarantee test will be carried out along with the initial operation. The O&M for complete CW Treatment System shall be for one (1) year operation after PG test of complete CW System. The entire system responsibility and maintaining the guaranteed parameters of the system along with supply of chemicals shall rest with contractor during this period. The contractor shall depute his engineer(s) (as required by Owner) to continuously monitor the system and take corrective measures in this period. Complete chemical analysis and micro-biological analysis of water is to be carried out by the bidder periodically at least once in a fortnight. Periodic report on the performance of the treatment program along with analysis report chemical consumption pattern and observation/recommendation shall be furnished by bidder to site. At mutually agreed intervals, the performance and guarantee of the scale, corrosion, fouling and biofouling shall be monitored and verified.		
3.00.00	The Bidder shall offer proven type of chemical treatment program for CW system. Reference list of previous contracts for similar CW chemical treatment program which includes supply of chemicals, operation and maintenance of the system, shall be furnished to the employer during detailed engineering.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-15 CW SYSTEM
			PAGE 28 OF 40

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	E) AUXILIARY WATER SYSTEM		
1.00.00	This Chapter describes the System Description, Basic Design Criteria and Minimum Technical Requirements of the Plant Auxiliary Water (AWS) System and associated equipment. The minimum technical requirements and equipment shall include, but not be limited to the following:		
2.00.00	SYSTEM DESCRIPTION		
2.01.0	Raw Water System to Water PT Plant and Ash Handling Plant (AHP)		
	From the water reservoir in the Plant, raw water shall be drawn to the Raw Water pump house sumps (existing system). Raw water pumps (PT and Ash) shall be provided to supply water up to the Water PT Plant, Ash water tank and fire water tank. For Raw Water Pumping System, the Contractor shall make necessary modification in the existing raw water pump house to install the pump, and associated piping, valves, lubrication system, etc. The relocation of existing lubrication water system is also in the scope of the contractor.		
2.03.00	Makeup (Clarified water) water system to CW System		
	From the Clarified Water collection chambers of the Clarifiers, water shall be led up to a Clarified water storage tank. From the Clarified water storage tank, CW makeup shall be led up to the CW Channel. The makeup shall be conveyed to the CW Channel either through a pumping system or by gravity depending on plant layout. The pumps drive and associated valves, controls shall be located in a pump house i.e., Clarified water pump house to be located near the clarified water storage tank.		
2.04.00	Make-up water system to Air Conditioning & Ventilation		
	Clarified water shall be supplied from the PT plant as makeup to the Condensing circuit of Air Conditioning Systems of the Plant and Evaporative type Ventilation system (HVAC Systems) to compensate for the Evaporation loss from the Systems.		
2.05.00	Make-up water system to FGD Gypsum wash		
	Clarified water shall be supplied from the PT plant as makeup to the FGD system for Gypsum washing.		
2.05.00	Service Water System		
	Blowdown water/ Clarified water from the clarified water tank (along with supply of treated wastewater from LETP) shall be used as service water. Service water pumps shall take suction from this tank and supply water to the service water pipe network. Service water distribution shall be used for effective cleaning /washing of each area and shall also fill the service water tank provided on roof top of each building to supply water to toilets.		
2.06.00	CW Blow Down System		
	The CW blow system shall be designed so that total quantity of CW blow down water can be led up to the Central monitoring basins of Liquid Effluent Treatment Plant for use in service water system in case of fluctuation of requirement of these consumers during operation of the plant.		
2.07.00	Demineralized (DM) Water Make-up System		
	a) DM water make-up system shall supply DM water to-		
	1) Cycle Make-up to the condensers		
	2) Make-up to the ECW System (Primary circuit) overhead tank,		
	3) Any other system envisaged by the contractor in design		
	b) The main storage for DM Water shall be provided in Water Treatment plant area.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-15 CW SYSTEM
			PAGE 29 OF 40

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	c) A DM water makeup pump house shall be provided near the main DM Water Storage tanks of Water Treatment Plant. All the pumps and associated pumps, drives, Valves etc. shall be located indoor in this pump house. d) For meeting above mentioned makeup requirement, a set of DM water pumps and one number pipe shall be provided by the Contractor. Pump re-circulation system shall be provided for the DM water pumps from the discharge to the DM tanks. e) The makeup to the various tanks shall be controlled through the respective motor actuated inlet control valves based on the level in the respective Tanks.			
2.08.00	Boiler Fill System	Set of pumps and piping shall be provided in DM Water makeup pump house to meet the requirements of Boiler filling system. Pump re-circulation system shall be provided for the Boiler fill pumps from the discharge to the DM tanks. The filling operation to Boiler and Deaerator shall be controlled through the respective motor actuated inlet valves.		
2.09.00	Potable Water System	Potable water system shall meet the drinking water required for all the plant facilities/buildings included in Contractor's scope and supply water up to the specified terminal point. Potable water shall be pumped from the existing potable water system of stage-I. Required connections including piping, valves and fittings are included in bidder's scope of work. The plant potable water network shall supply potable water required for all the facilities/buildings/ areas included in Contractor's scope except make up water pump house & ash water recirculation pump house and shall fill the potable water tanks provided on roof top of each building to supply drinking water (PVC tank of capacity as specified in Civil Works sub section) to drinking water point /water coolers inside the building.		
2.10.00	Air Pre-heater wash water System	The system is required for washing of Air pre-heater.		
2.11.00	Condensate Transfer System	The system shall be able to supply emergency make up water to condenser from condensate storage tanks.		
2.10.00	Various Sump Pumps, Drainage Pumps and Submersible Pumps	1) For de-watering of drain pits in TG Hall, boiler area, transformer yard, cooling tower basins, underground pump sumps of raw water pump house, CW pump house, other pump houses, pipe /cable trenches etc. sump pumps, drainage pumps and submersible pumps shall be used. 2) Each pit shall be provided with two numbers (2 x 100% Capacity) of respective type pumps so that the entire pit is evacuated within 15-20 minutes and the operation of the pumps shall be interlocked through with level measurements devices to be installed in the pit/sump.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-15 CW SYSTEM	PAGE 30 OF 40

CLAUSE NO.	TECHNICAL REQUIREMENTS			
Annexure-1				
HORIZONTAL CENTRIFUGAL PUMPS				
1.00.00	SCOPE			
	General requirements in respect of design, material, constructional features, manufacture, inspection, testing the performance at the Vendor's/ Sub-Vendor's works and delivery to site erection, field testing and commissioning of Horizontal Centrifugal Pumps. The minimum technical requirements and equipment shall include, but not be limited to the following:			
2.00.00	CODES AND STANDARDS			
2.01.00	Design, material, construction manufacture inspection and performance testing of Horizontal Centrifugal Pumps shall comply with all currently applicable statutes, regulations, and safety codes in the locality where the equipment will be installed. The equipment supplied shall comply with the latest applicable Indian standards listed below. Other National Standards are acceptable, if they are established to be equal or superior to the Indian Standards.			
2.02.00	List of Applicable Standards			
	i) IS : 1520 - Horizontal Centrifugal Pumps for clear cold fresh water.			
	ii) IS : 5120 - Technical requirements of roto-dynamic special purpose pumps			
	iii) API - 610 - Centrifugal pumps for general refinery service.			
	iv) IS : 5639 - Pumps Handling Chemicals & corrosion liquids.			
	v) IS : 5659 - Pumps for process water			
	vi) HIS - Hydraulic Institute Standards; USA			
	vii) ASTM-I-165-65 - Standards Methods for Liquid Penetration Inspection.			
3.00.00	DESIGN REQUIREMENTS			
3.01.00	The maximum efficiency of pumps shall be preferably within + 10% of the rated design flow indicated in data sheets.			
3.02.00	Total head capacity curve shall be continuously rising from the operating point towards shut - off without any zone of instability and with a minimum shut off head of 15% more than design head.			
3.03.00	Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. The head Vs capacity and BHP Vs capacity characteristics should match to ensure even load sharing and trouble-free operation throughout the range. Components of identical pumps shall be interchangeable.			
3.04.00	Pumps shall run smoothly without undue noise and vibration. Peak to peak vibration limits shall be restricted to the following values during operation.			
	Speed	Antifriction bearing	Sleeve bearing	
	1500 rpm and below	75.0-micron	75.0 micron	
	3000 rpm	50.0-micron	65.0 micron	
	The noise level shall not exceed 85 dBA. Overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1M from the equipment surface.			
4.00.00	DESIGN CONSTRUCTION			
4.02.00	Pump casing shall have radially/axially split type construction. The casing shall be designed to withstand the maximum shut - off pressure developed by the pump at the pumping temperature. The pumps shall be capable of starting with discharge valve fully open and close condition.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-15 CW SYSTEM
PAGE 31 OF 40				

CLAUSE NO.	TECHNICAL REQUIREMENTS		
4.03.00	Pump casing shall be provided with a vent connection and piping with fittings & valves Casing drain as required shall be provided complete with drain valves, piping and plugs. It shall be provided with a connection for suction and discharge pr. Gauge as standard feature.		
4.04.00	Impeller Impeller shall be closed or semi-closed as specified elsewhere and designed in conformance with the detailed analysis of the liquid being handled		
4.05.00	Impeller/ Casing Wearing Rings Replaceable type wearing rings shall be provided at suitable locations pumps.		
4.06.00	Shaft The critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed.		
4.07.00	Shaft Sleeves Shaft sleeves shall be fastened to the shaft to prevent any leakage or loosening		
4.08.00	Bearings The bearings offered shall be capable of taking both the radial and axial thrust. Anti-friction bearings of standard type, if provided, shall be selected for a minimum life 16,000 hours of continuous operation at maximum axial and a radial loads and rated speed. Bearings shall be easily accessible without disturbing the pump assembly.		
4.09.00	Stuffing Boxes / Mechanical Seals Stuffing boxes of packed ring construction type or mechanical seals shall be provided wherever specified. Packed ring stuffing boxes shall be properly lubricated and sealed as per service requirements. If external gland sealing is required, it shall be done from the pump discharge. The Mech sealing face should be low frictional co-efficient & resistance to corrosion against the liquid being pumped.		
4.11.00	Pump Shaft Motor Shaft Coupling The Pump and motor shaft shall be connected with a adequately sized flexible coupling of proven design with a spacer		
4.12.00	Base Plate A common base plate mounting both for the pump and motor shall be furnished. The base plate shall be of fabricated steel and of rigid construction, suitable ribbed and reinforced.		
4.13.00	Assembly and Dismantling Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouting base plate or alignment.		
4.14.00	Drive Motor (Prime Mover) The KW rating of the drive shall be based on continuously driving the connected equipment for the conditions specified. In case, where parallel operation of the pumps is specified, the actual motor rating is to be selected considering overloading of the pump in the event of tripping of operating pumps. Continuous motor rating (at 50 deg. Cent, ambient) for pump shall be at least 10% above the maximum load demand of the driven equipment in the complete range.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-15 CW SYSTEM
			PAGE 32 OF 40

CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.00.00	Technical Data sheet of Pumps			
	No	Designation\Application	Clarified/Raw/ Treated water	DM water
	1)	Operating Speed	1500 rpm (nominal)	
	2)	Pumps and drives to be designed for	Outdoor duty & Continuous Operation	
	3)	Type of lubrication	Grease	
	4)	Suction condition	Flooded Suction	
	5)	Type of Shaft Sealing	Gland packing	Mechanical Seal
	6)	Type of coupling (motor & pump)	Flexible	
	11)	Material of Construction		
	i)	Casing, Stuffing Box, Gland	2.5% Ni IS210 Gr 260	CI FG ASTM A CF8M
	ii)	Impeller	ASTM A351 CF8M	
		Wearing rings (if applicable)	SS – 316	
	iii)	Shaft, Shaft Sleeves	SS-410	
	iv)	Bolts & nuts	SS 316 for those encountering water and for others, material shall be high tension carbon steel.	
	v)	Base plate (min 12 mm thick)	Carbon Steel (Epoxy Painted)	
	7)	Accessories	a. Required Instrumentation b. Companion flanges with nuts, bolts and gaskets, Anchor bolts, nuts, sleeves and inserts. c. Internal piping with valves, filters & Instruments for sealing/ cooling/ lubrication system up to and including isolating valve etc. d. Positioning dowels, Eye bolts, lifting etc. e. Ladders, Platforms & Other accessories	
	SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	
			SUB SECTION-A-15 CW SYSTEM	
			PAGE 33 OF 40	

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	Annexure-2		
	VERTICAL PUMPS		
1.00.00	SCOPE		
1.01.00	This specification covers general requirements in respect of design, construction features, manufacture, inspection, and performance at Vendor's / sub-vendor's works delivery to site, erection field testing and commissioning of Raw Water Pumps (for PT & Ash). The minimum technical requirements and equipment shall include, but not be limited to the following:		
2.00.00	CODES AND STANDARDS		
2.01.00	The design, material, construction, manufacture, inspection, testing and performance of Vertical Pumps shall comply with all currently applicable statutes, regulations, and safety codes in the locality where the equipment will be installed. The equipment supplied shall comply with the latest applicable Standards listed below. Other national standards are acceptable, if they are established to be equal or superior to the listed standards.		
2.02.00	List of Applicable Standards		
	IS: 1710	:	Vertical Turbine Pumps for clear cold fresh water.
	IS: 5120	:	Technical requirement of rotor dynamic special purpose pumps.
	HIS	:	Hydraulic Institute Standards U.S.A.
	PTC 82	:	Centrifugal pumps-power test code
	API 610	:	Centrifugal pumps for general refinery purposes.
3.00.00	DESIGN AND PERFORMANCE REQUIREMENTS		
3.01.00	The maximum efficiency point of the pumps shall preferably lie within 10% of the rated design flow.		
3.02.00	Pumps of a particular category shall be identical, suitable for parallel operation and provided with interchangeable components. Head vs. capacity and BHP vs. Capacity characteristic should match to ensure even load sharing and trouble-free operation throughout the range.		
3.03.00	The pumps shall have stable Head vs. Capacity characteristic continuously rising towards shut-off with the highest at shut-off and with an approximate shut-off head of 15% or more than the design head for radial flow pumps and 50% more than the design head for mixed flow/ turbine type pumps.		
3.04.00	The operating range of operation of pumps shall generally be 40% to 120% of rated flow for sustained period of operation.		
3.05.00	The power requirement of the pump shall be non-over loading type for mixed flow/ turbine type pumps.		
3.06.00	The critical speed of the pump shall be less than 80% of the rated speed or more than 130% of the rated speed. Also, the critical speed of the pump-motor assembly shall be more than the maximum reverse run-away speed.		
3.07.00	Pump shall run smoothly without undue noise and vibration. The vibration limit measured at motor end shall not exceed the limit specified in Hydraulic Institute Standards. The noise level shall not exceed 85 dBA overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1M from the equipment surface.		
3.08.00	The base plate, foundation bolts, motor stool and other components shall be designed to take the full force coming on the discharge elbow under shut-off condition.		
3.09.00	Water for motor cooling and thrust bearing cooling, if required, shall be tapped from the discharge of the pumps and/or fed from an over-head tank. All piping, valves, strainer,		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-15 CW SYSTEM
			PAGE 34 OF 40

CLAUSE NO.	TECHNICAL REQUIREMENTS		
			
	instruments etc. required for this purpose and line shaft bearing lubrication (if required) shall be provided by the Contractor.		
3.12.00	Reverse Rotation		
	a) The pump shall be provided with an approved mechanical device to protect reverse rotation on loss of drive motor power and failure of discharge valve to close.		
	b) a reverse rotation detection switch shall be provided to prevent starting of motor while rotating in reverse direction.		
3.13.00	Motor Rating		
	The pumps shall be capable of starting with discharge valve fully closed as well as fully open conditions. Motors shall be selected to suit to the above requirements. Continuous motor rating (at 50°C ambient) for all pumps shall be at least ten per cent (10%) above the maximum load demand of the driven equipment in the complete operating range (including run out condition) to take care of the system frequency/voltage variation.		
	Drive motors shall be connected directly to the line shaft of the pump.		
4.00.00	DESIGN AND CONSTRUCTION		
4.01.00	Pump Type		
	Pumps shall be of vertical shaft, single stage/multi-stage, submerged suction, complete with bowl, column & head assembly, and drive assembly. The pump design shall be of pullout/non-pull-out type as specified		
4.02.00	Discharge head		
	The pump discharge shall be of above-floor type/sub-floor type. In certain cases of pump installation where expansion joint is located immediately at the pump discharge, the pump assembly will be subjected to the unbalanced hydraulic thrust. A thrust pad will be built in with the discharge head for transmitting the hydraulic thrust to external structures such that this hydraulic thrust is not transmitted to the foundation bolts for which they may not be designed.		
4.03.00	Column Pipe		
	Column pipes shall be flanged and bolted and shall be complete with gaskets, nuts, and bolts. The length of shaft & column sections shall not exceed 3.0 meters.		
4.04.00	Impeller		
	The impeller shall be closed, or semi-open or open as specified elsewhere.		
4.05.00	Wearing Rings		
	Replaceable type wearing rings shall be provided for both casing and the impeller. For open impellers replaceable casing liners shall also be provided. The difference in hardness of the casing & impeller wearing rings shall be minimum 50 BHN.		
4.06.00	Impeller & Line Shaft		
	Shaft size selected based on maximum combined shear stress must take into consideration the critical speed as per API - 610.		
4.07.00	Pump & Shaft Bearings - lubrication		
4.07.01	Adequate number of properly designed bearings shall be furnished. The type of lubrication i.e., self-water lubrication or forced water lubrication shall be provided.		
4.07.02	Self water Lubrication System		
	The line shaft bearings shall be lubricated by the water being pumped. The main pump and line shaft bearings which are above minimum water level shall be of 'Thordon' type/		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-15 CW SYSTEM
			PAGE 35 OF 40

CLAUSE NO.	TECHNICAL REQUIREMENTS																												
4.07.03	equivalent. For other line shaft bearings located below minimum water level, cutless rubber bearings can be used. Forced water lubrication system The line shaft shall be provided with shaft enclosing tube to exclude pumped water from shaft and bearings. Lubricating water pumps shall be provided to supply lubricating water for bearings. These lubricating water pumps shall get supply from the overhead water storage tank.																												
4.08.00	Thrust Bearings Single thrust bearing at motor top or separate thrust bearings at pump and motor shall be provided to take care of hydraulic thrust and weight of the rotating assembly. Thrust bearing shall be spherical roller type or superior, capable of absorbing axial thrust in both directions of rotation. Water required for cooling of thrust bearing shall be taken from pump discharge, wherever applicable. The thrust bearing shall be rated for continuous operation with thrust as developed in shut-off condition with clearance between the wearing rings in worn out condition to be at least four (4) times the clearance between the wearing rings in new condition.																												
4.09.00	Pump Motor Supports, Base plate etc. The pump and motor shall have a common support. The necessary supporting frame, base plates, mounting plates etc. as required shall be supplied under this specification.																												
4.10.00	Stuffing Box Gland packing shall be provided at the top-of-the-line shaft. Shaft sleeves shall be provided at the stuffing box.																												
4.11.00	Assembly and Dismantling Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouted base/sole plate or alignment.																												
9.00.00	Technical Data Sheet (if not mentioned specifically elsewhere in the CW System technical specifications) of Pumps <table><tr><th>SN</th><th>Description</th><th>Parameters</th></tr><tr><td>1</td><td>Designation</td><td>As applicable</td></tr><tr><td>2</td><td>Total No. of Pumps</td><td>As applicable</td></tr><tr><td>3</td><td>No. of Working Pumps</td><td rowspan="3">As applicable</td></tr><tr><td>4</td><td>No. of Standby Pumps</td></tr><tr><td>5</td><td>Guaranteed Flow & Total Head (Guaranteed)</td></tr><tr><td>6</td><td>Operating Speed (Max.)</td><td>1500 rpm</td></tr><tr><td>7</td><td>Pumps and drives to be designed for</td><td>Outdoor duty & Continuous Operation</td></tr><tr><td>10</td><td>Type of Pump</td><td>Vertical Wet Pit & Non-Pull out type</td></tr></table>				SN	Description	Parameters	1	Designation	As applicable	2	Total No. of Pumps	As applicable	3	No. of Working Pumps	As applicable	4	No. of Standby Pumps	5	Guaranteed Flow & Total Head (Guaranteed)	6	Operating Speed (Max.)	1500 rpm	7	Pumps and drives to be designed for	Outdoor duty & Continuous Operation	10	Type of Pump	Vertical Wet Pit & Non-Pull out type
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-15 CW SYSTEM	PAGE 36 OF 40																									

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	13	Type of Discharge	Above Floor
	14	Type of Impeller	Closed / Semi-open
	16	Type of Lubrication	Forced water/ Self lubrication (as specified)
	18	Minimum Water Level in sump	Min submergence level of pump plus 0.5.m
	19	Maximum Water Level in sump	As per system requirement (Min 0.2 m below FGL)
	21	Sump Invert Level	As per HIS
	22	Operating Floor Level	Min. 0.5 M above FGL
	23	Other dimensions of sump, Fore-bay etc	As per HIS & system requirement
	25	Accessories to be provided with each pump	a. Required Instrumentation b. Companion flanges with nuts, bolts and gaskets, Anchor bolts, nuts, sleeves and inserts. c. Internal piping with valves, filters & Instruments for sealing/ cooling/ lubrication system up to and including isolating valve etc. d. Positioning dowels, Eye bolts, lifting etc. e. Ladders, Platforms & Other accessories
	26	MOC	
	i	Suction Bell, Casing / Bowl	2.5% Nickel Cast Iron, IS: 210 Grade FG 260; S-0.1% max. P-0.15% max.
	ii	Casing Liner	Stainless steel (SS)
	iii	Impeller	Austenitic SS ASTM A743/ CF8M Grade
	iv	Wearing rings	SS-316
	v	Impeller Shaft, Pump & line shaft, Pump & Shaft Coupling, Pump & Shaft Sleeves	SS - ASTM A 276 Gr. 410.
vi	Shaft bearings	Cutless rubber with bronze retainer for below minimum water level and Thordon type for above minimum water level.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE			
TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001			
SUB SECTION-A-15 CW SYSTEM			
PAGE 37 OF 40			

CLAUSE NO.	TECHNICAL REQUIREMENTS																																
	<table><tr><td>vii</td><td>Column pipe</td><td>Fabricated steel as per IS: 2062 (minimum thickness - 10 mm) with 2 coats of epoxy coating inside & outside.</td></tr><tr><td>viii</td><td>Shaft Enclosing Tubes</td><td>Fabricated steel as per IS: 2062 (minimum thickness - 6 mm) with 2 coats of epoxy coating inside & outside.</td></tr><tr><td>ix</td><td>Discharge Head</td><td>Fabricated steel as per IS: 2062 (minimum thickness - 10 mm) with 2 coats of epoxy coating inside & outside.</td></tr><tr><td>x</td><td>Distance Piece (if applicable)</td><td>Fabricated steel as per IS: 2062 (min thickness 10 mm) with 2 coats of epoxy coating inside.</td></tr><tr><td>xii</td><td>Stuffing Box, Gland</td><td>2.5 % NI-CI to IS-210 FG-260</td></tr><tr><td>xiii</td><td>Gland Packing</td><td>Impregnated Teflon</td></tr><tr><td>xiv</td><td>Gaskets</td><td>Wire reinforced rubber gasket / Neoprene Rubber / Compressed Asbestos Fibre</td></tr><tr><td>xv</td><td>Ladders, Platforms & Other Accessories</td><td>Fabricated steel as per IS: 2062</td></tr><tr><td>xvi</td><td>Bolts & Nuts</td><td>Stainless Still AISI Type 316 for those coming in contact with water and for others material shall be High Tension Carbon Steel</td></tr><tr><td>xvii</td><td>Baseplate & Soleplate (min 12 mm thick), Matching flange</td><td>Fabricated steel as per IS: 2062</td></tr></table>			vii	Column pipe	Fabricated steel as per IS: 2062 (minimum thickness - 10 mm) with 2 coats of epoxy coating inside & outside.	viii	Shaft Enclosing Tubes	Fabricated steel as per IS: 2062 (minimum thickness - 6 mm) with 2 coats of epoxy coating inside & outside.	ix	Discharge Head	Fabricated steel as per IS: 2062 (minimum thickness - 10 mm) with 2 coats of epoxy coating inside & outside.	x	Distance Piece (if applicable)	Fabricated steel as per IS: 2062 (min thickness 10 mm) with 2 coats of epoxy coating inside.	xii	Stuffing Box, Gland	2.5 % NI-CI to IS-210 FG-260	xiii	Gland Packing	Impregnated Teflon	xiv	Gaskets	Wire reinforced rubber gasket / Neoprene Rubber / Compressed Asbestos Fibre	xv	Ladders, Platforms & Other Accessories	Fabricated steel as per IS: 2062	xvi	Bolts & Nuts	Stainless Still AISI Type 316 for those coming in contact with water and for others material shall be High Tension Carbon Steel	xvii	Baseplate & Soleplate (min 12 mm thick), Matching flange	Fabricated steel as per IS: 2062
vii	Column pipe	Fabricated steel as per IS: 2062 (minimum thickness - 10 mm) with 2 coats of epoxy coating inside & outside.																															
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-15 CW SYSTEM																														
			PAGE 38 OF 40																														

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	Annexure-3		
	SUBMERSIBLE PUMPS		
1.00.00	SCOPE		
1.01.00	This specification covers general requirements in respect of design, material, manufacture, construction, testing & inspection at Vendor's / sub-vendor's delivery to side, of submersible pumps. The minimum technical requirements and equipment shall include, but not be limited to the following:		
2.00.00	CODES AND STANDARD		
	The design manufacture and performance of submersible pumps shall be complied with all currently applicable statues, regulation, and safely codes in the locality where the Equipment will be installed. The Equipment shall also conform to the latest applicable Indian standards listed below/equivalent standards.		
2.01.00	List of Applicable Indian Standards		
	IS: 8034	-	Submersible pumps for clear cold fresh water
	IS: 5120	-	Technical requirement of Rotodynamic Special Purpose pumps.
3.00.00	DESIGN AND PERFORMANCE REQUIREMENTS		
	a) The pump shall be of single stage mono - block type with non-clog design.		
	b) Components of Identical pumps shall be interchangeable.		
	c) Pumps shall have continuously rising head characteristics.		
4.00.00	MOTOR RATING		
	Continuous motor rating (at 50 deg. C ambient) for pumps shall be at least ten percent (10%) above the maximum load demand of the driven equipment in the complete operating range to take care of the system frequency variations.		
5.00.00	FEATURES OF CONSTRUCTION		
	a) Pumps shall be of Submersible, wet pit type.		
	b) Pumps shall be able to pass through solids up to 60 mm and capable of handling wastewater which may contain, sludge, plastic solids etc.		
	c) Coupling device shall ensure leak proof joint between the pump and discharge elbow. This shall also enable pump to be removed from the sumps without the necessity of dismantling any nuts, bolts etc.		
	d) Pumps shall be portable type and capable of using in any sump as and when required. Pump shall be provided with required stool, flexible, hose chain connection etc. for easy installation, removal, and maintenance. Adequate length of chain required for lowering the pump into the sump and flexible type discharge pipe shall be provided.		
	e) Impeller		
	Enclosed impellers shall be equipped with seal rings on their hubs. In case of open impeller, the pump shall be designed to take care of the additional thrust produced.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-15 CW SYSTEM
			PAGE 39 OF 40

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	Annexure-4		
1.00.0	Control philosophy for CW System, ECW and Auxiliary Water Pumps etc.		
	1) The Pumps shall be controlled from the Control Room. The start/stop commands of these pumps, all associated auxiliaries/drives including all the motor operated discharge valves, shall be routed through control system where all interlocks & permissive shall be implemented and start/stop signals shall be issued to MCC/Switchgear. The operation of interconnecting valve and any other common drive shall be possible from pump house as well as DDCMIS. The exact details of the same shall be finalised during detailed engineering. 2) A local push button switch shall be used for emergency tripping of the motor. The pump can be started either with pump discharge valve partially open or in closed position depending upon contractor's standard practice. 3) Applicable for CW Pumps- The CW Pumps shall be controlled as specified in relevant chapters of Control & Instrumentation. Pump can be started only when either at least one of the flow circuits through the respective condenser to the discharge duct and cooling tower is established or re-circulation line to pump sump is open. 4) As applicable, an interlock shall prevent the starting of pump unless bearing lubricating water flow and motor bearing cooling water flow has been established over a period. Low flow of either pump or motor bearing cooling water when the pump is running will give alarm(s) and trip the pump with alarm in case of sustained low value over a preset time. 5) Low flow of either pump or motor bearing cooling water when the pump is running will give alarm(s) and trip the pump with alarm in case of sustained low value over a preset time. 6) In case of high pressure at pump discharge due to accidental closure of any of the butterfly valves, an alarm shall be generated. 7) In case of normal stopping, when a pump control switch is turned 'OFF', the butterfly valve at its discharge shall first close (25-30) % before the respective pump motor is de-energized. On tripping of motor due to any reason, the butterfly valve at the discharge shall close fully automatically. 8) If water level in pump sump is low, an alarm shall be initiated. Pump shall be tripped in case of very low level of water in the intake sumps and very high discharge header pressure. 9) Regulating the CW system makeup valve shall control the water level in the sump/fore bay. 10) Pump shall be tripped from very high winding temperature of motor and very high metal temperature of thrust bearings. Alarm shall be provided for high motor winding temperature and high motor/ pump bearing temperature. 11) The operation philosophy as detailed above is suggestive only and shall be finalized with the successful bidder after award of contract and shall be subject to Employer's approval.		
2.00.00	Instrumentation for CW System, ECW and Auxiliary Water Pumps.		
2.01.00	Vibration monitoring system, if necessary, shall be provided. The alarm and trip signals from vibration system shall be connected to the Control system. Bidder shall provide Duplex temperature elements for bearing & winding temperature monitoring points if specified. The excessive bearing/winding temperature shall be used for alarm and tripping of pumps/ motors. Further, Bidder shall provide required level & pressure sensing instruments as specified elsewhere in relevant Subsections of Control & Instrumentation and/or tender drawings.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-15 CW SYSTEM
			PAGE 40 OF 40



SUB-SECTION-A-16

COMPRESSED AIR SYSTEM

**SINGARENI THERMAL POWER PROJECT
STAGE-II (1X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC NO.:CW-CM-11159-C-O-M-001**

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	COMPRESSED AIR SYSTEM		
1.00.00	SYSTEM DESCRIPTION		
1.01.00	The compressed air system shall consist of Instrument Air compressors & their motor drives, Air Drying (ADPs) Plants, Service Air compressors & their motor drives, air receivers for each Air compressors, instrumentation and control, control panels, interconnecting compressed air piping in the compressor house, Instrument Air Piping network, service air piping network and Unit Instrument Air receivers (One for each unit).		
1.02.00	The Air compressors & Drives, instruments, control panels and ADPs shall be located indoor inside the compressor house and the air receivers shall be located outside the compressor house. The compressor house shall be provided with an electrically (with pendent control for long travel, cross travel and lifting) operated, overhead traveling type (EOT) crane.		
1.03.00	Unit Air receivers for instrument air system provided to cater the requirements of Instrument air requirement of respective SG (Steam generator) & auxiliaries and TG (Turbine Generator) and its auxiliaries. The Unit Air receivers shall be located in TG building area.		
1.04.00	Further, a dedicated air receiver shall be provided near Demineralising Plant to meet the instrument air requirement of Water Treatment plant. Dedicated air receivers shall be provided to meet the instrument air requirement of ash handling System.		
1.05.00	Air from Instrument air compressors shall be dried in respective Air Drying Plants in compressor house and delivered to the Air receivers. From the Compressed air piping header at the downstream of Air receivers, one instrument air piping header for each unit of main plant and one for balance of plant shall be provided. Distribution of instrument air network shall be provided as per the tender drawing.		
1.06.00	A separate service air header shall be tapped off from the pipe header at Service Air receiver outlet and distributed as per the tender drawing.		
1.07.00	Compressor house shall be steel framed structure with brick wall up to windowsill height & single skin metal panel cladding above it.		
2.00.00	EQUIPMENT DESCRIPTION:		
2.01.00	The minimum requirements of design and construction features of various components of Compressed air system (screw /Centrifugal type air compressor, air dryer, air receiver, etc.) are described below.		
3.00.00	SCREW AIR COMPRESSORS		
3.01.00	CODES AND STANDARDS		
3.01.01	The design, manufacture, testing and performance of the various components of the rotary screw type air compressors shall comply with the requirements of relevant codes (IS-5456, IS-10431 [part -1], ASME PTC-9, IS-6206, IS-5727, ISO-1217 and CAGI).		
3.01.02	Other International Standards like American/BS/DIN or superior to above mentioned standards are acceptable. Where IS specification is not available, the equipment shall conform to one such International Standard, which shall be indicated in the proposal.		
3.02.00	DESIGN AND CONSTRUCTION		
3.02.01	The compressor shall be oil free multistage, horizontal, water cooled, rotary screw type, heavy duty, rugged construction. Their speed shall be so selected as to result in low maintenance and trouble-free operation under specified conditions.		
3.02.02	Each compressor unit shall be complete with electric motor drive of suitable capacity. Driver rating shall be minimum 110% of compressor rated BkW at rated conditions.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE			
TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001			
SUB SECTION-A-16 COMPRESSED AIR SYSTEM			
PAGE 1 OF 7			

CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.02.03	The rotor and shaft shall be made of forged steel. The stator (casing) shall be of Cast-Iron (IS-210) construction with integral jacket cooling. The rotors shall be dynamically balanced to reduce vibration.		
3.02.04	The seal rings and retainers shall be of stainless steel construction and be free for radial self adjustment along the rotor shafts.		
3.02.05	Bearings shall be high precision antifriction type IS- 25 Grade 84). The axial thrust load shall be minimized by dividing the axial load of compression on the main and auxiliary bearings through suitable balancing arrangement.		
3.02.06	Any superior material & type (as per proven practice and relevant standard) of various components of screw compressor is also acceptable.		
3.02.07	Lubrication system shall be as per manufacturer standard practices.		
3.03.00	Gear Box		
3.03.01	Gears shall have a rating of AGMA-12 or equivalent. Speed increasing gears between the motor and compressor stages shall consist of a common helical gear driving the pinion of each stage. Helical timing gears shall be mounted on the rotor shafts to maintain accurate relative rotor position.		
4.00.00	CENTRIFUGAL AIR COMPRESSORS		
4.01.00	CODES AND STANDARDS		
4.01.01	The design, manufacture, testing and performance of air compressors and accessories shall comply with the requirements of one or more of the relevant codes as applicable (IS-2825, IS-4503, CAGI, IS-5727, IS-6206, ASME-PTC-10, API 672 and IS-11727).		
4.01.02	International Standards like American/BS/DIN or superior to above mentioned standards are acceptable. When IS specification is not available, the equipment shall conform to one such International Standard, which shall be indicated in the proposal. All codes and standards used/ referred to shall be to their latest edition/ version as on the date of the acceptance of the tender.		
4.02.00	DESIGN AND CONSTRUCTION		
4.02.01	Each compressor unit shall be complete with electric motor drive of suitable capacity. Driver rating shall be minimum 110% of compressor rated BKW at rated conditions or BKW at un-throttled minimum ambient temperature whichever is higher.		
4.02.02	Compressor components shall be interchangeable as far as possible.		
4.02.03	Air Compressors shall be oil free centrifugal air compressors with non-contact air/oil seals, each capable of delivering continuously rated volume flows at rated delivery pressure.		
4.02.04	The rotor shaft shall be made of Stainless Steel. The rotors shall be dynamically balanced to reduce vibration.		
4.02.05	Any superior material & type (as per proven practice and relevant standard) of various components of screw compressor is also acceptable.		
4.02.06	The gaskets shall be of asbestos free material.		
4.02.07	Lubrication system shall be as per manufacturer standard practices.		
4.02.08	Each compressor shall be provided with Inlet Guide Vane (IGV) control for suction air volume control.		
4.02.09	Each compressor shall be provided with coupling guard with fixing arrangement.		
4.02.10	Proper and robust supporting arrangement shall be provided from foundation/ floor for overhang casing, oil coolers, air piping, cooling water piping, oil piping, etc.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-16 COMPRESSED AIR SYSTEM PAGE 2 OF 7

CLAUSE NO.	TECHNICAL REQUIREMENTS		
4.02.11	Compressors shall be provided with adequate safety, protection control system including anti surge protection with bypass valve etc. and auto dual control (either; controlled for constant pressure or constant volume flow). The duty points shall be at least 15% away from the anti surge line.		
4.03.00	PERFORMANCE REQUIREMENT		
4.03.01	Air Compressors (Screw /Centrifugal type) shall be designed for continuous operation with high efficiency to satisfy the performance requirement.		
4.03.02	As more than one compressor with drive is specified, satisfactory operation in parallel shall be ensured without any uneven load sharing, undue vibration, keeping noise level within permissible limits for a number of compressors working simultaneously in the same room.		
4.03.03	Compressor shall have 25% minimum turndown capability (at 45 deg C & 75% RH). Compressor shall be provided with IGV at the suction flange.		
5.00.00	INTERCOOLER, AFTERCOOLER & OIL COOLERS (FOR SCREW/CENTRIFUGAL)		
5.01.00	Intercoolers & after coolers shall be designed in accordance with Section VIII, Division 1 of ASME Code or equivalent.		
5.02.00	Outlet temperature of air from intercooler shall be suitable to suit the equipment and outlet temperature of air from the compressor house outlet header shall be limited to 45 deg.C. However, the instruments or the pneumatic devices requires air temperature less than 45 deg.C., the same shall be achieved at the outlet header.		
5.03.00	Coolers shall be provided with removable tube bundle design in accordance with design code TEMA Class C and shall be constructed with removable shell cover. However, plate type oil coolers as per OEM standard & proven design are also acceptable.		
5.04.00	Design pressure shall be 8 Kg/cm2 (g) or based on shut-off head of cooling water pumps.		
5.05.00	The coolers shall be designed for maximum heat load and atleast 10 percent design margin shall be provided in the number of tubes.		
5.06.00	Adequately sized safety valves shall be provided for both intercoolers and after coolers. However, in case of centrifugal compressors, safety provisions as per manufacturer's standard & proven design are also acceptable.		
5.07.00	Each intercooler and aftercooler shall be provided with moisture separator units with suitable baffling. Moisture separator units shall be equipped with a level gauge glass with isolating cock.		
5.08.00	Electrically operated automatic drain trap stations with bypass and isolating valves shall be provided for moisture separators for automatically draining of condensed moisture. The drain trap shall be timer based. Manual draining facility shall also be provided in the drain trap.		
5.09.00	Cooler shells, channels and covers shall be of carbon steel (SA 285 Gr C / SA 516 Gr 70). Tube sheet shall be of Brass or SS and the tubes shall be of Admiralty brass or Aluminium brass or Copper or SS 304. However, any superior material as per proven practice and relevant standard is also acceptable.		
6.00.00	AIR RECEIVERS		
6.01.00	Capacity of each of the air receivers in the compressor house shall be of minimum 10 M ³ (nominal). The capacity of the Unit air receivers shall be minimum 10 M ³ (nominal) or to suit the emergency storage requirement (if any) for any of the Bidder's requirement whichever is higher.		
6.02.00	Receivers (other than unit air receivers) shall be outdoor located and vertical cylindrical vessel with dished ends.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-16 COMPRESSED AIR SYSTEM PAGE 3 OF 7

CLAUSE NO.	TECHNICAL REQUIREMENTS				
6.03.00	The design pressure and temperature shall be minimum 10 Kg/cm ² (g) and 50 deg.C respectively. Receivers shall be designed in accordance with Section VIII, Division 1 of ASME Code or equivalent.				
6.04.00	Air receivers are to be provided with gasketed inspection manhole of minimum 500 mm diameter with cover plate, lifting handle, davit cap etc.				
6.05.00	Receivers shall be of welded construction with minimum number of joints. Longitudinal seam in adjacent sections shall not be in same line. Welding shall be as per relevant codes. Filler material to have composition & structure as that of material welded. Welding electrodes to be approved by Employer. Electrodes to be dried before use.				
6.06.00	Relief valves shall be provided to suit compressor capacity and set pressure of the same shall be atleast 10% above working pressure. The spring in relief valve shall not reset for any pressure more than 10% above or below the design set pressure.				
6.07.00	Each receiver shall be provided with pressure indicator, temperature indicator and drain connection with electrically operated automatic drain trap arrangement with isolation and bypass valves. The drain trap shall be timer based. Manual draining facility shall also be provided in the drain trap.				
6.08.00	The material of construction of shell, dished ends, flanges, etc of the air receivers shall be of carbon steel as per IS:2062 or equivalent.				
7.00.00	INTAKE AIR FILTER AND SILENCER				
7.01.00	Filters with multiple elements quick removal type for easy cleaning shall be provided at suction of each air compressor and also be of heavy-duty dry type.				
7.02.00	The filters shall be complete with integral silencers. Separate silencers, if specified, shall be provided. The filtering elements shall be easily removable for cleaning.				
7.03.00	The filters shall be designed for an efficiency of not less than 99% for particles 2 microns and larger.				
8.00.00	AIR DRYING PLANTS				
8.01.00	One number Air drying plant shall be provided for each Instrument air compressor. Drying shall be by adsorption process through a desiccant medium.				
8.02.00	Air Drying (ADP) Plant may be of "Open Through type (Blower reactivated)" OR "Heat of (HOC) Compression type".				
8.03.00	Regeneration of desiccant shall be achieved by "open through" or "Heat of compression" method without any air purge loss.				
8.04.00	Hot unsaturated compressed air shall be used for regeneration of exhausted desiccant in case of "Heat of compression type ADP" and air from blower shall be used for regeneration after heating by electrical heater in case of "Open through type ADP".				
8.05.00	Each ADP shall be provided with two adsorber towers each sized for design drying cycle of minimum 8 hours. After this period, the adsorber tower which was under drying mode shall be put under regeneration/reactivation mode while the other tower will take over the drying duty. The change of drying mode to reactivation mode or vice-versa shall be automatic with provision for manual operation also. The change over from one mode to another shall be through automatic solenoid operated valves.				
8.06.00	In "Open Through" type ADP, for regeneration of desiccant, atmospheric air shall be filtered, heated through an electric heater and passed through the desiccant before exhausted to atmosphere. The reactivated desiccant shall be cooled through same atmospheric air without heater in operation. In case of HOC type drier, the reactivation shall be achieved by the heat of the compressed air itself. The hot unsaturated compressed air from the outlet of last stage of compressor				
<table><tr><td>SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE</td><td>TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001</td><td>SUB SECTION-A-16 COMPRESSED AIR SYSTEM</td><td>PAGE 4 OF 7</td></tr></table>		SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-16 COMPRESSED AIR SYSTEM	PAGE 4 OF 7
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-16 COMPRESSED AIR SYSTEM	PAGE 4 OF 7		

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	 shall be passed through the adsorber tower. The moist air shall be cooled in dehumidifier and passed through the second adsorber for final drying. The design reactivation cycle/period of the tower shall be less than 8 hours including cooling period for desiccant for both the types of ADP.			
8.07.00	Each ADP shall be provided with two (2) numbers of 100 percent capacity pre-filters and two (2) numbers of 100 percent capacity after-filters at the upstream & downstream of towers. The filtering media shall be of ceramic candle type elements designed to withstand atleast 50% of static pressure as differential pressure. However, as per manufacturer's standard & proven design, any superior material to the material specified is also acceptable. The pre-filters shall be provided with automatic electrically operated drain trap arrangement with isolation and bypass valves.			
8.08.00	The electric heaters (if required) (2x100% capacity for each ADP) shall be provided with thermostatic control for heater and relief valve for safety and shall be flanged type to facilitate easy replacement of element.			
8.09.00	Each electric motor driven blower (2x100% capacity for each ADP) shall be provided with individual dry type filters at inlet.			
8.10.00	The adsorber tower shall be designed with sufficient cross-sectional area resulting low air velocity and pressure drop. Minimum 20% of desiccant depth shall be provided as free board in adsorber vessels. Adsorber vessels to be provided with suitable number of inspection/sight windows of "Persplex" for observation of adsorbent condition. Desiccant filling and removal connections shall be provided for the adsorber vessels.			
8.11.00	The coolers/heat exchangers/ dehumidifiers of ADP shall be designed & constructed as per the requirements specified for "Intercoolers, After coolers & Oil coolers" above.			
8.12.00	All pressure vessels such as pre-filters, after-filters, adsorber vessels, heaters, heat exchangers/de-humidifiers / coolers etc associated with ADP shall be designed in accordance with Section VIII, Division 1, of ASME Code or equivalent. The pressure vessels shall be provided with air tight gasketed manholes/handholes and relief valves.			
8.13.00	Quantity of desiccant to be calculated shall take into account residual moisture content at the end of regeneration cycle.			
8.14.00	Desiccant shall be activated alumina only and adsorption capacity and density of the same shall not be more than 8% and 900 kg/m ³ respectively.			
8.15.00	In case of Heat of compression type, adsorbers shall be sized so that even when the compressor is operating at part load, complete regeneration shall be achieved within the cycle time and quality of air (dew point) shall be maintained throughout the design cycle period.			
8.16.00	Complete ADP equipments shall preferably be mounted on a skid.			
8.17.00	Required sample connections in piping be provided for sampling of air at desired locations.			
8.18.00	Non-lubricated two way / three way / four way valves ball valves with pneumatic actuators be provided.			
8.19.00	The material of Construction for various components of ADP shall be as per manufacturer's proven standard.			
8.20.00	HOC dryers of single rotating drum type design using packed desiccant with in-built regeneration and adsorption compartments are also acceptable in place of specified twin-tower type dryers, if the design ensures specified performance guarantee. In case, the Contractor offers such a type, the same shall be of proven design and shall meet the conditions stipulated under "proven-ness criteria" in relevant sub-section of Part-A, of Technical Specification. The control & instrumentation requirements specified is applicable for such design also.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-16 COMPRESSED AIR SYSTEM	PAGE 5 OF 7

CLAUSE NO.	TECHNICAL REQUIREMENTS			
9.00.00	INTERCONNECTING PIPING, FITTING AND VALVES The interconnecting piping & valves within compressor house for compressed air & cooling water etc shall be designed in line with the specification furnished in subsection titled "Low Pressure Piping" of Part-B of this Technical Specification.			
10.00.00	E.O.T. CRANE			
10.01.00	The crane shall be of electrically operated, pendant controlled, overhead travelling type. The Span and runway length shall suit the compressor house building. The design code for EOT crane shall be IS: 3177 latest edition.			
11.00.00	CONTROL PHILOSOPHY			
11.01.00	GENERAL			
11.01.01	The minimum requirements are specified herein and the same shall be elaborated by contractor. The Contractor shall include controls & instrumentation to facilitate safe, reliable and efficient operation for the system. The controls, protection, interlock and instrumentation system offered by the contractor shall be subjected to approval of the Employer during post award engineering stage.			
11.01.02	Any of the compressor and Air drying Plant may be selectable for "shutdown", "working" or "standby" duty.			
11.01.03	On tripping of working equipment, the standby equipment shall come into operation automatically in case of very low air pressure in the system.			
11.01.04	All abnormal conditions used for tripping the compressor or any other equipment shall be provided with pre-trip audio-visual indication/annunciation in the control panel.			
11.01.05	An electrically operated automatic valve shall be provided on cooling water return line of each compressor & dryer (if applicable) which will automatically shut off the cooling water supply, in case any of the compressor/dryer is not running for more than set time duration. Suitable interlock shall also be provided for opening the valve before starting of any of the compressor.			
11.01.06	The following indications shall be made available in the control panels for repeating the same in main plant Control System / Panels. (a) Status of each compressor (b) Instrument air pressure low/high (c) Service air pressure low/high (d) Dew point of instrument air (e) Status of each ADP			
11.01.07	Lube oil pressure and temperature in the oil circuit of compressor shall be automatically controlled.			
11.01.08	Unless otherwise mentioned in the relevant electrical sub-section, automatic motor overload control system shall be included to permit continuous operation of compressors at minimum ambient air without exceeding the name plate rating of the motor.			
11.02.00	Screw /Centrifugal compressor			
11.02.01	Each compressor shall be in the control panel to operate either in Base duty (Auto Load-Unload) or Standby duty (Auto On-Off) mode in case of Screw and unload/modulate/energy optimization (Auto Dual Mode) in case of centrifugal			
11.02.02	In "Base duty" mode, whenever air supply from compressors exceeds the demand, control system shall operate the load-unload circuit at a predetermined set pressure, throttle the inlet valve and open the blow off valve. The compressor shall run in unloaded condition. When system pressure drops due to more demand, the load-unload circuit shall operate again to bring the compressor to 100% load after closing the blow -off valve.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-16 COMPRESSED AIR SYSTEM	PAGE 6 OF 7

CLAUSE NO.	TECHNICAL REQUIREMENTS			
11.02.03	In "Stand-by" mode the compressor shall automatically assist base load compressors during periods of peak air demand. When air pressure in the system reaches a pre-set lower limit, compressor should start in unloaded condition and the compressor shall be fully loaded. When the pressure in the system rises to pre-set high value, the compressor shall be unloaded and shall run in idling mode for a specific period (set by a timer). The compressor may be loaded to full load in case of drop in system pressure or compressor may be stopped in case the system pressure does not drop and compressor continues to idle for more than a pre-set time.			
11.02.04	The control system shall provide warning to the operator that a hot-start condition exists for the motor driver and adequate cool-down period has not occurred after the motor was shut down.			
11.02.05	The alarms and shutdown scheme mentioned below are suggestive and shall be provided as per manufacturer's standard practice meeting the safe operational requirement of the equipment/system each compressor:			
	(a)	"Air temperature high" at inlet to last stage	Alarm & trip	
	(b)	"Low lube oil pressure"	Alarm & trip	
	(c)	"High Lube oil supply temperature"	Alarm & trip	
	(d)	"High oil filter differential pressure"	Alarm	
	(e)	"Low lube oil level in lube oil sump"	Alarm	
	(f)	"High inlet air filter differential pressure"	Alarm & trip	
	(g)	"Low cooling water flow to air compressor"	Alarm	
11.03.00	Air Drying Plant			
11.03.01	Sequential operation of the adsorber towers & air compressors shall be controlled automatically with a provision for manual take over.			
11.03.02	Change over of tower from drying mode to regeneration mode shall happen automatically if the dew point is high at the outlet of ADP sensed by the dew point (using aluminium oxide probe) meter/sensor. Automatic operation during regeneration, starting and stopping of blowers, starting and stopping of heaters, etc shall be timer controlled. During the process, in case, operation is taken over manually from the panel through push button or selector switch, the sequential operation shall start with the manual initiation for each of the steps.			
11.02.03	The control system shall provide the (as minimum) alarms, "High Reactivation air temperature", "Low Reactivation air temperature", "Low cooling water flow", "Low air pressure at the outlet of ADP" and "High dew point at the outlet of ADP". Adequate number of temperature elements etc. shall be provided for measurement and monitoring of the same.			
11.02.04	For rotary drum type Air drying plant, control philosophy as per manufacture's standard and proven practice is also acceptable.			
12.00.00	PAINTING			
	All the equipments shall be protected against external corrosion by providing suitable painting.			
	The surface of SS, galvanized steel, Gun metal, Brass, Bronze and non-metallic components shall not be applied with any painting.			
	The steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, shot blasting etc as per standard procedure. All Painting shall be done as per approved painting scheme of the vendors/Manufacture which shall be submitted by bidder and as approved by Employer.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-16 COMPRESSED AIR SYSTEM
PAGE 7 OF 7				



SUB-SECTION–A-17

AIR CONDITIONING & VENTILATION SYSTEM

**SINGARENI THERMAL POWER PROJECT
STAGE-II (1X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC NO.:CW-CM-11159-C-O-M-001**

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	AIR CONDITIONING SYSTEM			
1.00.00	GENERAL			
1.01.00	This section of specification covers details of system specifications, detailing the areas to be air conditioned, basis of design, brief description of the system, equipment and services to be furnished by bidder. The supply, delivery and erection of the entire equipment listed here shall be in bidder's scope of work.			
2.00.00	CODES & STANDARDS			
2.01.00	The design, manufacture and performance of equipment shall comply with all currently applicable statues, regulations and safety codes in the locality where the equipments are to be installed. Nothing in this specification shall be considered to relieve the bidder of this responsibility.			
2.02.00	Unless otherwise specified, equipment shall conform to the latest applicable Indian or IEC standard. Equipment complying with other authoritative standards such as British, USA, ASHRAE etc. will also be considered if it ensures performance equivalent or superior to Indian Standard.			
3.00.00	REDUNDANCY OF EQUIPMENTS			
3.01.00	Redundancy of various A/C system equipments shall be as follows: a) For Main Plant Areas [control room, offsite control room, control equipment room, UPS room, battery charger, static excitation control room (if applicable) SWAS room, water analysis lab, CEP VFD room, etc]: i) Vapor compression type water chilling units: 2X100% ii) Chilled water pumps: 2X100% iii) Condenser water pumps: 2X100% iv) Cooling Towers: 2X100% v) AHUs: At least one (1) no. unit, capacity same as each working unit shall be provided as common standby. b) For ESP control rooms, FGD control room, AHP control room, HCSD VFD room, etc.: i) Vapour compression type water cooled chiller units: 2X100% ii) Chilled water pumps: 2X100%. iii) Condenser water pumps: 2X100%. iv) Cooling Towers: 2X100%. v) AHUs: 2x100% AHUs for each control room of ESP/FGD/AHP/HCSD VFD Buildings. c) Water system Control Room Building: i) Air cooled (D-X Type) condensing units: 2X100% ii) AHUs: 2x100% d) CHP Control Room Building: i) Air cooled (D-X Type) condensing units: 2X100% ii) AHUs: 2x100% e) AIS Control Room Building: i) Air cooled (D-X Type) condensing units: 2X100%			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-17 AIR CONDITIONING AND VENTILATION SYSTEM
				PAGE 1 OF 31

CLAUSE NO.	TECHNICAL REQUIREMENTS															
	ii) AHUs: 2x100% f) Simulator Building: i) Air cooled (D-X Type) condensing units: 2X100% ii) AHUs: 2x100% g) Training center: i) Air cooled (D-X Type) condensing units: 2X100% ii) AHUs: 2x100% h) 100% standby shall be provided for control rooms/RIO room/etc. served by ductable split/package type air conditioners. At least one (1) no. unit, capacity same as each working unit as a common standby shall be provided for control rooms/RIO room/etc. served by non-ductable split (cassette / Hi-wall) type air conditioners. No stand-by shall be provided for office areas of offsite buildings (like O&M store, Gate Complex, O&M workshop, etc.). i) Fresh air fans shall be 1 x 100 % capacity for each AHU room. j) 24 hours operational rooms/areas (located in buildings served by 12 hours operational centralized A/C system) shall be provided with standalone A/C system as standby. Type of A/C system shall be as per design criteria stipulated in the specification. k) VFD (if applicable) shall be provided with bypass contactor for motors with standard features like indication, manual and Auto set point facility, control power source, capable of changing supply frequency from 50% to 125%, bypass harmonies suppression, etc.															
3.02.00	Redundancy of ventilation system equipments shall be as follows: a) Pump and fan for Air washer / UAF units shall be 1x100% for each unit.															
4.00.00	EQUIPMENT DESCRIPTION – AIR CONDITIONING SYSTEM															
4.01.00	Vapour compression type machines															
4.01.01	Each chilling unit shall comprise of compressor with drive motor, Water Chiller/evaporator, Chilled water pumps, Condenser Cooling Water pumps (if applicable) other accessories such as supporting structure, vibration isolators, insulation, piping, valves, instrumentation, microprocessor / PLC based Control panel, etc. Chilling unit shall have stepless capacity control. The screw compressor based chilling unit to be supplied shall be ARI /Eurovent/Equivalent standard certified (if applicable).															
4.02.00	Chilling Unit <table><tr><td>Type</td><td>:</td><td>Water-cooled type. (Chillers for main plant shall preferably be with multiple compressors)</td></tr><tr><td>Vibration isolators</td><td>:</td><td>Steel spring/ Neoprene rubber cushy foot/ neoprene serrated rubber pad type with isolation efficiency not less than 85%.</td></tr><tr><td>Compressor Type</td><td>:</td><td>Compressor shall be Screw type (open/semi-hermetic/multiple hermetic)</td></tr><tr><td>Type of drive</td><td>:</td><td>Motor driven, along with Star delta/Double delta Starter.</td></tr></table>				Type	:	Water-cooled type. (Chillers for main plant shall preferably be with multiple compressors)	Vibration isolators	:	Steel spring/ Neoprene rubber cushy foot/ neoprene serrated rubber pad type with isolation efficiency not less than 85%.	Compressor Type	:	Compressor shall be Screw type (open/semi-hermetic/multiple hermetic)	Type of drive	:	Motor driven, along with Star delta/Double delta Starter.
Type	:	Water-cooled type. (Chillers for main plant shall preferably be with multiple compressors)														
Vibration isolators	:	Steel spring/ Neoprene rubber cushy foot/ neoprene serrated rubber pad type with isolation efficiency not less than 85%.														
Compressor Type	:	Compressor shall be Screw type (open/semi-hermetic/multiple hermetic)														
Type of drive	:	Motor driven, along with Star delta/Double delta Starter.														
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-17 AIR CONDITIONING AND VENTILATION SYSTEM	PAGE 2 OF 31												

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.03.00	Capacity	:	Minimum capacity shall be suitable for the identified/selected evaporating temperature and condensing temperature.	
	Condenser			
	Type	:	Water cooled shell and tube type.	
	Fluid	:	Shell side – Refrigerant	
		:	Tube side - Water	
	Capacity	:	To match with respective compressor and to provide atleast 2 deg. C sub-cooling. To store full charge of refrigerant.	
	Design fouling Factor	:	Not less than 0.0002 (in MKS units)	
	Shell material	:	Mild steel (IS: 2062) / SA 106 Gr. B	
	Tube material	:	Replaceable seamless copper	
	Fin material		Copper	
	Accessories	:	As required such as Purge and drain connections, relief valves, liquid line shut-off valves, refrigerant filling charging, flow switches, Isolating valves, pressure & temperature indicators at inlet and outlet etc.	
	Refrigerant	:	The refrigerant shall be R-134a/R-410A/R-407C or any other environment friendly refrigerant.	
	Steel structure	:	The complete condensing/ chilling unit shall be mounted on steel structure and shall be provided with necessary vibration isolators	
	Inlet temperature		33-36 o C.	
	Leaving temperature differential	:	Maximum 5 o C.	
	Evaporator			
	Type	:	Shell and tube type	
	Superheating of	:	At least 2 deg.C	
	Design Fouling Factor	:	Minimum 0.0001 (MKS units)	
	Fluid	:	Shell side - Refrigerant	
		:	Tube side - Water	
	Capacity	:	To match with respective plant capacity.	
	Shell material	:	Mild steel (IS : 2062) / SA 106 Gr. B	
	Tube material		Plain tube internally /externally finned copper as per the manufacturer's standard practice.	
	Fin material	:	Integral	
	Accessories	:	Purge and drain connections, Isolating valves, flow switches, Pressure & temperature indicators at inlet and outlet, Anti-freeze thermostats, electronic expansion valve or float assembly as applicable, pilot solenoid valve, Relief valves, Operating thermostats for capacity control, supporting frame, etc.	
	Steel Structure	:	The complete condensing/ chilling unit shall be mounted on steel structure and shall be provided with necessary vibration isolators.	
	Condensing Unit -Air-Cooled (D-X type)			
	Condensing unit			
	Type	:	Air cooled scroll type	
	Vibration isolators	:	Steel spring / Neoprene rubber cushy foot type with isolation efficiency not less than 85%.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-17 AIR CONDITIONING AND VENTILATION SYSTEM	
			PAGE 3 OF 31	

CLAUSE NO.	TECHNICAL REQUIREMENTS				
4.04.00 4.04.01 4.04.02 4.04.03 4.04.04 4.04.05 4.04.06	Compressor				
	Type	:	The Compressor shall be scroll, serviceable, either hermetic type or semi-hermetic type with automatic capacity control (minimum 3 steps).		
	Type of drive	:	Motor driven.		
	Refrigerant	:	The refrigerant shall be R-134a/ R-410A/R-407C or any other environment friendly refrigerant.		
	Accessories	:	High/Low pressure cutouts, oil pressure switches, relief valves, pressure gauges at each stage, lube oil and control oil pressure gauges, suction & discharge stop valves, Muffler, Crank case heaters, oil filters, magnetic oil separators, temperature indicators for lube oil/heaters, oil level indicators, safety thermostat for crank case heater, vibration isolators, etc.		
	Capacity	:	Minimum capacity shall be suitable for the identified/selected at evaporating temperature and condensing temperature and shall be indicated.		
	Air Handling Unit (AHU)				
Each AHU shall consist of casing, fan impeller section, cooling coil section, damper section, steel frame with anti vibration mountings (AVMs) having minimum 85% vibration dampening efficiency and flame retardant, water proof neoprene impregnated flexible connection on fan discharge. Isolation dampers at the suction and discharge of each AHU shall be provided, in case return air duct is directly connected to AHU. However, in case AHU room is used for return air, isolation dampers are required to be provided only at AHU discharge of each AHU. Pre-filter at the suction and fine (micro-vee type) and absolute (HEPA type) filters (wherever applicable) at the discharge of each individual AHU, and heater section in the common discharge of AHUs. NRD shall be provided at outlet of each AHU when multiple AHU used for a common plenum.					
The casing of AHUs shall be of double skin construction. Double skin sandwich panels (inside and outside) shall be fabricated using minimum 0.63 mm (24g) galvanized steel sheet (thickness of galvanization as per manufacturer's standard) , with 25mm thick polyurethane foam insulation of minimum 38 Kg/Cum density in between. Suitable reinforcements shall be provided to give structural strength to prevent any deformation/buckling.					
Sloping condensate drain pan shall be made of minimum 1.2 mm thick Stainless Sheet Steel. It shall be isolated from bottom floor panel through 25mm thick heavy duty treated for Fire (TF) quality expanded polystyrene or polyurethane foam. Drain pan shall extend beyond the coil.					
Cooling coil (min. 4 row deep) shall be made of seamless copper tubes with aluminium fins firmly bonded to copper tubes and shall be provided with suitable drains and vents connections.					
All filter plenum shall be provided with a walking platform inside the plenum chamber for filter cleaning purpose. Inspection door shall be provided at the plenum chamber and a removable type ladder shall be attached to plenum.					
Centrifugal fan					
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-17 AIR CONDITIONING AND VENTILATION SYSTEM	PAGE 4 OF 31

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.04.07	a)	Fan Type	:	Double Width Double Inlet (DWDI) Centrifugal Type
	b)	Fan impeller	:	Backward curved blades
	c)	Casing material	:	GI /Mild steel with minimum thickness of 3 mm.
	d)	Impeller material	:	Carbon steel
	e)	Shaft	:	EN 8 Steel
	f)	Fan bearings	:	Self aligning type, permanently lubricated, heavy duty with a design life of 10,000 operating hours.
	g)	Critical speed	:	First critical speed of rotating assembly shall be at least 25% above the operating speed.
	h)	Drive	:	Motor driven with removable belt guard. Motor rating (at 50 deg.C ambient) shall be atleast fifteen percent (15%) above the maximum load demand of drives at the design duty point.
	i)	Fans	:	For AHUs of capacity 50,000 CMH and above, Bidder may offer two (2) Nos. centrifugal fans of equal capacity for each AHU provided all such AHUs are accommodated within the space identified by the Employer.
4.04.07	Mixing Box: Mixing box shall be complete with fresh and return air dampers. Mixing box shall be provided whenever the return air is ducted back to the AHU.			
4.04.08	Pan Humidifier: Pan humidifier shall be made of 22 gauge SS 304 tank, duly insulated with 25 mm thick resin bonded fiber glass insulation (min. 24 Kg/m3 density) with 0.5 mm GSS cladding. The humidifier shall be complete with stainless steel immersion heaters, safety thermostat, float valve with stainless steel ball, sight glass, overflow and drain connections, steam outlet nozzle and float switch. Step controller shall be provided for switching on / off heater banks as per system requirement.			
4.05.00	NON DUCTABLE SPLIT (HI-WALL/CASSETTE), DUCTABLE SPLIT, PACKAGED AIR-CONDITIONERS			
4.05.01	Air conditioners shall in general consist of the following: i) Casing ii) Hermetically sealed rotary/scroll Compressor iii) Air-cooled condenser iv) Evaporator and condenser cooling fan v) Cooling coil vi) Filters vii) Piping, valves, refrigerant strainer, etc. viii) Controls, instruments, control panel/starter panels. ix) Vibration isolator pads, ducting (if applicable), etc. as required. x) Refrigerant as per manufacturer practice. Note: (1) Humidity control inside air-conditioned space served by split air conditioners (Hi-wall / Cassette/ Ductable) is not envisaged.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-17 AIR CONDITIONING AND VENTILATION SYSTEM
PAGE 5 OF 31				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.05.02	(2) Split air conditioner shall conform to minimum three (3) star (***) rating and above of latest version of Bureau of Energy Efficiency (BEE) HVAC code issued by Ministry of Power, Govt of India. Indoor unit of Ceiling Mounted Cassette Type Unit (Multi Flow Type): The housing of the unit shall be powder coated galvanized steel. All the indoor units regardless of their difference in capacity should have same decorative panel size for harmonious aesthetic point of view. Unit shall have four-way supply air grills on sides and return air grill in center. Each unit shall have high lift drain pump and very low operating sound.			
4.05.03	PACKAGED AIR-CONDITIONERS (a) Packaged air conditioners shall be an encased assembly as a self-contained unit primarily for floor mounting, designed to provide free delivery of conditioned air to the conditioned space. It shall include a primary source of refrigeration for cooling and dehumidification, means for circulating and cleaning air and means for heating and humidifying air. Fresh air fan shall be provided in PAC Room. (b) The cabinet, housing the components of packaged air conditioners, shall be of heavy gauge sheet steel and suitable for floor mounting. The access panels shall be of easily removable type. The entire casing shall be thermally insulated with 25 mm thick insulation of totally flame proof type (T.F. type). Suitable drain connection shall be provided for removal of condensate collected inside a tray under cooling coil. (c) Controls shall be so provided that failure of one equipment of PAC will automatically trip that PAC unit. (d) HP and LP cutout shall be provided for compressor protection. A thermostat with adjustable setting shall also be provided in the return air circuit to control the room temperature by ON-OFF mode. (e) Provision shall also be made for manual re-starting and stopping of the compressor. (f) Interlock shall be provided such that compressor can start only starting the air handling fan. (g) Interlock shall be provided so that compressor can start only if condenser fan in running. Further if the condenser fan stops, the compressor shall also trip. (h) To control the humidity throughout the year, the humidistat shall be interlocked with humidifier and reheater.			
4.06.00	COOLING TOWERS (for chilling units)			
4.06.01	Type	:	Induced draft, cross or counter flow, vertical discharge	
4.06.02	Casing & Sump tank	:	F.R.P/G.R.P	
4.06.03	Fan	:	Cast Aluminum / FRP Propeller type and multi-blade aerofoil construction with adjustable pitch.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-17 AIR CONDITIONING AND VENTILATION SYSTEM
PAGE 6 OF 31				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.06.04	Fill	: Non combustible PVC or equivalent		
4.06.05	Louvers	: F.R.P. /PVC/ Aluminum.		
4.06.06	Nozzles	: Brass with chrome plating / Polypropylene.		
4.06.07	Eliminators	: In removable sections to reduce the drift loss to 0.2% of water flow.		
4.06.08	Supporting structure	: Mild steel with spray galvanization or epoxy painting.		
4.06.09	Strainer at water outlet	: Plate strainer made of GI/SS wire mesh of 16 gauge.		
4.06.10	Bird screen on top of tower	: 25 mm square made of GI/SS wire mesh of 16 gauge.		
4.06.11	Distribution Pipe (if any)	: Galvanised MS pipe.		
4.06.12	Accessories	a) Drain connection with isolation valve. b) Make up connection with ball – float valve, back up gate valve and a bypass with a gate valve for manual operation. c) Overflow connection. d) Equalizing connection to connect sump of all the towers wherever applicable. e) Access door in louvers/fan deck.		
5.00.00	EQUIPMENT DESCRIPTION - VENTILATION SYSTEM			
5.01.00	Air Washer Unit			
5.01.01	Each double skin Air Washer Units (Modular Type which shall be completely enclosed , Evaporative System) shall consist of the various Sections such as Air washer chamber / Casing, Tank, Distribution plates, set of metallic/fabric filters at suction, suction louvers, bird screens, water headers, Spray nozzle, piping, pumps, valves, Drift eliminators, Fans, and all other required accessories.			
	Housing/Casing of Air Washer Unit			
	The housing/casing of the Air Washer Unit shall be double skin construction. (25±2) mm thick Double Skin Panels shall be made of 0.80 mm pre-painted sheet on outer side and 0.8 mm Galvanized sheet (275 GSM) inside with 40kgs/cub mtr density, fire retardant P.U. insulation injected in between. This panel shall be screwed on to the aluminum frame work with soft rubber Gasket in between to make the joints air tight.			
	Frame work for each section shall be jointed together with soft rubber gasket in between to make the joints air tight with suitable size air tight access door at various sections for maintenance. The entire fan section housing shall be mounted on rolled formed GSS Channel frame work.			
5.01.02	The air washer tank shall be fabricated from MS plate of minimum 6 mm thick and inside and outside surface of the tank shall be spray galvanized (minimum 60 microns DFT). Minimum depth of the tank shall be 600 mm. Tank construction shall be such that the			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-17 AIR CONDITIONING AND VENTILATION SYSTEM	PAGE 7 OF 31

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	suction screen can be replaced while the unit is operating. Tank shall be provided with overflow, drain with valve, float valve makeup connection with a gate valve backup, quick fill connection with globe valve etc. The overflow pipe shall be connected to drain pipe after isolating valve on drain pipe.			
5.01.03	The distribution plate shall be fabricated out of 18G galvanized steel sheets & galvanized steel angle supports with minimum 50% free area.			
5.01.04	Air washer shall be two-bank construction (one uni-flow and the other cross flow). All header and stand pipes shall be galvanised. Cat Walks of suitable width shall be provided for maintenance of nozzles.			
5.01.05	The spray nozzles shall be of brass or bronze with chrome plating and shall be self cleaning type. The nozzle shall be designed to produce fine atomized spray and shall be properly spaced to give a uniform coverage of the air washer section. The pressure drop through the nozzle should be in the range of 1.4 to 2.4 Kg/cm2			
5.01.06	The eliminator plates shall be of 24G thick GS sheets class 275 or from 100% virgin PVC of minimum finished thickness of 2 mm. The eliminator section made of GSS shall have minimum six bends. The PVC eliminators shall be UV stabilized using Titanium di-oxide and shall withstand the weathering test as per IS:4892 for 500 hrs. Type test report of the compound testing carried out in any reputed laboratory shall be submitted for approval. All supports, tie rods and space bar shall be of either galvanised steel or PVC construction and shall be complete with suitable drip tray and drain pipe.			
5.01.07	An airtight inspection door of 600mm X 700mm size and a water marine light be provided for each air washer unit.			
5.01.08	Suitable number of brass screen shall be provided in the air washer tank to arrest the dirt entering the circulating water pump suction. Suitable GI grid shall be used inside the screen for reinforcement			
5.01.09	The specification for centrifugal fans shall generally be as indicated below. Centrifugal fans for air washer units shall be of DIDW type.			
5.01.10	Saturation efficiency of Air Washer units shall be minimum 90%.			
5.01.11	Air washer units shall be provided at various elevations in TG building (AB & BC Bay). However, air washer units if required to be placed on the roof shall be provided with steel shed (open).			
5.02.00	Unitary Air Filtration			
5.02.01	Each modular unitary air filtration shall consist of Casing, Tanks, Fans, Distribution plates, Moisture eliminator and water repellant type nylon filter with frame and support, Header and standpipe with support, Spray and flooding type nozzle. Screen type suction strainer, Pumps, Necessary controls & Instrumentation, and all other required accessories.			
5.02.02	The housing/ casing of air washer unit shall be double skin construction. Double skin panels shall be made of 22G galvanized sheet on outer side and 20G galvanized sheet inside with 25mm thick polyurethane foam insulation of minimum 38 kg/cub. Mtr. Density in between. Thickness of galvanization shall be minimum 60 microns DFT. Frame work for section shall be joined together with soft rubber gasket in between to make the joints air tight. The entire fan section shall be mounted on rolled formed GSS channel frame work.			
5.02.03	The unitary air filtration tank shall be fabricated from MS plate of minimum 6 mm thick and inside and outside surface of the tank shall be spray galvanized (minimum 60 microns			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-17 AIR CONDITIONING AND VENTILATION SYSTEM
PAGE 8 OF 31				

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	DFT). Minimum depth of the tank shall be 600 mm. Tank construction shall be such that the suction screen can be replaced while the unit is operating. Tank shall be provided with overflow, drain with valve, float valve makeup connection with a gate valve backup, quick fill connection with globe valve etc. The overflow pipe shall be connected to drain pipe after isolating valve on drain pipe.	
5.02.04	The distribution plate shall be fabricated out of 18G galvanised steel sheets & galvanised steel angle supports with minimum 50% free area.	
5.02.05	Unitary air filtration shall be one-bank construction. All header and stand pipes shall be galvanised. Cat walks of suitable width shall be provided for maintenance of nozzle, filter etc.	
5.02.06	The spray nozzles shall be of brass or bronze with chrome plating and shall be self cleaning type. The nozzle shall be designed to produce fine atomized spray and shall be properly spaced to give a uniform coverage of the air washer section. The pressure drop through the nozzle should be in the range of 1.4 to 2.4 Kg/cm2.	
5.02.07	The eliminator plates shall be of 24G thick GS sheets class 275 or from 100% virgin PVC of minimum finished thickness of 2 mm. The eliminator section made of GSS shall have minimum six bends. The PVC eliminators shall be UV stabilized using Titanium di-oxide and shall withstand the weathering test as per IS:4892 for 500 hrs. Type test report of the compound testing carried out in any reputed laboratory shall be submitted for approval. All supports, tie rods and space bar shall be of either galvanised steel or PVC construction and shall be complete with suitable drip tray and drain pipe.	
5.02.08	Air tight inspection doors of suitable size shall be provided for suction chamber. Spray chamber and fan suction for easy accessibility and maintenance and a water marine light be provided for each unitary air filtration.	
5.02.09	Suitable number of brass screen shall be provided in the air washer tank to arrest the dirt entering the circulating water pump suction. Suitable GI grid shall be used inside the screen for reinforcement.	
5.02.10	The specification for centrifugal fans shall generally be as indicated below. Centrifugal fans for UAF units shall be of DIDW type.	
5.02.11	All equipments, components used in unitary air filtration system shall be in line with the specification requirements stipulated in air washer units.	
5.02.12	Saturation efficiency of Unitary Air Filtration (UAF) units shall be minimum 60%.	
5.02.13	UAF units placed on the roof shall be provided with steel shed (open).	
5.03.00	Centrifugal Fan	
5.03.01	The casing shall be of welded construction fabricated with heavy gauge galvanised sheet steel or MS sheet with spray galvanization (minimum 60 micron DFT). The minimum thickness of casing shall be 3 mm. It shall be rigidly reinforced and supported by structural angles. The seams shall be permanently sealed air-tight. Split casings shall be provided on larger sizes of fans. Casing drain with valves shall be provided wherever required.	
5.03.02	The impeller shall have die-formed backward-curved blades tie welded to the rim and back plate to have a non overloading characteristic of the fan. Rim shall be spun to have a smooth contour. If required intermediate stiffening rings shall be provided. Shaft sleeves shall be furnished wherever required. The impeller, pulley and shaft sleeves shall be secured to the shaft by key and/or nuts.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001
		SUB SECTION-A-17 AIR CONDITIONING AND VENTILATION SYSTEM
		PAGE 9 OF 31

CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.03.03	The bearing shall be self aligning, heavy duly ball, roller or sleeve bearing. They shall be adequately supported. They shall be easily accessible and lubricated properly from outside.			
5.03.04	Inlet guard shall be spun to have a smooth contour. Inlet screen, if provided, shall be of galvanised wire mesh of 25 mm square.			
5.03.05	Base plate with necessary number of spring type vibration isolators or ribbed neoprene rubber pad or cushy foot mounting shall be provided. The vibration isolators should have a minimum of 70% efficiency.			
5.03.06	The first critical speed of the rotating assembly shall be at least 25% above the opening speed.			
5.03.07	The fans shall be provided with V-belts and sheaves. All belts shall be sized for 150% rated HP. All V-belt shall be equipped with removable belt guards that do not impede the air flow to the fan inlet. There shall be a minimum of two belts per drive. Motor rating (at 50 deg.C ambient) shall be atleast fifteen percent (15%) above the maximum load demand of drives at the design duty point.			
6.00.00	BALANCE EQUIPMENT SPECIFICATION			
6.01.00	CENTRIFUGAL PUMPS			
	a)	Type	:	Horizontal Centrifugal, Axially split type casing pump End suction, top discharge horizontal centrifugal pump may be provided for modular air washer units & UAF unit.
	b)	Impeller	:	Closed type
	c)	Material of Construction		
		i) Casing	:	2% Ni Cast Iron : IS:210 Gr. FG-260
		ii) Impeller	:	Bronze IS:318 Gr-2
		iii) Wearing rings	:	Bronze
		iv) Shaft	:	SS 316
		v) Shaft sleeve	:	SS 316
		vi) Lantern ring	:	Brass / Bronze
		vii) Packing	:	Asbestos free
		viii) Base Plate	:	Carbon steel as per IS:2062
		ix) Speed	:	Maximum 1500 rpm
		x) Other requirements	:	To refer to Annexure-I titled “Horizontal Pumps” of this sub section.
6.02.00	Material of Construction for Piping & Fittings			
	a)	Piping for Chilled and Condenser water lines	:	Heavy grade-IS:1239 or Equivalent upto150 NB and Grade 410 of IS:3589 or Equivalent for pipes beyond 200 NB with thickness as indicated in Annexure-II
	b)	Circulating water piping of Ventilation System	:	Heavy grade-IS: 1239 or Equivalent upto150 NB and Grade 410 of IS: 3589 or Equivalent for pipes beyond 200 NB with thickness as detailed at Annexure-II . The piping upto 100 mm diameter shall be of galvanized steel (galvanization shall be as per IS: 4736) and those above 100 mm dia. shall be black steel. The piping shall be adequately supported
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-17 AIR CONDITIONING AND VENTILATION SYSTEM
PAGE 10 OF 31				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	c)	Refrigerant piping :	:	Seamless steel tubes conforming heavy grade IS:1239 or copper tubes as per IS:2501 (copper material as per IS:191 hard copper grade).
	d)	Drain piping	:	Same as (a) above & galvanized as per IS:4736.
	e)	Fittings	:	1) The steel fittings shall conform to ASTM A234 Gr. WPB and dimensional standard to ANSI B 16.9/ANSI B16.11 / equivalent for sizes 65 NB and above. 2) For sizes 50 NB and below, the material shall conform to ASTM A-105. 3) All steel flanges shall be of slip on type and shall conform to ANSI B 16.5 4) For pipe sizes above 350 NB, fabricated fittings from sheets of adequate thickness may be used. The bend radius in case of mitre bends shall be minimum 1.5 times the nominal pipe diameter and angle between two adjacent sections shall not be more than 22.5 deg and shall be as per BS:2633/BS:534. 5) Fittings, flanges and pipe joints of refrigerant piping shall conform to ANSI B31.5
6.03.00	VALVES			
6.03.01	Technical data sheet of the various types of valves (Gate, Globe, Butterfly and check valve) shall be as per Annexure-III .			
6.03.02	Valves shall have full sizes port and suitable for horizontal and as well as vertical installation.			
6.03.03	Valves for regulating duty shall be of globe type suitable for controlling throughout its lift.			
6.03.04	All safety /relief valves shall be so constructed that the failure of any part does not obstruct the free discharge.			
6.03.05	Valves shall be furnished with back seating arrangement for repacking while working under full working pressure.			
6.03.06	Manual gear operators be provided for valves of size 200 NB and above.			
6.03.07	All valves shall be supplied with companion flanges, nut, bolts & washers, etc.			
6.03.08	The refrigerant line valves shall have steel or brass body with TEFLON gland packing. The construction of disc shall be either globe or angle type. The valve seat shall have white metal lining or equivalent.			
6.03.09	Balancing / Controller Valves: The valves of sizes 32 mm to 50 mm dia shall be of gun metal / cast iron construction with screwed ends. Whereas valves of sizes 65 mm and above shall be of cast iron construction with internal parts of SS 410 and EPDM / nitrile seat with flanged ends.			
6.04.00	AIR FILTERS			
6.04.01	Pre Filter			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-17 AIR CONDITIONING AND VENTILATION SYSTEM PAGE 11 OF 31

CLAUSE NO.	TECHNICAL REQUIREMENTS			
6.04.02	1)	Type : Flange / Cassette		
	2)	a) Fabric Filter*: Pre-filter shall contain washable non-woven synthetic fiber or High density Polyethylene (HDPE) media having 18G GSS / 16G Al alloy frame. The filter media shall be supported with HDPE mesh on air inlet side & Aluminium expanded metal on exit side or G.I. wire mesh on both sides. b) Metallic Filter*: Filter medium, aluminium alloy shall be supported on galvanized expanded metal casing. Frame shall be fabricated from aluminium alloy of minimum 16G thickness conforming to IS: 737 or 18 gauge. * For air washer units taking suction from C-row side, only metallic pre-filters shall be provided. However, for other air washer units, Contractor may provide fabric or metallic pre-filters.		
	3)	Other requirements : (as applicable)		
		a)	Suitable aluminium spacers be provided for uniform air flow;	
		b)	Casing shall be provided with neoprene sponge rubber sealing.	
		c)	Capable of being cleaned by water flushing.	
		d)	Density of filter medium shall increase in the direction of air flow in case of metallic filter.	
		e)	Filter media shall be fire retardant and resistant to moisture, fungi, bacteria & frost.	
	4)	Efficiency :		
		Average arresntance of 65 - 80 % when tested in accordance with BS:6540/ASHRAE – 52 – 76 / EN-779.		
	5)	Minimum thickness	:	50 mm
	6)	Face Velocity	:	Not more than 2.5 m/sec.
	7)	Pressure drop	:	Initial pressure drop - Not to exceed 5.0 mm WC at rated flow. Final pressure drop - Upto 7.5 mm WC.
	8)	Location	:	a) At the suction of each AHUs
			:	b) At the discharge of each Fresh air fan
			:	c) At the discharge of each Supply air fan
	Fine Filters (Microvee type)			
	1)	Type	:	Flange / Cassette
	2)	Fine filter shall contain washable non-woven synthetic fibre or High density Polyethylene (HDPE) media having 18G GSS / 16G Al alloy frame. The filter media shall be supported with HDPE mesh on air inlet side & Aluminium expanded metal on exit side or G.I. wire mesh on both sides.		
	3)	Other requirements	:	a) A neoprene sponge rubber sealing shall be provided on either face of the filter frame. b) Capable of being cleaned by air or water flushing. c) Filter media shall be fire retardant and resistant to moisture, fungi, bacteria & frost.
	4)	Efficiency	:	Average arresntance > 90% when tested in accordance with BS:6540/ASHRAE–52-76 / EN-779.
	5)	Minimum thickness	:	150 mm or 300 mm.
	6)	Face Velocity	:	Not more than 1.2 m/sec for 150 mm and not more than 2.4 m/sec. for 300 mm.
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-17 AIR CONDITIONING AND VENTILATION SYSTEM
PAGE 12 OF 31				

CLAUSE NO.	TECHNICAL REQUIREMENTS																				
6.04.03	7)	Pressure drop	:	Initial pressure drop - Not to exceed 10 mm WC at rated flow ; Final pressure drop-Up to 25 mm WC.																	
	8)	Location	:	i) At the discharge of each individual AHU. ii) At the discharge of each Fresh air fan. iii) At the discharge of each supply air fan having static pressure 30mm wc or more.																	
	Absolute Filter / Hepa Filter																				
	1)	Media	:	100% sub-microscopic glass fibers.																	
	2)	Frame	:	Aluminium alloy of (minimum 16 gauge conforming to IS: 737) with handles.																	
	3)	Other requirements	:	A neoprene sponge rubber sealing shall be provided on either face of the filter frame.																	
	4)	Efficiency	:	99.97 % down to 0.3 micron when tested in accordance with BS: 3928 (Sodium flame test)/FED-209B.																	
	5)	Minimum thickness	:	300 mm																	
	6)	Face Velocity	:	Not more than 1.2 m/sec.																	
	7)	Pressure drop	:	Initial pressure drop - Not to exceed 25 mm WC at rated flow; Final pressure drop - Up to 75 mm WC.																	
6.05.00	8)	Location	:	At the discharge of each individual AHUs for Control Equipment Room / Control room /UPS & battery Charger Rooms.																	
	LOW PRESSURE AIR DISTRIBUTION SYSTEM																				
	Material of air distribution system shall be through galvanized steel sheet (Conforming to Class 275 of IS: 277) or Aluminium alloy (grade 19000 / SIC or 3100 / NS3 of IS: 737)																				
	Thickness of rectangular ducts shall be as follows:																				
	<table><tr><th>Larger Dimension of duct (mm)</th><th>Thickness of GI sheet(mm)</th><th>Thickness of Aluminium sheet (mm)</th></tr><tr><td>up to 750 mm</td><td>0.63 (24 G)</td><td>0.80</td></tr><tr><td>751 to 1500</td><td>0.80 (22 G)</td><td>1.00</td></tr><tr><td>1501 to 2250</td><td>1.00 (20 G)</td><td>1.50</td></tr><tr><td>2251 & above</td><td>1.25 (18 G)</td><td>1.80</td></tr></table>				Larger Dimension of duct (mm)	Thickness of GI sheet(mm)	Thickness of Aluminium sheet (mm)	up to 750 mm	0.63 (24 G)	0.80	751 to 1500	0.80 (22 G)	1.00	1501 to 2250	1.00 (20 G)	1.50	2251 & above	1.25 (18 G)	1.80		
	Larger Dimension of duct (mm)	Thickness of GI sheet(mm)	Thickness of Aluminium sheet (mm)																		
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Thickness of round ducts shall be as follows :																					
<table><tr><th>Diameter of Round duct (mm)</th><th>Thickness of GI sheet(mm)</th><th>Thickness of Aluminium sheet (mm)</th></tr><tr><td>150 to 500</td><td>0.63</td><td>0.80</td></tr><tr><td>501 to 750</td><td>0.80</td><td>1.00</td></tr><tr><td>751 to 1000</td><td>0.80</td><td>1.00</td></tr><tr><td>1001 to 1250</td><td>1.00</td><td>1.50</td></tr><tr><td>1251 & above</td><td>1.25</td><td>1.80</td></tr></table>				Diameter of Round duct (mm)	Thickness of GI sheet(mm)	Thickness of Aluminium sheet (mm)	150 to 500	0.63	0.80	501 to 750	0.80	1.00	751 to 1000	0.80	1.00	1001 to 1250	1.00	1.50	1251 & above	1.25	1.80
Diameter of Round duct (mm)	Thickness of GI sheet(mm)	Thickness of Aluminium sheet (mm)																			
150 to 500	0.63	0.80																			
501 to 750	0.80	1.00																			
751 to 1000	0.80	1.00																			
1001 to 1250	1.00	1.50																			
1251 & above	1.25	1.80																			
Duct Fabrication and Supports:																					
a) Duct fabrication shall be as per the latest relevant BIS/SMACNA standard.																					
b) Ducts for A/C system may be site fabricated or factory fabricated and installed at site. However, in case of partly used factory fabricated ducts, vendor shall take																					
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-17 AIR CONDITIONING AND VENTILATION SYSTEM																	
PAGE 13 OF 31																					

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	back the unused ducts. c) The ducts routed inside the buildings with larger side greater than 2250 mm shall be supported by 16mm MS rods and 50x50x3 mm MS double Angles while those below 2250 mm shall be supported by 10mm MS Rods and 40x40x3 MS angles. The duct supports shall be at a distance of not more than 2000 mm for A/C system & Ventilation system. The MS rods for these ducts routed inside the building shall be hung from the existing floor beams/wall beams/roof beams/columns as provided by the Employer with provision of necessary auxiliary or special steel members or by hooks or can be provided by contractor by dash fasteners fixed to the ceiling slab. No supports shall be taken from horizontal/vertical bracings of the structures. All items of duct support including MS rods, MS angles and double angles, auxiliary or special steel members, hooks, dash fasteners coach screws and all other supporting material required shall be provided by the bidder. d) Where the sheet metal duct connects to the intake or discharge of fan units a flexible connection of fire retarding, at least 150 mm width shall be provided of closely woven, rubber impregnated double layer canvas or neoprene coated fibre glass. e) All curves, bends, off-sets and other transformations shall be made for easy and noiseless flow of air. The throat of every branch duct shall be sized to have the same velocity as in the main duct to which the branch duct is connected. f) Wherever duct passes through a wall, the opening between masonry and duct work shall be neatly caulked or sealed to prevent movement of air from one space to the adjoining space. g) Wherever pipe hangers or rods pass through the ducts, light and streamline easement around the same shall be provided to maintain smooth flow of air. h) Access doors shall be provided in the duct work or casing on the both sides of the equipment to be serviced. All access doors shall be of adequate size and shall be lined with substantial felt edging to prevent air leakage. Access doors shall be of built up construction, structurally strong and each shall have at least two hinges. Access doors shall have two rust proof window sash of approved type. All doors shall be set so as to flush with insulation or plaster finish on the duct. i) Where ever horizontal ducts are running outside the building and or at locations where it is not possible to support the ducts from Employers ceiling/floor due to non-availability of the same, the base steel frame/truss work for supporting the ducts between two columns shall be provided by Employer. However, all other auxiliary steel members, hooks, rods, etc. for supporting the duct work with the base frame/truss work shall be provided by the bidder. For vertical ducts running outside the building, bidder to take support from building columns and beams which is in Employer scope. However, all other auxiliary steel members, hooks, rods, etc. for supporting the duct work with the employers beam & columns shall be provided by the bidder.			
6.05.05	Splitters and dampers shall be provided for equipment/area isolation and for proportional volume control of system. The same shall be minimum 16 gauge GS sheet of quadrant type with suitable locking device, mounted outside of duct in accessible position.			
6.06.00	Factory fabricated ducts: i) All ducting shall be fabricated of LFQ (Lock Forming Quality) grade prime G.I. ii) Unless otherwise specified here, the construction, erection, testing and performance of the ducting system shall conform to the SMACNA-1995 standards (“HVAC Duct Construction Standards-Metal and Flexible-Second Edition-1995” SMACNA)			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-17 AIR CONDITIONING AND VENTILATION SYSTEM
PAGE 14 OF 31				

CLAUSE NO.	TECHNICAL REQUIREMENTS																		
	iii) All ductwork including straight sections, tapers, elbows, branches, show pieces, collars, terminal boxes and other transformation pieces must be factory fabricated by utilizing the machines and processes as specified in SMACNA or by equivalent technology. In equivalent method, the fabrication shall be done by utilizing the following machines and process to provide the requisite quality of ducts and speed of supply: a. Coil lines to ensure location of longitudinal seams at corners/folded edges only to obtain the required duct rigidity and low leakage characteristics. No longitudinal seams permitted along any face side of the duct. b. All ducts, transformation pieces and fittings to be made on CNC profile cutters for required accuracy of dimensions, location and dimensions of notches at the folding lines. c. All edges to be machine treated using lock formers, flangers and roll-bending for turning up edges. d. Sealant dispensing equipment should be used for applying built-in sealant in Pittsburgh lock where sealing of longitudinal joints are specified. Sealing of longitudinal joint is compulsory for the ducts over 2" w.g. static pressure iv) All transverse connectors shall be 4-bolt slip-on flange system with built-in sealant, if any. To avoid any leakage additional sealant shall be used. v) Factory fabricated ducts shall have the thickness of the sheet as follows: <table><tr><th>Sl.No.</th><th>Size of Duct</th><th>Sheet Thickness</th></tr><tr><td>i)</td><td>upto 750 mm</td><td>0.63 mm</td></tr><tr><td>ii)</td><td>751 mm to 1500 mm</td><td>0.80 mm</td></tr><tr><td>iii)</td><td>1501 mm to 2250 mm</td><td>1.00 mm</td></tr><tr><td>iv)</td><td>2251 mm and above</td><td>1.25 mm</td></tr></table>				Sl.No.	Size of Duct	Sheet Thickness	i)	upto 750 mm	0.63 mm	ii)	751 mm to 1500 mm	0.80 mm	iii)	1501 mm to 2250 mm	1.00 mm	iv)	2251 mm and above	1.25 mm
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iv)	2251 mm and above	1.25 mm																	
6.07.00	Diffusers, Grills & Dampers:																		
6.07.01	Supply air diffusers/grills with factory fitted volume control dampers be provided for all air-conditioned areas and evaporative cooling system areas.																		
6.07.02	Return air diffusers of air-conditioned areas shall be without volume control dampers. Inlet/Exhaust air grills/louvers are required for all negatively pressure ventilated areas. Back draft dampers shall be provided for all areas pressurized under ventilation system.																		
6.07.03	For AC system the diffusers/grills shall be of extruded Aluminum of minimum 1.2 mm thick with powder coating. The color of power coating shall be as per the interior Décor. The diffusers/grills shall be of powder coated mild steel construction for Ventilation system.																		
6.07.04	For AC system Supply air grills shall be of double deflection type and return air grills shall be of single deflection type. For ventilation system supply air grills shall be of double deflection type.																		
6.07.05	The nozzle type diffusers shall be fabricated from minimum 1.5mm aluminium sheet. The base shall be fixed type. The nozzle shall be of volute design with the Spout diameter being half the base dia. and designed for low noise and long throw. The nozzle shall be able to rotate to any angle within the base. The whole assembly shall be powder coated as per interior decor.																		
6.07.06	All volume control (VC) damper shall be operated by a key from the front of the grills/diffusers and shall be of GI sheet.																		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-17 AIR CONDITIONING AND VENTILATION SYSTEM	PAGE 15 OF 31															

CLAUSE NO.	TECHNICAL REQUIREMENTS	
6.07.07	The thickness of VC dampers shall be of minimum 20 gauge and thickness of louvers shall be of minimum 22 gauge.	
6.07.08	Suitable vanes shall be provided in the duct collar to have uniform and proper air distribution. Bank of Baffles wherever required shall also be provided.	
6.07.09	Fire dampers shall be motor operated type and shall have fire rating of minimum 90 minutes.	
6.07.10	All plenum chambers of connections to fans, dampers etc. shall be constructed in 18 gauge GS sheet and supported on MS angle frames,	
6.07.11	All ducting surfaces coming in contact with corrosive fumes or gases shall be painted with three coats of epoxy paint over a coat of suitable primer.	
6.07.12	Suitable number of VAV box (if applicable) shall be provided for optimum use of VFD (if applicable) driven AHU.	
6.08.00	Thermal and Acoustic Insulation	
6.08.01	A) Application with Glass Wool (a.) All surfaces to be insulated both thermally and acoustically shall be thoroughly cleaned, dried and an adhesive (CPRX compound of Shalimar Tar Products or Equivalent) be applied @ 1.5 Kg /Sqm on the surface. (b.) Insulation material (either expanded polystyrene foam or Glass Wool/ Glass fiber or Equivalent) shall be struck to the surface. All the joints shall be sealed with bitumen. (c.) Insulation mass to be covered with 500 gauge polythene sheet with 50 mm overlaps and sealing all joints on hot side. (d.) Insulation Finish of types specified under shall be provided thereafter. B) Application with Nitrile Rubber: (a) All surfaces to be insulated shall be properly cleaned. (b) A suitable adhesive such as SR 998 or equivalent shall be applied over the surfaces to be insulated and insulation material surfaces. (c) Insulating material shall than be pasted onto the surfaces in a manner to avoid stretching and any air entrapment within. (d) Two layers of Glass Cloth with a suitable adhesive as SR 998 or equivalent shall be then applied over the insulating material to avoid surface weathering. C) Application with Polyurethane Foam & Polyisocyanurate Foam (a) All surfaces to be insulated shall be cleaned. (b) A suitable adhesive such as CPRX or Loid Bond 83 or equivalent shall be applied over the surface to be insulated and insulation material surfaces. (c) Insulating material with aluminum foil lamination shall then be pasted onto the surface in a manner to avoid stretching and any air entrapment within. (d) Two layers of Glass Cloth with a suitable adhesive as Loid Bond 130 shall be then applied over the insulating material, to avoid surface weathering.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		PAGE 16 OF 31

CLAUSE NO.	TECHNICAL REQUIREMENTS																																																								
6.08.02	(e) Insulation Finish of types specified under shall be provided thereafter. D) Application with FR Closed Cell Chemically Cross Linked Polyethylene Material (XLPE) (a) All surfaces to be insulated shall be properly cleaned of any dust, grease and moisture. (b) A suitable adhesive, normally, a pressure sensitive acrylic base, such as SR 998/STAR Glue R242 or Neosole AA 900 or equivalent shall be used to paste the insulating material over the cleaned surface. (c) XLPE cut to size for each surface, with overlaps provided for two faces shall be stuck to the surfaces in a manner to avoid air entrapment. The extent of over-lap shall be equivalent to the thickness of the material to be applied. The adhesive is applied on both the surfaces to be insulated and the insulation foam material. (d) Application of the insulating material to surfaces should preferably be carried out at ground level, in a clean dust free area. (e) All joints- lateral & longitudinal, shall be taped with self adhesive aluminium foil tape 75 mm wide. The insulation over the surface shall be then held in position with 12mm wide PVC straps at every 600mm, to provide a neat & clean finish. Type of Insulation & Finish <table><tr><th>Sl. No.</th><th>Surface</th><th>Insulation Material</th><th>Insulation Form</th><th>Thickness (mm)</th><th>Finish (mm)</th></tr><tr><td rowspan="3">1.</td><td rowspan="3">Supply & return air duct of AC System</td><td>Resin bonded glass wool or</td><td>Roll /Slab</td><td>50</td><td>F-3</td></tr><tr><td>Closed Cell Elastomeric Nitrile Rubber</td><td>sheet</td><td>19</td><td>As per manufacturer std.</td></tr><tr><td>Or Polyisocyanurate Foam</td><td>Slab</td><td>30</td><td>F-3</td></tr><tr><td rowspan="2">2.</td><td rowspan="2">Refrigerant (Suction and liquid lines)</td><td>Closed Cell Elastomeric Nitrile Rubber</td><td>tube</td><td>19</td><td>As per manufacturer std.</td></tr><tr><td>Or Rigid Polyurethane Foam</td><td>Pipe Section</td><td>50</td><td>F-1 (a)</td></tr><tr><td rowspan="2">3.</td><td rowspan="2">AHU drain pipe</td><td>Closed Cell Elastomeric Nitrile Rubber</td><td>tube</td><td>19</td><td>As per manufacturer std.</td></tr><tr><td>or Rigid Polyurethane Foam</td><td>Pipe Section</td><td>50</td><td>F-1 (a)</td></tr><tr><td>4.</td><td>AHU condensate pan (insulation if required)</td><td>Mineral wool or resin bonded glass wool</td><td>Slab</td><td>25</td><td>As per manufacturer std.</td></tr><tr><td>5.</td><td>Chilled water piping, valves & specialties</td><td>Resin bonded Mineral wool or resin bonded glass wool</td><td>Pipe section</td><td>75</td><td>F-1/F-3</td></tr></table>					Sl. No.	Surface	Insulation Material	Insulation Form	Thickness (mm)	Finish (mm)	1.	Supply & return air duct of AC System	Resin bonded glass wool or	Roll /Slab	50	F-3	Closed Cell Elastomeric Nitrile Rubber	sheet	19	As per manufacturer std.	Or Polyisocyanurate Foam	Slab	30	F-3	2.	Refrigerant (Suction and liquid lines)	Closed Cell Elastomeric Nitrile Rubber	tube	19	As per manufacturer std.	Or Rigid Polyurethane Foam	Pipe Section	50	F-1 (a)	3.	AHU drain pipe	Closed Cell Elastomeric Nitrile Rubber	tube	19	As per manufacturer std.	or Rigid Polyurethane Foam	Pipe Section	50	F-1 (a)	4.	AHU condensate pan (insulation if required)	Mineral wool or resin bonded glass wool	Slab	25	As per manufacturer std.	5.	Chilled water piping, valves & specialties	Resin bonded Mineral wool or resin bonded glass wool	Pipe section	75	F-1/F-3
	Sl. No.	Surface	Insulation Material	Insulation Form	Thickness (mm)	Finish (mm)																																																			
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-17 AIR CONDITIONING AND VENTILATION SYSTEM		PAGE 17 OF 31																																																			

CLAUSE NO.	TECHNICAL REQUIREMENTS						
6.08.03	Sl. No.	Surface	Insulation Material	Insulation Form	Thick (mm)	Finish (mm)	
			or Rigid Polyurethane Foam	Pipe Section	50	F-3	
	6.	Chiller (insulation if required)	----- As per manufacturer std.-----				
	7.	Chilled water pumps	Resin bonded Rockwool wool or resin bonded glass wool	Slab	75	F-1/ F-3	
			or Rigid Polyurethane Foam	Slab	50	F-3	
	8.	Expansion tank with associated piping	Resin bonded Rockwool wool or resin bonded glass wool	Slab/ Pipe section	75	F-1/ F-3	
			or Rigid Polyurethane Foam	Slab	50	F-3	
	9.	Acoustic insulation of duct	Resin bonded Glass wool	Slab	25	As per specifications	
	10.	Exposed air duct	Resin bonded Glass wool/Rockwool	Roll/Slab	50	F-4	
			or Polyisocyanurate Foam	Slab	50	F-4(a)	
	Specification for insulation shall be as follows: -						
6.08.04	Insulation Material		Code	Thermal conductivity (w/m/°C)	Density Kg/m ³		
	Resin bonded glass wool		IS:8183	0.049 at 50oC 0.043 at 50oC	i) 24 (For Glass wool) ii) 48 (For Rockwool) iii) 48(For acoustic insulation)		
	Mineral wool pipe section. Min.Gr.2		IS:9842	0.043 at 50oC	144		
	Closed Cell Elastomeric Nitrile Rubber			0.036 at 20oC	40 – 60		
	Polyurethane Foam		IS12436	0.03 at 50 oC	34 + 2		
	Polyisocyanurate Foam			0.03 at 50 oC	34 + 2		
	Note : Insulation used for HVAC application shall be CFC/HCFC free						
	The specification for various finishes shall be as follows						
	a)	Finish F-1 (with Resin Bonded Glass Wool/Resin Bonded Mineral Wool) Step-1 Wrapping of Poly-Bonded Hessain (PBH – to act as vapour seal) on outer surface of insulation with 50 mm overlap stitching and sealing of overlap with synthetic adhesive like CPRX or Equivalent compound.					
		Step-2 The surface then shall be wrapped with 19 mm mesh 24 SWG GI wire netting, butting all the joints and laced down with 22 SWG lacing wire.					
	SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-17 AIR CONDITIONING AND VENTILATION SYSTEM		PAGE 18 OF 31

CLAUSe NO.	TECHNICAL REQUIREMENTS			
		Step-3 Sand cement (4:1) plaster shall be applied in two layers totalling to 12.5 mm thick, the second layer being brought to a smooth finish. A water proofing compound shall be added to the cement before its application.		
	aa)	Finish F-1(a) (With Polyurethane Foam & Polyisocyanurate Foam) Wrapping of two layers of 7 mil 10 x 10 mesh glass cloth dipped in suitable adhesive such as SR 998 or Loid Bond 130 equivalent		
	b)	Finish F-2		
		Step-1 Insulation shall be covered with 500g polythene with 50mm overlap and sealing of overlap with synthetic adhesive like CPRX/ Loid Bond 83 or Equivalent compound.		
		Step-2 Same as Step-2 of Finish F-1 above.		
		Step-3 Same as Step-3 of Finish F-1 above.		
	c)	Finish F-3		
		Step-1 Same as Step-1 of Finish F-2 above		
		Step-2 The polythene shall be covered with 26 gauge Aluminium sheet and locking of joints with self-locking screws at a pitch of minimum 100 mm.		
	d)	Finish F-4		
Step-1 Same as Step-1 of Finish F-1 above.				
Step-2 Same as Step-2 of Finish F-1 above.				
Step-3 Same as Step-3 of Finish F-1 above.				
Step-4 Application of 3 mm thick coat of suitable water proofing compound and wrapped with fibre glass RP tissue followed by final coat of 3 mm thick water proofing compound over the RP tissue.				
	Step-5 After the above treatment, 22G Aluminium sheet cladding, properly stiched at all joints shall be provided over the external surface.			
dd)	Finish F-4(a) (With FR Closed Cell Chemically Cross Linked Polyethylene) Application of aluminium sheet 22G cladding to be provided over the XLPE insulating material. Cladding sheet is held in position with SDST screws @ 150 mm C/c over tongue-in-groove joints applied with a felt for sealing joint against water ingress. All sheet joints to be done in a manner to shed water.			
6.08.05	For all inspection covers and hatches on equipment, pump casing, valve bodies and flanges (100 mm and above), insulation shall be applied so as to facilitate removal without minimum damage to the insulation by encasing the insulation in 24 gauge GI box or 22 gauge Aluminium sheet metal boxes which are bolted together around the equipment. However continuity of the vapour seal between the static and removable portions of the insulation is to be maintained.			
6.08.06	ACOUSTIC INSULATION a) All ducts up to a distance of 5 meters from AHU , Air washer unit fan, UAF fan and other centrifugal fan outlet shall be acoustically lined from inside with 25 mm thick resin bonded glass wool of 48 Kg/Cu.M. density and 30 gauge perforated aluminium sheet having 5 mm dia perforation at 8 to 10 mm centre-to-centre distance. Insulation shall be fixed on wooden frame of 600 x 600 mm dimension. b) Fibre glass tissue sheet shall be applied over the outer surface of insulation before applying perforated aluminium sheet. Application of acoustic insulation shall be inline with the requirements specified above.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-17 AIR CONDITIONING AND VENTILATION SYSTEM	PAGE 19 OF 31

CLAUSE NO.	TECHNICAL REQUIREMENTS	
6.09.00	Axial Fans a) These fans shall have fixed / variable pitch cast aluminum blades of aerofoil design. b) The fan casing shall be of heavy gauge sheet steel construction. c) Necessary rain protection cowl, inlet and outlet cones, bird protection screen, adjustable damper, vibration isolators, back draft dampers etc. shall be provided. d) The speed of the fan shall not exceed 1000 rpm for fan with impeller diameter above 450 mm and 1500 rpm for fan with impeller diameter 450 mm or less. However for fans having static pressure of 30 mm WC or above the speed of the fan shall not exceed 1500 rpm for fan with impeller diameter of above 450 mm and 3000 rpm for fan with impeller diameter of 450 mm or less. The first critical speed of rotating assembly shall be atleast 25% above the operating speed. e) All other accessories like supporting structure etc. as required shall be provided. f) Fans of capacity 1000 m³/hr & lower shall be of propeller exhaust type. g) Fuel oil pressurizing pump house, fuel oil unloading pump house, central lube oil purification room, Gas rooms in TG building and battery rooms of TG building, GIS control building, etc. shall be provided with spark proof (with flame proof motor) fans.	
6.10.00	Roof Ventilators	
6.10.01	The roof extractors shall be "COWL" type.	
6.10.02	Impeller shall be of axial flow type, cast Aluminum in one piece and dynamically balanced. Casing shall be heavy gauge sheet steel construction of 3 mm thick for impeller upto 750 mm diameter and 5 mm for fans with impeller of diameter 750 and above. In casing, access door with locking arrangement be provided.	
6.10.03	The cowl shall be designed for weather protection of the fan also inside of the roof on which the extractor is installed. Galvanised bird screen of 15 mm Square be provided with the cowl. All accessories, steel supports as required will be provided.	
6.10.04	The speed of the fan be limited as per limitation given above for axial fans.	
6.10.05	All accessories rain protection exhaust hood, transformation piece, vibration isolators, steel supports vibration isolators, bird screen, etc. as required shall be provided.	
6.10.06	The vibration level for fans shall be as per ISO: 14694.	
7.00.00	PLANT CONTROL OF AC SYSTEM:	
7.01.00	Brief scheme of controlling the operation is described below. Detailed description of the control system for safe and efficient operation of the plant shall be elaborated, got approved from employer. The descriptions in the sub-sections of the control & instrument sections shall also be referred to.	
7.02.00	Control Scheme for Air-Conditioning System	
7.02.01	All the functional requirements specified below and general control logic specified under this section shall be implemented in the respective control system.	
7.02.02	The basic function of the system shall be to closely control and monitor temperature and humidity conditions inside the air-conditioned spaces, to optimize / minimize energy consumption by automated operation, to provide remote centralized monitoring & control for various mechanical facilities including sequential start/stop of the whole Air conditioning System, automatically calculate record and cooling load for each hour /day/season, to generate maintenance data & alarms, to maintain records of plant operation & energy consumption for varying loads, duty cycling to operate all the equipment including standby equipment for equal duration, automatic startup of standby equipment in case of failure of operating unit and displaying fault alarm status of the tripped unit, activating /deactivating	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001
		SUB SECTION-A-17 AIR CONDITIONING AND VENTILATION SYSTEM
		PAGE 20 OF 31

CLAUSE NO.	TECHNICAL REQUIREMENTS			
7.02.03	water valves to startup/stop water flow through chiller/condenser circuit. For sequential operation /duty cycling, Programmed startup/stop of individual AHU as per operating requirements and inside room temperature and humidity of “CR, CER, SWAS control room, UPS and Battery Charger room, static excitation room (as applicable)”, “ESP control rooms, AHP control room, HCSD VFD room, FGD control room” shall be maintained by controlling the chilled water flow by means of motor operated three way modulating valve at chilled water line, humidified system and duct heater. The operation of each Air Conditioning system shall be possible through Microprocessor based dedicated controllers to be provided by Contractor for each Screw /centrifugal Chiller units with local start / stop & indication for main plant A/C system in addition to Main DDCMIS based Control system of A/C plant for “Main plant area”, “ESP control rooms, FGD control room, HCSD VFD room & AHP control room”. Further these microprocessor-based control panels of Chiller units shall be suitably interfaced with DDCMIS based Control panels.			
7.02.04	Air-Conditioning system for “Water system control room” shall be controlled through microprocessor based Distributed Digital Control Monitoring and Information System (DDCMIS). Air-Conditioning system for “Switchyard control room building” shall be controlled through microprocessor based Distributed Digital Control Monitoring and Information System (DDCMIS) / control system as per Manufacturer’s standard & proven practice.			
7.03.00	Water Chilling Plant Control			
7.03.01	Microprocessor based controls shall be provided as per manufacturer’s standard practice along with facilities to interface with control system and to meet the requirement of all system operations and controls. Water chilling unit control system shall be designed to have a constant chilled water outlet temperature from evaporator at all load condition by means of controlling ON-OFF thermostat (one for each compressor). The closure of liquid line solenoid valve and tripping of compressor at lower water temperature and opening of solenoid valve and starting of compressor at high water temperature set point shall be automatic through the thermostat. Between the above set points the compressor capacity shall be controlled automatically through cylinder “load-unload” mechanism activated through the suction pressure or return chilled water temperature.			
7.03.02	Water chilling unit shall be equipped with superheat control of water chilling unit through thermostatic expansion valve which gets its impulse from temperature element connected with suction line after chiller outlet.			
7.03.03	High discharge pressure cut-out and oil pressure (OP) differential cut-out shall be of manual reset type and low pressure cut-out shall be automatic reset type. The OP cut-out shall trip the compressor in case of low oil pressure.			
7.03.04	Facility toggle switch to close the liquid refrigerant line solenoid valve shall be provided to shut the compressor by the operation of low pressure cut-out (after the refrigerant has been pumped to the condenser).			
7.03.05	Switching of Crank case heaters shall be interlocked with starting and stopping/tripping of compressor motor. Further, the safety thermostat shall switch off the crank-case heater in the event temperature rises above safe limit.			
7.03.06	Provision shall also be made for the manual restarting of the compressor.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-17 AIR CONDITIONING AND VENTILATION SYSTEM
PAGE 21 OF 31				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
7.03.07	On-off type anti-freeze thermostats, one for each chiller shall be provided in addition to the controlling on-off thermostat for safety purpose and shall act in the event of failure of on-off thermostat to close the liquid line solenoid valve and also to simultaneously trip the compressor.			
7.03.08	Compressor starting/running shall be interlocked with the low / adequate flow at the outlet of each chiller and each condenser and as well as with pressure in the inlet of the condensers. In addition, closure or open status of various valves shall be used for interlock, alarm and control of Air Conditioning System.			
7.03.09	Condenser water pumps shall be interlocked with the low - level switch in each cooling tower sump and operation of cooling tower fans. High level in the cooling tower shall be annunciated in the panel by means of a separate level switch.			
7.03.10	The standby condenser water pumps, standby chilled water pumps & standby AHU shall be started automatically when the working equipments are stopped/ tripped. Auto/ Manual selecting and working/ standby selecting facility for the pumps/ AHU/ fresh air fan shall be provided.			
7.03.11	Closure of fire dampers shall raise an alarm in the system.			
7.03.12	There shall be provision for temperature and flow measurement in chilled water inlet and outlet line across AHUs to monitor the air conditioning load of each area.			
7.03.13	Operation of air conditioning system shall be interlocked with the required minimum pressure and temperature of cooling tower at inlet to the condenser. Status indication of condenser water pumps and associated cooling towers shall be provided in the control panel of air conditioning plant.			
7.04.00	Air Handling Unit a) Inside room temperature and humidity shall be maintained by controlling the chilled water flow by means of motor operated three way modulating valve which shall get its signal from the Control system for main plant A/C system and ESP/FGD/HCSDFDroom/AHP control rooms A/C system. b) Humidity sensor and gyserstat located in the return air duct shall actuate the PAN humidifier to obtain the desired degree of humidification. c) Humidity and temp. sensor shall be provided and interlocked in steps with winter heater / re-heater / strip heaters for monsoon and winter re-heating or heating as the case may be. d) Heater banks shall be interlocked with the running of AHU, temperature of return air, humidity of return air and safety thermostat (airstat - located in front of the each heater in the supply air duct) e) AHU shall be started either locally or from the main control room of AC system by means of Remote / Manual selection facility. f) The closure of fire dampers, automatic tripping of AHU fans and fresh air fans shall be interlocked with fire detection system. g) Each AHU shall be provided with temperature indicators and pressure transmitter in the chilled water piping inlet and outlet to monitor the air-conditioning load of each area.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-17 AIR CONDITIONING AND VENTILATION SYSTEM	PAGE 22 OF 31

CLAUSE NO.	TECHNICAL REQUIREMENTS	
7.05.00	D-X Air-Conditioning System a) The control and interlocks described above for water chilling plants are applicable for this system also. b) Further the compressor starting/running shall be interlocked with the flow switches in condenser water (if applicable) circuit as well as with AHU motors. c) The standby condenser water pumps (if applicable) & standby AHU shall be started automatically when the working equipments are stopped / tripped. Auto/ Manual selector Switches and working / standby selector switches for the pumps, fresh air fans and AHU shall be provided in the panel.	
7.06.00	Cassette /Hi-wall Split Air Conditioners Control and interlocks for these type of units shall be as per manufacturer's standard practice.	
7.07.00	Miscellaneous Control Requirements a) Separate emergency local stop push button shall be provided for each pump, compressor, fans etc. of A/C system. b) Status shall be provided of each pump, compressor, fans etc. of A/C system and Ventilation system on HMI system at control room. c) All the annunciations related to failure of equipments, tripping of equipments, source of failure / reason due to which the equipment is stopped/tripped, low & high limits of parameters such as level, temperature, pressure drop, pressure etc. shall be provided for each pump, fan, compressor, AHU, PAC, etc. of centralized A/C system. d) The fans (both supply and exhaust fans) associated with mechanical ventilation system shall be operated locally. e) Relative humidity and temperature measurement of all control rooms, CERs and all major air-conditioned areas shall be available in DDCMIS. Relative humidity and temp. measurement for main plant control room and CERs to be available in multiple numbers.	
8.00.00	PLANT CONTROL OF VENTILATION SYSTEM	
8.01.00	GENERAL	
8.01.01	Brief scheme of controlling the operation is described below. Detailed description of the control system for safe and efficient operation of the plant shall be elaborated, got approved from Employer.	
8.01.02	Control Scheme of Ventilation System The Ventilation system for main Plant area (excluding roof extraction fans, standalone Air supply and Air Exhaust fans) shall be controlled through microprocessor based Distributed Digital Control Monitoring and Information System (DDCMIS). This DDCMIS system shall perform all functions such as auto/manual operation of valves, pumps, drives, local/remote selection of operation, status indication, annunciation, interlock and protection of pumps/drives, etc.	
8.02.00	Air Washer Units (AWU) & Unitary Air Filtration Units (UAF)	
8.02.01	Air washer units shall be started/stopped by initiation from Main DDCMIS based control system of A/C plant (provided by contractor) for Main plant area and ESP/FGD/AHP control rooms. Starting/stopping of pumps shall be automatic upon such initiation.	
8.02.02	The operation of the pumps shall be interlocked with the low level of water in the sump. High level of the sump shall be alarmed.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001
		SUB SECTION-A-17 AIR CONDITIONING AND VENTILATION SYSTEM
		PAGE 23 OF 31

CLAUSE NO.	TECHNICAL REQUIREMENTS			
8.03.00	Miscellaneous control requirements			
8.03.01	Separate emergency local stop push button shall be provided for each pump, fans, etc. of Ventilation system.			
8.03.02	The status of each pump, centrifugal fans, etc. of centralized ventilation system is available on OWS in control room locally.			
8.03.03	All the alarms related to failure of equipments, tripping of equipments, source of failure / reason due to which the equipment is stopped / tripped, low & high limits of parameters such as level, temperature, pressure drop, pressure etc shall be provided for each pump, fan, AWU etc. in the control system.			
8.03.04	The fans (both supply and exhaust fans) associated with mechanical ventilation system shall be operated locally.			
9.00.00	PAINTING:			
9.01.00	All the Equipments shall be protected against external corrosion by providing suitable painting.			
9.02.00	The surfaces of stainless steel, Galvanized steel, Gunmetal, brass, bronze and non-metallic components shall not be applied with any painting. The Contractor shall clean the external surfaces and internal surfaces before Erection by wire brushing and air blowing. The steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, shot blasting, etc. as per the agreed procedure.			
9.03.00	For all the steel surfaces (external) exposed to atmosphere (outdoor installation), one (1) coat of red oxide primer of thickness 30 to 35 microns followed up with three (3) coats of synthetic enamel paint, with 25 microns as thickness of each coat, shall be applied. For plant at coastal area, epoxy resin based zinc phosphate primer followed by epoxy resin based paint pigmented with titanium di-oxide shall be used in place of enamel paints.			
9.04.00	For all the steel surfaces inside the building (indoor installation), One (1) Coat of red oxide primer of thickness 30 to 35 microns followed up with two (2) coats synthetic enamel paint, with 25 microns as thickness of each coat shall be applied. For plant at coastal area, epoxy resin based zinc phosphate primer followed by epoxy resin based paint pigmented with titanium di-oxide shall be used in place of enamel paints.			
9.05.00	For centrifugal fans/axial/Roof extractor fans - Casing shall have hot dip/ spray galvanization (minimum 60 micron DFT).			
9.05.00	However for all parts coming in contact with acid fumes (in Battery rooms), a coat of epoxy resin based zinc phosphate primer of minimum thickness 30 to 35 microns followed up with undercoat of epoxy resin based paint pigmented with Titanium dioxide of minimum thickness of 25 microns shall be applied and a top coat consisting of one coat of epoxy paint of approved shade and colour with glossy finish of minimum thickness of 25 microns.			
9.07.00	Touch up painting shall be as per standard industrial practice.			
10.00.00	Cooling Tower, Expansion Tank, Water Softening Plant (if required) of A/C System shall preferably be placed on the roof of respective building under open sky.			
11.00.00	Centrifugal fans alongwith filter plenum of mechanical centralized ventilation system envisaged for GIS switchyard shall atleast be provided with steel shed (open).			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-17 AIR CONDITIONING AND VENTILATION SYSTEM
PAGE 24 OF 31				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Annexure –I			
	GENERAL SPECIFICATION FOR HORIZONTAL PUMPS			
1)	SCOPE This specification covers the design, material, construction features, manufacture, inspection, testing the performance at the Vendor's/Sub-Vendor's Works and delivery to site of Horizontal Centrifugal Pumps.			
2)	CODES AND STANDARDS The design, material, construction, manufacture inspection and performance testing of Horizontal Centrifugal Pumps shall comply with all currently applicable statutes, regulations and safety codes in the locality where the Equipment will be installed. Nothing in these specifications shall be construed to relieve the Vendor of this responsibility. The Equipment supplied shall comply with the latest applicable Indian Standards listed below. Other National Standards are acceptable, if they are established to be equal or superior to the Indian Standards.			
3)	List of Applicable Standards. IS : 1520 : Horizontal Centrifugal Pumps for clear cold fresh water IS : 5120 : Technical requirements of roto dynamic special purpose pumps API : 610 : Centrifugal pumps for general refinery service. IS : 5639 : Pumps Handling Chemicals & corrosion liquids IS : 5659 : Pumps for process water HIS : Hydraulic Institute Standards, USA ASTM-1-165-65 Standards Methods for Liquid Penetration Inspection. In case of any contradiction with aforesaid standards and the stipulations as per the technical specifications as specified hereinafter the stipulations of the technical specifications shall prevail.			
4)	DESIGN REQUIREMENTS a) The Pump shall be capable of developing the required total head at rated capacity for continuous operation. Also the pumps shall be capable of being operated to give satisfactory performance at any point on the HQ characteristics curve. The operating range of the pump shall be 40% to 120% of the duty point unless otherwise mentioned elsewhere. The maximum efficiency of pump shall preferably be within ± 10% of the rated design flow as indicated in data sheets. b) The total head capacity curve shall be continuously rising from the operating point towards shut-off without any zone of instability and with a minimum shut-off head of about 15% more than the design head. c) Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. The head Vs capacity and BHP Vs capacity characteristics should match to ensure even load sharing and trouble free operation throughout the range. Components of identical pumps shall be interchangeable.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-17 AIR CONDITIONING AND VENTILATION SYSTEM
PAGE 25 OF 31				

CLAUSE NO.	TECHNICAL REQUIREMENTS												
	Annexure –I												
d)	Pumps shall run smoothly without undue noise and vibration. Peak to peak vibration limits shall be restricted to the following values during operation: <table><tr><td>Speed</td><td>Antifriction Bearing</td><td>Sleeve Bearing</td></tr><tr><td>1500 rpm and below</td><td>75.0 micron</td><td>75.0 micron</td></tr><tr><td>3000 rpm</td><td>50.0 micron</td><td>65.0 micron</td></tr></table> The noise level shall not exceed 85 dBA overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1 M from the equipment surface.				Speed	Antifriction Bearing	Sleeve Bearing	1500 rpm and below	75.0 micron	75.0 micron	3000 rpm	50.0 micron	65.0 micron
Speed	Antifriction Bearing	Sleeve Bearing											
1500 rpm and below	75.0 micron	75.0 micron											
3000 rpm	50.0 micron	65.0 micron											
e)	The pumps shall be capable of starting with discharge valve fully open and close condition. Motors shall be selected to suit to the above requirements. Continuous Motor rating (at 50 deg.C ambient) shall be atleast ten percent (10%) above the maximum load demand of the pump in the entire operating range to take care of the system frequency variation and no case less than the maximum power requirement at any condition of the entire characteristic curve of the pump.												
f)	The kW rating of the drive unit shall be based on continuously driving the connected equipment for the conditions specified. However, in cases where parallel operation of the pumps are specified, the actual motor rating is to be selected by the Bidder considering overloading of the pumps in the event of tripping of operating pump(s).												
g)	Pumps shall be so designed that pump impellers and other accessories of the pumps are not damaged due to flow reversal.												
h)	The Contractor under this specification shall assume full responsibility in the operation of pump and motor as a unit.												
5)	DESIGN CONSTRUCTION												
a)	Design and construction of various components of the pumps shall conform to the following general specifications. For material of construction of the components, data sheets shall be referred to.												
b)	Pump Casing Pump casing shall have axially split type construction as specified. The casing shall be designed to withstand the maximum shut-off pressure developed by the pump at the pumping temperature. Pump casing shall be provided with a vent connection and piping with fittings & valves. Casing drain as required shall be provided complete with drain valves, piping and plugs. It shall be provided with a connection for suction and discharge pressure gauge as standard feature. It shall be structurally sound to provide housing for the pump assembly and shall be designed hydraulically to minimum radial load at part load operation.												
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-17 AIR CONDITIONING AND VENTILATION SYSTEM									
PAGE 26 OF 31													

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	Annexure –I c) Impeller Impeller shall be closed, semi-closed or open type as specified elsewhere and designed in conformance with the detailed analysis of the liquid being handled. The impeller shall be secured to the shaft, and shall be retained against circumferential movement by keying, pinning or lock rings. On pumps with overhung shaft, impellers shall be secured to the shaft by a lockout or cap screw which tightness in the direction of normal rotation. d) Impeller/Casing Wearing Rings Replaceable type wearing rings shall be provided at suitable locations of pumps. Suitable method of locking the wearing ring shall be used. Wearing rings shall be provided in pump casing and/or impeller as per manufacturer's standard practice. e) Shaft The critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed. The shaft shall be ground and polished to final dimensions and shall be adequately sized to withstand all stresses from rotor weight, hydraulic loads, vibration and torques coming in during operation. f) Shaft Sleeves Renewable type fine finished shaft sleeves shall be provided at the stuffing boxes/mechanical seals. Length of the shaft sleeves must extend beyond the outer faces of gland packing of seal end plates so as to distinguish between the leakage between shaft and shaft sleeve and that past the seals/gland. Shaft sleeves shall be fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation. g) Bearings Heavy duty bearings, adequately designed for the type of service specified in the enclosed pump data sheet and for long, trouble free operation shall be furnished. The bearings offered shall be capable of taking both the radial and axial thrust coming into play during operation. In case, sleeve bearings are offered additional thrust bearings shall be provided. Antifriction bearings of standard type, if provided, shall be selected for a minimum life 20,000 hrs. of continuous operation at maximum axial and radial loads and rated speed. Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid pumped. Where there is a possibility of liquid entering the bearings suitable arrangement in the form of deflectors or any other suitable arrangement must be provided ahead of bearings assembly.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-17 AIR CONDITIONING AND VENTILATION SYSTEM
		PAGE 27 OF 31

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Annexure –I Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearings housing. h) Stuffing Boxes Stuffing box design should permit replacement of packing without removing any part other than the gland. Stuffing boxes of packed ring construction type shall be provided wherever specified. Packed ring stuffing boxes shall be properly lubricated and sealed as per service requirements and manufacturer’s standards. If external gland sealing is required, it shall be done from the pump discharge. The Bidder shall provide the necessary piping valves, fittings etc. for the gland sealing connection. i) Mechanical Seals Wherever specified in pump data sheet, mechanical seals shall be provided. Unless otherwise recommended by the tenderer, mechanical seals shall be of single type with either sliding gasket or bellows between the axially moving face and shaft sleeves or any other suitable type. The sealing faces should be highly lapped surfaces of materials known for their low frictional coefficient and resistance to corrosion against the liquid being pumped. j) The pump supplier shall coordinate with the seal maker in establishing the seal chamber of circulation rate for maintaining a stable film at the seal face. The seal piping system shall form an integral part of the pump assembly. For the seals under vacuum service, the seal design must ensure sealing against atmospheric pressure even when the pumps are not operating. Necessary provision for seal water supply along with complete piping fittings and valves as required shall form integral part of pump supply. k) Pump Shaft Motor Shaft Coupling The pump and motor shafts shall be connected with an adequately sized flexible coupling of proven design with a spacer to facilitate dismantling of the pump without disturbing the motor. Necessary coupling guards shall also be provided. l) Base Plate A common base plate mounting both for the pump and motor shall be furnished. The base plate shall be fabricated steel and of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the piping unit so mounted as to minimise misalignment caused by mechanical forces such as normal piping strain, internal differential thermal expansion and hydraulic piping thrust. Suitable drain troughs and drip lip shall be provided. m) Assembly and Dismantling Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouting base plate or alignment.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-17 AIR CONDITIONING AND VENTILATION SYSTEM	PAGE 28 OF 31

CLAUSE NO.	TECHNICAL REQUIREMENTS																																																			
n)	Annexure –I Drive Motor (Prime Mover) The kW rating of the drive shall be based on continuously driving the connected equipment for the conditions specified. However, in cases where parallel operation of the pumps are specified, the actual motor rating is to be selected by the Bidder considering overloading of the pumps in the event of tripping of operating pump(s).																																																			
	ANNEXURE-II PIPING THICKNESS: Pipes for sizes 200 NB & above shall confirm to IS: 3589 Grade 410. The final thickness shall not be less than that specified as per IS: 3589 as indicated below. <table><tr><th>Nominal pipe Size (mm)</th><th>Outside Diameter (mm)</th><th>Wall Thickness (mm)</th></tr><tr><td>200 NB</td><td>219.1</td><td>4.5</td></tr><tr><td>250 NB</td><td>273</td><td>5</td></tr><tr><td>300 NB</td><td>323.9</td><td>5.6</td></tr><tr><td>350 NB</td><td>355.6</td><td>5.6</td></tr><tr><td>400 NB</td><td>406.4</td><td>6.3</td></tr><tr><td>450 NB</td><td>457</td><td>6.3</td></tr><tr><td>500 NB</td><td>508</td><td>6.3</td></tr><tr><td>600 NB</td><td>610</td><td>6.3</td></tr></table>	Nominal pipe Size (mm)	Outside Diameter (mm)	Wall Thickness (mm)	200 NB	219.1	4.5	250 NB	273	5	300 NB	323.9	5.6	350 NB	355.6	5.6	400 NB	406.4	6.3	450 NB	457	6.3	500 NB	508	6.3	600 NB	610	6.3																								
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ANNEXURE-III I. DATA SHEET FOR WATER LINE GATE / SLUICE VALVES <table><tr><td>1.0</td><td>1. Size Range</td><td>50 MM & Above</td></tr><tr><td>2.0</td><td>2. Design Code</td><td>a) IS: 14846 or BS : 5150</td></tr><tr><td>3.0</td><td>3. Pressure Rating</td><td>a) PN 1.0 (as per IS:14846) b) PN 10 (as per BS:5150)</td></tr><tr><td>4.0</td><td>Construction Features</td><td></td></tr><tr><td>4.1</td><td>Stem</td><td>Outside screw and yoke type, rising stem</td></tr><tr><td>4.2</td><td>Ends</td><td>Flanged, ANSI B16.5 Cl 150 (minimum)</td></tr><tr><td>4.3</td><td>Bonnet</td><td>Bolted</td></tr><tr><td>4.4</td><td>Wedge</td><td>Solid Wedge</td></tr><tr><td>5.0</td><td>Operation</td><td>by handwheel (Gear reduction unit for valve size 200 NB and above wherever applicable)</td></tr><tr><td>6.0</td><td>Seat</td><td></td></tr><tr><td></td><td>a) Body</td><td>Renewable</td></tr><tr><td></td><td>b) Disc.</td><td>Renewable</td></tr><tr><td>7.0</td><td>Material of Construction</td><td></td></tr><tr><td>7.1</td><td>Body/Bonnet/Handwheel</td><td>Cast Iron to IS:210 FG-200</td></tr><tr><td>7.2</td><td>Wedge Gland</td><td>Cast Iron to IS:210 FG-200</td></tr><tr><td>7.3</td><td>Stem</td><td>S.S. 410</td></tr><tr><td>7.4</td><td>Body Seat</td><td>GM to IS:318 Gr.-2</td></tr></table>	1.0	1. Size Range	50 MM & Above	2.0	2. Design Code	a) IS: 14846 or BS : 5150	3.0	3. Pressure Rating	a) PN 1.0 (as per IS:14846) b) PN 10 (as per BS:5150)	4.0	Construction Features		4.1	Stem	Outside screw and yoke type, rising stem	4.2	Ends	Flanged, ANSI B16.5 Cl 150 (minimum)	4.3	Bonnet	Bolted	4.4	Wedge	Solid Wedge	5.0	Operation	by handwheel (Gear reduction unit for valve size 200 NB and above wherever applicable)	6.0	Seat			a) Body	Renewable		b) Disc.	Renewable	7.0	Material of Construction		7.1	Body/Bonnet/Handwheel	Cast Iron to IS:210 FG-200	7.2	Wedge Gland	Cast Iron to IS:210 FG-200	7.3	Stem	S.S. 410	7.4	Body Seat	GM to IS:318 Gr.-2	
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-17 AIR CONDITIONING AND VENTILATION SYSTEM	PAGE 29 OF 31																																																	

CLAUSE NO.	TECHNICAL REQUIREMENTS				
II.	7.5	Wedge Seat	GM to IS:318 Gr.-2		
	7.6	Packing	Non-Asbestos		
	7.7	Back Seat Bushing	GM to IS:318 Gr.-2		
	7.8	Bolts, Nuts, & Studs	Carbon Steel to IS:1367, CL – 4.6/4.0		
	8.0	Accessories Required			
		a) Position Indicator			
		b) Draining arrangement for Valve Seat			
		c) Locking Facility with lock			
		d) Gear reduction unit for valve size 200 NB and above.			
	DATA SHEET FOR GLOBE VALVES				
	1.0	Size Range	50 MM & Above		
	2.0	Design Code	a) BS : 5152 / Equiv.		
	3.0	Pressure Rating	a) PN 10 (as per BS:5152)		
	4.0	Construction Features			
	4.1	Stem	Outside screwed & rising spindle		
	4.2	Ends	Flanged, ANSI B16.5 Cl 125 / Cl. 150		
	4.3	Bonnet	Bolted		
	4.4	Wedge	Solid Wedge		
	5.0	Operation	by handwheel (Gear reduction unit for valve size 200 NB and above wherever applicable)		
	6.0	Seat			
		a) Body	Renewable		
		b) Disc.	Renewable		
	7.0	Material of Construction			
7.1	Body/Bonnet/Handwheel	Cast Iron to IS:210 FG-200			
7.2	Wedge Gland	Cast Iron to IS:210 FG-200			
7.3	Stem	S.S. 410			
7.4	Body Seat	GM to IS:318 Gr.-2			
7.5	Wedge Seat	GM to IS:318 Gr.-2			
7.6	Packing	Non-Asbestos			
7.7	Back Seat Bushing	GM to IS:318 Gr.-2			
7.8	Bolts, Nuts, & Studs	Carbon Steel to IS:1367, CL – 4.6/4.0			
8.0	Accessories Required				
	a) Position Indicator				
	b) Draining arrangement for Valve Seat				
	c) Locking Facility with lock				
	d) Gear reduction unit for valve size 200 NB and above.				
III.	DATA SHEET FOR CHECK VALVES				
	1.0	Size range	Below 50 NB	50 NB and above	
	2.0	Design Code/rating	IS : 778	IS : 5312/ BS:5153	
	3.0	Type	————Swing check type————		
	4.0	Pressure Rating	a) PN 1.0 (as per IS:5312)		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-17 AIR CONDITIONING AND VENTILATION SYSTEM	PAGE 30 OF 31

CLAUSE NO.	TECHNICAL REQUIREMENTS			
IV.			b) PN 10 (as per BS:5153)	
	5.0	End connection	Screwed ends ANSI B16.5	Flanged to Class 150 min
	6.0	Material Specifications		
		a) Body, cover, flap, hinges	GM to IS:318 Gr.2	Cast Iron IS:210 Gr. FG.200
		b) Hinge pin, door pin	HT Brass	SS
		c) Body seat ring, Disc. facing ring	—————	GM to IS:318, LTB 2
		d) Gaskets	—————	Non-Asbestos
	DATA SHEET FOR BUTTERFLY VALVE			
	1.0	Size Range	50 MM & Above	
	2.0	Design Code	Double flanged or lugged wafer type of low leakage rate confirming to AWWA C-504/BS:EN:593/API 609/equivalent	
	3.0	Pressure Rating	PN 10	
	4.0	End Connection	Flanged as per ANSI B.16.5 Class 125 / BS-EN 1092	
	5.0	Material of Construction		
	5.1	Body & Disc	Cast Iron	
	5.2	Shaft	SS 410 / SS 420	
	5.3	Seat Rings	EPDM	
	6.0	Accessories Required		
		a) Position Indicator		
		b) Locking Facility with lock		
		c) Gear reduction unit for valve size 200 NB and above.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-17 AIR CONDITIONING AND VENTILATION SYSTEM PAGE 31 OF 31



SUB-SECTION-A-18

FIRE PROTECTION AND DETECTION SYSTEM

**SINGARENI THERMAL POWER PROJECT
STAGE-II (1X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC NO.:CW-CM-11159-C-O-M-001**

CLAUSE NO.	TECHNICAL REQUIREMENTS 												
	FIRE PROTECTION AND DETECTION SYSTEM 1.00.00 GENERAL DESCRIPTION 1.01.00 A comprehensive fire detection and protection system covering all the equipments/system/ buildings/areas of entire power plant under scope of the Bidder. 1.02.00 The complete Fire Detection and Protection Systems shall be as per the guidelines/ codes/ standards / rules of TAC/ NFPA / IS: 3034 /OISD, etc. 1.03.00 Fire Water Source Existing fire water storage tanks and pumping system provided in Stage-I shall be used for fire water requirements for Stage-II also. For this purpose, fire water mains (Hydrants & Spray) shall be interconnected at multiple locations suitably. For the existing Stage – I fire water pumps details please refer Annexure- III. 1.04.00 Pressurization System This system consists of electric motor driven jockey pumps of existing Stage – I. 1.05.00 Minimum pipe size to be considered for hydrant and spray mains/ring headers shall be as follows : <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 60%;">Area</th><th style="width: 40%;">Minimum Pipe size in</th></tr> </thead> <tbody> <tr> <td>Along CD bay hydrant/spray</td><td>300NB</td></tr> <tr> <td>Along A row hydrant/spray</td><td>300NB</td></tr> <tr> <td>Between boiler &ESP hydrant/spray</td><td>300NB</td></tr> <tr> <td>Main ring from switchyard to ESP hydrant/spray</td><td>300NB</td></tr> <tr> <td>CHP area main ring hydrant/spray</td><td>300NB</td></tr> </tbody> </table> 2.00.00 HYDRANT SYSTEM Hydrant system shall consist of hydrant pumps, pressurization arrangement, water mains network, hydrant valves, landing valve, water monitors, hoses, branch pipes, nozzle, hose boxes, central hose houses etc. 3.00.00 HVW AND MVW SPRAY SYSTEM 3.01.00 General It shall consist of spray pumps, pressurization arrangements, water mains network, deluge valves, alarm valves, flow switches, isolation valves, Y-type strainers, spray nozzles/projectors, spray nozzles piping network, detection system, instrumentation, local control panels, cables etc. 3.02.00 Spray system shall mainly comprise of the following: - Automatic deluge valve (DV) assembly suitable size and trims - Isolation Valve (Gate Valve) with limit switch at the upstream & downstream of each DV. - Y-strainer of suitable size at upstream of each DV - S.S Spray nozzles - QB Detectors - Solenoids valve for each DV	Area	Minimum Pipe size in	Along CD bay hydrant/spray	300NB	Along A row hydrant/spray	300NB	Between boiler &ESP hydrant/spray	300NB	Main ring from switchyard to ESP hydrant/spray	300NB	CHP area main ring hydrant/spray	300NB
Area	Minimum Pipe size in												
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CHP area main ring hydrant/spray	300NB												
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001 SUB SECTION-A-18 Fire Detection & Protection System PAGE 1 OF 15												

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	- One (01) no. pressure switch each in detection line & spray discharge - One (01) no. limit switch for each isolation valve - Local control Panel with relays and interface units for each DV - GI piping for spray network at downstream of DV 25NB M.S. Black wet detection piping network. - Additional pressure switch (wherever required) on wet-detection line (inside the respective protected area having high elevation) shall be provided for required interfacing and operations of solenoid valves to facilitate deluge valve operations.			
3.03.00	For Stacker-Reclaimer machines: Water for spray system shall be tapped from hydrant header running along the stock-yard. For this, combination of butterfly valves & quick cam couplings (SS-304construction) with one end flanged shall be provided at every 20M interval in the hydrant header running along the stock yard. Whenever, stacker-reclaimer is in stationary condition, a flexible hose (SS-304 construction) with suitable end coupling shall be connected to quick cam coupling installed on hydrant header. The other end of flexible hose shall be permanently connected to deluge valve.			
3.04.00	Criteria for taking two (2) spray pumps in service: While designing the HVW/MVW spray system for crusher house, LDO tanks, cable galleries TG Building & ESP Building where flow of one spray pump of 410m3/hr may not be adequate, operation of two (2) spray pumps (existing one (1) motor driven and one (1) diesel driven) shall be considered.			
3.05.00	BLADDER TYPE FOAM PROTECTION SYSTEM			
3.05.01	GENERAL The fixed foam system of bladder tank foam proportioning type consist of skid mounted foam bladder tank assembly, foam makers, discharge outlets, interconnection piping, valves, fittings and instrumentation. Semi-fixed system consisting of a separate foam solution ring main around the tank with foam hydrant valves at regular intervals shall also be provided in addition to the water hydrants. The operation of the fixed foam system shall be automatic with the aid of dedicated fire detection system provided in the tank. The semi-fixed system shall be operated through the foam hydrants/ monitors, portable type foam water monitors (wheeled type with in-built foam maker), hoses and nozzles for extinguishing spill fire in and around the tank area.			
4.00.00	FIRE EXTINGUISHERS			
4.01.00	As indicated in Bidder's Scope (Refer Relevant Sub-section, Part A, Section VI).			
5.00.00	FIRE DETECTION, ALARM AND CONTROL SYSTEM			
5.01.00	Codes and Standards a. The design, manufacture, testing, performance, etc. of the various components of the analog addressable Fire Detection and Alarm System shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall be construed to relieve the contractor of this responsibility. b. Unless otherwise specified, the Fire Detection and Alarm System and the components shall conform to the latest applicable Indian or IEC Standards. Equipment complying with any other authoritative National Standards such as British, USA, VDE, etc. will also be considered, provided the parameters specified are equivalent or better than the corresponding IS.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-18 Fire Detection & Protection System	PAGE 2 OF 15

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	c. The Contractor shall be solely responsible for obtaining the required approval and clearance for the different components and systems of the Fire Detection and Alarm System from the following authorities, as applicable: i. Department of Atomic Energy (Certification of safety from Radioactivity). ii. Central Building Research Institute, Roorkee. iii. Central Mining Research Station, Dhanbad. iv. Local Fire Authorities.		
5.02.00	The equipment and the system shall be of types approved by any of the following bodies, as applicable: a. Loss Prevention Council, (LPC), U.K. b. National Fire Protection Association, (NFPA), USA c. Under-writers laboratories, (UL), USA d. Factory mutual (FM)		
5.03.00	General requirements for all types of Detectors		
5.03.01	Detectors shall be provided with the necessary compression type cable terminating glands for the incoming cables of flameproof type or PVC/metallic flexible/rigid conduits.		
5.03.02	The detector shall be located where the largest combustion gas concentration can be expected.		
5.03.03	Adequate compensation and considerations shall be made for effects for wind velocities such as air-conditioning system and exhaust fans where dilution of particles of combustion is greater.		
5.03.04	The exact location of detectors shall be coordinated with other services like air-conditioning grills, light fittings, cable trays etc. to provide aesthetically pleasing appearance. The return air paths of air-conditioning shall be avoided for detector location.		
5.03.05	The detectors shall not be affected by temperature, humidity; air flow or by drift failures and shall not give any false alarm due to above.		
5.03.06	The detectors shall not be sensitive to vibrations. Any special mounting arrangements required to counteract vibration shall be included in the contractor scope.		
5.03.07	The quantity of multi- sensor detectors in each zone shall be based on the coverage factor of 25-sq. meter per detector. However, the actual quantity of detectors required, taking into consideration obstructions due to floor beams, ventilation, doors, windows etc., shall be worked out and supplied (based on the actual layout) and installed by the contractor.		
5.03.08	The detectors shall not give false alarm due to high humidity, temperature, and velocity of air in the surroundings and static electricity conditions.		
5.03.09	Process actuated switch devices such as pressure switches, flow switches, level switches, etc. shall be provided with suitable individual addressable interface (local or remote) units or modules so that these devices are addressable from the panel.		
5.04.00	Infra-red Detectors		
	Application	Detection of Moving Fire on Coal Conveyors/Biomass Conveyors as well as hot spot beneath the surface	
	Sensor type	Infrared	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-18 Fire Detection & Protection System
			PAGE 3 OF 15

CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.05.00	Working voltage(detection)	24 V DC		
	Working voltage(purging)	230 V AC / 24V DC as applicable		
	Purging type	Air purging		
	Purging Unit	Either inbuilt blower or separate blower for purging		
	Location	Head of the conveyor		
	Features	1.	Ability to detect both black body and diffusion flame radiation.	
		2.	Reject electric arc, heaters, artificial light sources and sunlight etc	
		3.	Ability to function in heavily coal-dust prone atmosphere without regular maintenance	
		4.	Insensitive to vibrations	
	Annunciations	Trouble in purging, Fault Alarm, Trip LED, Power supply ON		
Output Controls	Two nos. Change over contacts for Alarm & Trip			
Accessories	Air purge unit including blowers, starter for blowers, hose pipe etc			
5.06.00	Linear Heat Sensor Cables			
	Application	Detection of Stationary fire		
	Type	Digital		
	Operating voltage	24 V DC		
	Operating Temperature (Alarm):	70 Deg C for cable gallery		
		90 Deg C for conveyors		
	Approval	FM/UL		
	Conductor material	Steel		
	Insulation	Heat sensitive polymer		
	Outer Sheath	Black or colored PVC or flouropolymer suitable for the application environment		
	Installation features for LHSC/IR detectors			
	1.	Mounting arrangement have been indicated in tender drawing.		
	2.	The detection zone/loop divisions of LHSC system shall match with MVW spray zones. Conveyors where LHSC shall be installed shall be divided into no. of various zones whereas conveyor for which IR detector is installed shall be considered as one zone.		
	3.	Linear heat sensing cable detector shall run in a zigzag fashion (with an included angle of 90 deg) on each top cable tray, bottom tray and every alternate intermediate trays of each section of cable tray without undue sagging and interfering the normal operations. All supporting materials for mounting of LHSC shall be provided by the bidder.		
	4.	Further, linear heat sensing (LHS) cable detector shall run in a zigzag fashion (with an included angle of 90 deg) in all vertical trays.		
Addressable Analog Intelligent Detectors				
In addition to the features specified under the item General requirements for all types of Detectors, the Addressable Analog Intelligent Detectors shall be provided with the following features:				
a) Detectors not specifically listed for sensitivity testing from the control panel are not acceptable due to the expense involved with manual testing as required by NFPA 72E.				
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-18 Fire Detection & Protection System	PAGE 4 OF 15

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	b) Each detector in a loop shall have short circuit isolator suitable for style-7 wiring as per NFPA-72. c) The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system.	
5.07.00	Multi sensor Detectors	
5.07.01	Multi sensor detectors shall incorporate a heat detection element and a photoelectric detection element. Both the elements shall be incorporated in a single unit. Both the elements shall be operative at all times and the fire signal shall be available from any or both elements combined together.	
5.07.02	The detectors shall be sensitive to very low smoke densities of the order of say 0.05 g/m ³ . Also it shall be possible to adjust this sensitivity on a step less basis over a range so that the optimum sensitivity could be selected at site to suit the conditions of installations. The coverage area of the smoke detection under standard NFPA test conditions shall not be less than 80-90m ² .	
5.07.03	In areas such as false ceiling where detectors themselves are not easily accessible, the remote response indicators outside the enclosed areas shall be provided to indicate the fire condition.	
5.08.00	System Configuration	
5.08.01	Each of the Addressable Fire Alarm panel shall be able to communicate with one another as well as with repeater annunciation panel and PLC based control panels located at different places. The detectors or other devices of any other unit/area shall be addressable only from the respective Addressable Fire Alarm Panel, so that each of the Addressable Fire Alarm Panel is under the control of designated operating personnel at that location. Facility to operate pumps of booster pump house shall be provided from PC based monitoring station.	
5.08.02	At least one spare loop shall be provided in each of the addressable type fire alarm panel located in control equipment room and in CHP control room with complete loop card and all other accessories so that Employer can expand the system in future. Further, at least 10% of loop capacity be left free in each of the connected loop in all the panels, so that, additional devices may be connected to the system in any of the loop by Employer in future.	
5.08.03	Fire system (as a whole including PLC control systems) shall be provided with necessary interface hardware and software for dual fibre optic connectivity & interconnection with station wide LAN for two –way transfer of signals for information sharing. The information shall be made available through Ethernet link following TCP/IP standard. The system shall be OPC compliant. All required plant data shall be transferred ensuring complete security. The exact number of points shall be finalized during detailed engineering.	
5.09.00	Analog Addressable Fire Detection and Alarm System	
5.09.01	General Requirements	
5.09.02	This specification in general covers the functional requirements, and general design aspects of Microprocessor based, Analog Addressable Fire Detection Alarm / Annunciation and Control System.	
5.09.03	The following description intends to describe only the brief hardware and functional requirements, scope of hardware requirements etc. but the actual configuration of the	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001
SUB SECTION-A-18 Fire Detection & Protection System		PAGE 5 OF 15

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	system shall be in line with the prevalent normal practices in the industry and shall conform to latest product range of selected manufacturer. The fire detection and control system offered shall be complete in all respects for the safe and reliable operation of the entire system. Any additional hardware/software than those mentioned herein required to make the system complete shall be included in the scope of the Bidder.	
5.09.04	Conventional detectors with interface modules are not acceptable. Each zone of LHSC detector and each IR detector shall be provided with interface module.	
5.09.05	All the fire detection systems, process actuated switch devices such as pressure/ flow/temperature switches and relays of control functions shall be hooked up with the analogue addressable fire detection and alarm system. Required addressable interface units shall be provided for various switch devices by the bidder to make them addressable.	
5.09.06	Bidder shall provide isolators at the start & end of the loop.	
5.09.07	The complete system shall include, but not be limited to the following: a) Master system CPU. b) Analog Addressable Fire Detection and Alarm System panels including alarm modules, system supervisory control modules, auxiliary output control modules etc. c) PC based monitoring station with colour graphic display terminal with programming and historical archiving facility along with laser printer. d) Power supplies, batteries and battery chargers. e) Analog addressable type smoke detectors. f) Non addressable type conventional detectors (Linear heat sensing cable detector/ infra red type heat detector) and switching devices each with its own addressable interface modules. g) Software and hardware as required for complete operation of the system. h) Complete Wiring/cabling including its conduits/trays/fixtures etc.	
5.10.00	System Functional Requirements	
5.10.01	The fire alarm panel shall evaluate the signals received from the detectors and shall handle the following functions: 1. System self monitoring and fault signaling. 2. Transmission of alarm and fault signals to the respective fire alarm panels and as well as in the repeater panel in fire station. Further, the panel shall activate a hooter/sounds in each of the area locally provided with fire/smoke detection system. Further, the system shall enable operation of spray system from the panel through monitoring station when the system operation is selected under remote, manual mode. 3. Initiate control functions like stoppage of conveyor, closure of fire doors, shutdown of draft fans, air-conditioning and ventilation plant/ equipment, opening smoke extraction vents, switching on smoke extraction equipment, emergency lighting etc. 4. Triggering stationary extinguishing systems such as clean agent system. 5. Supervising of unauthorised removal of a detector head from its base and giving a fault alarm on the control panel. 6. Supervising and monitoring the detection cabling, to indicate fault conditions in case of open/short circuit in the wiring.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001
SUB SECTION-A-18 Fire Detection & Protection System		PAGE 6 OF 15

CLAUSE NO.		TECHNICAL REQUIREMENTS																							
5.10.02		7. Supervising by a separate annunciation window, changeover from mains supply to battery supply. "Mains On" indication shall be continuously on, as long as the main supply is available. 8. Facilitating simulation of fire conditions to enable the testing of circuits (without creating actual fire) under the test mode from the fire Alarm panel. 9. The control unit shall contain all the systems main switches lamps and fuses. Switches and lamps shall be easily identified even in closed casings. 10. All the circuits from the detectors to the panels and the circuits from panels to the actuating/operating devices of the respective extinguishing system shall be of closed loop type and shall be supervised for open-circuiting and short-circuiting of cables. The cable fault shall be audio-visually annunciated on the panels. Separate hooters with different tones shall be provided for 'fault' alarms and 'fire' alarms. 11. Actuate solenoid valve in spray system in case of fire from respective fire alarm panel. For achieving this if any additional hardware is required like relays, power supply and cables, the same may be provided.																							
		Analog Addressable Fire Detection and Alarm System shall also meet the following functional requirements: <table><tr><td>i.</td><td>Each of the system shall support analog addressable detectors of all types, non-addressable type detectors/devices along with its addressable interface units/modules, Video display units etc.</td></tr><tr><td>ii.</td><td>Each of the devices and/or detectors shall be individually, uniquely and continuously addressable by the panel to which it is connected.</td></tr><tr><td>iii.</td><td>Detectors shall be interrogated for sensitivity settings from the control panel, logged for sensitivity changes indicating the requirement for cleaning and tested by a single technician using the field test routine. Sensitivity of each of the detectors made available in the panel shall be adjustable from the panel.</td></tr><tr><td>iv.</td><td>The system shall be capable of self-adjustment to compensate for the accumulation of contaminants that would change the detector sensitivity in either a more or less sensitive direction to prevent false indications or failure to alarm in the actual fire conditions. The system shall annunciate a trouble condition when any analog addressable smoke detector reaches 80% of its alarm threshold due to gradual contamination, signaling the need for service and eliminating unwanted alarm.</td></tr><tr><td>v.</td><td>Continuous supervision/monitoring of all the circuits and its components shall be made available from the panel for open, short circuits and grounding.</td></tr><tr><td>vi.</td><td>The system shall be able to recognize and indicate and alarm condition in a degraded mode of operation, in the event of processor failure or the loss of system communications to the circuit interface panels.</td></tr><tr><td>vii.</td><td>The system shall be programmable at site and required hardware shall be included in the scope of supply. The system software Programs shall be password protected and shall include full upload and download capability. During program upload or download the system shall retain the capability for alarm reporting. The system shall download to a PC for program editing. The software shall eligible employer to add the spare loop provided in the fire alarm panel or addition of additional devices/detectors in and of loop in any of the fire alarm panel.</td></tr><tr><td>viii.</td><td>The system shall support the use of color interactive History Reporting video display terminal for the display of information in an appropriate format.</td></tr><tr><td>ix.</td><td>The system shall include software for system database, historical event log, logic and operating system. The system shall require no manual input to initialize in the event of a complete power down condition. It shall return to an on line state performing all programmed functions upon power restoration.</td></tr><tr><td>x.</td><td>Software logic modules and system database shall be programmable using a windows compatible program on PC. It shall be possible to program or edit the</td></tr></table>				i.	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		vii.	The system shall be programmable at site and required hardware shall be included in the scope of supply. The system software Programs shall be password protected and shall include full upload and download capability. During program upload or download the system shall retain the capability for alarm reporting. The system shall download to a PC for program editing. The software shall eligible employer to add the spare loop provided in the fire alarm panel or addition of additional devices/detectors in and of loop in any of the fire alarm panel.																						
		viii.	The system shall support the use of color interactive History Reporting video display terminal for the display of information in an appropriate format.																						
ix.	The system shall include software for system database, historical event log, logic and operating system. The system shall require no manual input to initialize in the event of a complete power down condition. It shall return to an on line state performing all programmed functions upon power restoration.																								
x.	Software logic modules and system database shall be programmable using a windows compatible program on PC. It shall be possible to program or edit the																								

SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-18 Fire Detection & Protection System	PAGE 7 OF 15

CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.11.00		system database off site after down loading from the panel.		
	xi.	All detectors shall incorporate internal automatic temperature compensation to overcome the effects of either high or low ambient temperatures in the installed environment on the detector sensitivity. The detectors shall be tested at a specified frequency by raising the detector sensitivity level to the alarm threshold, to check the operation of the detector without system alarming automatically by the control panel.		
	xii.	In an alarm or trouble condition the following shall occur on the monitoring station:		
		1.	Sound an audible.	
		2.	Write details of the actuation to a system log file on the PC.	
		3.	Print the details of the actuation to the system printer.	
		4.	Activate the color graphic display system controls, providing functions such as zooming, scrolling of Alarms, troubles, etc.	
	xiii.	System configuration shall be menu driven and capable of being operated by a person with no previous computer programming experience.		
	Panel Display Requirements.			
	System display shall consist of minimum 80 character back lighted alphanumeric LCD display readable at any angle. Thirty-two character customer defined custom messages shall describe the location of the active device. In addition to the above, the following features shall be available.			
5.13.00	a.	The system shall be capable of programming to allow troubles occurred and restored in the system to be automatically removed from the display queue, eliminating the necessity for individual acknowledging of these events. This feature shall not affect the historical logging of events as programmed.		
5.13.01	b.	As a minimum an LED display for “Alarm”, “Audible Silenced”, “Supervisory”, “Trouble”, “Security”, “Power On”, And “Partial System Disabled”.		
	c.	Touch activated membrane switches for “Alarm Acknowledge”, “Audible Silence”, “Supervisory Acknowledge”, “Security Acknowledge”, “Reset”, “Display Hold”, And “Display Next”.		
	d.	All membrane switches shall be tactile with audible feedback when pressed.		
	Power Supply for Fire Alarm Panels & Repeater Alarm Panel			
5.13.02	One set of 24V DC redundant power supply system comprising of 2 x 100% chargers and 1 x 100% batteries shall be provided for each fire alarm panel and repeater alarm panel. The batteries for fire alarm system shall be sealed maintenance free lead acid type. The battery backup for each fire alarm panel and repeater alarm panel shall be 24 hours and 30 minutes (in alarm conditions). At least 25% of the devices shall be considered to be active in alarm conditions. Each of the redundant chargers shall be sized to meet connected load requirements and keep the connected batteries full charged (Float Mode). Furthermore, the charger shall be sized to enable the boost charge of a fully discharged battery in 10 hours while feeding the load.			
5.13.03	The batteries shall be sized as per relevant IEEE standard. For battery sizing calculation, an aging factor of 0.8, a temperature correction factor (based on temperature of 4 deg. C), voltage drop of 2V in cables. Capacity factor, Float Correction Factor, as per Battery Supplier Standard, shall be taken into consideration, if applicable and ambient temperature shall be considered as the electrolytic temperature. The sizing of the battery shall be as approved by Employer during detailed engineering.			
5.13.03	The battery chargers and batteries shall be placed at a suitable location inside the fire alarm panel with partitions.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-18 Fire Detection & Protection System
PAGE 8 OF 15				

CLAUSE NO.	TECHNICAL REQUIREMENTS																			
5.13.04	The detailed specification related to power supply system of fire detection & protection system shall be as specified in other sections of the technical specification.																			
5.14.00	Control & Instrumentation requirements																			
5.14.01	The specification for PLC control system for fire protection system shall be as specified in other sections of the technical specification.																			
5.14.02	The specification for PC, printer and other HMI items shall be as specified in other sections of the technical specification.																			
5.14.03	The specification related to Basic design criteria, Measuring Instruments, Process connection & piping, Control panels, Type test requirements etc shall be as specified in other sections of the technical specification.																			
5.15.00	Cabling for fire alarm system All instrumentation cables twisted & shielded, FRLS PVC insulated and sheathed data highway / fibre optical cables, short term fire proof cables including prefabricated cables (with plug-in connectors) etc shall be provided by Contractor. The contractor shall follow the cable philosophy as below:																			
<table><tr><th colspan="2">Application</th><th rowspan="2">Type of cable</th></tr><tr><th>From</th><th>To</th></tr><tr><td>PLC cabinets</td><td>PC, Printers etc.</td><td>As Mfr.'s Standard. However, connection between PLC and the remote I/Os shall be through fibre optic cable by Bidder if length is>300 M & coaxial cable if length<300 M</td></tr><tr><td>Detectors (including detectors mounted inside panels) /Any loop device</td><td>Detector (including detectors mounted inside panels) / Isolator/ Interface unit</td><td>Shielded, Twisted, PVC Cu. FRLS cables type "S" Refer Note 2, 3, 4 and 5 below.</td></tr><tr><td>Detectors (including detectors mounted inside panels) / Isolator / Interface Unit</td><td>JB</td><td>Shielded, Twisted, PVC Cu. FRLS cables type "S" Refer Note 2, 3, 4 and 5 below.</td></tr><tr><td>JB</td><td>Fire alarm Panel</td><td>Shielded, Twisted, PVC Cu. FRLS cables type "S" Refer Note 2, 3, 4 and 5 below.</td></tr></table>				Application		Type of cable	From	To	PLC cabinets	PC, Printers etc.	As Mfr.'s Standard. However, connection between PLC and the remote I/Os shall be through fibre optic cable by Bidder if length is>300 M & coaxial cable if length<300 M	Detectors (including detectors mounted inside panels) /Any loop device	Detector (including detectors mounted inside panels) / Isolator/ Interface unit	Shielded, Twisted, PVC Cu. FRLS cables type "S" Refer Note 2, 3, 4 and 5 below.	Detectors (including detectors mounted inside panels) / Isolator / Interface Unit	JB	Shielded, Twisted, PVC Cu. FRLS cables type "S" Refer Note 2, 3, 4 and 5 below.	JB	Fire alarm Panel	Shielded, Twisted, PVC Cu. FRLS cables type "S" Refer Note 2, 3, 4 and 5 below.
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JB	Fire alarm Panel	Shielded, Twisted, PVC Cu. FRLS cables type "S" Refer Note 2, 3, 4 and 5 below.																		
Notes: 1. 10% spare pair shall be provided for all cables having more than four pairs. 2. Type "S" cable shall be multicore control cable having overall shielding & specification similar to instrumentation cable except insulation thickness and voltage grade which shall be 1100 V. Type "S" cable shall also satisfy requirements of Article 760 of NFPA 70. 3. Over and above, contractor may note that short term fire proof cables shall be provided for coal handling plant and inert gas protected areas. Short term fire proof cables shall be Mineral insulated copper conductor and copper sheathed type satisfying requirements of Fire resistance, safety in the industrial application areas mentioned in the specification and also, shall be approved by UL standards and certified by LPCB. The contractor shall provide all the cables so as to complete the system 4. Cable size of 2 core 1.5 sq.mm shall be used for loop wiring in-case of both control cable and short term fire proof cable.																				
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION-A-18 Fire Detection & Protection System PAGE 9 OF 15																	

CLAUSE NO.	TECHNICAL REQUIREMENTS				
5.16.00	5. Cable size of 2 core 2.5 sq.mm shall be used to provide power supply to various devices in the loop in-case of both control cable and short term fire proof cable. 6. The detailed specification of instrumentation cables and optical fiber cable shall be as specified in other sections of the technical specification. 7. Detector cables outside the building shall be corrugated steel taped armoured laid through cable trays wherever available and for rest of the areas, cable shall be buried at 600 mm depth with sand filling and brick covering at the top. 8. Detector cable within the building shall be either unarmoured & laid through galvanized iron (GI) conduits or armoured cables, as per the standard and proven practice of the manufacturer. Detection System for Conveyors i) Linear Heat Sensor Cables for coal/biomass/limestone & gypsum conveyors: d) The LHS cable detector for each conveyor to be provided for both forward and return conveyors and shall be mounted as per the standard practice of the manufacturer/ supplier. Suspension of LHSC through flexible chains is a preferred arrangement. Further, LHS cable shall also be provided for return side of conveyors inside the bunker house. e) The detection zone/loop divisions of LHSC system shall match with the MVW spray system. f) Upon detection of fire either by QB detector or LHSC detector, the spray system shall be initiated. It shall also initiate spray system for the two adjacent zones after a time delay settable at site. g) The LHSC detector shall be provided with suitable interface unit, which shall generate/ make the signal compatible with fire alarm panel. ii) Infra Red Detector for coal/biomass conveyors: (a.) The infra red type (IR) detectors shall be suitable for detecting moving fires in conveyors. The IR detector shall stop the conveyor upon detection of fire and give audio-visual annunciation locally and in fire alarm panel. (b.) Each of the IR detector shall be provided with its own purging arrangement using blowers, hoses, etc and required power supply shall be derived from the fire alarm panel. Alternatively, bidder may offer separate blowers (2x100%) for purge air supply for all the detectors and the complete air piping from the blowers to each of the IR detector shall be provided by the bidder.				
5.17.00	Detection System of Cable Galleries & Cable Trestles i) In cable galleries, MVW spray system shall be actuated either by detection of fire by Linear Heat sensing cable detectors or by fire signal from Multisensor detection system. Apart from the automatic operation of spray system in the detected zone, the adjacent two zones shall also be sprayed with water automatically after a set time delay simultaneously. ii) In cable trestle, MVW spray system shall be actuated by detection of fire by Linear Heat sensing cable detectors. Apart from the automatic operation of spray system in the detected zone, the adjacent two zones shall also be sprayed with water automatically after a set time delay simultaneously. iii) The detection zone/ loop divisions shall match with MVW spray zones.				
5.18.00	Multisensor Detection System i) Upon detection of fire, multisensor detector shall be annunciated in the respective panels and shall activate a local hooter/sounder in the areas where fire is activated and this fire signal shall be employed to initiate the fire extinguishing system of that area such as automatic MVW spray system of cable galleries, fire extinguishing system of Control rooms/Control Equipment Rooms. ii) Cross zoning of the signal from two adjacent multisensor detectors shall be employed to initiate the fire extinguishing system of inert gas protected areas and MVW spray system of cable galleries.				
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-18 Fire Detection & Protection System	PAGE 10 OF 15

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	iii)	Duct detector shall be provided for return air ducts of main plant, which shall consist of intake probe, detector housing, and exhaust pipe etc. The detector shall be mounted outside the duct.		
	iv)	The design coverage area for detectors (to be considered) shall not exceed 25 Sq.M. for each detector.		
6.00.00	AUTOMATIC TOTAL FLOODING INERT GAS EXTINGUISHING SYSTEM			
6.01.00	General			
	a)	Fire protection system for the Central control room and other areas as defined below shall be by means of INERT gas extinguishing system. The INERT gas system shall employ any of the proven inert gas system specified under NFPA-2001. System shall be automatic and shall be activated by a dedicated detection system to be provided for each hazard area.		
	b)	System shall consist of inert gas (as per NFPA-2001) gas cylinders filled with the agent gas, cylinder mounting accessories, cylinder manifold, automatic discharge valves, discharge piping, nozzles, automatic operating devices, manual actuation devices/abort switches, associated fire detection/alarm system audio-visual safety warning devices, instrumentation associated control systems, panels etc.		
7.00.00	FIRE WATER STORAGE, PUMPS & PUMP HOUSE (AS APPLICABLE)			
	i)	Horizontal type centrifugal pumps shall be provided for hydrant, spray and jockey pumps. Maximum speed of the pumps shall be 1500 rpm. However, for jockey pumps the speed upto 3000 rpm is acceptable. The motor driven pump and the corresponding diesel engine driven pump shall completely interchangeable in respect of speed, impeller diameter, etc.		
	ii)	Capacity, discharge pressure & quantity of pumps for the hydrant water system and spray water system shall be individually designed as per Tariff Advisory committee (TAC) guidelines. However for minimum design requirement please refer Annexure- II		
	iii)	The headers of spray and hydrant system shall be interconnected with an isolation and a non-return valve so that hydrant pumps can feed to spray system not vice-versa.		
	iv)	The diesel engine drive of the pump shall conform to the requirements of TAC. Each of the diesel engine shall be provided with batteries (2x100%) and battery chargers (2x100%).		
	v)	Battery of the diesel engine shall be lead acid type as per IS and shall be large enough to crank the engine twelve times successively, each for a duration of 10 sec. without any charging in between.		
	vi)	Each engine shall be provided with fuel oil tank having adequate capacity to hold sufficient fuel oil for a minimum of twelve (12) hours of full load run. The fuel oil tank shall preferably be mounted on the engine. No fuel oil tank will be provided by the Employer.		
	vii)	Continuous drive motor rating (at 50°C ambient) shall be at least 10% (ten percent) above the maximum load demand of the pump in the entire operating range of the pump.		
	viii)	The feeding line of the spray system from the header shall be provided with 2x100% capacity basket type filters to avoid any particles in the spray system.		
	ix)	The system shall be complete with required instrumentation, control recirculation pipe line with valves for each of the pumps, NRV in discharge outlet etc.		
	x)	Pumps shall be designed for continuous operation at its best efficiency point to meet the specific requirements of the system for which it is to be employed. Pumps of each category shall be suitable for parallel operation.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-18 Fire Detection & Protection System
PAGE 11 OF 15				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
8.00.00 8.01.00	xii) Main fire water storage tanks: Two numbers each of 50% capacity vertical cylindrical column supported fixed cone roof type fire water storage tanks made of MS alongwith foundation shall be provided by the bidder. To avoid vacuum creation inside the tank, two (2) nos. vents each of size 300 NB shall be provided on the roof of the tanks. Bidder shall ensure that the total capacity of fire water storage tank shall be as per the recommendation of TAC with a minimum capacity of each tank equal to 2300 m³. Each tank shall be provided with ultrasonic type level transmitter and level indicators, etc. 8.00.00 PIPING AND VALVES 8.01.00 General Data for Pipes etc. i) Mild steel as per IS:1239 (Part-I) heavy grade (upto 150 NB) & as per IS:3589 Gr 410 (above 200 NB) or Equivalent for pipes normally filled with water. ii) Mild steel as per IS:1239 (Part-I) heavy grade (upto 150 NB) & as per IS:3589 Gr.410 (above 200 NB) or Equivalent and galvanised as per IS:4736 for pipes normally empty and periodically charged with water and foam system application. iii) Pipe protection shall be as follows: To prevent soil corrosion buried pipes / pipes in trench shall be properly lagged with corrosion protective tapes of coal tar type as per IS:15337 or AWWA C 203. The total thickness of protective tapes to be applied on buried pipes / pipes in trench shall be 4.0mm. This can be achieved by using 4.0mm thick tape in single layer or 2.0mm thick tape in double layer. iv) Pipe thickness: a) For Pipe sizes upto 150 NB: As per IS:1239 Part-I heavy grade. b) For Pipe sizes 200 NB and above refer Annexure-I. v) All valves shall be as per applicable IS/BS codes & approved by TAC for specific fire protection system and shall be provided with locking arrangement (with locks) in open or close condition. Further, all gate/butterfly valves of size 200 mm & above shall be provided with spur gear reduction unit. vi) All the flanges and counter flanges shall conform to ANSI B 16.5 Cl 150. vii) Strainer Body as per IS: 2062 (tested). viii) Pipe Fittings 1) The material shall conform to ASTM A 234 Gr WPB or ASTM A 105 or equivalent and dimensional standard conforming to ANSI B 16.11 (socket & threaded type), ANSI B 16.9 (for butt welded fittings) and ANSI B 16.5 (for flanges and flanged fittings) as the case may be. Further, galvanised malleable cast iron fittings as per IS:1879 in Cast iron fitting as per BS-1641 are also acceptable. 2) Grooved couplings: Vendor may also use mechanical grooved couplings type fittings in GI pipe lines for HVW / MVW spray system. All materials and products shall be either Underwriters Laboratories (UL) Listed or Factory Mutual (FM) Approved and installed in accordance with NFPA Standard 13 / equivalent Standard. 3) The fittings shall be galvanised as per IS: 4736 for galvanised pipe application. In case of branching connections from GI mains for spray piping network, socket may be welded for more than two pipe reduction instead of standard tees. 4) Fabricated fittings shall not acceptable up to pipe size to 300 NB. For sizes 350 NB and above, fittings may be fabricated as per BS: 2633/BS: 534.			
	SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001 SUB SECTION-A-18 Fire Detection & Protection System PAGE 12 OF 15			

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	ix)	Welding of galvanised iron pipes/fittings would be permitted provided the same is carried out by means of special electrodes suitable for the above application and the same shall be approved by Employer. After, welding, welded portions shall be applied with three coats of zinc silicate treatment/rich paint over one coat of suitable primer. Further, the Contractor shall provide proper zinc paint at the point of welding.		
9.00.00	PAINTING			
9.01.00	All the Equipments shall be protected against external corrosion by providing suitable painting.			
9.02.00	The surfaces of stainless steel, Gunmetal, brass, bronze and non-metallic components shall not be applied with any painting.			
9.03.00	Fire Water Storage Tanks (AS APPLICABLE):			
	i)	The Contractor shall clean the tank plates and structure steel before erection by wire brushing and air blowing. After erection of tank and hydro testing, tanks are subjected to surface preparation and painting as per procedure detailed below:		
	ii)	Surface Preparation: Outside/inside surface preparation shall be carried out by shot blasting as per SA2 ½.		
	iii)	Inside surface painting: One coat of epoxy zinc phosphate primer of min. DFT of 30-35 micron followed by three (3) coats of epoxy resin based finish paint with 25 micron as thickness of each coat.		
	iv)	Outside surface painting: One coat of epoxy zinc phosphate primer of min. DFT of 30-35 micron followed by three (3) coats of epoxy resin based finish paint with 25 micron as thickness of each coat.		
	v)	Outside bottom surface painting: One coat of epoxy zinc phosphate primer of min. DFT of 30-35 micron followed by three (3) coats of coal tar epoxy paint with 25 micron as thickness of each coat.		
9.04.00	All Steel Surfaces (external) exposed to atmosphere (outdoor installation)			
	(i)	Surface Preparation: The steel surfaces to be applied with painting shall be thoroughly cleaned before painting by wire brushing, air blowing, etc.		
	(ii)	Painting: One (1) Coat of red oxide primer of thickness 30 to 35 microns followed up with three (3) coats synthetic enamel paint, with 25 microns as thickness of each coat. For plant at coastal area, epoxy resin based zinc phosphate primer followed by epoxy resin based paint pigmented with titanium di-oxide shall be used in place of enamel paints.		
9.05.00	All Steel Surfaces (external) inside the building (indoor installation)			
	(i)	Surface Preparation: The steel surfaces to be applied with painting shall be thoroughly cleaned before painting by wire brushing, air blowing, etc.		
	(ii)	Painting: One (1) Coat of red oxide primer of thickness 30 to 35 microns followed up with two (2) coats synthetic enamel paint, with 25 microns as thickness of each coat. For plant at coastal area, epoxy resin based zinc phosphate primer followed by epoxy resin based paint pigmented with titanium di-oxide shall be used in place of enamel paints.		
9.06.00	Deluge Valves, Alarm Valves, Foam monitors, Water monitors, Foam Proportioning equipments, Foam makers, etc.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-18 Fire Detection & Protection System
PAGE 13 OF 15				

CLAUSE NO.	TECHNICAL REQUIREMENTS																																										
	Painting of all equipments/.components of FDPS package shall be as per manufacturer's standard practice or as detailed below whichever is superior in quality. <table><tr><th>Environment</th><th>Paint scheme</th><th>Total DFT</th></tr><tr><td>Normal / Mild Corrosive Environment</td><td>Primer- zinc filled epoxy Finish – Aliphatic Polyurethane (shade RAL3000)(P.O Red)</td><td>Min 125 microns</td></tr><tr><td>Corrosive Environment (as in coastal areas)</td><td>Primer- zinc filled epoxy Intermediate – Epoxy MIO Finish – Aliphatic Polyurethane (shade RAL3000)(P.O Red)</td><td>Min 200 microns</td></tr></table>				Environment	Paint scheme	Total DFT	Normal / Mild Corrosive Environment	Primer- zinc filled epoxy Finish – Aliphatic Polyurethane (shade RAL3000)(P.O Red)	Min 125 microns	Corrosive Environment (as in coastal areas)	Primer- zinc filled epoxy Intermediate – Epoxy MIO Finish – Aliphatic Polyurethane (shade RAL3000)(P.O Red)	Min 200 microns																														
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10.00.00	The hydrant and spray lines shall be overground. It shall be laid either on pedestals, trestles etc. However, if the layout does not permit laying of overground pipe in that case it shall be laid underground with the approval of Engineer.																																										
11.00.00	MULTIPURPOSE NOZZLE The multipurpose nozzle should be such that water under pressure is applied on fire in the form of a jet, spray or fog. Material of construction for multipurpose nozzle shall be as per manufacturer's standard.																																										
12.00.00	TYPE OF BUILDINGS (AS APPLICABLE) <table><tr><th>Sl. No.</th><th>Area/Facility</th><th>Type of building</th></tr><tr><td>1.</td><td>Fire Water Pump House</td><td>The fire water pump house shall be single storeyed and single bay RCC superstructure. The building shall be fully covered with external brick wall with provision for doors, windows, rolling shutters and supply & exhaust air fans.</td></tr><tr><td>2.</td><td>Fire Water Booster Pump House</td><td>The fire water Booster pump House shall be housed in a shed. Sides shall be fully covered with external brick wall with provision for doors, windows, rolling shutters and supply & exhaust air fans.</td></tr><tr><td>3.</td><td>Foam System Shed</td><td>Shed with roof covering and side walls shall be provided for foam system including associated civil works for foam bladder tank foundations, grade slab, pipe pedestals, etc.</td></tr></table> ANNEXURE-I PIPING THICKNESS: Pipes for sizes 200 NB & above shall confirm to IS: 3589 Grade 410. The final thickness shall not be less than that specified as per IS: 3589 as indicated below. <table><tr><th>Nominal pipe Size (mm)</th><th>Outside Diameter (mm)</th><th>Wall Thickness (mm)</th></tr><tr><td>200 NB</td><td>219.1</td><td>6.3</td></tr><tr><td>250 NB</td><td>273</td><td>6.3</td></tr><tr><td>300 NB</td><td>323.9</td><td>7.1</td></tr><tr><td>350 NB</td><td>355.6</td><td>8.0</td></tr><tr><td>400 NB</td><td>406.4</td><td>8.0</td></tr><tr><td>450 NB</td><td>457</td><td>8.0</td></tr><tr><td>500 NB</td><td>508</td><td>8.0</td></tr><tr><td>600 NB</td><td>610</td><td>8.0</td></tr></table>				Sl. No.	Area/Facility	Type of building	1.	Fire Water Pump House	The fire water pump house shall be single storeyed and single bay RCC superstructure. The building shall be fully covered with external brick wall with provision for doors, windows, rolling shutters and supply & exhaust air fans.	2.	Fire Water Booster Pump House	The fire water Booster pump House shall be housed in a shed. Sides shall be fully covered with external brick wall with provision for doors, windows, rolling shutters and supply & exhaust air fans.	3.	Foam System Shed	Shed with roof covering and side walls shall be provided for foam system including associated civil works for foam bladder tank foundations, grade slab, pipe pedestals, etc.	Nominal pipe Size (mm)	Outside Diameter (mm)	Wall Thickness (mm)	200 NB	219.1	6.3	250 NB	273	6.3	300 NB	323.9	7.1	350 NB	355.6	8.0	400 NB	406.4	8.0	450 NB	457	8.0	500 NB	508	8.0	600 NB	610	8.0
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION-A-18 Fire Detection & Protection System	PAGE 14 OF 15																																						

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Annexure-II			
	Technical Data:			
	1. Main Fire Water Pumps			
	Description	Hydrant Booster	Spray Booster*	
	Number of pumps	2 (1 motor driven & 1 diesel engine driven)	2 (1 motor driven & 1 diesel engine driven)	
	Design Capacity	171 m³/hr	410 m³/hr	
	TDH of pump (MWC)	45 (min) or as per system reqt.	45 (min) or as per system reqt.	
	MOC	Casing:IS:210 Gr. FG 260 (2.5% Ni), Impeller: Bronze IS:318 Gr.II, Impeller shaft, coupling :SS316		
	2. Hydrant Valve	Oblique female type as per IS:5290		
		MOC: Body/bonnet/stop valve/valve seat/trim : SS304/SS316		
	3. Water monitor	As per IS:8442 Type-I, Size: 75mm, Nozzle dia: 38mm		
		MOC: Water barrel/reducer/elbow: CS (seamless)/SS Nozzle: Copper alloy / SS confirm in to IS:3444		
	4. Water branch pipe & nozzle	As per IS:903 / IS:2871		
		MOC: Branch pipe: SS316 (Gr 4 of IS:3444) (both ends) Nozzle : SS316 (Gr 4 of IS:3444), Size: min 16mm & max 25mm		
	5. Water line Gate / Sluice Valve	- Design Code: a) IS:14846 or BS:5150 (for valves coming inside fire water pump house) b) BS:5150 (for valves at other locations) - Pressure rating: PN1.6 (as per IS:14846) / PN16 (as per BS:5150) -Working Pr. :12Kg/cm2		
		MOC: Body/bonnet/Yoke/Wedge: CI to IS:210 FG-200 Spindle: SS to ASTM-A-276 type 410		
	6. Check Valve	Below 50NB size	50NB & above	
		Design Code; IS:778 (below 50NB)	IS:5312 / BS:5153	
		MOC: Body/cover/flap: Leaded tin bronze to IS:318 Gr. LTB-2	CI to IS:210 FG-200	
	7. Butterfly Valve	Design Code: Double flanged or lugged wafer type of low leakage rate confirming to BS:EN:593/API-609/AWWA C-504 Pressure class: PN 16		
		MOC: Body & Disc: Cast Iron, Shaft: SS 410 / SS 420 Seat Rings: EPDM		
	Annexure-III			
	Description	Hydrant	Spray	Jockey
	Number of pumps	4(3 motor driven & 1 diesel engine driven)	2 (1 motor driven & 1 diesel engine driven)	2 (both motor driven)
	Design Capacity	410 m³/hr	410 m³/hr	75 m³/hr
TDH of pump (MWC)	105	105	105	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE				
TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001				
SUB SECTION-A-18 Fire Detection & Protection System				
PAGE 15 OF 15				



SUB-SECTION-A-19

FUEL OIL UNLOADING SYSTEM

**SINGARENI THERMAL POWER PROJECT
STAGE-II (1X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC NO.:CW-CM-11159-C-O-M-001**

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	TANKS			
1.00.00	DESIGN AND CONSTRUCTION			
1.01.00	LDO Storage Tanks			
1.01.01	Tanks shall be designed, fabricated, erected and tested in accordance with the IS: 803, latest edition. Supporting framework wherever required, shall be in accordance with IS: 800, latest revision or equivalent. Tank shall be designed,fabricated and erected keeping in view of the future provisions for storage of Methanol in place of LDO.			
1.01.02	The tanks shall be "Non-pressure" fixed roof type with atmospheric vents and shall be designed for an internal pressure of 66 kgf/m². Tank shall be designed with provisions so that fixed roof type may be converted into floating roof typefor future storage of Methanol.			
1.01.03	Light Oil Storage along with the associated facilities for the entire installation shall be in accordance with the requirements specified in the existing rules of Chief Controller of Explosives, Government of India. Associated facilities shall include provisions of fire protection facilities which shall be required for change-over to Methanol in future.			
1.01.04	Tanks shall be made from IS: 2062 quality mild steel plates of tested quality. The plates shall be cold rolled through plate bending machine by several number of passes to true curvature. The tanks shall be of welded construction.			
1.01.05	Vessel seams shall be so positioned that they do not pass through vessel connections.			
1.01.06	Tank Connections (a) All pipe material required for the tank connection shall be as specified. (b) Unless otherwise specified, for all flanged connections, Contractor shall furnish suitable counter flanges and necessary nuts, bolts and gasket materials. The flanges and counter flanges shall be fabricated by the Contractor from plates. (c) Flange faces of all nozzles shall be machined and shall be square with the vessel centerline.			
1.01.08	For other salient technical data and test requirements, Refer Table M1 appended to this section.			
1.02.00	Drain Oil Tank One drain oil tank shall be furnished to collect the oil drained from various pipes and from the equipments in the unloading pump house. The tank shall conform to IS: 800. The tank shall have accessories as indicated in tender drawing and shall have minimum liquid holding capacity of 6 m³. The technical details and design specification for tank shall be as per Table -M1 appended to this Section.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION A-19 FO UNLOADING SYSTEM
PAGE 1 OF 8				

CLAUSE NO.	TECHNICAL REQUIREMENTS															
1.03.00	Vent Line (a) The vent for LDO tanks and drain oil tank shall be of proven design. (b) The design shall be such as to offer adequate areas for venting. Venting area shall be such that over pressure / vacuum is not created in the tank during maximum filling / draw-off rate. (c) The vent sizing shall be done as per API Standard. (d) The open end of the vent line shall be covered with two layers of fine copper wire gauge of not less than 11 meshes per cm. and fitted with hood.															
1.04.00	Lightning Protection Contractor shall install a lightning protection system conforming to the requirements of IS-2309 (Ref Clauses 14 for protection of vessel tanks containing flammable liquids). System shall constitute of suitable number of horizontal and vertical air terminals. All the air terminals shall be connected to the risers of underground earth mat provided 300 mm above ground.															
2.00.00	PRECUATIONARY MEASURES															
2.01.00	No oil connection shall be made to any tank for any purpose until the tank is ready to be filled with oil.															
2.02.00	After oil connections have been made to a tank, no welding or any other hot work shall be carried out on the tank for repairs or any other purpose until all lines connected to the tank have been disconnected, the open ends of the pipelines blanked off and the tank and its vicinity tested and found gas free to the satisfaction of the Engineer / Employer.															
2.03.00	When a tank has once contained oil, no welding or other hot work shall be done on it for any purpose until in addition to the requirement of Clause 2.02.00 above, the tank has been completely emptied and the Engineer/Employer issues gas free and written authority for the work.															
3.00.00	CLEANING AND PAINTING															
3.01.00	After erection of tanks all surfaces shall be cleaned thoroughly by wire brushing and sand blasting to remove completely all loose dirt, rust, mill scales and any deleterious material. The surface shall then be prepared in accordance with manufacturers recommendations for applying an approved primer. After preparation of the surfaces in strict conformance to the specification the painting shall be applied. Further please refer separate painting chapter of Technical Specification elsewhere.															
3.02.00	Interior surface of the tanks shall be coated with the primer and finish paint as noted below: <table><tr><td>i)</td><td>LDO storage Tank</td><td>(a)</td><td>Epoxy red oxide zinc phosphate primer</td><td>-</td><td>2 coats of 30 microns each</td></tr><tr><td></td><td></td><td>(b)</td><td>Epoxy high build coating</td><td>-</td><td>2 coats of 100 microns each</td></tr></table>				i)	LDO storage Tank	(a)	Epoxy red oxide zinc phosphate primer	-	2 coats of 30 microns each			(b)	Epoxy high build coating	-	2 coats of 100 microns each
i)	LDO storage Tank	(a)	Epoxy red oxide zinc phosphate primer	-	2 coats of 30 microns each											
		(b)	Epoxy high build coating	-	2 coats of 100 microns each											
3.03.00	All external surfaces (non insulated) of the tanks shall be painted with primer coat of Epoxy resin based zinc phosphate (1 X 100 microns), one intermediate coat of epoxy resin based paint pigmented with titanium dioxide (1 X 100 microns) and finish coat of epoxy paint of approved shade (1 X 75 microns).															
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION A-19 FO UNLOADING SYSTEM	PAGE 2 OF 8											

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.04.00	Outside surface of bottom plates of all tanks resting on ground shall be given one (1) coat of coal tar epoxy enamel.			
4.00.0	TEST REQUIREMENTS AND TECHNICAL SPECIFICATION AND DATA-SHEETS FOR TANKS Test requirements for various equipments described in this sub-section are indicated in the enclosed specification sheets. The requirements indicated herein shall be included in the comprehensive inspection, testing and quality program to be submitted by the contractor and to be finalized with the Employer.			
	TABLE - M1			
4.01.00	TECHNICAL SPECIFICATION AND DATA-SHEETS FOR TANKS			
4.01.01	(A) LDO STORAGE TANKS			
	LDO STORAGE TANKS/DAY OIL TANK			
	i)	Type of Construction	Vertical, Cylindrical, non-pressure, fixed roof type with atmospheric vents	
	ii)	Codes	Design and construction as per IS: 803	
	iii)	Design pressure		
		a) Internal Pressure	66 Kgf/m ²	
		b) Vacuum	63.5 Kgf/m ²	
	iv)	Design Temperature	Ambient Temperature	
	v)	Nominal Capacity m ³	As specified	
	vi)	*Dimensions (I.D x height)	Shall be decided by bidder	
	vii)	Material of construction		
		a) Tank Shell, roof and bottom	IS: 2062 Tested quality steel plates	
		b) Structural	IS: 2062 Tested quality steel plates	
	viii)	Corrosion Allowance (minimum)	----- 1.8 mm -----	
	ix)	Shell Joint efficiency factor	----- 0.85 -----	
	x)	Vent	Tank shall be provided with open and free flow type atmospheric vent, which allows unimpeded flow of vapors out of and allows air into tank and at the same time prevents rain and air-borne dust from getting into the tank.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION A-19 FO UNLOADING SYSTEM
				PAGE 3 OF 8

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	xi) Nominal Venting capacity			

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	40 NB	:	3.68 mm	
	25 NB	:	3.38 mm	
	20 NB	:	2.87 mm	
	15 NB	:	2.77 mm	
5.01.05	The pipe size shall be selected as per following criteria of velocity of the fluid in the pipeline.			
	a)	Suction side of the pump for oil & water application 0.6-1.2 m/s.		
	b)	Discharge side of the pump for oil & water application 1.0-1.5 m/s.		
5.01.06	Fittings for oil service shall be Butt welded fittings, conforming to ANSI B16.9 and material to ASTM-A-234. Fittings of 50mm size and below shall be socket welded conforming to ANSI B16.11, material to ASTM-A-105.			
5.01.07	Vents at the highest point and drains at the lowest point shall be provided.			
6.00.00	VALVES			
6.01.00	All valves shall be suitable for most stringent service conditions i.e. flow, temperature and pressure under which they may be required to operate. The valves shall be full bore and sizes of valves shall be the same as that of the parent pipe.			
6.02.00	All manually operated valves shall be provided with gear operator of proven quality, reputed make and conforming to internationally accepted standard, if the effort required to operate the valve exceeds 25 kgf.			
6.03.00	All valves shall be provided with hand wheels, extension spindles and floor stands or any other arrangement wherever required so that they can be operated manually with ease by a single operator from the nearest operating floors either at a lower or higher elevation as the case may be. Wherever necessary for safety purpose, locking devices shall be furnished with valves.			
6.04.00	Gate Valves			
6.04.01	Gate valves shall be used for isolation purpose sizes above 300 NB for oil lines. The gate valves shall be provided with hand wheel, position indicator and draining arrangement.			
6.04.02	Gate valves for sizes up to and including 40 NB shall be of class 800, forged carbon steel valves with solid wedge, OS & Y rising stem, bolted bonnet with deep stuffing box and lantern ring. Trim shall be of 13% chrome steel. Body material shall conform to ASTM A 105 and ends shall be socket welded.			
6.04.03	For sizes above 40 NB, valves shall be of class 150/300 (depending on service), Cast Carbon Steel gate valves. Face to face dimensions shall be as per ANSI B 16.10. Body material shall be ASTM A 216 Gr. WCB and ends shall be flanged to ANSI 150/300 lbs rating with raised face. Other particulars shall remain same as above.			
6.04.04	The valves shall conform to API-600/API-602 and shall be tested to API 598/IS: 6157 requirements. IBR certificates as necessary shall also be provided.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION A-19 FO UNLOADING SYSTEM
PAGE 5 OF 8				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
6.05.00	Globe Valves			
6.05.01	Globe valves shall be used for regulation purpose for all sizes in oil lines. They shall be provided with hand wheel, position indicator and draining arrangement.			
6.05.02	Globe valves for sizes up to and including 40 NB shall be of class 800 forged carbon steel valves with plug type disc. Other particulars shall be same as 6.04.02 above.			
6.05.03	For sizes above 40NB, valves shall be class 150/300 (depending on service) Cast Carbon steel globe valves with plug or ball type disc. Other particulars shall be same as 6.04.03 above.			
6.05.04	The valve shall conform to BS: 1873/BS: 5352 and shall be tested to BS: 6755/BS: 5146 requirements. IBR certificates as necessary shall also be provided.			
6.06.00	Check Valves			
6.06.01	Check valves shall be used for non return service for all sizes in oil lines.			
6.06.02	For sizes up to and including 50NB, check valves shall be of class 800 forged Carbon Steel horizontal lift type, with bolted cover. Valves shall have 13% Chrome Steel trim and body material to ASTM A 105. Ends shall be socket welded.			
6.06.03	For sizes above 50NB, check valves shall be of class 150/300 (depending on service) Cast Carbon Steel valves of swing check type having bolted cover. Trim shall be of 13% Chromium Steel and body material to ASTM A 216 Gr. WCB. Ends shall be flanged to ANSI Class 150/300 lb rating with raised face.			
6.06.04	The valve shall conform to BS: 1868/BS: 5352/ANSI B16.34 and shall be tested to BS: 5146 / BS: 6755/API 598 requirements. IBR certificates as necessary shall also be provided.			
6.07.00	Oil Line Plug/Ball Valves			
6.07.01	Plug/Ball valves shall be used for isolation purpose in oil lines for sizes up to and including 300 NB. Valves shall be wrench or gear and hand wheel operated and shall have 'port' position indicators with CLOSE/OPEN indications marked on valve body.			
6.07.02	Ball valves for sizes up to and including 300 NB shall be of class 150 full bore type. Body material for plug/Ball valves shall be ASTM-A-216 GR. WCB. The ball shall be of SS-AISI-316 quality and plug material (for plug valves) shall be hardened steel to ASTM-A-216 Grade WCB with suitable heat treatment. Plug valves shall be self lubricated taper type of proven design.			
6.07.03	FO storage tank Inlet/fill line shall be provided with remote operated valves. The details of valves shall be as per clause No.6.07.01 and 6.07.02. The actuator details shall be furnished by the bidder for Employer's approval.			
6.07.04	All ball valves shall conform to BS: 5351 and fire safe test shall conform to BS: 6755 part-2/ API 607. All plug valves shall conform to BS: 5353 and fire safe test shall meet the requirements of BS: 6755 part-2. Fire safe certificates shall be submitted to Employer for approval. In absence of the certificates, the fire test shall be carried out by valve supplier.			
7.00.00	HOSES			
7.01.00	The hoses for LDO shall conform to BS: 1435 (latest edition), type S-7. The design temperature of the oil is 105 deg.C. The length of the hose shall be 8000 mm and dia 75 NB.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB SECTION A-19 FO UNLOADING SYSTEM	PAGE 6 OF 8

CLAUSE NO.	TECHNICAL REQUIREMENTS															
7.02.00	Both the end connections shall be galvanized in accordance with BS: 729/zinc sprayed as per BS: 2569, Part-1. Strainers: The strainers at the suction of various pumps shall be simplex type basket strainers. The strainer shall be provided with plugged drain/blow off and vent connections. The free area of the strainer element shall be at least six (6) times the internal area of the connecting pipe lines. The strainer element shall be 40 mesh. Pressure drop across the strainers in new connection shall not exceed 1.5 MLC at full flow. The material of construction of various parts shall be as follows: <table><tr><td>(a)</td><td>Body</td><td>:</td><td>MS to IS: 2062 (min. 8mm thk) or Pipe to IS:3589 (min. 6.35 mm thk)</td></tr><tr><td>(b)</td><td>Strainer Element</td><td>:</td><td>Stainless Steel (AISI 316)</td></tr><tr><td>(c)</td><td>End connection</td><td>:</td><td>Flanged</td></tr></table>				(a)	Body	:	MS to IS: 2062 (min. 8mm thk) or Pipe to IS:3589 (min. 6.35 mm thk)	(b)	Strainer Element	:	Stainless Steel (AISI 316)	(c)	End connection	:	Flanged
(a)	Body	:	MS to IS: 2062 (min. 8mm thk) or Pipe to IS:3589 (min. 6.35 mm thk)													
(b)	Strainer Element	:	Stainless Steel (AISI 316)													
(c)	End connection	:	Flanged													
8.00.00	Not Used															
09.00.00	CONTROL PHILOSOPHY															
The basic control philosophy of the fuel oil handling and storage system is described in the succeeding paragraph. The contractor shall provide all the features as specified herein including other features as required for safe and efficient operation of the system.																
09.01.00	Light Oil Unloading and Storage															
09.01.01	Out of the two (2) tanks, one tank shall be selected manually for filling operations. The other tank shall be in use. After the desired tank is selected the inlet/outlet valves of the selected tank and the tank under use shall be opened/closed automatically.															
09.01.02	After the selected tank level reaches High there shall be an alarm followed by tripping of all the unloading pumps when the tank level reaches High-High.															
09.01.03	Control interlocks for safe operation of various pumps shall be provided in DDCMIS.															
09.01.04	Similar operations and controls shall be provided for inter tank transfer system also.															
09.01.05	In case the running LDO unloading pump trips there shall be an alarm and the standby pump will be started manually from local push button.															
09.01.06	Signals shall be provided to achieve Control & Operation philosophy as required by the equipment.															
09.02.00	DRAIN OIL/ OIL RECOVERY/SUMP PUMPS AND PUMPS IN OIL WATER SEPARATOR															
09.02.01	In case of drain oil pumps and sump pumps there shall be an alarm on level reaching High.															
09.02.02	On alarm for HIGH level, or if physically the level is found to be HIGH, respective pumps will be started manually from local push buttons.															
09.02.03	In case of low level the pump will trip automatically with provision of low level contacts.															
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION A-19 FO UNLOADING SYSTEM												
PAGE 7 OF 8																

CLAUSE NO.	TECHNICAL REQUIREMENTS			
09.02.04	In case the running pump trips due to any other reason the standby pump will be started manually only from local push button.			
09.02.05	In case of pumps in oil water separator system both the pumps will be started from the local push button manually or if physically the level is found to be high or there is HIGH level alarm.			
10.00.00	BUILDINGS AND LAYOUT REQUIREMENT			
10.01.00	The fuel oil unloading pump house shall be RCC building.			
10.02.00	While deciding the layout of building namely Pump House the Bidder shall consider the following parameters. (a) Working space around the equipment shall be approx.1000 mm as a good engineering practice. (b) Generally 1200 mm passage all around inside periphery of the building shall be provided. (c) Building height shall take care of the following parameters: i) In case of handling of the equipment one over the other, the clearance between moving & stationary equipment shall be 500 mm (minimum). ii) In case of handling of the equipment on the side of the other equipment, ground clearance of moving equipment shall be 2500 mm (minimum). (d) One maintenance bay of 6m (minimum) x the width of the building shall be provided. (e) Two (2) nos. of rolling shutter of size 4000 x 4000 mm (min) shall be provided one at the entrance and the other at exit of maintenance bay. In case entrance & exit of maintenance bay is common i.e. on the same side, only one rolling shutter of size 4000 x 4000 can be provided. (f) For handling of equipments in the pump house One (1) no. hand operated monorail Hoist of minimum 2 tonnes capacity alongwith monorail in the fuel oil unloading pump house shall be provided.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB SECTION A-19 FO UNLOADING SYSTEM
PAGE 8 OF 8				



SUB-SECTION–A-20

COAL, BIOMASS PLANT

**SINGARENI THERMAL POWER PROJECT
STAGE-II (1X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC NO.:CW-CM-11159-C-O-M-001**

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.0.0	INTRODUCTION			
	This section of the specification provides the detailed technical requirements for the Coal & Biomass Handling System.			
2.0.0	CODES AND SPECIFICATIONS			
2.1.0	All plant, equipment, systems and works covered under this contract shall comply with the latest editions including amendments of applicable codes, standards, statutes, regulations, and safety rules as on the date of submission of bid. Care shall be exercised in observing compliance with the rules and regulations governing the locality where the plant is to be installed. Contractors' obligations in this regard shall not be limited to only those codes and standards mentioned in this contract. Nothing in these specifications shall be construed to relieve the Contractor of his responsibility.			
2.2.0	In the event of any conflict between the applicable codes and standards and the requirements of this contract, the more stringent of the two shall govern.			
2.3.0	The specific codes / standards followed for the design of the system are as below and relevant codes are also indicated against each equipment:			
	CEMA	Conveyor Belt Manufacturing Association		
	IS:11592 - 2000	Code of practice for selection and design of belt conveyors		
	IS:1891 - 1994	Conveyor and elevator textile beltings spec. Part.1 General		
	IS:14386 -1996	Belt conveyors-Traveling Tripper-Motorized for belt widths 650mm to 1600 mm- Dimensions		
	IS:8531-1986	Specification for Pulleys for Belt conveyors		
	IS:8598 - 1987	Specification for Idlers and idlers set for belt conveyors		
	IS 9295 - 1983	Steel tubes for Idlers for Belt conveyors		
	IS 800	Code of construction of structural works.		
	IS 16143 (Par 2 & 4) / ASTM C50/ ASTM D2013	Coal Sampling System Sampling System		
	IS:2062 - 2006	Steel for general structural purposes.		
	IS:1239 2004-part 1	Spec for mild steel tubes tubular and other wrought steel		
	IS:3589: 2001	Steel pipes for water and sewage (168.3 to 2504 mm outside diameter)		
	IS: 325	Three Phase induction motors		
	ASHRAE :2007	HVAC applications		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
Page 1 of 122				

CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.0.0	IS 3832: 2005	Manual hoist / CPB	
	IS 3938: 1983	Electric hoist	
	IS 3177: 1999	EOT Crane	
	IS 4894: 1987	Specification for centrifugal fan	
	IS 7155 :1990	Code of Recommended Practice for Conveyor safety	
	The extraction capacity of dust extraction system shall be based on "American Conference of Governmental Industrial Hygienists"(ACGIH).		
	SYSTEM DESCRIPTION		
	The coal handling system comprises the following:		
	-Unloading of coal at Wagon tippler hopper, crushing and bunker Feeding System		
	-Stacking, Reclaiming and Bunker Feeding System		
3.1.0 (a)	Coal conveying from Mines, Unloading, Crushing and Bunker Feeding System		
	Indian Railway rakes consisting of type of wagons as specified in RDSO G-33 (Rev-2) guidelines shall transport coal to the power plant. The coal received from wagons shall be unloaded in underground RCC WT Hopper. Side discharge type WT Tippler are to be employed for unloading BOXN type Coal rake. Side arm charger are envisaged for placement of BOXN wagons on the tippler table & removal of empty wagon from tippler table after tipping. Clear access shall be provided for movement of pay loaders/ bulldozers on the hopper grating of wagon tippler. Gratings over wagon tippler hopper shall be placed and designed accordingly. Apron feeder along with dribble conveyor are employed under each wagon tippler for extracting coal from wagon tippler.		
	The coal received from Coal wagons shall be unloaded in underground RCC WT Hopper and conveyed to the crusher house for sizing of coal to (-) 20 mm.		
	Crushed Coal shall be conveyed on to Bunker for bunkering or shall be conveyed to Stockyard for stacking through 2x100% parallel stream conveyor system.		
3.2.0	Crushing		
	In the Crusher house, coal from incoming Conveyor of one Stream shall pass through two (2) numbers (dedicated) Vibrating Feeders and two (2) number (dedicated) crushers respectively. Similarly, coal from incoming Conveyor of one Stream shall pass through two (2) numbers (dedicated) Vibrating Feeders and two (2) numbers (dedicated) crushers respectively. Each stream shall have a set of Rod gates and Rack & Pinion Gates before Vibrating Feeders to permit maintenance of equipment, hoppers, and chutes in one stream without affecting the operation of other stream. A coal sampling unit shall be provided to sample the coal from either stream.		
	Passenger cum goods elevator shall be provided in Coal Crusher House.		
3.3.0	Bunker Feeding System of Coal & Biomass		
	From the crusher house, crushed coal of (-) 20 mm size would be fed to coal bunkers		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
			Page 2 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.4.0	through a series of belt conveyors, passing through various Transfer Points and traveling trippers.			
	Biomass would be blended through Biomass conveyors into Transfer point which in turn fed to bunkers along with Coal through Coal Conveyors.			
	Stacking, Reclaiming of Coal			
	Stacker cum Reclaimer machine shall be provided on yard conveyor. The Stacker Reclaimer machines shall operate on rails for stacking/reclaiming the coal in the stock yard area. During reclaiming operation, the reclaimed coal shall be conveyed to the yard conveyor by the boom conveyor of the Stacker Reclaimer machines for Conveying to Boiler Bunker. Electronic Belt weighers mounted one each on stacker reclaimer, boom conveyor complete with all mechanical, supporting arrangement, electrical, and accessories.			
4.0.0	Stacker cum reclaimer shall be provided with hydraulic drive for bucket wheel to reclaim at the required rate. Stockyard Management System shall be provided as per C&I Annexure-I to sub section A-20.			
	MAJOR EQUIPMENT OF COAL & BIOMASS HANDLING SYSTEM			
	4.1.0 Belt Conveyors System			
	The belt conveyor system shall confirm to the latest edition of the following standards & codes :			
4.1.1	“Belt Conveyors for Bulk Materials” published by Conveyor Equipment Manufacturers’ Association.			
	IS:7155	:	Codes of Practice for Conveyor Safety.	
	IS:1891 (Part-I)	:	General Purpose Belting	
	IS:8598	:	Idlers and Idler Sets for Belt Conveyors	
	IS:4009 (Part-II)	:	Conical Head Grease Nipples	
	IS:8531	:	Pulleys for Belt Conveyors.	
	IS:226	:	Structural Steel (Standard Quality)	
	IS:4682	:	Codes of Practice for Lining of Vessels and Equipment for Chemical Processes.	
	IS:11592	:	Code of practice for selection and design of Belt Conveyors.	
	CAN / CASA - M422 M87: Canadian standard association.			
	Belting :			
	The belting shall be of either synthetic fabric such as Nylon-Nylon, Steel Cord, etc. with rubber covers of adequate flexibility to give a troughing angle of 35 deg.			
	Belt Width: As specified in Equipment Sizing Criteria chapter A-01			
	SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	
				Page 3 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Internal Belt Cleaner V-plough type belt cleaner made of mild steel flats and hard rubber strips with automatic wear adjustment and necessary accessories shall be furnished for cleaning internal surface of the conveyor belt.			
4.1.4	Belt Take-up Arrangement			
4.1.4.1	Automatic take-up of gravity type shall be generally provided with necessary take-up arrangements complete with bend pulleys, take-up pulley, with its supporting / sliding assembly, wire ropes with turn buckle arrangement (to adjust the level) for suspending the separate take - up weight sliding assembly close to the ground, counterweights and other accessories. Suitable guards marked up scale attached to the frame to monitor belt stretch and access/maintenance platforms with handrails all around etc. shall be provided. Adequate access from conveyor gallery/transfer house/ground etc., as the case maybe, shall be provided to inspect, repair and maintain the gravity take-up arrangement. Suitable arrangements shall be provided for clearing accumulated coal from various platforms to ground level. Guides of take up pulley/counterweights shall be sufficiently strong so that they do not bend during belt snapping.			
4.1.4.2	The prime consideration should be to locate the automatic take-ups at a place where these will work best, in relation to the drive, to keep belt tension at a minimum. Other considerations such as available space, maintenance considerations and the economics of the location should also be considered while designing. Take up shall not be located over buildings unless indicated in tender drawings. Height of take-up guide structure shall be sufficient to allow the take-up weight movement up and down for all operating conditions of conveyor and to allow minimum two (2) vulcanizing lengths margin in the belt or percentage of conveyor length (2.5% for synthetic belting, 0.5% for steel cord belting) whichever is larger. Suitable guides shall be provided both for take up pulley and take up weight.			
4.1.4.3	Two (2) meter safety fencing along with suitable gate and locking arrangement shall be provided around gravity take-up at the base level / ground level.			
4.1.4.4	Irrespective of take-up location, the travel zone of take-up weight shall start from a suitable height above ground level.			
4.1.4.5	Suitable buffer arrangement shall be provided to arrest the fall of take-up pulley in order to avoid damage of the pulley assembly in case of belt snapping. Similar buffer arrangement shall be provided for take-up weight also, in case of, take-up weight travel zone terminating above a building floor. Sandpits of 600 mm deep shall be provided at ground below the take-up weights.			
4.1.4.5	In case of double stream conveyors, a partition of 3 mm steel plate shall be provided between the two take-up pulleys along entire travel zone of take-up pulleys. Intermediate platforms shall be provided in the take-up zone for maintenance of take - up pulleys / counterweight.			
4.1.4.6	Take-up weight shall consist of multi-blocks and not of single block to facilitate adjustment in weight if required during operation. Single heaviest piece shall be suitable for easy handling. Take-up weight block shall be provided with edge protection angle to take care of any damage. Take up weights shall be kept inside a take up weight box and shall be properly anchored / bolted with the main frame, so that the none of the weight shall be loose/free inside the box. The box shall be painted with counterweight and conveyor number and shall have good aesthetic look.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
Page 5 of 122				

CLAUSE NO.	TECHNICAL REQUIREMENTS																			
4.2.0 4.2.1 4.2.2 4.2.3 4.3.0 4.3.1 4.3.2	Electro Hydraulic Thruster Brakes and Clamp The necessary Electro-hydraulic Thruster (AC) brakes / disc brakes, totally enclosed and fail safe, shall be provided as required for various equipment. Braking torque shall be adjustable from 0 to 100% of rated braking torque. Limit switches shall be provided for brake applied/released positions. The windings shall be provided with class-B insulation suitable for 415V $\pm$ 10% at 50 Hz $\pm$ 5% and combined variation of $\pm$ 10%. The brake lining shall be asbestos with inter woven brass wires capable of withstanding 200°C temperature. Non-asbestos material is also acceptable, subject to proven performance. Clamp Electro-hydraulic thruster rail clamp shall be actuated by compression springs, the spring shall apply the clamping force directly on the Rail clamp mechanism once power supply is cut-off. Manual rail clamp shall be provided with positive locking arrangement and shall apply clamping force directly on rails. The manual rail clamp shall be of proven design. Hold back devices Suitable hold back devices for preventing running back of the conveyor belt in case of conveyor being stopped in loaded conditions due to power failure or during normal operational delays shall be provided to give positive protection. The hold back shall instantaneously engage without shock and be capable of protecting equipment and personnel. It shall be released instantly when 'power' resumes or the 'delay' is removed. The holdback devices shall be integral with gearbox. MONORAILS AND HOISTS The Monorails & Hoists shall conform to the latest edition of the following standards & codes. Other internationally acceptable standards/codes, which ensure equal or higher performance than those specified, shall also be accepted. <table border="0"> <tr> <td>IS:3938</td> <td>:</td> <td>Specification for Electric Wire Rope Hoist</td> </tr> <tr> <td>IS:3832</td> <td>:</td> <td>Chain pulley blocks</td> </tr> <tr> <td>IS:2429</td> <td>:</td> <td>Round steel short link chain</td> </tr> <tr> <td>IS:6216</td> <td>:</td> <td>Short link chain grade 80</td> </tr> <tr> <td>IS:8610</td> <td>:</td> <td>Points hooks with shank for general engineering purposes</td> </tr> <tr> <td>IS:210</td> <td>:</td> <td>Cast Iron Castings</td> </tr> </table> For the Hoists with more than 2.0 tons lifting capacity or more than 10.0 M lift, except for hoists for GTU and bend pulleys motor operated hoist blocks for both long travel and lift shall be provided. Other hoist blocks shall be of hand operated type for both travel and lift. All monorails coming out of the buildings shall be provided with electric hoist blocks, irrespective of load and lift. Minimum 3-meter length of Cantilever from edge of building/cladding, shall be provided in monorails coming out of the building to lower the equipment to ground level clearing the building sidewalls / cladding and any other facilities beneath the floor up to ground level. Clear height shall be maintained when handling one equipment over other, in such case dismantling of any equipment shall not be permitted. The center line of monorail shall not deviate by more than 500 mm from the center of gravity of any equipment that is to be lifted.	IS:3938	:	Specification for Electric Wire Rope Hoist	IS:3832	:	Chain pulley blocks	IS:2429	:	Round steel short link chain	IS:6216	:	Short link chain grade 80	IS:8610	:	Points hooks with shank for general engineering purposes	IS:210	:	Cast Iron Castings	
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant Page 7 of 122																		

CLAUSE NO.	TECHNICAL REQUIREMENTS		
4.3.3	The electric hoist shall be designed and constructed in accordance with the latest revision of IS:3938 and shall be suitable for duty class 2. For electric hoists, trolley movement and hoisting shall be affected by using two separate motors. Motors shall be as per technical requirements discussed elsewhere. However, the motors shall be suitable for 150 starts per hour at 40% CDF. Motor operated geared trolley shall have two (2) pairs of wheels, one pair of which shall be driven through motor. An electromechanical brake shall be provided for hoisting as well as cross travel. The brake lining shall be of asbestos. Non-asbestos material is also acceptable, subject to proven performance.		
4.3.4	Wire rope shall be of pre-formed type, steel cored, regular lay 6/36 construction with a breaking strength of 160 -175 kgf/ sq. mm. The reverse bend of ropes is not acceptable. The minimum number of falls of rope shall be four (4). All running shafts and wheels shall be fitted with ball / roller bearings with a rated life of not less than 20 years based on equivalent running time as per IS:3938.		
4.3.5	All chain pulley blocks shall be designed to IS:3832, the operating hand chain shall conform to IS:2429 grade 30 pitched and polished and the load chain to IS:6216 grade 80. The chain pulley block shall be suitable for duty class 2. Hooks shall be as per IS: 8610 & with antifriction bearing.		
4.3.6	The hoist mechanism shall consist of a grooved rope drum driven by electric motor through gears. Each end of the rope shall be anchored to the drum in such a way as the anchorage is readily available for maintenance. Each rope shall have two (2) full turns of the drum when the hook is at its lowest position and one (1) spare groove when the hook is at its highest position. The leading rope taken by the drum should not slope sideways when slack and it should not be caught between the gear wheels.		
4.3.7	Inline magnetic separator shall have motorized hoist for handling / maintenance purpose. Each suspended magnet shall be provided with a dedicated motorized trolley.		
4.3.8	Pendent shall be provided with fluorescent up/down/forward/reverse travel push buttons and indicating lamps. The control panel shall be wall mounted type and easily approachable from the floor by a standing man.		
4.4.0	Chutes, Skirt Board, Flap Gate, Rod Gate and Rack & Pinion Gate		
4.4.1	Chutes The Contractor shall supply all the necessary chutes for feeding the coal/biomass onto the conveyors. The design of the chutes shall be suitable for the trajectory of the material as it leaves the conveyor, so that minimum wear takes place, and no spillage occurs. The size and shape of the chutes shall ensure free flow of material at the transfer point, without plugging even under extreme moisture. Chutes shall be fabricated from wear resistant steel plates Tiscral or equivalent. The material selection shall assist the free flow of material. The thickness of the chutes shall be 20 mm for the three sides where material slides/impacts the chute and 10 mm for the chute wall that is not subject to abrasion. The chutes shall include external integral stiffeners and shall be provided with support brackets to attach chutes to adjoining structures. Chutes and supports shall be designed to withstand the load imposed by a totally plugged condition and designed so that the load is shared by the floor(s) the chute passes through. Chutes shall be provided with permanent lifting lugs and shall be designed to allow removal of parts or the entire chute without removing other equipment such as conveyor pulleys, crushers, etc. Suitable access doors to allow ease of maintenance to items such as detectors, bearings, liners, and belt cleaners shall be provided for all chutes. Chutes, which feed onto conveyors,		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
			Page 8 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS	
4.4.2 4.4.3 4.4.4 4.4.5	shall be supplied with skirt boards. A suitable soft rubber dust curtain shall be provided on all entries into conveyor head chutes and at the end of each covered skirt plate area. A suitable arrangement, i.e., tilt-switch or better, according to experience of Contractor, shall be provided to indicate a blocked chute. Hoods over the conveyor head pulleys shall be made of suitably stiffened minimum 4 mm M.S. Plates and shall be provided with hinged and gasketed inspection doors with suitable access to them. Further, serrated rubber seal shall also be provided at the very inlet of head chute to minimize dust nuisance. In the inspection doors and chute plate jointing area joints area to be provided with MS round or strip to give a labyrinth effect. Inspection doors to be provided with hinge. Skirt Board The skirt board shall ensure centralized loading of conveyor belt to avoid material spillage. Suitable 'Skirt Plates' shall be provided for the entire feeding chute and shall be extended minimum 3m ahead of front edge of chute and 500 mm beyond rear edge of chute. The width of the Skirt Boards shall be two-thirds the conveyor belt width. In the belts where coal of appreciable lump size (250 mm) is being conveyed, the gap between the bottom of the skirt board and the belt shall be made to increase uniformly in the direction of belt travel. The height of the skirt boards shall be sufficient to contain the material volume as it is loaded on the belt and shall not be less than 750 mm for conveyors. The height of the skirt board for belt feeders/ reversible belt feeders shall be minimum 1000 mm. The skirt plates shall be fitted with proper 'skirt material' having facility of adjusting the pressure on the belt conveyor. 'Skirt sealing Material' shall be of low friction, high tear resistance & abrasion resistant polyester-based polyurethane/Rubber with Durometer Shore A Hardness of '65 (+/-) 5 and min thickness should be 15 mm. Chamfering to be done at one edge of the skirt. Skirt sealing material of each side shall be in single piece. Flap Gate The motor operated 2 position flap gates shall be provided in transfer chutes as specified and shall be complete with electrically operated actuators. The face of the flap gate shall be made from 20 mm thick. The equipment shall be capable of being operated for at least 15 switching per hour at rated load and thrust and shall be suitable for 10 Nos. consecutive switching at rated load and thrust. The flap gate travel shall be in the range of 60 deg. to 70 deg. Suitable travel-dependent limit switches controlling the travel of the flap gates in either direction shall be furnished. These shall be placed internal to the driving unit and shall be completely dust-proof. The limit switches shall be capable of adjustments to vary the total length of travel of the gates. Suitable thrust dependent limit switches shall be provided in the actuator, which shall trip off the actuator motor in case of excessive thrust due to jamming of the gates during its travel in either direction. The same shall also be integral to the driving unit and shall be dustproof. Approach/maintenance platforms complete with the chequered plate floor, handrails, ladders etc. shall be provided for all flap gates. The platforms shall be extended for access to dust & debris chute inside buildings. Provision for alternative manual operation shall also be made using declutchable hand wheel of 500 mm diameter. Limit switch for safety of person operating the hand wheel shall be provided. Manual effort required to operate the flap gate shall not exceed 25 kgs. All the actuators in the plant should be selected based on heaviest loading, but the rating shall not be less than 3500 kg with a lever arm of 1.0 m in any case. For standardization purposes, only one standard type of actuator for flap gates shall be provided.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant Page 9 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS	
4.4.6	The material of shaft shall be EN-8 or equivalent. The diameter of the shaft shall be suitable for motor stalled condition and associated twisting. However, the diameter of the shaft shall not be less than 150 mm.	
4.4.7	Rod Gate Suitable manually operated rod gates shall be provided over rack and pinion gates for their easy operation and maintenance. The Rod gate shall be guided properly, and suitable bearings sealed for life and dust proof arrangement shall be provided. The diameter of rod shall be 40 mm minimum.	
4.4.8	Rack & Pinion Gate The rack and pinion gate shall be guided properly and suitable rollers with bearings sealed for life and dust proof arrangement shall be provided. A rotary actuator operated rack and pinion gates shall be provided. The rack and pinion gates shall be of mild steel construction with liner plate of 10 mm thick TISCRAAL or equivalent material. The gates shall be operated by means of double rack and pinion. The material for rack & pinion wheel shall be cast steel and shaft shall be EN-8. Provision for alternative manual operation (manual effort 25 kgs) of motorized rack and pinion gates shall also be made. Limit switch for safety of person operating the hand wheel shall be provided.	
4.5.0	DRIVE EQUIPMENT	
4.5.1	Gear Box The gearboxes shall be designed for 24 hours continuous duty. Gearboxes with cooling coils or external cooling are not acceptable. The gears used shall be helical conforming to IS:3681 (latest revision) or worm reduction units or spiral bevel speed reduction units conforming to suitable Indian Standards. The dimensions of the shaft end shall conform to IS:3688 or its latest revision. Above 40 kW drive rating, all gearboxes shall be helical or bevel helical type only. all gearboxes shall have suitable breather plugs, dipstick, drain plug etc.	
4.5.2	Flexible / Rigid Coupling The design of the coupling shall be such that it can take shock and misalignment without sacrificing its efficiency. Geared type flexible coupling shall be used on low-speed side for all conveyors and other drive chains where gear box is provided. Other couplings in the drive chains shall be either rigid or flexible type, depending upon the requirement of equipment design.	
4.5.3	Fluid Couplings Fluid couplings shall be provided in all the drive machinery for belt conveyor systems and coal crushers if the actual power requirement at motor output shaft is more than 40 kW. The fluid coupling for LT motors shall be of traction type and for HT motors, shall be of scoop tube type. Suitable electrically operated actuators shall be provided for scoop tube operation from local as well as remote. Manual operation may also be provided. Separate pump with motor or integral shaft driven oil pump shall be provided for circulating the fluid coupling oil through oil cooler. Forced cooling water supply to oil cooler shall be provided for which cooling water pumps to be provided for group of scoop couplings. Suitable interlock using flow switches shall be provided in both oil as well as water lines to trip the drive motor in the event of flow in either line falling below acceptable levels. Alternatively, Air cooled type scoop coupling is also acceptable for all conveyors with HT motors and crusher scoop couplings.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		Page 10 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	Suitable pressure indicators and flow indicators shall be provided in the cooling water lines along with all-relevant valves, and accessories. Necessary isolation valves shall be provided in the oil / water line for maintenance of any equipment in the line. Necessary interlock shall also be provided so that the HT motor cannot be started from remote / local unless position of scoop tube permits no load start of the motor. Tripping of downstream equipment while the system is under normal operation shall result in scoop tube re-positioning to permit no load run of the concerned HT motor. A temperature switch shall be provided in the oil circuit and shall trip the system in case of high oil temperature. The scoop tube operation must be such so to ensure draining of oil from the operating circuit by providing a double speed motor. The speed (for draining) shall be selected to match the coasting time of downstream equipment/conveyor.	
4.6.0	CHP/BHP BUILDINGS	
4.6.1	All buildings shall have sufficient space to accommodate all relevant equipment of Plants. Moreover, ample space shall be provided for maintenance purposes. Outside stairs to transfer points and crusher house shall be open type. However, a weather canopy shall be provided at the top.	
4.6.2	Building floors shall be washed periodically with water for which necessary slope & drains shall be provided from each floor leading to minimum 4 no's down comers of minimum 273 mm OD each building. However, for MCC, control buildings and pump houses, minimum 150 mm diameter, 4 no's galvanized MS pipes conforming to IS :1239 shall be provided. The system shall be designed considering water mixed with coal. A drain pit shall be provided near each building to collect water/coal mixture. Overflow from this pit shall be connected to nearest drain. 1 mtr x 1 mtr size dust/debris MS chutes from all the floors to ground floor shall be provided at all buildings/transfer houses and crusher house. The plate thickness shall not be less than 6mm. Openings in the floors of CHP/GHP/BHP buildings (i.e., TPs/CH etc.) shall be provided with curb of 100mm high to avoid water falling down to lower floors.	
4.6.3	Floor at ground shall be provided in all transfer points, crusher house, ground conveyors etc. Level of floor at ground shall be 500 mm above ground/grade level unless noted otherwise. For the enclosed ground conveyor 750 mm wide plinth protection along with drainage arrangement shall be provided along the conveyor on both sides. Suitable opening at every 50 mtr interval shall be provided on either side in a staggered manner for exit / entry of personals. Necessary drains must be provided all along the floors of ground conveyor.	
4.6.4	While deciding the layout of buildings namely Transfer Points, Crusher house, Pump Houses the Bidder shall consider the following parameters. (1) Working space around the equipment shall be approx.1000 mm as a good engineering practice. (2) Generally, 1200 mm passage all around inside periphery of the Transfer points/Crusher house (except at Conveyor entry/ exit) shall be provided. (3) Building height shall take care of the following parameter: In the case of handling of the equipment one over the other, the clearance between moving & stationary equipment shall be 500 mm (minimum). (4) One maintenance bay of 6m (minimum) x the width of the building shall be provided for the pump house.	
4.6.5	The pump house for potable water, service water, cooling water and dust suppression system shall be shed type with side sheeting.	
4.6.6	Hoists with monorail of adequate capacity shall be provided in the service water/dust suppression/ potable water pump houses.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001
SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant		Page 11 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS					
4.6.7	All vertical steel members (in Transfer Points and Crusher House) supporting the conveyors, equipment shall be mounted on 150 mm concrete pedestals above floor level to avoid their direct contact with water.					
4.7.0 (A)	RING GRANULATOR AND VMS					
4.7.1 (A)	Ring granulator type crusher shall be provided for sizing the input coal to (-) 20 mm size. The crusher shall be of ring granulator type. Maximum crushing efficiency shall be obtained, i.e., thermo dynamically, the ratio of surface energy produced to the kinetic energy expended should be maximum. Accordingly, the number of central discs along the rotor shaft shall be maximum with minimum spacing in between. The crusher shall be capable of delivering the normal rated output even when handling damp sticky coal having maximum moisture content. No clogging or building up of material on the crushing element shall develop. Temperature sensing devices shall be installed on both bearings of each of the crusher to trip the crusher in case temperature goes beyond limit.					
4.7.2 (A)	Separate cage actuating shaft, gear train and suitable hinge connection shall be provided. The drive chain equipment for crusher shall consist of drive motors scoop type fluid couplings and other couplings. The crushers with its drive chain equipment's shall be mounted on a base plate with necessary accessories, e.g., anchor bolts, coupling guards etc. The entire inside surface of crusher coming in contact with coal shall be provided with abrasion resistant steel liners. The Plummer block shall be of 'Split Type' design and shall be fixed with a minimum of four numbers of high tensile steel bolt studs of adequate size complete with adequate locking device and locating arrangement. In addition, the jacking screw shall be provided for easy lifting of top part of the Plummer block. Two suspension bars shall be provided in each row to facilitate replacement of broken hammers without requiring withdrawal of other hammers.					
4.7.3 (A)	The general arrangement of crusher and the drive equipment shall permit at least 50% extraction of suspension bars towards the drive end also, besides full extraction towards non-drive end also, besides full extraction towards non-drive end. Hydraulically operated top cover of crushers shall be provided for quick inspection and replacement of hammers.					
4.7.4 (A)	Vibration monitoring system should be offered for crushers as indicative below:					
	Sl. No	Equipment	Type	No.	* No. of location per equip.	Equipment bearing type
	1.	Coal Crusher	Radial ring	4	(2 Nos.) 1 at DE & 1 at NDE	As per manufacturer's design
	Vibration shall be measured at each location in Horizontal as well as vertical direction.					
	To monitor vibration of crusher, vibration monitoring system including key phasors shall be provided. To mount vibration sensors suitable arrangement including vibration pads and notches in the shaft of Crusher for mounting Key Phasor shall also be provided.					
4.7.5 (A)	For details of Vibration Monitoring System kindly refer relevant portion of the specification in Measuring Instruments (Primary and Secondary), Part B sub section VI of the specification.					
4.8.0	VIBRATING FEEDER					
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE			TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant	Page 12 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS	
4.8.1	The Vibrating Feeder shall conform to the latest edition of standards and codes. Other internationally acceptable standards/codes, which ensure equal or higher performance than those specified, shall also be accepted: IS:8723-Dimensions for vibrating conveyors and feeders	
4.8.2	The vibrating feeder shall be of mechanical type. The drive unit shall be complete with mechanical type of vibrator. The vibrating feeder shall be suitable for maximum lumps size of (-) 400 mm. The feeder shall be designed to feed coal to the crusher without material sticking to it. The flow of material shall cease as soon as vibration of the trough or pan ceases.	
4.8.3	The vibrating feeders shall be mounted on the floor with the help of helical springs made of alloy steel. No rubber/synthetic material for the support shall be acceptable. Vibrator bearings shall be grease lubricated, double spherical roller type suitable for vibrating equipment. The bearings shall be sized for a minimum of 8,000 hours of operation. Suitable sealing arrangement shall be provided between the vibrating structure and chute work to avoid dust nuisance in the surrounding area. Marker plate to indicate stroke length and stroke angle shall be mounted. Vibrating feeder shall be provided with removable abrasion resistant liner plate.	
4.8.4	In case of V- belt drive, suitable arrangement like taper bush or dobikon coupling shall be provided, to avoid loosening of sheave mounted on eccentric shaft. Dust hood shall be provided over the deck of screening feeder to avoid dust nuisance.	
4.9.0	Stacker cum Reclaimer	
4.9.1	The Stacker cum Reclaimer shall conform to the latest edition of the following standards and codes. Other internationally acceptable standards/codes, which ensure equal or higher performance than those specified, shall also be accepted. ISO 5049/1 : Mobile Continuous Bulk Handling Equipment. FEM : Federation Europeans De La Manutention Section-I-Rules for Design of Hoisting Appliances	
4.9.2	The design average capacities shall be not less than 110% of rated (guaranteed) capacities as specified elsewhere for both stacking and reclaiming. The continuous motor rating at 50°C of the drive motor to be provided on each side of the yard conveyor shall be 110% of the actual power requirement at motor output shaft. Stacker/Reclaimer shall be capable of operating at high wind velocities up to 65 km/hr. It shall also be able to withstand maximum wind velocity as indicated in Project Synopsis, when it is not operating. A suitable anemometer shall be provided which shall indicate the wind velocity in the control cabin.	
4.9.3	Electro-hydraulic thruster operated rail clamp and manual rail clamp shall be provided for holding the stacker-cum-reclaimer. A suitable arrangement shall be provided for keeping the stacker-reclaimer in a fixed stable position when the weather is stormy. The wheel load of the stacker-reclaimer shall not exceed 27.0 tons. The ratio of boom length (as specified) to the rail track gauge shall not exceed 5. The top of the rail level shall be maintained at 0.7 m above the ground level, i.e., coal pile base level unless specified otherwise. A suitable number of rail scrappers shall be provided. The machine shall be mounted on traverse carriage provided with driven and non-drive wheels of cast or forged steel and double flange design. The track wheels shall be combined in pairs in the track wheel bogies. The wheels shall rotate on self-aligning roller bearings.	
4.9.4	The lower works of the under-carriage of the machine shall be designed to transmit load on the wheel sets of the travel carriage in such a manner that the equipment is stable during	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001
		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
		Page 13 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	normal operating condition as well as during hazardous weather condition with maximum permissible variation in Centre distance of rails and rail top levels. The rail mounting for under-carriage shall be a four-legged system with hydraulic/mechanical equalizing arrangement to make it a three-point suspension system for the best stability during operation. The traverse carriage and the under-carriage shall be interconnected in a manner which will permit uniform distribution of overloads even if the rails are not level. The roller bearing slewing ring shall be sealed against penetration of water and dust. Angular movement points (hinge points) namely between equalizing beam and base frame, luff pivots and hydraulic cylinder hinge points shall be provided with maintenance free bearings requiring no periodic lubrication during entire life span of bearings. The minimum life span of self-lubricating type bearings shall be 25 years with an average of 10 hrs. daily operation.		
4.9.5	The luffing motion shall be through hydraulic pumps and cylinders. In case of more than one cylinder being used for boom luffing operation, necessary provisions shall be provided such that the differential oil pressure between two cylinders are always maintained within permissible limits, during luffing operation and as well as when the boom is fixed at any position. In case of any undue increase in differential pressure, the hydraulic circuit shall trip, and suitable alarm indication shall be provided before tripping. The hydraulic system of luffing shall be such that in case of failure of hydraulic system due to leakage or any other reason the boom could be held in position.		
4.9.6	Bucket size shall be selected for peak reclaim capacity based on maximum 80% degree of fill with respect to water fill capacity of the bucket. Further, not more than 50% of annular ring volume shall be considered as effective volume. Rate of bucket discharges shall not exceed 55 per minute. The teeth of the bucket shall be hard faced. The bucket wheel drive shall be complete either with Hydraulic drive (with or without gear box) or with electric motor, reduction gear unit moving in oil bath and suitable coupling between motor and the gear unit. Bucket wheel drive system, structural members, mast, hydraulic system etc. shall be designed considering completely wet coal with max. surface moisture. Adequate safety devices shall be provided to prevent overloading of the bucket wheel drive, particularly when the wheel gets stuck-up in the stockpile. In such an event the power supply of the drive shall automatically get cut off. Suitable electro-hydraulic thruster brake (if applicable) shall be provided to avoid backward movement of the bucket wheel after the power supply is cut-off and during maintenance work.		
4.9.7	The slew speed shall be variable. Manual locking of boom shall be provided. The tripper shall be complete with supporting structure, walkways, platforms, railing, belt scrapper, head pulleys, bend pulleys, hold-down pulley, chute, and support with adequate number of wheels in bogie construction travelling on the same rails as those of the stacker-cum-reclaimer.		
4.9.8	Group-wise lubrication system shall be provided combining different zones of lubrication points under different groups depending upon location and number of lubrication points. Each group lubrication unit shall be independently functional through separate pumps (motorized), grease container, valves, metering devices, pipes and other accessories etc. Preferably, the grease entry into various lubrication points shall be vertically downwards. The grease container shall have adequate capacity for supply of lubricants to all points and grease quantity for the points to be greased shall be adjustable. Further, all the lubrication points shall be easily accessible.		
4.9.9	The stacker-reclaimer shall receive power through trailing cables. Separate motorized cable reeling drums / <u>Flexible cable carrier (Energy Chain System)</u> for power and control cable shall be provided with arrangements for winding and rewinding of the cables. The trailing cables/<u>Flexible cable carrier (Energy Chain System)</u> shall run in a cable tray. Further, the trailing cable arrangement/<u>flexible cable carrier (Energy Chain System)</u> shall be such that the cables run in-between the track rails. Cushion shall be provided in the cable reeling		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
			Page 14 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	drums for about 15 m extra cabling length. Limit switches shall be provided to prevent traverse movement, slew and hoisting etc. beyond the respective safe extremities. Interlocking shall also be provided for S/R rail clamps and travel motors. A yard conveyor can be stopped from control panel of stacker – reclaimer. Provision also be given to trip the stacker- reclaimer from CHP control room. The travel drive equipment and slew drive equipment shall be suitable for 150 starts/hr. with continuous reversals. Speed control of long travel and slew drive motor (in case of electric drive) shall be through Variable Voltage Variable Frequency System (VVVF) with minimum 6 (six) pulse design. Necessary input & output devices to be provided to reduce harmonics, as per IEE 519. All necessary protections e.g., Input Phase Loss, Earth Fault, Over Voltage, Output Short Circuit, Load Loss, Input Transient Protection, Overload etc. to be provided. VVVF system shall be capable of generating suitable starting torque with/without encoder. Squirrel cage Induction motor with VPI insulation shall be provided with VVVF system.			
4.9.10	Hydraulic control shall be provided for Hoisting/luffing, Operator cabin level adjustment and Equalizing arrangement for travel carriage (in case of hydraulic equalizing).			
4.9.11	Should the stacker reclaimer undergo any structural distress/ failure during operation or in the anchored condition during the plant life of 30 years, apart from meeting the other contractual requirements specified elsewhere, the supplier shall have to furnish, to NTPC, the complete structural design document / calculations, pertaining to the equipment.			
4.9.12	Continuous R.C. C. Stacker / Reclaimer rail foundation to be provided throughout the length of travel zone and suitable RCC platform to be provided at one end of travel of the stacker-cum-reclaimer to rest the head end of the boom while either under maintenance or out of operation. Walkways with hand railings shall be provided on both sides of boom conveyor. The upper structure shall consist of rigid box type steel plate construction on which the super-structure supporting mast, boom with bucket wheel and counterweight boom with ballast are erected. The upper works shall be mounted on under-carriage by means of large diameter ring bearing of Double roll roller type/ Ball roller combination type.			
4.9.13	The stacker-reclaimer shall be provided with one enclosed dustproof & air-conditioned operator's cabin and so located as to enable the operator to get clear vision of both sides of the track and the cutting of coal by buckets. The cabin shall be suitable for operation in monsoon and tropical conditions and the inside ambient temperature shall be maintained at 27°C. The cabin shall be provided with toughened glass with wipers and the arrangement shall be such that glass can be cleaned from outside without any scaffolding, Cabin door shall be provided with hydraulic door closes. The cabin shall be kept in horizontal position through hydraulic cylinders irrespective of the angle of inclination of the boom conveyor. All controls for operation of all parts of the stacker-reclaim unit shall be provided in the cabin within easy reach of the operator. Lights and fans for the operator's cabin and an adequate number of flood lights for all necessary illumination for working at night shall also be provided. Coal cutting by bucket wheel shall be clearly visible from operator's cabin. The electrical/MCC room shall be fabricated of sheet steel with suitable floor matting. The room shall be dust tight and air conditioned. Fireproof insulation shall be provided under the roof of MCC room. Further, the door shall be provided with a hydraulic door closer. Dry type transformers, PCRD, CCRD or flexible cable carrier (Energy Chain System) and all drives shall be suitably protected from accumulation of coal dust falling from the tripper section of machine by providing canopy.			
4.9.14	Stacker-Reclaimer machine shall be designed to operate in equal load sharing mode between slew gear boxes provided to avoid unequal load sharing mode. Suitable electrical interlock to be provided for the drive units of slew gear boxes, such that in case of any unequal load sharing, the drive units shall trip immediately.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
Page 15 of 122				

CLAUSE NO.	TECHNICAL REQUIREMENTS		
4.9.15	Fire resistant fiber grating/ steel grating for walkways on stacker reclaimer and trippers to be provided to reduce weight.		
4.9.16	Stacker Reclaimer shall be provided with a Stock Yard Management System as detailed in C&I Annexure to Sub Section A-20.		
4.9.17	Bidder shall validate the mechanical and structural design of reversible stacker cum reclaimer by Finite Element Analysis method to demonstrate that the stresses are within allowable limits. The same shall be vetted by reputed institutions like IITs/IISc etc./International consultant before review of NTPC.		
4.9.18	Intermediate Conveyor (if applicable) shall be provided.		
4.10.0	TRAVELLING TRIPPER AND BUNKER/STORAGE SHED SEALING ARRANGEMENT		
4.10.1	Mobile Trippers on Coal bunker conveyors along with belt sealing arrangement shall be furnished and erected complete with rails, including necessary supporting structures, approach/ maintenance platforms with ladders and hand railings, trailing cables with Energy chain arrangement, all electricals including machine mounted local control panel & control panel on one end of Bunker. The Mobile tripper on bunker conveyors shall be motor driven type. The tripper shall have provision for dropping coal/gypsum from conveyor onto both sides of tripper (maybe on one side for front mill arrangement) to the bunker or back to the conveyor for the purpose of skipping intermediate bunkers. The rating of tripper travel motor shall be adequate to move the tripper smoothly either in same or opposite direction to belt direction under fully loaded conditions. Adhesive weight requirement and tractive effort calculations shall be subject to the approval of Employer. Coefficient of adhesion shall be considered as maximum 0.15. A minimum of two drive axles shall be provided for tripper travel. Arrangement shall be provided at the starting point of the tripper to avoid folding of belt. In case of tripper running at a speed more than its rated speed due to chute jamming or other reason, conveyor shall trip, and annunciation shall appear. Supply of adequate length of rails to cover the runway length for the motor-driven tripper shall be included. The supporting structures for the rails with necessary end stops shall also be supplied under this specification. Suitable belts hold down guide pulley shall be provided over the concave curve of belt over tripper. The travelling trippers shall be provided with fail safe A.C. thruster operated brake of totally enclosed type which shall engage as soon as tripper travel motor stops. Travelling Tripper & respective Tripper Conveyors shall be designed in such way that Tripper shall not overtravel during feeding to Bunkers while travel motor not in operation, with/without application of brake. In addition, A.C. thruster operated rail clamps and separate manual Rail clamps on both side of the tripper shall also be provided. An independent motorized linear actuator shall be provided to operate each flap gate of the tripper chute.		
4.10.3	The sealing belt shall be of suitable grade (minimum 2 plies) with 5 mm x 5 mm covers (fire resistant) in line with other conveyor belting. The belt shall rest on 20 x 50 mm MS plates spaced at 200 mm placed 50 mm below floor level, provided over the bunker slot on tripper floor for tripper conveyor. The width of the bunker seal belt shall be at least 100 mm more than the bunker slot opening.		
4.10.4	The tripper shall run on rails (90 lbs./yard) with double flanged wheels. Rails for tripper travel shall be mounted on supporting structure of respective conveyors. A suitable system having encoders for monitoring position of tripper in DDCMIS shall be provided. In addition, travel end limit switches and end stops shall also be provided. Suitable access platform of chequered plate with ladders, handrailing and walkways on both sides shall be provided for access/maintenance of equipment on tripper. In addition, the crossover platform shall be		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
			Page 16 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS																					
	provided with tripper so that operator can cross the belt through the same. 3 mm deck plate continuous shall be provided below carrying idlers on the trippers.																					
4.11.0	DUST CONTROL AND MISCELLANEOUS SYSTEM																					
4.11.1	The dust control system to be furnished under this specification is required for control of fugitive dust emissions from dust generation points such as transfer points, feeders, crushers etc. Dust control is achieved by dust suppression/extraction system. Service water systems, potable water system, cooling water system & sump pumps shall be provided. All pumps/ compressors envisaged to meet dust control and miscellaneous system requirements for CHP/BHP shall be provided with 100% standby. Each pump house shall have one no. dedicated over ground tank. Each tank shall be sized for ½ hour storage capacity considering maximum water drawn to meet the specified requirement. Tank shall be completely enclosed and provided with manhole and access ladder (internal and external). All areas around tanks shall be paved with concrete and shall have proper drain. Water tank along with pumps and pipeline to be provided on stacker cum reclaimer for plain water dust suppression system for boom conveyor and tripper discharge.																					
4.11.2	Plain Water Dust Suppression System																					
	Complete with water supply system, piping, spray heads, pumps, drive motors with canopy (wherever required), couplings with enclosure, electricals, supporting structures, approach/maintenance platforms, handling for equipment, civil and structural works, and necessary accessories.																					
4.11.3	(A) Dry Fog Type Dust Suppression System																					
	Complete with water supply system, compressed air system, pressure regulating units, flow activation system, necessary instrumentation for auto & manual operation, drives, pumps, along with associates civil/structural & electrical works.																					
	(B) Ultra fine (Cold Fog) Type Dust Suppression System																					
	Complete with water supply and water treatment system, reciprocating type (VFD driven) Pumps, Fog modulation units, Flow activation system, necessary instrumentation for auto & manual operation, drives, SS Piping & accessories, Fogging nozzles along with associates civil/structural & electrical works.																					
4.11.4	Service Water and cooling Water System																					
	Service water and Cooling water distribution system (for scoop coupling) complete with water supply system, valves, quick couplings, hose pipes with nozzle, piping, pumps, drive motors with canopy, couplings with enclosure, electricals, including supporting structures, handling for equipment's, civil and structural works and necessary accessories shall be provided throughout the coal handling plant area.																					
4.11.5	The Dust Control & Miscellaneous Systems shall conform to the latest edition of the following standards and codes. Other internationally acceptable standards/codes, which ensure equal or higher performance than those specified, shall also be accepted. <table><tr><td>IS:778</td><td>:</td><td>Gun Metal gate, globe & check valves for general purpose.</td></tr><tr><td>BS:5150</td><td>:</td><td>Cast Iron Gate Valve for water works purposes.</td></tr><tr><td>BS:5152</td><td>:</td><td>Cast Iron Globe Valve for water works purposes.</td></tr><tr><td>BS:5312</td><td>:</td><td>Cast Iron Check Valve for water works purposes.</td></tr><tr><td>ASTM A269</td><td>:</td><td>Seamless & welded Austenitic Stainless-Steel Tubing</td></tr><tr><td>ASME B31.3</td><td>:</td><td>Code for Process Piping</td></tr></table>				IS:778	:	Gun Metal gate, globe & check valves for general purpose.	BS:5150	:	Cast Iron Gate Valve for water works purposes.	BS:5152	:	Cast Iron Globe Valve for water works purposes.	BS:5312	:	Cast Iron Check Valve for water works purposes.	ASTM A269	:	Seamless & welded Austenitic Stainless-Steel Tubing	ASME B31.3	:	Code for Process Piping
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant	Page 17 of 122																		

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.11.6	S:1239 : Mild Steel tubes & fittings. IS:2379 : Color for the identification of pipeline. IS:3589 : Electrically welded steel pipes for water, gas & sewage (200 to 2000 mm) IS:5312 : Swing check type reflux (non-return) valves. IS:1520 : Horizontal centrifugal pump for clean, cold fresh water. IS:5120 : Centrifugal pump for clean, cold & fresh water. BS: 5169 & BS: 1123 : Air Receivers. ANSI B 31.1: Code for pressure piping. Hydraulic institute Standards of U.S.A			
	(A) Dry fog dust suppression system shall be provided which comprises spray nozzles discharging plain water & air in a fine spray to form dry fog to capture air borne dust particles and direct them into the main coal flow. This dry fog shall be discharged through spray heads at the dust suppression zones. The dry fog dust suppression system shall consist of the following:- (a) Fogging system & controls consisting of: (i) Spray bar assemblies. (ii) Pressure regulating units (iii) Flow activation system (iv) Instrumentation for auto spray (b) Compressed air system consisting of: (i) Two (2) nos. (one no. working and one (1) no. standby) air compressors (screw type) for each group of dry fog dust suppression system, along with air receivers as specified elsewhere. (ii) Air receivers' Various instrumentation & valves (B) Ultra fine (Cold fog) dust suppression system shall be provided which comprises spray nozzles discharging water in a fine spray to form fog to capture air borne dust particles and direct them into the main coal flow. This ultra fine fog shall be discharged through nozzle orifice at the dust suppression zones. Total Moisture addition to the material shall be limited to 0.05 % to prevent material wetting. Mist type Dust Suppression system shall not be allowed. The ultra fine (cold fog) dust suppression system shall consist of the following: (a) Fogging system & controls consisting of: (i) Cold Fog producing Nozzles (SS 316 body), Nozzles orifice shall be suitably protected with Anti-abrasive material. (ii) Spray bar assemblies. (iii) Fog modulation units (iv) Flow activation system (v) Instrumentation (b) Water supply and Pumping system consisting of:			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
				Page 18 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(i) Water treatment unit (one (1) no. working and one (1) no. standby) for each group of dust suppression system, associated drives, piping and Various instrumentation & valves. (ii) Water Tanks: - Tank shall be complete with all the fittings etc. Min. capacity to suit 1 hrs operation of CFDS system. (iii) Two (2) nos. (one no. working and one (1) no. standby) High Pressure Pumps (Reciprocating type) for each group of Cold fog dust suppression system, associated Filter, Piping and Various instrumentation & valves			
4.11.7	Coal Stockyard Dust Suppression System Water shall be drawn from the water storage tank by electric motor driven pumps and discharged via a pipe work system through spray heads. Spray heads shall comprise of swiveling type spray units spaced at an interval of approximately 40 meters around each coal pile. Solenoid (of Stainless-Steel Material) operated globe valve shall be provided to control water supply to each spray unit. Pressure at inlet to spray unit shall not be less than 4.5 kg/cm²(g). These solenoids shall be operated automatically through PLC of Automatic Sprinkler System (part of Stockyard Management System, refer C&I Annexure to Sub Section A-20).			
4.11.8	Sump pumps along with level switches & piping up to nearest drain (max up to 50.0 mtrs. from outside the building) shall be provided at all locations wherever natural drainage is not possible. The capacity of each pump shall not be less than 50 M³/hr. Minimum 10% margin on capacity and 20% margin on computed head shall be considered for selection of pumps. Size of the drain pit shall not be less than 2.0 meters x 2.0 meters x 1.8 meters deep. One no. of settling pit shall also be provided before sump pit so that water without heavy coal particles goes into sump pump pit. High- and low-level switches shall be provided in the sump pump pit.			
4.11.9	Service water connections are to be provided in conveyor galleries and tunnels at 50-meter intervals. Adequate number of these connections shall be provided in all transfer houses with minimum one no. at each floor and with minimum two (2) nos. at each floor in crusher house. Each connection shall be provided with one (1) no. 32 NB globe valve and quick coupling. One (1) no. hose pipe with nozzle shall be provided in each building.			
4.11.10	Potable water connections are to be provided in all transfer points, crusher house, all tripper floors, and all control rooms/MCC rooms and toilets etc. Water shall be drawn from the water storage tank by electric motor driven pumps and discharged via a pipe work system to the overhead drinking water storage PVC tanks of 250 litres capacities. The drinking water storage tanks shall have provision for maintenance & drain.			
4.11.11	Hoists with monorail of adequate capacity shall be provided in the service water/dust suppression/potable water pump houses.			
4.11.12	Bidder shall provide Venturi scrubber type wet dust collection system for Vibrating feeder and Belt Feeders after crusher in crusher house. The dust extraction system shall be of Venturi scrubber system. One independent dust extraction system for each stream shall be provided (Total 2 nos. system to be provided). Bidder may provide multiple Units in each of the independent dust extraction system.			
4.11.13	The system shall operate on the principle of mixing dust laden air with water by collision in the venturi throat forming a mass of larger particles for successful collection in the cyclones. The scrubber unit shall have a design for built in collection of the damp dust in a sedimentation tank which shall be discharged automatically at periodic intervals (time setting			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
Page 19 of 122				

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	variable) into an additional ground-based settlement pit from which only clear water shall be led by drain line (by bidder) up to coal slurry pond. The system shall be complete with venturi unit, water pockets, risers, circulating water pumps, throttling valve, pressure gauges, all associated valves/accessories, baffles, reducing discs, partition plates, cyclones, discharge pipe, inlet, deflectors, inspection doors of dust light/airtight construction, sedimentation tank, float control valve, overflow trap, quick filling/discharge connection, duplex structures automatic sludge disposal arrangement. The dust sedimentation tank with the scrubber shall have water level maintained inside by means of float valves. Also, water overflow with trap shall be provided. Requisite water shall be circulated in the unit by means of circulating pump located outside this scrubber. All items of scrubber exposed to water shall be spray galvanized. Min. 6mm thick M.S. plate shall be used for tanks. Pressure drop through the scrubber unit shall not exceed the range of 180 mm w.c. An external monometer drops during operation. The system shall be designed with min. consumption of slurry water. The dust collection efficiency shall be 95% down the 10-micron size. The velocity of air in the duct shall be high enough (in the range of 18 to 21 meters/sec.) to transport in the suspended dust in the air. Electrically operated dampers shall be provided at all dust extraction points.		
4.11.14	The pumps shall be complete with drive motors, baseplate, and other accessories. Pump casing may be axially or radially split. Impeller shall be made in one piece and securely keyed to the shaft. The wearing surface shall be of hardened material and shall have a hardness difference of at least 50 BHN. The design of the shaft shall take into consideration the critical speed, which shall be at least 20% away from operating speed. Pump bearings shall be of antifriction type. Pump speed shall be less than 1500 rpm for pumps of capacity more than 10 m3/hr. The power, head and flow characteristics of each pump shall be suitable for parallel operation. The Power characteristics of the pumps shall be of a non-overloading type. All rotating parts of the pumps shall be statically and dynamically balanced. The design duty point of pump shall match with the average value of maximum and minimum flow rates of the pump in the stable operation zone.		
4.11.15	The sump pumps shall be of wet pit types, vertical shaft and impeller shall be specially designed to pass large solids or unscreened liquids. The construction and material shall be suitable for pumping coal/dust contaminated water with a minimum of maintenance. All bearings of the pump shall be located above the water level.		
4.11.16	In general pipe sizes 65 mm NB and larger are to be joined by butt welding and pipe work of size 50 mm NB and below by socket welding/screw connections. Joints at valves or specialties shall be flanged for sizes 65 mm NB or large and screwed for sizes 50 mm NB and below. All galvanized piping shall be joined by screwed connections. The minimum pipe diameter selected for DS/SW/PW/Cooling Water System (along with branch pipes) shall be 32 NB. However, for Agglomerative Dust Suppression System, Pipe size below 20 NB (for Dry Fog) / 15 NB (for Cold Fog) shall not be used.		
4.11.17	Valves & Specialties shall be used to start, stop or regulate the flow. All valves/specialties below 50 mm size in service water/dust suppression/ potable water lines should be plug type. Gate/sluice valves shall be used for isolation of flow of pipelines above 50NB and Globe valves shall be used for regulating the flow. All gate and globe valves of size 65 NB and large shall be bolted bonnet, outside screw, rising type with flanged ends. Valves of size 50 NB and smaller shall be with screwed ends. Non-return valves shall be swing check type. These valves will have a permanent 'arrow' inscription on its body to indicate direction of motion of the fluid.		
4.11.18	Strainer shall be of duplex type designed with 3-way valves so that one filter can be cleaned while the other is in operation. Suitable vent and drain valves shall also be provided. Screen opening area shall be at least four times the pipe cross sectional area. Pressure drop in clean conditions shall not exceed 1.5 MWC at full flow.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
			Page 20 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS 				
4.11.19	Track Hopper Dust Suppression (Not Applicable) The dust suppression system for the track hopper shall consist of maximum fifteen (15) zone headers, each of 20 meters length, routed along the entire length of track hopper on each side. Each nozzle header shall be provided with an adequate number of spray nozzles of suitable range spaced at max. 500 mm intervals. Further, at the track hopper the water spray shall be of fogging type with a minimum pressure of 4.5 kg/sq.cm(g) at spray nozzle inlet. It should be possible to operate a minimum four (4) number of zones simultaneously on both sides of track hopper.				
4.11.20	Paddle feeder dust suppression (Not Applicable) A trolley mounted pumping arrangement shall be provided for supplying water to the mobile paddle feeders. In this arrangement, tank, supply pump(s) and spray nozzle header shall be mounted on paddle feeder water tank trolley. The tank on P/F trolley shall be filled through flexible hose tapings from a ring header, which will remain, flooded through a connection from ground storage tank. This storage tank shall have make up connection from the common dust suppression system.				
4.12.0	BELT SCALE				
4.12.1	The Belt Scales shall conform to the latest edition of the following standards and codes. Other internationally acceptable standards/codes, which ensure equal or higher performance than those specified, shall also be accepted. NEMA NEC For electronic circuit enclosures. IS:11547 Electronic weighing in motion system				
4.12.2	The weigh scale shall be automatic and electronic type. It should be designed for continuous automatic weighing, metering, and printing of coal flow.				
4.12.3	Belt scale shall be designed for a range of 20% to 120% of rated capacity with an accuracy of at least ($\pm$) 0.25 percent throughout its range. Belt scale provided on Stacker Reclaimer Boom Conveyors shall have accuracy (in the horizontal position of Boom) of ($\pm$) 1 percent for the range of 20% to 120% of boom conveyor rated capacity.				
4.13.0	IN-LINE MAGNETIC SEPARATOR AND SUSPENDED MAGNET				
4.13.1	Inline Magnetic Separators shall be provided for continuous and automatic extraction and discharge of tramp magnetic pieces from coal being discharged from conveyors as specified. The sets shall be complete in all respects with drives, magnets, inline belts, hoppers, chutes, tramp-iron boxes and all electrical ancillaries like control panels etc. Suspended Magnetic Separator shall be provided for picking up tramp magnetic pieces buried under coal from moving coal over Conveyor.				
4.13.2	The magnetic separator shall be located such that it picks-up tramp iron from coal trajectory after it has been discharged from head pulley.				
4.13.3	The tramp magnetic pieces buried under coal picked up by the magnetic separator shall be discharged suitably to ensure that it falls into the tramp iron chute, which shall be provided up				
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; text-align: center;"> TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001 </td> <td style="width: 50%; text-align: center;"> SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant </td> </tr> <tr> <td colspan="2" style="text-align: right;"> Page 21 of 122 </td> </tr> </table>	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant	Page 21 of 122	
TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant				
Page 21 of 122					

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.13.4	to ground level. All conveyors with magnetic separator at head end shall have non-magnetic SS pulleys. Head pulleys of all conveyors within line magnetic separator at head end shall be provided with SS shell and end disc. However, hub and shaft shall be of same materials as in other pulleys. (EN-8 or equivalent). The motor and the gear reduction unit for driving the in-line belt should be adequately sized with a minimum 20% margin to avoid any overloading during operation. A suitable zero speed switch shall be provided. No Chain/belt drives shall be accepted. The belt shall be designed to withstand high temperature at the bottom of the magnet and any serious damage due to the impact of the sharp edges of the tramp iron. The belt shall be provided with rubber cleats spaced suitably. The belt shall be of fire-resistant grade.			
	The magnetic separator units shall be supported by suitable structural members from the top by taking support from the operating floor beams with turn buckle arrangement to facilitate the necessary adjustments during operation. Further, electric Hoists operated cross travel arrangement shall be provided to move magnetic separator away to facilitate maintenance of the conveyor discharge pulley/Belt. ON/OFF control push buttons with indicating lamps shall be provided at the local station. The materials of chutes and hoppers associated with magnetic separators above the drive floor shall be SS-304 in the magnetic zone. Other chutes shall be of 1 mtr. sq. dimension and shall be made of MS. chutes shall have poking doors at all floors to clear jammed material.			
	4.14.00	METAL DETECTOR Metal detectors shall be provided at specified locations to detect metallic objects in the coal stream. Metal detectors shall have high reliability with enough sensitivity to detect 25 mm aluminum sphere below the burden of coal in case of synthetic belting. However, for steel cord belting the sensitivity shall be 35 mm. It shall also detect other metals, like brass, copper, stainless steel, manganese steel, bars, scraps etc. The equipment shall have provision for automatic static calibration with adjustable sensitivity.		
	4.15.0	COAL SAMPLING UNIT		
	4.15.1	The design, manufacture, inspection and testing of Coal Sampling Unit shall comply with all the currently applicable statutes, regulations and safety codes in the locality where the equipment is to be installed. The Coal Sampling Unit shall conform to the latest edition of standards and codes. Nothing in this specification shall be construed to relieve the contractor of the required statutory responsibility. In case of any conflict in the standard and this specification, the decision of the Employer shall be final and binding. The sampling system shall be designed as per following standard: IS: 16143 (Part 2): Hard Coal and Coke — Mechanical Sampling (Part-2 Coal- Sampling from moving streams) IS: 16143 (Part 4): Hard Coal and Coke — Mechanical Sampling (Part-4 Coal-Preparation of Test Samples) ASTM C50/ASTM D2013: Standard practice for sampling, sample preparation, packaging and marking of limestone & limestone products.		
4.15.2	Coal sampling unit shall be automatic & provided at place specified elsewhere. The coal sampling units suitable to give “Samples” conforming to IS: 16143 (Part 2) shall be selected by the Contractor for taking samples from any of the two streams running at guaranteed capacity. The different Equipment selected for coal sampling unit shall be such that there shall be no loss of fines and moisture from the samples. The capacity, make and model of all equipments of coal sampling unit shall be subject to approval of Project Manager.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant	Page 22 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS	
4.15.3	The normal input feed size shall be considered as (-) 250 mm for coal sampling unit before coal crusher. However occasionally (-) 400 mm lumps may also arrive. Coal lump size after crusher (as fired coal) shall be (-) 20mm. However occasionally (-) 50 mm lumps may also arrive in as fired coal.	
4.15.4	Cross belt type Primary samplers (separate for each conveyor) shall be rugged, able to withstand severe shock loads and operate trouble free. Belt feeders shall be provided for the entire sampling path upto sample collector. The feeders shall meter the flow accurately by using VFD, produce a non-plugging condition and resist sticky and wet coal. For rejects path also, belt feeders shall be preferred. Screw conveyors for the same shall be accepted only where space constraints do not permit distribution of coal rejects to receiving conveyors below. Sample crushers (make subject to Employer's approval) shall be provided for reducing the main input feed coal to 95% minus 8 mesh size and 99% minus 4 mesh size. Single stage crushing shall be provided. There should be no re-circulation of fines in the crushers. 'Lot size' shall be equivalent coal quantity handled in 8 hours operation assuming average conveyor loading at 75% of rated conveyor capacity. However, Coal sampling system shall also be suitable for taking one gross sample for each lot of "3500 Te" coal (approx. equal to one rake load).	
4.15.5	The traversing mechanism and all electric parts shall have dust tight protection. Belt feeders shall be positively self-cleaning and have dust tight construction. It shall be provided with a flanged belt, rubber lagged head pulleys and inspection doors. No chain/belt drives shall be accepted. The crusher's base should be built of reinforced concrete and be sufficiently large in mass. The primary / secondary samplers shall be of dust tight construction and self-contained type. The sample chutes shall have minimum valley angle of 60 degrees to horizontal and shall be of stainless-steel plates. The chutes shall be suitable to handle wet sticky coal as specified elsewhere. The welding of chutes shall be done externally only. The inside surface of the material near welds shall be smooth. Radius at corners not less than 1" shall be provided in chute work. All solid connected members shall be by means of bolting flanges with at least 6 mm thick standard grade neoprene gasket material between the metal flanges. No control gates to regulate the flow of material shall be incorporated in the chute work. Bias connections shall be provided at suitable locations. The materials rejected from samplers shall be returned to the main conveyor stream. Minimum 4 nos. sample collecting bins shall be provided with auto indexing. The bins shall be provided with airtight connection. The system shall be suitable for operation through standalone PLC and a Local control panel provided by Contractor.	
4.16.0	ELEVATOR Elevator shall be of conventional type for Coal, Biomass Handling & Ash handling Plants. The elevator shall Meet the quality of international standard.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001
SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant		Page 23 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS																																
	Bidder to provide conventional type elevator as per following specifications. Elevators shall be designed based on following criteria: <table><tr><td>i)</td><td>Design/construction/installation codes.</td><td>Latest edition of IS: 14665 (all parts)</td></tr><tr><td>ii)</td><td>Load carrying capacity</td><td>1068 kgs. for passenger cum goods elevator</td></tr><tr><td>iii)</td><td>Rated speed</td><td>1.0 m/sec.</td></tr><tr><td>iv)</td><td>Position of machine room</td><td>Directly above the elevator shaft</td></tr><tr><td>v)</td><td>Machine room</td><td>Window air conditioner of minimum 2T capacity per elevator shall be provided by bidder</td></tr></table> CONSTRUCTION Construction of the elevators shall specifically meet all requirements of the codes indicated and shall have following additional features: <table><tr><td>i)</td><td>Flooring of Cabin</td><td>Vitrified Tiles</td></tr><tr><td>ii)</td><td>Car enclosure & car panels</td><td>Stainless Steel</td></tr><tr><td>iii)</td><td>Handrails on 3 sides</td><td>Mirror Stainless Steel</td></tr><tr><td>iv)</td><td>False ceiling</td><td>Powder painted</td></tr><tr><td>v)</td><td>Car opening & Hoist way opening</td><td>Protected by central opening sliding Stainless Steel door</td></tr></table> 1.AUTOMATIC RESCUE DEVICE (ARD) - (BATTERY DRIVE): Bidder to provide a modern Advanced electronic drive system of “RESCUING Passenger Trapped in a ELEVATOR”. 2 EMERGENCY SAFETY DEVICES: The lift shall be provided with safety Device attached to the lift car frame and placed beneath			i)	Design/construction/installation codes.	Latest edition of IS: 14665 (all parts)	ii)	Load carrying capacity	1068 kgs. for passenger cum goods elevator	iii)	Rated speed	1.0 m/sec.	iv)	Position of machine room	Directly above the elevator shaft	v)	Machine room	Window air conditioner of minimum 2T capacity per elevator shall be provided by bidder	i)	Flooring of Cabin	Vitrified Tiles	ii)	Car enclosure & car panels	Stainless Steel	iii)	Handrails on 3 sides	Mirror Stainless Steel	iv)	False ceiling	Powder painted	v)	Car opening & Hoist way opening	Protected by central opening sliding Stainless Steel door
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant																														
			Page 24 of 122																														

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	the car. The safety device shall be capable of stopping and sustaining the lift car up at governor tripping speed with full rated load in car 3. Elevator shall have Floor announcement system & Braille switches No. of floors to be served shall be as per the requirement of the Employer. The final landing elevations for all buildings shall be subject to approval by the Employer after award. Guide rails complete with supporting brackets for the car and counterweights. Vitrified Tiles to be provided for cabin flooring and bidder shall take care of the height of same in selecting counterweights. Elevator drive machines complete with electric motor, reduction gear unit, suspension ropes , buffers for the cars and the counterweights and other drive and control mechanism. All foundation anchor bolts, sleeves, anchoring steel and any item required to complete the job satisfactorily shall be provided by the bidder. The bidder shall also provide for the grouting of anchor bolts, sleeves, anchoring steel, etc. and other anchorages Any other steel works as well as all other accessories/components not specified in the specification but necessary for making the Elevator complete. All building work including the supply of steel items, associated with installation of equipment in the machine room hoist way, hoist way door, frames and Elevator pit, shall form part of bidders scope of service, Bidder shall also provide the Elevator-well complete with foundation and brick walls around the lit-well together with overhead machine room. The machine room will be provided with R.C.C. floor slab with necessary pockets for anchor bolts and slots. OPERATION Elevator shall have provisions to meet following operational requirements: a) Selective collective, automatic operation with or without attendant through illuminated push button station located inside the lift car. b) Door operating shall be automatic door operation and electronic door protection system for opening/closing of car and landing doors. c)Bidder shall provide car operating panel with luminous buttons, car position indication in car (both visual and audio) combined with direction arrows, overload warning indicator, battery operated alarm bell and emergency light and fan & hands free speaker telephone set with suitable battery, charger & controls. d)Bidder shall provide emergency indicator to indicate the location of elevator in case of elevator being stuck up between the floors through automatic flashers (both audio & visual) e) Bidder shall provide electronic door detector (Infra-red curtain type). f) Two push buttons, one for upward movement and the other for downward movement at each intermediate landing and one push button at each terminal landing shall be provided in order to call the car. Digital hall position indicator at all floors, tell lights at all floors shall also be provided by the bidder.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
		Page 25 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	g) For facilitating the movement of visually & hearing-impaired persons, hall lantern and car arrival chimes shall be provided. h) All fixtures shall be in stainless steel face plates. i)Push buttons shall be fixed in the car for holding the doors open for any length of the time required. j) All other safety/protection/operation interlocks as required by IS:14665 (latest edition). Elevator Electricals: (a) Electric motor: The driving motors shall conform to I.S 325 and suitable for the Variable Voltage Variable Frequency (VVVF) application. All motors shall be squirrel cage induction type, suitable for operation at 415V (+/- 10% variation), 3 phase, 3 wire, 50HZ (+3% to -5% variation) supply. Motors shall be provided with thermal class 130 (B) or better insulation (b)Controls: The controls shall be Variable Voltage and Variable frequency type and shall provide smooth and constant acceleration and retardation under all conditions of operation. Suitable control panel shall be provided in the machine room. (c) Cables and wiring: All the cables except trailing cables shall be as per IS:1554-1 or IS-7098-I. the PVC outer sheath of these cables shall be flame retardant, low smoke (FRLS) type with the following FRLS properties. (i) Oxygen index of min. 29 (as per IS:10810 Part-58) (ii) Acid gas emission of max. 20% (as per IEC-754-I). (iii) Smoke density rating shall not be more than 60% (as per ASTM D-2843). The circular trailing cables shall be either in accordance with IS 4289 Part-I (Elastomer insulated) or IS-4289 Part-II (PVC insulated). The flat type trailing cables if offered shall be in accordance with IEC-60227-6. All wiring / cabling between the equipments in the lift machine room and that between the machine room and equipments in the lift well and at the landings shall be wired in HDP conduits/ galvanized steel conduits to be supplied by the contractor. Alternatively armored cables may be used. (d) Earthing: The elevator structures and all Electrical equipment, including metal conduits shall be effectively earthed with the earth conductors provided in the machine room as per IS: 3043. i)Type of services : Passenger cum goods.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
		Page 26 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	ii)Load carrying capacity: As per specification iii)Rated speed : One (1) meter/second iv)Total Travel : As per layout As per layout v)No. of floor to be served: TO be decided during detailed engineering. vi)Method of control : Variable voltage variable frequency (VVVF) vii)Position of M/c room : Directly above lift shaft viii) Size of platform: As per IS14665 & manufacturer's standard latest. ix) Size of lift well: -do- All mechanical and electrical operating devices and Trailing cable shall be designed for outdoor operation with dusty and high humidity conditions and shall operate equally well in any ambient temperature as per project synopsis. Additionally, all mechanical and electrical components of the elevator shall be designed to withstand a temperature of 50°C ambient.	
4.17.00	Stone Picking Manual Stone Picking arrangement at a suitable location in the Coal conveyor gallery before Crusher House shall be provided complete with platforms, overhead lighting, hand railings, suitable seating, safety hook & holding arrangement for manual pickers, disposal chutes to ground level etc. Six (6) nos. manual pickers shall be positioned for stone picking. Three (3) nos. manual pickers shall be positioned in a row on each belt. Each manual picker shall cover 3 m long belt stretch adjacent to each other and shall have provision of individual stone collector discharge hood. The picked-up stone lumps (up to 600 mm size) shall be collected over the conveyor gallery walkway level from where these stones can be pushed into the hopper/chute up to the ground level. Disposal chute from discharge hoods of length up to 2 meters from ground level shall be provided etc. In the gallery span of stone picking area, the gallery width shall be extended by a minimum of one (1) mtr. on either side to accommodate the stone picking accessories. Accordingly, the width of Conveyor Gallery shall be 2 meters wide all along the span of stone picking zone as compared to other gallery span. All trestle coming in the zone of stone picking area shall be suitably encased by RCC. The stone picking area should be suitably barricaded upto 2 mtr. height above ground level so that no damage take place due to stone pile formation and its handling by pay loaders.	
4.18.00	BUCKET ELEVATOR SYSTEM	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
		Page 27 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.18.01	General Requirement The type (Centrifugal/Continuous) of the Bucket Elevator (Chain type) shall be chosen by Bidder for the material and conditions specified. The Bucket Elevator shall be sized to handle the design capacity at the specified material bulk density & maximum material size. The equipment shall be complete with all necessary sub-systems and components and shall be designed and supplied in conformance with the attached datasheets, site conditions, specific Employer's requirements and applicable International, National, State and Local codes. The Equipment shall be complete in all aspects and all items required for erection/smooth operation shall be in Bidder's scope, unless otherwise noted in exclusions. Sizing of the equipment and components shall be the responsibility of the Bidder, based on the service conditions specified.			
4.18.02	Codes and Standards All design, fabrication, testing, supply and erection, if applicable, shall conform to the latest edition of all the relevant standards and regulations issued by the governing bodies. Bidder shall follow the applicable INDIAN/INTERNATIONAL codes by the following organizations. EN European Norm IEC International Electro technical Commission ISO International Organization for Standardization DIN German Institute for Standardization (To be used when no EN standards exist) Other internationally acceptable standards/codes, which ensure equal or higher performance than those specified, shall also be accepted. Nothing in this specification shall be construed to relieve the contractor of the required statutory responsibility. In case of any conflict in the standard and this specification, the decision of the Employer shall be final and binding.			
4.18.03	Design Requirement			
4.18.04	Design Criteria The equipment shall be designed for continuous twenty-four hour service. The Equipment shall be designed for service in a heavy-duty industrial application, handling abrasive materials in a dusty environment. The Bucket Elevator should be sized to handle the design capacity as indicated on the Data Sheet with the minimum material bulk density and a maximum bucket filling of 75%.			
4.18.05	Casing Casing to be self-supported, dust-tight construction and capable of supporting head shaft, drive, and service platform. Head section is to be split and equipped with handles or lifting lugs for easy removal. Access and inspection doors are to be provided. Intermediate sections are to have a minimum plate thickness of 4 mm. Boot section to be fabricated of minimum 6mm steel plate, with front and rear access panels. A beam is to be provided in casing for servicing internal gravity take-up. The beam may be located either in the boot section or intermediate section as applicable.			
4.18.06	Buckets Size, capacity and type of buckets and appropriate reinforcement necessary for the application shall be adequately sized. Provide pin holes in bottom of buckets for air relief, as necessary, when handling materials such as Biomass or gypsum. Bucket width is to be a minimum of four times the maximum particle size.			
4.18.07	Chain & sprocket Chain and Sprockets selection shall be as per the applicable standard and suitability for the application. Material of the chain & sprockets(drive/non-drive) shall be wear-resistant & durable suitable for the application.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
Page 28 of 122				

CLAUSE NO.	TECHNICAL REQUIREMENTS	
4.18.08	Pulley – Shall not be applicable for ‘chain type’	
4.18.09	Head Shaft and Bearings The bearings on head shaft to be antifriction type with one bearing fixed and the other expansion. All bearings are to have an L10 life of 60000 hours.	
4.18.10	Foot Shaft and Bearings The tail shaft is to be of hardened steel with tool steel sleeves operating in heat treated white iron bearings. All bearings are to have an L10 life of 60000 hours.	
4.18.11	Take-up Take-up shall be screw or internal gravity type with guide rails and weights included.	
4.18.12	Drive Bucket elevator drive should be sized as follows: Minimum power for drive, either: 100% bucket filling @ minimum material bulk density, or 75% bucket filling @ maximum material bulk density, whichever is greater.	
4.18.13	Inspection and Access Doors Inspection doors and access doors shall be loose-hinged type with quick-opening jamb bar fasteners and gaskets enclosed and retained in the door. Access doors shall be 1.5m minimum.	
4.18.14	Dust Vent A dust collecting vent in the head section and boot section shall be furnished with drilled flanges. Bidder quote is to include recommended vent volumes for the boot and head sections of the elevator. The Pick-Up velocity shall not be greater than 2.5m/sec.	
4.18.15	Drive Equipment The Drive Equipment for Bucket Elevator shall be as specified elsewhere in the specification.	
4.19.00	BOX FEEDER OR BULK MATERIAL RECEIVING UNIT OR TRUCK UNLOADING SYSTEM OR SURFACE FEEDER The Box Feeder should be a robust, proven, above the ground for unloading from trucks / self-tipping trucks or from loader shovels. The unit should be designed for rapid intake and temporary live storage of material before transferring on to the crusher house. The intake and onward discharge capacity to be 200 TPH per Box Feeder. Maximum angle of outgoing feeder from BRU to be 20 deg. HARDOX-500 Liner of suitable thickness (min-6 mm) to be provided in entire surface come under feeding and abrasion zone of BRU. Unloading area for Biomass shall be enclosed type so that dust could not spread into the surrounding. Adequate ventilation and dust extraction system shall be provided.	
4.20.00	TRUCK TIPPLER a) The hydraulic Truck tippler shall consist of heavy-duty steel fabricated frame with anti-skid chequered plate welded on it, pair of heavy-duty hydraulic cylinder for lifting, overturning arrestor, a pair of back stopper and mechanical locking arrangement. b) The hydraulic power pack shall be totally enclosed and consist of hydraulic gear pump, electric motor with starter panel, hydraulic oil tank, control valves, high pressure pipe line & hoses, control panel fitted with push button switches etc c) Capacity: 60 Ton Max. Tilting angle: 55 Main Structure: Steel IS 2062/IS 1570	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001
SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant		Page 29 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.21.00	Hydraulic cylinder Tubes: Honed/Roller Burnished of seamless with internal surface finish less than 0.4 micron Hydraulic Cylinder piston rod: C45/EN8 Seal & guide ring: PTFE			
	Silo /Bin for storage of Biomass Storage shall be provided to store with adequate air space. The Silo/Hopper/Bin shall be used for main storage facilities of Biomass for further conveying to downstream conveyors. It shall have facilities for receiving Biomass from belt conveyors/bucket elevators at the top of the Silo and shall house the conveyor drive equipment and accessories and the associated handling arrangements. The design of storage silos shall confirm to IS 9178 (part 1 of 3). Each Silo/Hopper/ Bin shall be provided with level transmitter. Silo/Bin shall be fabricated of minimum 12 mm thick (including corrosion allowances) with proper lining (minimum 4 mm thickness) in the complete conical portion to ensure reliable discharge of material. Material of the Silo/Bin shall be suitable for Biomass storage and as per the applicable standard. Each storage silo shall be equipped with suitable Air blasting/Vibrating Bin type arrangement to ensure proper flowability of material.			
	Surface preparation and painting for Coal & Biomass Handling Plant a) All equipment’s inclusive of belt conveyor system and technological structures shall be kept clean. Surfaces to be painted shall be thoroughly cleaned of loose mill scale, rust etc. by wire brushing. All ferrous surfaces shall be applied with one shop coat of 35 micron and one 35-micron site coat of red oxide zinc chromate and two coats, each of 25 micron, synthetic enamel finishing paints unless specified otherwise. A minimum of 120 microns Dry Film Thickness (DFT) after finished coat of paint shall be ensured. b) However, idler roller shall be applied with two coats of red oxide Zinc chromate only of total thickness of 70 micron at shop. c) For steel buried pipeline, three (3) coats of heavy duty bitumastic paint shall be applied on the cleaned surface. Finally, it should be wrapped with minimum 3 mm thick bitumen impregnated tar felt. The lap joint of the felt shall be generally touched with heavy duty bitumastic paint.			
4.23.00	All equipment furnished by the Contractor shall be complete in every respect, with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or those needed for erection, commissioning and safe operation of the equipment and for the safety of the operating personnel, as required by applicable codes. All equipment shall be ‘fail safe’ in any conditions. Technical specification stipulates compliance to applicable statutory regulations and safety codes of India as well as of the locality where those will be installed. In particular, the CHP shall conform to the latest edition of the following standards, rules, acts.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant	Page 30 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	▪ NTPC Safety Rules for Construction and Erection ▪ NTPC Safety Policy ▪ IS:7155: Codes of Practice for Conveyor Safety. ▪ ASME B20.1 "Safety Standard for Conveyors and Related Equipment". ▪ ASME Standard B15.1 "Safety Standard for Mechanical Power Transmission Apparatus" ▪ ISO 7149, "Continuous handling Equipment-Safety Code-Special Rule" ▪ ISO 12944 - Corrosion protection of steel structures ▪ IS:3764- EXCAVATION WORK CODE OF SAFETY ▪ Occupational Safety and Health Administration- Guidelines ▪ CEMA Publication No. 201, "Safety Label Brochure" ▪ IE (Indian Electricity) Rules and Acts ▪			
4.24.00	Wind Barrier Wind barrier shall be installed all around the coal stockyard to a height of 11 m (1 m above the coal heap) to reduce wind force acting on the coal. Material of wind barrier screen mesh – HDPE monofilament knitted UV wind screen mesh with 80% blockade, 275 GSM (minimum), 6 gauge in black colour.			
5.1	WAGON TIPPLER (SIDE DISCHARGE TYPE)			
5.1.0	The rake comprising of specified maximum 59 number of wagons shall be pushed into the reach of in-haul equipment by a locomotive. Further placing of wagons over tippler platforms and carrying away the empty wagons shall be accomplished with the help of a side arm charger under scope of bidder.			
5.1.1	Wagon tipplers shall be suitable to handle any type of wagons being used by Indian Railways as on date for transportation of coal as per IS-10095 (Latest edition) and latest RDSO standard G-33 Rev 2. It shall conform to all stipulations with regard to suitability for handling wagons having width, height and length over coupler faces as indicated by RDSO/railway authorities at the time of approval of wagon tippler drawings.			
5.1.2	Maximum moving dimensions of locomotive & wagon as per Indian Railway norms shall be adopted for providing clearances with respect to structures, equipment and tippler arrangement.			
5.1.3	Complete wagon tippler and accessories shall have the approval of concerned Indian Railway Authorities and RDSO. Further, the contractor shall submit to the Owner detailed drawings of wagon tippler and accessories after getting the same approved from the concerned Railway authorities. Bidder shall take care of the observations of RDSO G-33 with Latest Amendments in their design & drawings for wagon tippler and its accessories.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
Page 31 of 122				

CLAUSE NO.	TECHNICAL REQUIREMENTS	
5.1.4	The top opening of wagon tippler hopper shall be suitable for receiving coal from wagons for which the wagon tippler drawing shall be approved by RDSO/railway authorities.	
5.1.5	The bidder shall obtain all statutory approvals from the relevant RDSO/Railway authorities, before the wagon tippler complex is put into operation. Any statutory payment charges to be made to the concerned authorities shall be to Bidder's account. It is the responsibility of the Bidder to carry out any modifications as required by the RDSO/Railway authorities, at no extra cost to the Owner.	
5.2.0	Wagon Tippler	
5.2.1	The wagon tippler shall be of RCC construction and adequately sized to accommodate the coal load of Minimum 250 MT received by 4 axle bogie having a gross load of 140 MT and axle load of 32.5 MT wagons of RDSO design used by Indian Railways. For effective volumetric capacity computation of the hopper, the angle of repose of coal shall be considered as 37°. The minimum valley angle of the hopper shall be considered as 60°. The hopper shall have opening below which apron feeders shall be provided to evacuate coal from the hopper and feed onto associated belt conveyors below. Complete inside surfaces of the hopper shall be provided with 50 mm thick guniting. Further it shall be possible to empty out all the coal, without any dead stock from the hopper.	
5.2.3	Steel gratings of mesh size 300mm x 320mm over wagon tippler hopper shall be provided. The hopper and gratings shall be designed for movement of front-end loader/bulldozer over them. Bull-dozer weight shall be considered as approx. 35 Te.	
5.3.1	CODES AND STANDRDS The design, manufacture, inspection and testing of Wagon Tippler shall comply with all the currently applicable statutes, regulations and safety codes in the locality where the equipment is to be installed. The Wagon Tippler shall conform to the latest edition of the standards, codes and RDSO G-33 Rev.2 Nothing in this specification shall be construed to relieve the contractor of the required statutory responsibility. In case of any conflict in the standard and this specification, the decision of the Employer shall be final and binding.	
5.4.1	DESIGN REQUIREMENT	
5.4.2	The wagon tippler shall be 'Side Discharge' type suitable to unload a coal wagon by lifting and rotating it sideways. The angle of tip shall be not more than 160° giving 60° angle to the side of the wagon for emptying the coal contents into the hopper below. Wagon tippler design should take care of locomotive (weighing up to 150 MT) moving over tippler table at a speed of 8Kmph.	
5.4.3	During each cycle of operation, the tippler shall be capable of holding, completely unloading and replacing the wagon to its original position without damage to the tippler, wagon or the track.	
5.4.5	The tippler shall be suitable for continuous operation, 24 hours a day, round the clock. The tipping rate shall be 25 Tips per hour, accordingly all drive components, hydraulics, electricals, structures shall be designed for 25 tips per hour round the clock operation.	
5.4.6	The wagon tippler structure shall be designed to conform to the requirements of Indian Railway's "Research, Design and Standards Organization, (RDSO)" with regard to the nature	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001
		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
		Page 32 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	of loading, impact factor and allowable stresses. It shall be the sole responsibility of the contractor to ensure that each and every component of the wagon tippler is adequate in rigidity, strength and of heavy duty construction of first class quality to guarantee against failure or major damage, assuming proper maintenance and usage. The tippler shall be designed to allow passage of all standard broad gauge (1676 mm) Indian Railways diesel locomotives over tippler table at restricted speed.			
5.5.1	Wagon Tippler Weighing System			
5..5.2	This specification calls for an electronic static weighing system to measure / record the quantum of coal, wagon wise on the wagon tippler table before & after tipping. The weighbridge with adequate number of load cells shall be provided beneath the wagon tippler platform with a minimum accuracy of ($\pm$) 0.25% of the gross weight of the wagon. The platform shall be freely supported on the weigh bridge before and after tipping for accurate weighing. The wagon tippler weighbridge shall be designed to statically weigh the wagons in an uncoupled condition. The system shall comprise of a weighbridge, a tippler table, load cells, weight digitizer and an intelligent terminal with printer for computerized printed output of data gross weight, tare weight, wagon number, time, date etc. The weighbridge shall be chosen to accommodate 8-wheeler wagons of RDSO design used by Indian Railways to move coal. The weighbridge shall be supported on a minimum of 4 nos. compression type load cells mounted on free motion structural unit assembly. The load cells shall be suitable for dusty environmental conditions.			
5.5.3	The dimensions and elevations for Wagon Tippler and its complex as indicated in the tender drawings are minimum requirements of the employer. Any increase in the sizes or the parameters, if required to meet the requirement of RDSO Design Guidelines G-33, Rev.02 shall be supplied by the Contractor without any cost implication to employer.			
5.5.4	Bidder shall validate the mechanical and structural design of Wagon Tippers by Finite Element Analysis method to demonstrate that the stresses are within allowable limits. The same shall be vetted by reputed institutions like IITs/IISc etc./International consultant before review of NTPC.			
5.5.5	A minimum plate thickness of 20 mm shall be used for fabrication of Side Beam manufacturing.			
5.5.6	Puncturing of the side beam for movement of the Top Clamp cylinders shall preferably be avoided.			
5.5.7	A forewarning system (Wagon Tippler Stress Measurement System) using suitable numbers of Permanent type strain gauges shall be provided on critical locations of all critical structural members such as Side Beam, Movable Side Beam etc., as applicable, to give early warning signal to operating staff. This system shall comply with the specification requirements as per Annexure-I “WAGON TIPPLER STRESS MEASUREMENT SYSTEM”.			
5.6.1	CONSTRUCTION REQUIREMENT			
5.6.2	Cradle The cradle shall consist of a pair of heavy welded steel plate sections reinforced with stiffeners and connected by side bearer beams pivotally attached, each section being fitted with a massive trunnion shaft carried in bronze bushed cast steel bearings/antifriction type spherical roller bearing on each side, bolted to steel pedestal carried on concrete pedestals. Circumferential driving rack shall be rigidly bolted to the peripheries of the sectors. The			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
Page 33 of 122				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.6.3 5.6.4 5.6.5 5.6.6 5.6.7 5.6.8 5.6.9 5.6.10	sectors shall be made of cast steel. Necessary features of safety against coming down of wagon tippler in the event of failure of one of the drive pinions and / or gear racks shall be provided.			
	Rail Table The rail table shall be constructed of rolled steel joints with standard steel rails (60 kg/meter) mounted on it. The table shall be pivoted from arms extended from the sectors. The table shall be covered with chequered plates between the rails.			
	Feeders and Clamps The wagon shall be clamped automatically by hydraulic system and firmly on the cradle during the tipping without any damage or undue pressure on any part of the wagon and no hand adjustment of any sort shall be necessary. Sliding side stop pads shall be of resilient material to prevent damage to either the wagon or the stops. Hydraulic top clamp over wagon tippler shall be suitable to grip the wagon top in case of coal heap over wagon. The coal heap shall be of approx. 800 to 1000mm over wagon top.			
	Spill Plate Fixed to the cradle of the tippler shall be a plain steel spill plate for deflecting material into the tippler hopper.			
	Driving Gear Multiple pinions meshing with cast steel racks bolted to the end sectors shall impart drive directly through hydraulic motor without gearbox. Suitable oil coolers shall be provided for the hydraulic power pack. Suitable dust protective cover shall be provided. The hydraulic power pack shall be located inside the wagon tippler control room.			
	Brake Brake integral with hydraulic drive shall be furnished to hold the tippler in any position with the load and against any movement except that provided by drive.			
	Limit Switches Limit switches of suitable type which can be readily adjusted to give the desired tipping angle shall be provided. An emergency over tip limit switch operated by a striker on the tippler trunnion shaft shall be furnished.			
	Lubrication All bearings shall be properly lubricated. Grease nipples and reservoirs shall be furnished wherever necessary.			
	Guards All gears inside machinery pits and other moving parts shall be securely guarded. All necessary base plates, guide plates, chequered plate covering for drive pit and any other pits, all required fixing materials, inserts and sleeves shall be furnished.			
	SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant	Page 34 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.7.1	RDSO REQUIREMENT			
	The Wagon Tippler shall fully meet the requirements of RDSO along with Latest Amendments. However, Major requirements are as follows:			
5.7.2	The Tippler shall be designed for handling a gross load of 140 tons taking into consideration a 4 axled bogie wagon with an axle load of 32.5 tons plus the overloading caused due to variable density of the bulk material and heap loading of the wagon.			
5.7.3	The Tippler shall be capable of handling one 4 axled wagons at a time having a maximum length of 15m over the buffers or Centre buffer couplers (CBC's).			
5.7.4	The top clamping pressure shall be such as to hold the wagons firmly in position on rails keep the bearing brasses and running gear from getting dislodged without causing any deformation to the wagon structure.			
5.7.5	Devices shall be built-in for spotting of wagons on the tippler table, so as to the discharge the material in hoppers.			
5.7.6	Size and gauge of rails on the wagon tippler platform shall be as per railway specifications taking into consideration the maximum duty condition that the wagon tippler has to undergo in field operation.			
5.7.7	Marking- All tipplers shall be marked permanently and legibly at a clearly visible place with the name of the manufacturer, serial number, the year of manufacturer, type and capacity of tippler and RDSO allotted serial no.			
5.7.8	Devices shall be built-in to prevent any overrunning of the wagons in either direction. The tipper shall be designed so that the wagon is securely held in all operating positions. Automatic devices shall be provided to hold the tipplers securely in any position in the event of failure of the drive units. All tipplers shall have means to limit the angle of tipping. Arrangements shall be made on tipplers to prevent feet being trapped between the platform and the base of the tippler. Device shall be provided to prevent an empty wagon from being released unit the tippler is back in original position. The emergency stop controls shall be provided adjacent to the wagon tipplers in a readily accessible position.			
5.8.1	Train & wagon Holding Devices			
5.8.2	Wheel grippers: These are mandatory and should be so designed that balanced pressure is applied on both sides of the wheel rim. It should have a floating arrangement to ensure that force on each gripper is same and should have some lateral float so that it can take a new position in case of variation in wheel gauge. Wheel grippers should be free from serrations or any such provision on its holding face wheel grippers should be made of soft material.			
5.8.3	Retractable wheel chocks: These are mandatory and should be so designed that the flange of the wheel is not contacted while blocking the tread of the wheel. The shape of the chock should take into account the wheel incline, so that a line contact is made with the wheel.			
5.8.4	Clicking stops: These are not acceptable.			
5.8.5	The design of the top clamping arrangement shall fulfill following requirements.			
5.8.6	The top clamping of the wagon shall be done through hydraulically locked top clamps. No external or moveable counter weights should be used with the hydraulic clamps.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
Page 35 of 122				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.8.7	Top clamps should engage when the wagon tilts by more than 15 degree. Top clamp locks should include a wagon bogie spring relief mechanism for permitting release of bogie springs. Top clamps should exert the bare minimum pressure on the top coping of the wagon, so as to just keep it in position. The pressure exerted by the top clamps at the tilt angle of 160 degrees should be just enough to bear the weight of the empty wagon. Wagon bogie springs should get fully relieved in this position, through the bogie spring relief mechanism.			
5.8.8	The design of Top Clamping arrangement shall be of longitudinal/ transverse type and provided with self-aligning feature, whereby the load is borne on the top at each of the wagons. The longitudinal/ transverse type clamping shall have six transverse top clamping beams i.e. the bearing face of the beam shall contact the top of the wagon at 12 locations (six on each side). Each bearing face shall contact the top of the wagon over a width of not less than 250 mm and shall provided with rubber pads or suitable alternative not less than 50 mm thick.			
5.8.9	The side supports for tipplers shall meet the following requirements.			
5.8.10	Full face contact between the side support beam and the side stanchions shall be ensured. The side supports shall extend from a height of 1000 mm upto 2950 mm, from rail level, i.e. contact the side of the wagon over a width of not less than 1950 mm. There shall be metal to metal contact between the side support beam and the side stanchions of the wagon i.e, no rubber pad or any other alternative, shall be provided on the contact face of the side support beam.			
5.8.11	The side support beam shall be movable type, the movement being done by hydraulic arrangement (No external or moveable counterweights should be used with the side support beam). Facility of forward/backward movement should exist, such that it should be able to move & touch the wagon without applying any pressure on the wagon side wall. Movement of the side support should be controlled and the speed should be crawling just before making contact with the wagon side wall.			
5.8.12	Pressure gauges should be mounted, at easily accessible location, for reading the hydraulic pressure of the side support hydraulic arrangement. The hydraulic power pack shall be located in dust free atmosphere inside wagon tippler control room. The main oil tank of wagon tippler and side arm charger shall be pressurized and the breather shall also be pressurized in order to avoid dust ingress. A portable centrifuge for cleaning the oil shall also be provided. The maximum working pressure for the hydraulic system in Hydraulic Power Pack shall not be more than 210 bar.			
5.9.0	SIDE ARM CHARGER			
	DESIGN REQUIREMENT			
5.9.1	A single module of side arm charger shall be used for inhaul and outhaul operations. The side Arm charger shall be suitable to handle 59 (DFC 25) numbers of loaded wagons. Thus, side arm charger shall be used for indexing forward the rake of 59 (DFC 25) nos. loaded wagons, placing decoupled wagons on the tippler table and out hauling the empty wagons.			
5.9.2	The rake of 59 (DFC 25) loaded wagons will be brought by locomotive and placed on the pre-tipping line such that the leading wagon will be within the reach of the side arm charger. Now the side arm charger will be coupled to the leading wagon, pull the rake of 59 (DFC 25) loaded wagons towards tippler table. The first wagon will be de-coupled			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
Page 36 of 122				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	manually from the rake and signal will be given to the side arm charger operator that the wagon is de-coupled. Now the leading wagon will be placed centrally onto the tippler table by side arm charger, (simultaneously ejecting the empty wagon from the tippler table). After the loaded wagon is placed on the tippler table, the arm is de-coupled from the loaded wagon. Adequate clearance between tippler table and empty wagon shall be ensured. The side arm charger will stop at the end of its strokes, the arm will be swung vertically-up and the machine will move towards in-haul direction and occupies the initial position. In the meantime, the tippler will tip the loaded wagon placed on the tippler table and return to its original position. Before tipping operation of wagon tippler is completed, the arm of the side arm charger will be swung to horizontal position and will be coupled to the rake of remaining loaded wagons at waiting position just before the tippler table and is now ready for the next cycle to start. After the tipping operation of wagon tippler is completed, the cycle will be repeated.			
5.10.0	CONSTRUCTION REQUIREMENT			
5.10.1	The Side Arm Charger shall be suitable to handle 59 (DFC 25) number of loaded wagons. The pusher arm shall be vertically rotatable arm mounted on a carriage running back and forth parallel to the train track.			
5.10.2	The arm shall be raised to clear the movement of wagons and locomotives during reversing back of positioner carriage and shall be lowered for engaging the head of the arm with the wagon coupler for index strokes.			
5.10.3	The arm shall be raised and lowered by means of hydraulic cylinder mounted on the carriage. Suitable means shall be provided to prevent damage to the arms should the arm be accidentally lowered into the side of wagon.			
5.10.4	The arm shall be of robust construction either of cast steel or of heavy duty fabricated steel for the required duty.			
5.10.5	The construction of the head assembly of the push arm shall be such that no damage is suffered by the couplers of wagons and engagement of arm over the coupling assembly as well as transmittance of indexing forces to accelerate, run and decelerate the train during the positioning cycle shall be very smooth.			
5.10.6	The carriage frame shall be a suitable fabrication assembly of large proportions massive enough in strength and rigidity for the required duty.			
5.11.0	Travel Carriage Drive System			
5.11.1	The travel carriage with push arm shall be propelled to and fro, parallel to train track through direct hydraulic drive.			
5.11.2	The rating of the drive equipment and its characteristics shall match with indexing forces required to be exerted in varying amounts depending upon train dynamics and to suit haulage of 59 (DFC 25) wagon loaded rake.			
5.11.3	The travel carriage shall ride on vertical bearing wheels and will be guided by horizontal bearing wheels by suitably transmitting the thrust load from the positioner arm to the foundation. The wheels/rollers shall be of forged steel and shall run on the rails supported over the RCC pedestal.			
5.11.4	Cushioned emergency bumpers (buffers) shall be provided at the forward and return end of carriage travel run for protection. These shall be designed to arrest the machine without undue shock in case the machine exceeds its extremities because of any mal-operation.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
Page 37 of 122				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Bidder to refer Annexure I to Sub-section A-20 for compliance of the 'Safety Module', as applicable.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant	Page 39 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	DATA SHEET for each of above system and equipment is as below: <u>DATA SHEET: BELT CONVEYOR</u> 1.0.0 GENERAL 1.1.0 Design Capacity 110% of rated (guaranteed) capacity for all conveyors excepting boom conveyor. For boom conveyor, the design capacity shall be 125% of rated (guaranteed) capacity. 1.2.0 Maximum slope 14 deg for trough belt conveyors Bidder to decide for pipe conveyors 1.3.0 Max. belt Sag between idlers 2% 1.4.0 Minimum Radius (i) Concave curve 250 m (In case of travelling trippers, the requirement of minimum radius shall be decided based on the space availability) (ii) Convex Curve 50 m 1.5.0 Coal Parameters As specified elsewhere 2.0.0 DESIGN & CONSTRUCTION 2.1.0 Belting 2.1.1 Type Synthetic Fabric of Nylon / Nylon, Steel Cord. etc. 2.1.2 Cover Grade a) Flame test: Conforming to ISO:340 b) Drum Friction and Electrical Surface Resistance Test: Conforming to Canadian standard association CAN / CSA M-422- M87 Grade - C. 2.1.3 Cover Thickness (without –ve tolerances). Synthetic belting Steel Cord (a) Face 5.0 mm (min.) 8.0 mm (min.) (Inclusive of steel or fabric breaker) (b) Bottom 2.0 mm (min.) 6.0 mm (min.) (Inclusive of steel or fabric breaker) 2.1.4 No. of plies Minimum 4 for Coal Conveyor			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant Page 40 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS		
2.1.5 <			

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.2.4	(a) Carrying	Ball Bearings of deep groove type (630* series) or seize resistance type of min. 35 mm size, lubricated for life for Coal Conveyors		
		Ball Bearing of deep groove type or seize resistance type of min. 30 mm size, lubricated for life for Biomass/Limestone & Gypsum Conveyors		
	(b) Return	Ball Bearings of deep groove type (630* series) or seize resistance type of min. 25 mm size, lubricated for life, for Coal Conveyors		
		Ball Bearing of deep groove type or seize resistance type of min. 20 mm size, lubricated for life for Biomass, Limestone & Gypsum Conveyors.		
	Material			
	(a) Roller	ERW Steel tube min. wall thickness 4.0 mm		
	(b) Spindle	E.N. 8 or equivalent.		
	2.3.0	Belt Cleaners		
	2.3.1	External		Sprung loaded scraper type pre cleaner (mounted separately), fitted with modular segmented and replaceable Polyurethane Blade & separate Main Cleaner having segmented metallic Cleaning Blade with cleaning tip of Tungsten Carbide.
2.3.2	Internal	V-Plough type, mild steel flats with hard rubber strips.		
2.4.0	Not used			
2.5.0	Belt Take up			
2.5.1	Type	Automatic Gravity Type for Coal/Gypsum Conveyors		
2.5.2	Location	In relation to the drive to keep belt tension at minimum.		
2.5.3	Take-up travel	To suit all operating conditions or (2.5% for synthetic belt and 0.5% for steel/cord belt) of conveyor center to center length whichever is larger. Further the initial location of take-up shall be decided in such a way that it is possible to carryout min. two (2) nos. Vulcanizing Joints without adding any external		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant	
Page 42 of 122				

CLAUSE NO.	TECHNICAL REQUIREMENTS		
		belt.	
2.5.0	Hold Back Device	Integral with gear Box	
2.6.0	Pulleys		
2.6.1	General (for all types of Pulleys)		
	Pulley shaft diameter	Margin of minimum 20% shall be Considered on maximum tension at design capacity for arriving at the shaft dia.	
2.6.2	Drive Pulleys		
	(1) Lagging	Hot lagged with vulcanised natural rubber	
	(2) Lagging thickness	12 mm thick grooved in diamond pattern with grooves 6 mm wide x 6 mm deep	
	(3) Minimum angle of wrap	210° degrees	
	(4) Maximum Out of roundness	0.5% of nominal diameter	
2.6.3	Other pulleys		
	(1) Lagging	Hot lagged with vulcanised natural rubber	
	(2) Lagging thickness	12 mm thick plain	
2.6.4	Rubber for lagging		
	(1) Type	Natural rubber blended with styrene Butadiene rubber.	
	(2) Hardness	55 to 65 durometer (Shore A)	
	(3) Elongation	Over 300%	
	(4) Strength	160-245 kg/cm ²	
	(5) Abrasion loss	250 mm ³ (max.) as per DIN 53516	
	(6) Specific Gravity	Max. 1.5	
	(7) Adhesion Strength	10 kg/cm (minimum)	
2.6.5	Bearings for Pulleys		
	(1) Type	Heavy duty roller type	
	(2) Casing	Horizontal Split Type	
	(3) Sealing	Dust tight with double labyrinth seals.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
			Page 43 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS																			
	(4) Lubrication	Greasing arrangement with conical head shape nipples.																		
	2.6.6 Pulley Material	Mild steel conforming IS:226 / IS : 2062																		
	2.6.7 Shaft Material	Forged Steel shaft EN-8 or equivalent material.																		
	2.7.0 Belt Protection Equipment																			
	2.7.1 Pull Chord Switches:-																			
		<table><tr><th>Feature</th><th>Description</th></tr><tr><td>Type</td><td>Addressable Type</td></tr><tr><td>Contact Rating</td><td>Continuous 10 amp Breaking 2 Amp (240 V AC)</td></tr><tr><td>No. of Contact</td><td>2NO+2NC</td></tr><tr><td>Reset Facility</td><td>Manual Reset</td></tr><tr><td>Type of Enclosure</td><td>Die Cast Aluminium</td></tr><tr><td>Degree of Protection</td><td>Flame proof/ Explosion proof for NEC Class 2,Division 1 area</td></tr><tr><td>Local Trip Indication</td><td>Required</td></tr><tr><td>Accessories</td><td>1. Canopy over lever of pull chord switch. 2. Linking of switches through a single cable for each section. 3. Each pull chord switch shall be provided with RED LED indication lamp for prominent visible indication of tripping.</td></tr></table>	Feature	Description	Type	Addressable Type	Contact Rating	Continuous 10 amp Breaking 2 Amp (240 V AC)	No. of Contact	2NO+2NC	Reset Facility	Manual Reset	Type of Enclosure	Die Cast Aluminium	Degree of Protection	Flame proof/ Explosion proof for NEC Class 2,Division 1 area	Local Trip Indication	Required	Accessories	1. Canopy over lever of pull chord switch. 2. Linking of switches through a single cable for each section. 3. Each pull chord switch shall be provided with RED LED indication lamp for prominent visible indication of tripping.
	Feature	Description																		
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Degree of Protection	Flame proof/ Explosion proof for NEC Class 2,Division 1 area																			
Local Trip Indication	Required																			
Accessories	1. Canopy over lever of pull chord switch. 2. Linking of switches through a single cable for each section. 3. Each pull chord switch shall be provided with RED LED indication lamp for prominent visible indication of tripping.																			
(2) Spacing	Approx 30 m																			

SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant	Page 44 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS																													
2.7.2	Belt Sway Switches		<table><tr><th>Feature</th><th>Description</th></tr><tr><td>Type</td><td>Addressable Type</td></tr><tr><td>Body</td><td>Cast Iron</td></tr><tr><td>Contact Rating</td><td>Continuous 10 amp Breaking 2 Amp (240 V AC)</td></tr><tr><td>No. of Contact</td><td>2NO+2NC</td></tr><tr><td>Reset Facility</td><td>Auto Reset</td></tr><tr><td>Type of Enclosure</td><td>Die Cast Aluminium</td></tr><tr><td>Degree of Protection</td><td>Flame proof/ Explosion proof for NEC Class 2, Division 1 area</td></tr><tr><td>Accessories</td><td>1. Canopy 2. The belt sway switches shall be provided with a common bridging push button which may be kept pressed to bypass the limit switch before starting the conveyor</td></tr></table>	Feature	Description	Type	Addressable Type	Body	Cast Iron	Contact Rating	Continuous 10 amp Breaking 2 Amp (240 V AC)	No. of Contact	2NO+2NC	Reset Facility	Auto Reset	Type of Enclosure	Die Cast Aluminium	Degree of Protection	Flame proof/ Explosion proof for NEC Class 2, Division 1 area	Accessories	1. Canopy 2. The belt sway switches shall be provided with a common bridging push button which may be kept pressed to bypass the limit switch before starting the conveyor									
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Accessories	1. Canopy 2. The belt sway switches shall be provided with a common bridging push button which may be kept pressed to bypass the limit switch before starting the conveyor																													
2.7.3	Spacing		One pair at 50m interval (Minimum two (2) pairs)																											
	Zero Speed Switches																													
	(1) Location		Mounted on Bend pulley of GTU																											
			<table><tr><th>Feature</th><th>Description</th></tr><tr><td>Type</td><td>Proximity Based</td></tr><tr><td>Body</td><td>Cast Iron</td></tr><tr><td>Contact Rating</td><td>Continuous 10 amp (240 V AC)</td></tr><tr><td>No. of Contact</td><td>2NO+2NC</td></tr><tr><td>Reset Facility</td><td>Manual Reset</td></tr><tr><td>Type of Enclosure</td><td>Die Cast Aluminium</td></tr><tr><td>Degree of Protection</td><td>Flame proof/ Explosion proof for NEC Class 2, Division 1 area</td></tr><tr><td>Accuracy</td><td>+/- 5%</td></tr><tr><td>Repeatability</td><td>+/-1%</td></tr><tr><td>Differential</td><td>+/- 5%</td></tr><tr><td>Accessories</td><td>Canopy</td></tr><tr><td>Temp. Rating</td><td>900 C minimum</td></tr></table>	Feature	Description	Type	Proximity Based	Body	Cast Iron	Contact Rating	Continuous 10 amp (240 V AC)	No. of Contact	2NO+2NC	Reset Facility	Manual Reset	Type of Enclosure	Die Cast Aluminium	Degree of Protection	Flame proof/ Explosion proof for NEC Class 2, Division 1 area	Accuracy	+/- 5%	Repeatability	+/-1%	Differential	+/- 5%	Accessories	Canopy	Temp. Rating	900 C minimum	
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant																										
Page 45 of 122																														

CLAUSE NO.	TECHNICAL REQUIREMENTS		
2.7.4	Chute Block Switches	These shall be provided with digital RPM indication in local and a 4-20 mA output signal shall be provided to show the speed in CHP DDCMIS.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
2.8.3	Continuous motor rating (Name plate rating) at 50OC Ambient	110% of actual power requirement at motor output shaft at design capacity.	SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001 SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant Page 47 of 122
2.9.0	Conveyor Bridges		
2.9.1	Walkways		
	(a) Construction	Chequered plate with antiskid arrangement.	
		Chequered plate steps shall be provided where conveyor slope exceeds 10 degrees. (Totally sealed so that no water falls while washing.)	
	(b) Central walkway width	1100 mm	
	(c) Side walkway width	800 mm (for single conveyors, the width of side walkways shall be 800 mm on one side and 1100 mm on the other)	
2.9.2	Side Windows		
	(a) Spacing (Center to center)	25.0 m on each side (in staggered fashion)	
	(b) Size	1.2 m x 1.5 m	
	(c) Window material	Refer Civil Section	
2.10.0	Trestles		
2.10.1	Spacing of monkey ladders on trestles		
(a)	Where height of conveyor gallery (walkway level) is 10 m or more.	: On every trestle	
(b)	Where height of conveyor gallery (Walkway level) is less than 10m.	: On alternate trestle	

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<u>DATA SHEET: BRAKES AND CLAMPS</u>			
1.0.0	GENERAL			
1.1.0	Brakes	(i) For decelerating conveyors & rotating equipment's. (ii) Brakes are mandatory for H.T. drives involving scoop type coupling except crusher motor.		
1.2.0	Rail Clamps	For various mobile equipment travelling on rails.		
2.0.0	DESIGN & CONSTRUCTION REQUIREMENT			
2.1.0	Brakes			
2.1.1	Type	Electro-Hydraulic Thruster brakes A.C. operated or Disc brakes.		
2.1.2	Braking Torque	Adjustable from 0 to 100% of rated braking torque.		
2.1.3	Brake Shoes	Operated directly by spring		
2.1.4	Shoe lining	Asbestos with interwoven brass wires.		
2.1.5	Max. Temperature for shoe lining	200-degree C.		
2.1.6	Thruster	Class-B insulation, IP-65 protection.		
2.2.0	Clamps			
2.2.1	Rail Clamp support	Independent from the rails.		
2.2.2	Limit Switches	“ENGAGED” & “DISENGAGED” signals.		
2.2.3	Clearance between Rail clamp face & Rail surface	Minimum 50 mm		
2.2.4	Material for Rail clamp Mechanism	Forged steel		
2.2.5	Thruster	Class-B insulation, IP-65 Protection		
2.2.6	Type	Electro-hydraulic thruster, manual		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
Page 48 of 122				

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	DATA SHEET: MONORAILS AND HOISTS		
1.0.0	GENERAL		
1.1.0	Functional Requirement :	To transfer equipment's to maintenance area or outside the building.	
2.0.0	DESIGN & CONSTRUCTION REQUIREMENT		
2.1.0	Hoists		
2.1.1	Drive		
	(i) More than 2.0 ton or more than 10.0 m lift or hoists coming out-side the buildings	Motor driven for both travel & lift.	
	(ii) Other hoists including the hoists for handling take up pulley and take up weight	Manual for both travel & lift.	
2.1.2	Maximum trolley travel speed for electric hoists	15m/min	
2.1.3	Maximum Hoisting speed for electric hoists	6 m/min	
2.1.4	Drive Motors	SQIM, Separate for travel & lift	
2.1.5	No. of starts for drive motor	150 starts/hr at 40% CDF	
2.1.6	Wire Rope		
	(i) Type/Construction	Pre-formed type, hemp cored, regular lay 6/36 construction	
	(ii) Breaking Strength	160-175 kgf/sq. mm	
2.1.7	Bearing		
	(i) Type	Ball/Roller bearing	
	(ii) Life	20 years	
2.1.8	Brake	Electro-Mechanical type with asbestos lining.	
2.1.9	Load Hook	Swiveling type forged circular shank section.	
2.1.10	Duty	Class –2	
2.2.0	Monorail location/layout		
2.2.1	Cross section	I beam	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
			Page 49 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
2.2.2	Distance between C/L of monorail & C.G. of equipment to be lifted	Maximum 500 mm	
2.2.3	Power Cables Support	Festoon type arrangement	
2.3.0	Manual Hoists		
2.3.1	Maximum manual effort for operation.	30 Kg	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant Page 50 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<u>DATA SHEET: CHUTES AND HOPPERS</u>		
1.0.0	GENERAL		
1.0.1	Coal/Gypsum Parameters	As specified elsewhere	
2.0.0	DESIGN & CONSTRUCTION		
2.1.0	Chutes & Hoppers		
2.1.1	Minimum Valley Angle	60 degrees	
2.1.2	Material :		
	(a) Chute work		
	(b) Sliding zones & adjacent sides	20 mm thk. Tiscral or equivalent	
	(c) No striking/ Non sliding zones	10 mm thk MS	
	(d) Chute with valley angle 80 degree and above	All four sides of 20 mm thk. Tiscral or equivalent	
	(e) In the zone of magnetic field of ILMS (chute above floor over which ILMS is suspended)	SS-304 10 mm thk.	
	(f) In the zone of flap gates	20 thk TISCRAL/ equivalent material	
	(g) Discharge Hoods over head pulleys	4 mm thk M.S. with rubber curtain	
2.1.4	Inspection Doors	Hinged & leak proof construction (min. size 350 x 450 mm) Joints areas in between inspection door and chute plate to be provided with MS round or strip/ equivalent so that sufficient labyrinth effect shall be created for arresting of dust leakage.	
2.1.5	Chute Construction		
	(a) Corners	One face of removable bolted flange connection	
	(b) Joints Bolted	Flange joints of dust tight construction	
	(c) Bolt size	Min. M-16	
	(d) Bolts spacing	Not more than 125 mm C/C	
	(e) Fixing Arrangement	Bolts with plain spring washers	
2.2.0	Skirt Boards		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
			Page 51 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS		
2.2.1	Length	Entire feeding chute shall be extended minimum 3 mm ahead of front edge of chute & 500 mm beyond rear edge of chute.	
2.2.2	Height	Not less than 750 mm	
2.2.3	Width	2/3 of belt width	
	Side plate	Min. 10 thk TISCRALE/equivalent	
	Top cover	6 mm thk M.S.	
2.3.0	Flap Gate		
2.3.1	Type	Linear actuator operated, 2 position	
2.3.2	Travel	60 to 70 deg. (with limit switches on both sides).	
2.3.3	Automatic operation		
	(i) Drive	Dust tight motor driven with suitable linkages	
	(ii) Minimum Actuator Rating	3500 kg with 1 m lever arm for CHP 2500 kg with 1 m lever arm for GHP	
	(iii) No. of Operation / Hr	15 (with 10 consecutive switchings)	
	(iv) Protection	Travel and Thrust dependent limit Switches.	
2.4.4	Manual Operation		
	(a) Maximum effort	Convenient for single operator by declutchable hand wheel regardless of electrical power.	
	(b) Minimum Hand-wheel Diameter	500 mm	
2.4.5	Flap gate shaft		
	(i) Diameter minimum	150 mm	
	(ii) Material	EN-8	
2.5.0	Rack & Pinion Gate	Rotary actuator operated with provision of manual operation	
2.5.1	Material	Mild Steel	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
			Page 52 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
2.5.2	Liner	10 mm thick TISCRALE/equivalent	
2.5.3	Rack & Pinion	Cast Steel	
2.5.4	Shaft	EN-8	
2.5.5	Max. time for closing/ opening	50 sec.(Approx)	
2.5.6	Maximum manual effort	25 kgs.	
2.5.7	Limit switches	Both travel & thrust dependent	
2.5.8	Main shaft dia. Minimum	150 mm	
2.5.9	No. of Operations /hr.	15 (with 10 consecutive)	
2.5.10	Diameter of rod for Rod Gate	40 mm (Min.)	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	
SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant		Page 53 of 122	

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	DATA SHEET: DRIVE EQUIPMENT		
1.0.0	GENERAL		
1.1.0	Continuous Motor Rating (Name Plate Rating) at 50 Degree Centigrade Ambient temp. for Electric Motors		
	a)	For conveyors of belt conveyor systems	*110% of actual power at drive motor output shaft at specified design capacity
	b)	Crushers, Mobile trippers travel drive, mono-rail hoists (travel and hoisting), elevators, rack and pinion gates, all the drives in sampling units, various pumps of DS/DE systems, service water systems, cooling water system, potable water system and sump pumps, Ventilation Fans	*110% of actual power requirement at drive motor output shaft at guaranteed (rated) capacity.
	*The actual power at drive motor output shaft shall be calculated after considering all the losses of down the line equipment's of the drive train.		
2.0.0	DESIGN & CONSTRUCTION REQUIREMENT		
2.1.0	Gear Box	TYPE	
2.1.1	(a)	Below 40 KW	Helical, worm, bevel as per requirement without cooling coil
	(b)	Equal to and Above 40 KW	Helical / bevel helical without cooling coil
2.1.2	Service Factor	As per accepted engineering practice / manufacturer's recommendations.	
2.1.3	Ambient temperature for Thermal rating	50°C Minimum	
2.1.4	Mounting	On Machined/Ground Surfaces	
2.1.5	Output Rating	a) For belt conveyor systems @ Service factor X {1.2 times the actual power requirement at drive pulley shaft at design capacity} b) For other equipment @ Service factor X {1.2 times the actual power requirement of the driven equipment}	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
			Page 54 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	<u>DATA SHEET: CHP/BHP BUILDING</u> 1.0.0 GENERAL 1.1.0 Underground /partially underground RCC Construction Transfer Houses 1.2.0 Overground Transfer Houses, Crusher House Steel Construction 1.3.0 Control/MCC rooms & S&T room RCC construction 2.0.0 DESIGN & CONSTRUCTION REQUIREMENT 2.1.0 Transfer Houses & Crusher House 2.1.1 Space requirement To accommodate all equipments drive units, head/ tail ends of conveyors transfer chutes etc. and to provide adequate space for maintenance. 2.1.2 Floors RCC construction with facility to wash the floors. Min. slope of 1:80 for floors in TPs and 1:100 for floors in crusher house shall be provided towards drain pipes. 2.1.3 Walls/Enclosure Permanently colour coated cladding 2.1.4 Stairs Steel construction with minimum 1000 mm width. 2.1.5 Doors & Windows Steel construction 2.1.6 Monorails Capacity as per equipment installed 2.1.7 Drainage From each floor to drain pit suitable to handle coal slurry. 2.1.8 Elevators Necessary space, platforms / interconnections with the respective buildings, machine room etc. wherever applicable. 2.1.9 Vertical bracing Only along four sides. 2.1.10 Maintenance platform with handrails. Chequered plate floors Min.1500 mm wide 2.1.11 Flooring 50 mm thick metallic hardener like ironite floor finish. 2.1.12 Level of ground floor 500 mm above ground level.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant Page 56 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
2.2.0	Control/MCC		
2.2.1	Construction		
	RCC construction with Brick Enclosure		
	MCC Rooms		
	Pressurized with dust free air		
	Control Rooms		
	Air-conditioned Environment		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant Page 57 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	DATA SHEET: CRUSHER/RING GRANULATOR		
1.0.0	GENERAL		
1.1.0	Type	Ring granulator for Coal	
	Material to handle		
1.2.0	Input Coal Parameters	(-) 250 mm, occasionally 1-2% of 400 mm size	
1.2.1	Extent of oversized lumps (occasional) in feed coal		
	(a) Maximum percentage	1 to 2%	
	(b) Maximum lump size	400 mm	
1.3.0	Feeding Arrangement	Through vibrating feeder for Coal	
2.0.0	DESIGN AND CONSTRUCTION (FOR COAL)		
2.1.0	Number of rows of hammers	4 rows placed at 90 deg	
2.2.0	Hammer profile (for Coal)	Toothed and plain alternately or only toothed	
2.3.0	Weight of each ring hammer	Not to exceed 40 Kg.	
2.4.0	No. of suspension bars passing through each row of ring hammers	Max. of Two (2) number	
2.5.0	No. of holes in each segment of central and end discs for suspension bars (for each row of hammers)	Max. of Three (3) number	
2.6.0	Drive arrangement		
2.6.1	Motor rating at 50°C	Refer technical specification elsewhere	
2.6.2	Fluid coupling		
	Type	Scoop tube type	
2.7.0	Rotor Balancing		
2.7.1	Type of balancing reqd.	Both static and dynamic	
2.7.2	Grade of balancing	Q-16 as per VDI-2060 1966 (However, for purpose of calculating the unbalanced force for the design of machine supporting structure, balance grade as given in the relevant section)	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
			Page 58 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	for foundation design shall be followed). 2.8.0 Plummer Block 2.8.1 Type of Plummer block Split type 2.8.2 Type of sealing Labyrinth, dust tight arrangement 2.8.3 Type of bearings Spherical roller 2.8.4 Lubrication Manual through grease gun OR with recommended grade of oil in which case the Plummer block shall be designed with oil filling, oil draining and visual oil checking facilities 2.9.0 Tramp iron rejection Required for unbreakable material facility 2.10.0 Output size adjustment facility Desirable 2.11.0 Top cover of crushers Hydraulically operated 3.0.0 MATERIAL OF CONSTRUCTION 3.1.0 Ring Hammers Manganese steel to IS - 276 Gr. III or made of low alloy (silicon manganese) steel in forged condition as per ASTM –A 322 grade 9260 or 4140 3.2.0 Rotor Shaft ASTM-A668, Class E / C-45(IS 2004) / E8D, BS 970/1955 3.3.0 Suspension bars ASTM-A322, Grade AISI 4140 / EN-24, Bright bar 3.4.0 Cage bars/cage screens and side screen plates Manganese Steel (IS:276) / 3.5.0 Rotor Discs ASTM-A108, AISI 1045 3.6.0 Breaker plate Manganese steel IS-276 Gr. III min. 40mm thick 3.7.0 Liners (a) Material Material composition shall be as that of breaker plate above (b) Thickness 20 mm minimum.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant	Page 59 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	DATA SHEET: VIBRATING FEEDER/VIBRATING SCREEN FEEDER		
1.0.0	GENERAL		
1.1.0	Functional Requirement	Uniform feeding of (-) 250 mm coal to crushers. Occasionally, 1-2% 400 mm lumps need to be handled	
2.0.0	DESIGN & CONSTRUCTION REQUIREMENT		
2.1.0	Type	Mechanical vibrator	
2.2.0	Inclination	Suitably selected to ensure proper flow ability of Coal without any hinderance.	
2.3.0	Pan Size		
	(a) Screen area	As required	
	(b) Pan width	To match with crusher rotor length without deflector plates	
2.4.0	Performance size on deck	Suitable to feed size	
2.5.0	Liners on solid deck		
	- Type, Material	Replaceable, Wear Resistant plate	
	- Thickness	16 mm minimum.	
2.6.0	Support	Helical springs only	
2.7.0	Bearings		
	(a) Type	Double spherical roller suitable for vibrating screens.	
	(b) Lubrication	Grease	
	(c) Life	8,000 hours Min.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
			Page 60 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	DATA SHEET: REVERSIBLE STACKER CUM RECLAIMER			
1.0.0	GENERAL			
1.1.0	Stacker Reclaimer			
1.2.0	Type	:	Travelling boom stacker cum bucket wheel boom reclaimer	
1.3.0	Input Coal Parameters	:	As specified elsewhere	
1.4.0	Wind Velocity			
1.4.1	Maximum under operating condition	:	65 kmph	
1.4.2	Maximum under non-operating condition	:	As indicated in weather data in Project Synopsis	
1.5.0	Height of Stockpile	:	As per equipment sizing criteria	
1.6.0	Design Capacity	:	110% of rated (guaranteed) capacity	
1.7.0	Peak Reclaim Capacity	:	125% of rated capacity, (For bucket size calculations)	
1.8.0	Width of stockpile at base	:	min 50 m.	
2.0.0	DESIGN REQUIREMENT			
2.1.0	Stacker Reclaimer Travel Mechanism			
2.1.1	Type of Rail	:	52 kg/ mtr.	
2.1.2	Rail Track Gauge	:	Not Less than 20% of boom length.	
2.1.3	Wheel Load	:	Not to exceed 27.0 Te.	
2.1.4	Wheel Bearings	:	Self-aligning roller bearings.	
2.1.5	Top of Rail Level	:	0.7 m above ground level unless specified otherwise.	
2.1.6	Drive Equipment	:	Electric motor with suitable coupling & electro-hydraulic Thruster brakes.	
2.2.0	Bucket Wheel Mechanism			
2.2.1	No. of Buckets	:	(Min) Eight (8)	
2.2.2	Type of Buckets	:	Cell-less	
2.2.3	Max. degree of fill for Buckets to be considered.	:	80%	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
Page 61 of 122				

CLAUSE NO.	TECHNICAL REQUIREMENTS 
2.2.4	Effective Ring volume to be : Max. 50% of annular ring Volume. considered
2.2.5	Bucket discharge rate : Not to exceed 55 per min.
2.2.6	Drive : Hydraulic drive (without gearbox
2.2.7	Brake : Brake: Brake shall be integral with hydraulic motor.
2.2.8	Overload Protection : Suitable safety device with power supply tripping.
2.3.0	Boom Conveyor
2.3.1	Design average capacity : 125% of rated reclaiming capacity.
2.3.2	Belt speed : Approx. 3m/sec.
2.3.3	Length & Width of Belt
	a) for Boom conveyor : 41 mtr Suitable for above capacity
2.3.4	Carrying Idlers : 35° troughing three equal rolls
2.3.5	Return Idlers : Single piece rollers
2.3.6	Drive : Electric motor with suitable coupling.
2.3.7	Gear Unit : Helical / bevel helical
2.3.8	Brake : Electro-Hydraulic Thruster (if applicable)
2.3.9	Skirt Board
	a) for Boom conveyor : Lifiable at head/tail end.
2.3.10	Type of Take up arrangement : Screw
2.4.0	Slewing Mechanism
2.4.1	Drive : Pinion driven by hydraulic drive (with or without gear box) Or Pinion driven by Squirrel cage induction motor with gear unit & suitable coupling.
2.4.2	Drive Mechanism : Gear rim mounted with under frame
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	
TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	
SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant	
Page 62 of 122	

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.4.3	Bearing	:	Ring type roller bearing/Ball Roller combination type	
2.4.4	Brakes	:	Electro-hydraulic thrustor operated (for electric drive only). For hydraulic motor the brake shall be integral to the system.	
2.5.0	Luffing Mechanism			
2.5.1	Drive	:	Hydraulic pumps & cylinders.	
2.5.2	Protection	:	Against undue differential pressure	
2.5.3	Hinge point bearings	:	Life lubricated antifriction bearings.	
2.5.4	Bearing life to be considered	:	25 years with 10 hrs/day operation.	
2.6.0	Operators Cabin			
2.6.1	Construction	:	Dustproof & Air conditioned	
2.6.2	Inside Temperature	:	27°C	
2.6.3	Doors	:	Hydraulic door closers	
2.6.4	Level Maintaining Mechanism.	:	Hydraulic type.	
2.7.0	Material for chutes and hoppers	:	10 mm thk S.S. liner for cylindrical portion of central hopper/chute. For other locations, as specified in the relevant section for chutes & hoppers.	
2.8.0	Walkways on the tripper	:	Both sides, 800 mm wide each	

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	DATA SHEET: DUST CONTROL & MISCELLANEOUS SYSTEM			
1.0.0	GENERAL			
1.1.0	Dust Control	Dust suppression/ extraction system		
1.2.0	Miscellaneous systems	Service water system, Potable water system, Cooling water system & Sump pumps.		
2.0.0	DESIGN REQUIREMENT			
2.1.0	Dust Suppression			
2.1.1	Operation	Water sprayed through nozzles.		
2.1.2	Pumps	2x100% for water		
2.1.3	Spray Head			
	(i) Minimum No. of nozzles per spray head	4 (Four)		
	(ii) Pressure at inlet (dry fog)	Min. 0.5 kg/cm ² for water		
		Min 5 kg/cm ² for air		
	Pressure at inlet (ultra fine fog)	Min 70 kg/cm ² for water		
	(iii) Pressure at inlet (Plain water)	Minimum 2.5 kg/sq. cm		
2.2.0	PLAIN WATER DUST SUPPRESSION			
2.2.1	Pumps	2x100% electric motor driven		
2.2.2	Minimum Pressure at inlet of spray nozzles	4.5 Kg/sq. cm		
2.2.3	Nozzle spacing	500 mm		
2.2.4	Nozzles	Fogging type (without air assisted)		
2.2.5	Flow from each nozzle	2.0 Lpm		
2.3.0	(A) Dry Fog Dust Suppression			
	(i) Compressor	Screw Type		
	(ii) No. of Compressors to be provided	One working & one Standby, per group		
	(iii) Air receivers	One no. of min. 2 cu.m capacity located near compressors & 200 liters capacity at various location		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
				Page 64 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	(iv) Nozzles Dry Fog type (B) Ultra fine (Cold Fog) Dust Suppression (I) High Pressure Pumps: Reciprocating Type (VFD driven) (ii) No. of Pumps to be provided: One working & one Standby, per group. (iii) Water Pipelines: Shall consist of SS-316/304 seamless tubes with Pressure rating of min 2.5 times to the max operating pressure. (iv) Nozzles: Ultra fine spray (Cold fog) type with SS 316 body, orifice shall be protected with anti-abrasive material 2.4.0 Coal Yard Dust Suppression 2.4.1 Pump 2 X 100% electric motor driven 2.4.2 Spray heads (i) Type Swiveling type spray unit (ii) Spacing 40 m. (iii) Minimum Pressure at inlet 4.5 Kg/sq.cm (iv) Flow from each sprinkler 500 LPM (v) Throw of sprinkler spray Suitable to cover entire stockpile surface as per tender drawing (vi) Material of construction: a) Nozzle SS-316L 2.5.0 Sumps Pumps (i) Type 2x100% electric motor driven (ii) Capacity 50 cub.m /hr minimum with 10% margin (iii) Head 20% margin on computed head 2.5.1 Drain Pits Minimum 2 x 2 x 1.8 mts. and 1 No. settling pit for slurry & high/low level switches in drain pit.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant	Page 65 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS		
2.5.2	Piping	To nearest plant drain	
2.6.0	Service Water System		
2.6.1	Water connections		
	(a) Conveyor Galleries and tunnels	every 50 m	
	(b) Transfer points & Drive house	Min. 1 no. at every floor	
	(c) Crusher House	Min. 2 nos. at every floor	
2.6.2	Connection details	32 NB plug valve	
2.7.0	Potable Water System		
2.7.1	Pumps	2 X 100% electric motor driven	
2.7.2	Water connections		
	a) Transfer points & Drive House	Minimum one (1) no. at each floor	
	(b) Crusher house	Minimum two (2) no. at each floor	
	(c) Tripper floor	Minimum one (1) no. at every tripper bay.	
	(d) Wagon tippler top	Not applicable.	
	(e) Control room	Minimum one (1) no. at each floor	
	(f) MCC rooms and toilets	Minimum one (1) no. each	
3.0.0	CONSTRUCTION REQUIREMENTS		
3.1.0	Water Supply Pumps for DS/SW/PW/CW		
3.1.1	Casing	Axial or radially split with drain & vent connection	
3.1.2	Impeller	One piece, keyed to shaft along with locking device	
3.1.3	Shaft	Critical speed at least 20% away from operating speed	
3.1.4	Shaft sleeves	At bearings & stuffing boxes.	
3.1.5	Bearings	Antifriction type	
3.1.6	Wearing rings	Renewable type (preferable)	
3.1.7	Pump speed	Below 1500 rpm for capacity more	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant Page 66 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS		
		than 10 cub. m/hr.	
3.1.8	Head flow characteristics	Suitable for parallel operation.	
3.1.9	Materials		
	(a) Casing	Cast Iron to IS:210, FG 260	
	(b) Impeller	Bronze conforming to Gr.I of IS:318	
	(c) Impeller Wearing ring	Bronze conforming to Gr.I of IS:318	
	(d) Casing Wearing ring	Bronze conforming to Gr.I of IS:318	
	(e) Shaft	Medium carbon steel	
	(f) Shaft sleeve	Stainless steel conforming to AISI-416 hardened.	
	(g) Gland packing	Impregnated teflon	
3.2.0	Sump Pumps		
3.2.1	Type	Wet pit type vertical shaft	
3.2.2	Duty	Capacity to handle large solids or unscreened liquid.	
3.2.3	Materials		
	(a) Casing and rotor housing	Ni-Cast Iron (350 BHN)	
	(b) Rotor	Ni-Cast Iron (350 BHN)	
	(c) Shaft	Medium carbon steel	
	(d) Gland	Bronze	
	(e) Wearing rings	Stainless steel	
	(f) Shaft enclosing tube	Carbon steel	
3.3.0	Pipings & Fittings		
3.3.1	Joints		
	(i) Pipe to pipe		
	Pipe size $\leq$ 50 NB	Socket welding/screwed	
	Pipe size $\geq$ 65 NB	Butt welding	
	(ii) Pipe to valves		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
			Page 67 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
3.3.2 3.3.3 3.3.4 3.3.5 3.3.6	Pipe size $\leq$ 50 NB	Screwed	
	Pipe size $\geq$ 65 NB	Flanged	
	Isolation of flow	Plug / Gate / Sluice valves	
	Regulation of flow	Globe Valve	
	Valves		
	(i) Size > 65 NB	Bolted bonnet outside screw rising type.	
	(iii) Size < 50 NB	Union bonnet with screwed ends for Globe valve & screwed ends for plug valve	
	Materials for Pipework		
	(a) For sizes 200 NB and Larger	ERW carbon steel pipes to API-5L-Gr.B/IS:3589 with minimum thickness 6.35 mm	
	(b) For sizes 150 NB to 65 NB	ERW carbon steel black pipes to IS:1239 (Part-Heavy class).	
	(c) For sizes below 65 NB	ERW carbon steel galvanized pipes to IS:1239 (Part-I) Heavy class.	
	Materials for Valves & Specialities		
	(a) Cast Iron Valves	65 NB and above	
	(i) Body and bonnet	Cast Iron to IS:210, Gr.FG-200	
	(ii) Disc for non- return	Cast Iron to IS:210, Gr.FG-200 valves	
	(iii) Seating surfaces and rings	13% chromium steel	
	(iv) Hinge pin for non return valves	Stainless steel type AISI-316	
	(v) Stem for gate and globe valves	13% chromium steel	
	(vi) Back seat bush	13% chromium steel	
	(a) Gun metal valves (50 NB & below and upto a working pressure of 10 kg/cm²)		
	(i) Body	Gun metal to IS:318, Gr-2.	
	(ii) Trim	Gun metal to IS:318, Gr-2.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant Page 68 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(b)	Duplex Strainer		
	(i)	Body	MS fabricated	
	(ii)	Strainer	Stainless steel type element AISI-316	
	(c)	Pressure Gauge/Switch (to be provided with isolating valves, gauge cock, snubber and syphon)		
	(i)	Dial size	150 mm	
	(ii)	Accuracy	(+/-) 1% of range span	
	(iii)	Bourdon	AISI 316 SS	
	(iv)	Block	AISI 316 SS	
	(v)	Movement	AISI 316 SS	
	(vi)	Case and Bezel	Die cast Alum. Weather proof case stove enameled block with screwed type inner bezel of ABS plastic and glycerin filled.	
	(vii)	No. of contacts	2 NO + 2 NC	
	(viii)	Type of contact	Adjustable throughout the range.	
	(ix)	Degree of protection	IP. 65	
	(d)	Solenoid valve (to be provided with isolating valve)		
	(i)	Type	2/2 way Diaphragm type pilot operated	
	(ii)	Diaphragm	molded synthetic rubber	
	(iii)	Body	Forged brass / SS	
	(iv)	Pressure	0.5 to 10 kg/cm2	
	(v)	Protection Class	IP 65	
	(e)	Flow Switch (to be provided with isolating valves)		
	(i)	Body	Forged steel	
	(ii)	Extension Rod/wire	SS-304	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
				Page 69 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	(iii) (iv) (v) (vi) (vii) (viii) (ix) (f) (i) (ii) (iii) (iv) (iv) (v) (vi) (viii) (g) (i) (ii) (iii) (aa) (bb) (cc) (dd) (h) Sleeve and Sleeve pipe Cover Max. working pressure Repeatability No. of contacts Type of contact Protection class Level Switch Type Displacer Wire rope Spring Housing Spring and sleeve pipe Cover No. of Contacts Type of Contact Protection class Level gauges Type Accuracy Material of construction Float & Guide wire Elbows Housing Cable fastener Plain water Dust Suppression Nozzles (except for Stockyard DS) SS-304 Die cast aluminum 10 kg/sq.cm ± 0.5% 2 NO + 2 NC Adjustable throughout the range. IP – 65 Displacer operated magnetic type SS – 316 SS – 316 SS – 316 Cast Aluminum 2 NO + 2 NC Adjustable throughout the range. IP – 65 Float type mechanical gauge with arrow scale (+/-)1% of full scale range 316 SS Suitable grade of SS Mild Steel SS 304 			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant Page 70 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	(i) Type	Fogging, non-clogging type	
	(ii) Material	Stainless Steel	
	(iii) Nozzle housing	To ensure protection of nozzle against damage.	
	(i) Y Strainer		
	(a) Body	SS 304	
	(b) Plug	SS 304	
	(c) Filter Element	SS 316, 60 mesh	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001 SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant Page 71 of 122			

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	<u>DATA SHEET: BELT SCALE</u> 1.0.0 GENERAL 1.1.0 Ambient Temperature 50°C 1.2.0 Relative Humidity 100% 2.0.0 DESIGN & CONSTRUCTION 2.1.0 Type Electronic load cell type 2.2.0 Operation Microprocessor based fully automatic 2.3.0 No. of floating idlers Minimum four (4) 2.4.0 Load Cells 2.4.1 Type Strain gauge type hermetically sealed 2.4.2 Minimum Nos. As specified 2.4.3 Overload protection 100 % of rated belt scale capacity 2.4.4 Structural capacity 250 % of rated belt scale capacity 2.5.0 Flow Rate Indicator Electronic Digital Display Minimum 4 digits 2.6.0 Flow totalizer 8 digit display with reset facility. 2.7.0 Accuracy For entire range of 20% to 120% of rated capacity For S/R belt scale : Minimum $\pm 1\%$ For others : Minimum $\pm 0.25\%$ 2.8.0 Calibration 2.8.1 Automatic Zero & span calibration 2.8.2 Manual With test load chain (a) Test load chain length Two idler spaces more than weighing lengths (b) Chain reel equipment Complete with weight adding facility.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant	Page 72 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	<u>DATA SHEET: ILMS/SM</u> 1.0.0 GENERAL 1.1.0 Type In line or suspended magnet type as specified. 2.0.0 DESIGN & CONSTRUCTION 2.1.0 In-line Magnetic Separator / Suspended Magnet 2.1.1 (a) Location of ILMS Over discharge pulley. (b) Location of SM Over Conveyor (as per tender drawing) 2.1.2 Force index (As defined earlier) Minimum 100,000 2.1.3 Strength of magnet at the specified mounting height 1000 gauss. 2.1.4 Mounting height Mounting height of In Line Magnetic Separator and Suspended Magnet shall be 450 mm in the conveyors carrying uncrushed coal & 400 mm in the conveyors carrying crushed coal & biomass (between top of conveyor belt & surface of magnetic separator) 2.1.5 Magnetic Separator Belt (i) Drive Unit Adequately sized with 20% margin. (ii) Belting Suitable to withstand high temp. & impact of tramp iron. (FR Grade) (iii) Discharge Into Tramp iron chute. 2.2.0 Tramp Iron Items (i) MS cube of 20 mm size (ii) Brake shoe of Railway Wagon (Cast Iron 15 Kg.) (iii) MS plate of 250 x 250 x 100 mm size. (iv) Shovel Teeth and spikes. Material Carbon Steel Size Typical		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant	Page 73 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS				
2.3.0	(v)	MS round bar of 50 Kg with L/D ratio not exceeding 5.			
		Control			
		Inline Magnetic Separator / Suspended Magnet	Local and remote		
	2.4.0	Electric Supply 415V, 3 phase, 50 Hz input	Silicon Rectifier units		
	2.5.0	Location of silicon rectifier unit	Nearby control/MCC room		
2.6.0		Handling Arrangement for inline Magnetic separator/Suspended magnet			
	(a)	Height adjustment	With turn buckle arrangement		
	(b)	Cross-travel	Electric Hoist operated cross travel facility.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant	Page 74 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	<u>DATA SHEET: COAL SAMPLING UNIT</u> 1.0.0 GENERAL 1.1.0 Type Automatic 2.0.0 DESIGN & CONSTRUCTION 2.1.0 Codes & Standard IS: 16143 (Part 2 & 4) for Coal 2.2.0 Uncrushed feed coal size (-) 250 mm 2.3.0 Crushed feed coal size (-) 20 mm 3.0.0 CHUTES 3.3.1 Min. angle 60 deg 3.3.2 Cross section Square/rectangular with rounded corners. 3.3.3 Joints Bolted flanges with 6 mm thick standard grade neoprene gasket. 4.0.0 CRUSHER 4.4.1 Uncrushed (as received) feed coal size (-)250 mm 4.4.2 Crushed (as fired) feed coal size (-) 20 mm 4.4.3 Output size IS: 16143 (Part 2 & 4) for Coal 4.4.3 Stages of size reduction Single stage crushing 5.0.0 BELT FEEDER 5.5.1 Belt Flanged type, FR grade 5.5.2 Pulleys Rubber lagged head pulley 5.5.3 Drive Electric Motor			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant Page 76 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	<u>DATA SHEET: TRAVELLING TRIPPER</u> 1.0.0 GENERAL 1.1.0 Mobile Tripper Motor driven type rail mounted. 1.2.0 Bunker/Storage shed Sealing Arrangement Sealing belt type. 2.0.0 DESIGN & CONSTRUCTION 2.1.0 Mobile Tripper 2.1.1 Mounting Rail mounted on rails (90 lbs/yard) with double flanged wheels. 2.1.2 Drive Motor driven with suitable gearbox. Suitable for minimum 60 starts/hours. 2.1.3 Pulleys Head & Bend Pulleys As specified elsewhere 2.1.4 Brakes AC operated electro-hydraulic thruster type on either side of tripper. 2.1.5 Clamps Manual Rail clamps on either side of tripper. 2.1.6 Walkways Both sides of tripper, 800 mm wide each 2.2.0 Bunker Sealing Arrangement 2.2.1 Sealing Belt (a) No. of plies Minimum two (b) Thickness Top/Bottom cover 5 mm/5 mm (Fire Resistant) (c) Width At least 100 mm more than bunker/storage shed slot. 2.2.2 Guide Rollers As per requirements. 2.2.3 Bunker Slot (a) Width Shall be at least 100 mm more than the chute width of tripper at bunker feeding. (b) opening Cross bars over the slot 12 mm x 50 mm MS grating			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant Page 77 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	<u>DATA SHEET: ELEVATOR</u> 1.0.0 GENERAL 1.1.0 Type of Service Passenger-Cum-Goods 2.0.0 DESIGN & CONSTRUCTION 2.1.0 Carrying capacity 1088 Kg 2.2.0 Rated speed 1 mtr / sec. 2.3.0 Total Travel Shall be as per actual dimension of the Building 2.4.0 No. of floors to be served As per requirement 2.5.0 Entrance As per requirement 2.6.0 Method of control Variable voltage variable frequency (VVVF) 2.7.0 Position of M/c room Directly above lift shaft 2.8.0 Size of platform As per IS14665 & manufacturer's standard latest 2.9.0 Size of lift well As per IS14665 & manufacturer's standard latest. 2.10.0 Specification code As per IS: 14665 (5 parts) (Latest Edition) 2.11.0 Design seismic co-efficient According to the IS 1893-1977			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant Page 78 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	DATA SHEET: WAGON TIPPLER (SIDE DISCHARGE TYPE)			
1.0.0	GENERAL			
1.1.0	Wagon Type	:	Standard broad gauge, 4 axled wagons as per RDSO standard and design used by Indian Railways to move coal	
1.2.0	Moving Profile	:	As per IR norms.	
1.3.0	Rail Gauge	:	1676 mm.	
1.4.0	Weigh bridge	:	Load cell type	
1.5.0	Duty	:	Continuous 24 hrs.	
2.0.0	DESIGN & CONSTRUCTION			
2.1.0	Wagon Tippler Hopper			
2.1.1	Construction	:	RCC Construction.	
2.1.2	Size	:	250 Te	
2.1.3	No. of openings	:	One (1)	
2.1.4	Angle of repose of coal for wagon tippler hopper sizing	:	37°	
2.1.5	Lining	:	50 mm thick guniting.	
2.1.6	Steel Grating			
	(i) Mesh size	:	As per civil specification	
	(ii) Grating Section	:	As per civil specification	
2.2.0	Wagon Tippler			
2.2.1	Type	:	Side Discharge type	
2.2.2	Tipping angle	:	not more than160°	
2.2.3	Duty Requirement	:	Continuous operation	
2.2.4	Cradle	:	Heavy welded steel plate construction trunion mounted.	
2.2.5	Driving Gear			
	(i) Racks	:	Cast steel rack sections bolted to end sectors.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
Page 79 of 122				

CLAUSE NO.	TECHNICAL REQUIREMENTS 
2.2.6	(ii) Pinion : Multiple pinions meshing with rack. Rail Table : Rolled steel joints with steel rails mounted on it. 2.2.7 Drive : Direct Hydraulic Drive without gearbox 2.2.8 Brake : Integral with hydraulic drive 2.2.9 Clamping Top & side stops : Hydraulically operated
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001 SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant Page 80 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	DATA SHEET: SIDE ARM CHARGER			
1.0.0	GENERAL			
1.1.0	No. of wagons to be handled	:	59 (DFC 25)	
	By each side arm charger			
	at a time			
2.0.0	DESIGN & CONSTRUCTION REQUIREMENTS			
2.1.0	Arm	:	Robust construction either of cast steel or heavy duty fabricated steel.	
2.2.0	Arm Drive	:	Hydraulic cylinder	
2.3.0	Carriage Frame	:	Single fabrication assembly.	
2.4.0	Travel Carriage drive	:		
2.4.1	Motor	:	Direct Hydraulic Drive without gearbox.	
2.4.2	Travel brake	:	Integral part of hydraulic motor	
2.4.3	Bearings for sheaves	:	Anti friction bearings.	
	DATA SHEET: APRON FEEDER			
	Angle of Installation	:	Horizontal	
	Chain Link	:	Forged alloy Steel	
	Apron pan	:	MS fabricated with wear resistant plate or special alloy steel .	
	Traction wheel	:	Cast Steel	
	Rollers	:	Forged Alloy Steel	
	Drive	:	VVVF	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
Page 81 of 122				

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<u>DATA SHEET: EOT CRANE</u>		
	1	Number of crane required/ designation	Three (3)
	2	Location	Wagon Tippler
	3	Type of Crane required	Double girder EOT Crane
		Duty	Class: M5, Indoor [IS 3177 / IS:807]
	5	Mode of operation	Pendant Station [consists of push buttons housed in dust proof housing and suspended from hoist, movable on independent monorail]. To prevent pull on pendant, cable steel wire rope provided.
	6	Crane span/ Crane runway length /lift, m	To Suit. Bidder to furnish
	7	Capacity of Main Hoist (SWL)/ Aux. Hoist (SWL)	Min 20tonne/ 6.3tonne`
	8	Rated Speed [For any load from zero to SWL]	Main hoist - 3m/min Aux. hoist - 6m/min Trolley travel - 10m/min Bridge travel - 15m/min
	9	Design Temperature for Motors	50 degree C
	10	No. of Starts Per Hour	150
	11	Type of Main Hook	C-shank Type swiveling hook with locking device, Trapezoidal section
	12	Type of Auxiliary hook	Standard single swiveling type with locking device
	13	Wire rope/ Drum	IS:2266,6x36, steel core/ seamless pipe drum ASTM A106
	14	Crane Structure	Bridge Girders of box steel type steel fabricated construction. Full-length access platforms shall be provided on both sides of crane with walkways [IS:807/IS:3177/ IS:800]
	15	End carriage	Fabricated from rolled sections/plate box
	16	LT wheels	EN-8/ EN-9 forged steel, double flanged
	17	LT wheel bearings	Heavy duty sealed ball bearings
	18	Pinion/axles	En-9/16MnCr5, heat treated carbon alloy steel
19	Crane runway rails	Minimum CR-60	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
Page 82 of 122			

CLAUSE NO.	TECHNICAL REQUIREMENTS				
	20	Hoists	Generally conforming to IS:3938		
	21	Brakes	Hoist motion: Electrohydraulic thruster operated Cab travel: DC disc type Bridge travel: DC disc type		
	22	Control panel	Sheet metal clad in totally enclosed construction, IP-55 protection		
	23	Runway conductors (DSL)	MS angle ISA – 75x75x6 section		
	24	Control supply	240 V, single phase 50 HZ AC supply (necessary step - down transformer for control/ lighting/ space heater power supply required for crane shall be provided by contractor)		
	25	Safety	Electrical interlocking to be provided to avoid accidental simultaneous motions of crane due to activation of multiple push buttons at the same time.		
	26	Limit switches	Limit switches shall be provided against over hoisting/over lowering/over travel in cross and longitudinal direction.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE			TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant	Page 83 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<u>SYSTEM PARAMETERS AND OPERATION & CONTROL PHILOSOPHY</u>			
1.00.00	The specifications as brought out in various Sub-sections for mechanical equipment shall be applicable to the system of proposed Coal, Biomass, Limestone & Gypsum handling plant and specifically to all mechanical including their operation & control philosophy. However, some specific parameters of the entire system as a whole and the major equipment are brought out as below.			
2.00.00	PARAMETERS			
(a)	Maximum Belt Speed of Belt Feeders	:	(Approx) 1.5 m/sec.	
(b)	Maximum Belt speed of trough Conveyors (Coal):	3.4	m/sec.	
(c)	Maximum Belt speed of Biomass Conveyors	:	2.0 m/s	
2.01.01-(I)	Belting and Pulleys for Coal Handling system			
(a.)	Belt ratings shall be selected in such a way that there are only three (3) ratings for Nylon/Nylon belting and maximum two (2) ratings of steel cord belting. This however excludes sealing belt (for sealing slots of tripper floor) and belting of belt feeders. (Belting shall be completely interchangeable among same rating of belt.) Minimum number of plies for belting shall be four (4). Other details of belting shall be as specified elsewhere in the specification.			
(b.)	For Pulley, following minimum parameters shall be followed:			
(1.)	Shell thickness	:	20 mm (Min.)	
(2.)	End disc plate thickness	:	30 mm (Min.)	
(3.)	Maximum allowable deflection of shaft at hubs	:	5 Minutes	
(4.)	Diameter:			
(i)	All drive pulleys	:	800 dia (min.)	
		:	1000 dia(min.) for steel cord belt	
(ii)	All balance pulleys	:	630 dia (min)	
	Further approval from belt manufacturers shall be obtained by the contractor regarding the adequacy of the pulley diameters.			
	The maximum type of pulleys permitted based on pulley diameter and shaft diameter shall be limited to five (5). These shall comprise of two (2) nos. drive pulleys and three (3) nos. for all balance pulleys. Pulleys for Belt Feeder, fixed & travelling tripper, SS pulleys & Stacker Reclaimer pulleys are not included in the above categories.			
2.01.01-(II)	Belting and Pulleys for trough conveyors (Biomass application)			
	Belt ratings shall be selected in such a way that there is only one (1) rating for Nylon/Nylon belting. The minimum number of plies shall be three (3). Other details of belting shall be as specified elsewhere in the specification. This, however, excludes belting of belt feeders. Belting shall be completely interchangeable among same rating of belt.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
Page 84 of 122				

CLAUSE NO.	TECHNICAL REQUIREMENTS	
2.01.02	(a) For Pulley, following minimum parameters shall be followed: (1.) Maximum allowable deflection of shaft at hubs: 5 Minutes (2.) End disc plate thickness : 12 mm (min.) (3) Shell plate thickness : 12 mm (min.) (4.) Diameter: (i) All drive pulleys : 630 dia (min) (ii) All balance pulleys : 500 dia (min) Further approval from belt manufacturers shall be obtained by the contractor regarding the adequacy of the pulley diameters.	
	Dust Control System The capacity of the dust control system specified hereinafter is for Contractor's guidance only. Contractor shall provide adequately sized and fool proof dust control system, the performance of which should be guaranteed by the Contractor as required in the technical specifications. The performance guarantee test procedure is to be submitted by the Contractor. However, the capacity of the offered system shall not be less than the specified values below.	
	a) Dust Suppression System (Dry fog type/Cold fog type)	
	(1) Operation : Water & air sprayed by Fogging nozzle (Dry Fog) : Ultra fine spray of water by Fogging nozzle (Cold fog)	
	(2) Location of spray : At all coal discharge & receipt point on all transfer point & crusher. house	
	(3) Capacity & Pressure : 0.5 Kg/cm ² for water (min.) at inlet of spray head (Dry Fog) : 5.0 Kg/cm ² for air (min.) Pressure at inlet of : 70 Kg/cm ² for water (min.) spray head (Cold Fog)	
	b) Stockyard Dust Suppression System	
	(1) Maximum number of nozzles : Two (2) Nos. operating simultaneously	
	(2) Capacity & Pressure : 500 Lpm/4.5 kg. /sq. cm(g) of each spray nozzle	
	c) (i) Dust extraction system for Coal Crusher House	
Type : Venturi scrubber type Location : Belt feeder after crusher & Vibrating Feeder at crusher house of Coal		
	(ii) Dust Extraction system for Biomass Handling area Dust extraction System for biomass handling system shall be dry type comprising of dust collection hoods, ducting, fans, bag filter and duct collection hopper. The limestone dust	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
		Page 85 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	collected in dust collection hopper shall be periodically emptied back to the conveyor leaving the building.		
d)	Wagon Tippler (Plain water type) (1) Capacity of each nozzle : Minimum 2.0 lpm at 4.5 kg/ cm² (2) Nozzle spacing. : Maximum 500 mm (3) No. of dust suppression nozzles that can be operated simultaneously on both side of Hopper : minimum four (4) such zones (One zone means 20 mtr. Length of header on both sides)		
f)	Dust Suppression System (Plain water type) (1) Operation : Water sprayed with fogging nozzle (2) Location of spray : Paddle Feeder (trolley mounted)/External transfer Points/Gypsum storage area (3) Capacity / Pressure at inlet of spray head : 2.0 lpm / 2.5 kg/cm2		
2.01.02	Service Water System Service water connections are to be provided in conveyor galleries & tunnels at 50-meter interval and one (1) no. on each floor of Transfer Points, toilets and minimum two (2) nos. on each floor of crusher house. (a.) Flow at each valve : 5 cub.m/hr (b.) Minimum discharge Pressure at tap point : 2 kg/sq.cm (c) No. of valves operated simultaneously : 6 nos.		
2.01.03	Ventilation System A Mechanical Ventilation System i. Underground Areas : Minimum 15 supply air changes and minimum 7 exhaust air changes per hour. ii. Other Areas : Minimum 10 supply air changes per hour. B. Pressurized Ventilation System: Minimum 15 supply air changes per hour C. Air Conditioning System : Adequate number of air changes to Maintain in uniform temp. & humidity as specified elsewhere.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
			Page 86 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.01.04	Chutes for Coal Handling Minimum clear cross section of chute : 1800 mm x 1200 mm (inside both ways). As specified in equipment sizing criteria for specified belt width. Minimum clear cross section of discharge chute for stone picking : 750mm X 1000mm (inside both ways)			
2.01.05	Hoists Suitable hoists, as specified elsewhere shall be provided for erection & servicing of all major equipment. The equipment to be covered shall include (but not limit to) all conveyor drive units, all pulleys, crushers along with drive units, in line magnetic separators, sampling units, sump pumps, various DS/service water/potable water pumps, gravity take up units, suspended magnet, removal of equipment from tunnels, & underground building lifting of belt drum at all transfer houses/crusher house/bunker floors etc.			
3.0.00	OPERATION AND CONTROLS			
3.01.00	This section is intended to cover control/instrumentation and operational philosophy as specified hereinafter complete in all respects, required for complete coal and Biomass handling plant.			
3.2.00	General Requirements The instruments and controls to be furnished and erected under this specification are as required for safe and satisfactory operation of the Coal, Limestone & gypsum, Biomass Handling System, as outlined under mechanical section and as specified elsewhere in the specification. For the equipment and materials procured by the Contractor from his sub-vendors, the Contractor shall study the specification, safety requirements, interface drawings for such equipment and material in detail and shall coordinate his work with his sub vendors and DDCMIS system and supply instrumentation and control to suit the actual Coal, Biomass limestone & gypsum Handling equipment.			
3.2.1	Standards / Codes All construction, installation, workmanship, design & equipment shall conform to acts, rules & regulations of the jurisdiction within which the project is to be located, and to the current edition of the following or equivalent standards or codes, in so far as they apply: American Iron & Steel Institute (AISI) American Society for Mech. Engineers (ASME) American Society for Testing & Materials (ASTM) American Wire Gauge (AWG) Institute of Electrical & Electronic Engrs. (IEEE) Instrument society of America (ISA) National Electrical Code (NEC)			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
Page 87 of 122				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.03.00	National Electrical Manufacturers Association (NEMA)			
	United States of America standards (USAS)			
	Bureau of Indian Standards (BIS)			
	Conveyor Equipment Manufacturers Association (CEMA)			
	This Sub-section shall be read in conjunction with Electrical and C&I Sub-sections.			
3.04.00	General Construction and Design			
3.04.01	General Construction			
3.04.02	Control desks/panels and annunciation system shall be as per the requirement of electrical Section. Annunciations, indications, electrical meters, and instrumentation shall be provided as specified.			
	Design			
	The complete coal, Biomass handling plant except for stacker-reclaimer shall be controlled from DDCMIS system as detailed elsewhere.			
	The Contractor shall provide a comprehensive control indication and annunciation scheme. The contractor shall furnish a block diagram and write-up on the scheme proposed. The final scheme will be approved by the Employer. In general, interlocking shall be achieved through feedback signals from field equipment. A comprehensive annunciation and indication scheme shall be provided such that it will be possible for the operator to locate and identify the fault from the face of DDCMIS/LVS/Control-Panel/ TFT itself. The scheme shall include the basic remote-control instrumentation, indication and annunciation requirements as per various technical specification requirements.			
	However, the Contractor may offer any alternative proposal which he considers to be equal, superior to the scheme as described in subsequent clauses below for achieving reliable and trouble-free operation of the plant, for consideration of the employer.			
4.00.00	OPERATION AND CONTROL PHILOSOPHY			
4.01.00	The coal, Biomass handling system shall be controlled from the following control points.			
	Coal Handling Plant Main Control Room			
	Overall, operation of the following equipment of Coal, biomass shall be controlled from the main CHP control room as specified in C&I sections.			
	Overall, operation of the following equipment of Coal, Biomass Handling Plant shall be controlled from CHP DDCMIS located at main CHP control room.			
	a)	Conveyors, feeders, flap gates, R & P gates, crushers, hydraulic scoop couplings.		
	b)	Complete Dust Suppression system, service water system, cooling water system & potable water system.		
	c)	Ventilation system (group/individual control as required).		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
				Page 88 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.02.00	d)	In line Magnetic separators and Suspended Magnet (ON/OFF control with indication).		
	e)	Metal Detectors (ON/OFF control with indication).		
	f)	Coal Sampling Units.		
	g)	Belt weigher (ON/OFF control with indication)		
	h)	Stacker Reclaimer (ON/OFF status with stop facilities).		
	i)	Mobile trippers over bunkers (tripper position indications).		
	j)	Dribble conveyor (indication only).		
	k)	Apron feeder		
	Local Control Panels			
	Local control stations for following equipment's shall be provided			
a)	Mobile trippers over bunkers			
b)	Belt Weighers			
c)	Metal detectors			
d)	Electric hoist - wall mounted control box with pendent push button controls.			
e)	In line magnetic separators			
f)	Suspended Magnet			
g)	Sump Pump			
h)	Coal Sampling Units			
i)	Dust suppression system for wagon unloading at wagon tippler.			
j)	Hydraulic scoop coupling.			
4.03.01	All the above local control panels shall be accessible and located near their respective equipment and shall be complete with all the required controls, interlocks, annunciation's etc. However, for items (h) (i), and (j) above, controls shall be through Employer's DDCMIS/PLC as applicable. Further, necessary controls, indications and annunciations for all the above equipment shall also be provided at main CHP Control Room as described under relevant clause.			
	Stacker Reclaimer Control			
The entire control & operation of Stacker Reclaimer machine shall be from the operator's cabin on the machine itself. A flat TFT monitor shall be provided at the Control desk of the operator's caption.				
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
Page 89 of 122				

CLAUSE NO.	TECHNICAL REQUIREMENTS	
4.04.00	In addition to the remote control of various equipment, local stop push button stations shall be provided for all equipment.	
4.05.00	System Operation	
4.05.01.1	Operation philosophy of the plant, in general, shall be as elaborated below: Coal flow path selection shall be done from CRT/Keyboard to select any one of the following conveying paths. (1) Wagon Tippler to stockyard (2) Wagon Tippler to boiler bunker (1.) Stock yard to boiler bunkers (3) Stockyard or WT to boiler bunkers for blending (4) Combination of above The coal handling system operator will select any one of the above paths from OWS located on the main control desk. The flow stream path is then selected by positioning different flap gates/ movable discharge pulley at desired positions by means of keyboard available at the central control desk. Once the system is in operation, the gates/ movable discharge pulley cannot be moved from their positions and path. Flap gates which do not come in the stream in which coal flow is taking place, can be operated at any time. However, for the flap gates in bunker area conveyors, it shall be possible to change flap gate position while the conveyor is in operation and feeding coal using interlock bypass facility, provided that sequential permissive are available. The Control system will be designed for “Auto” & “Manual” operation of the conveyors in the selected path. Auto/Manual Selection shall be done from keyboard. Auto Mode: In the “Auto” mode, the conveyors and related equipment will start sequentially when the “System Start” is activated. During stopping, when the “System Stop” is activated, all conveyors will also stop sequentially (in the reverse sequence) allowing time delays for clearing the belts. Manual Mode: In Manual Mode, the operator will start the conveyor system, in the same sequence as in Auto mode from keyboard. The operator will also stop the conveyor system, by pressing "System stop" or individual “Stop” push buttons/command from keyboard in the reverse sequence. During “Sequence Start” in both Auto and Manual modes, first the required number of hooters (3 phase induction motor type) will be energized simultaneously for a pre-set time of 1 minute or so (adjustable at site) as per the program. After the pre-set time, the hooters will stop and a pre-set time of two minutes (adjustable at site) as per program will be allowed for the movement of the personnel and for the permissive of the conveyor system operation. This condition will be indicated on the panel by glowing of lamp “Coal Handling Sequence Start”. The starting permissive will be available for a period of 5 minutes (Pre-programmed and adjustable in the field). In the event the last conveyor / equipment is not started within this pre-set time of 5 minutes, the start command for equipment not started will be withdrawn. The system cannot be started again unless the “Sequence Start” push button is	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001
SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant		Page 90 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.06.00	again pressed and the hooters sound again, as described before. Those conveyors and equipment, which have already started, will continue to run. The status indication in the graphic display against all conveyors and equipment in the selected path/stream will start slow flickering. However, all status indications against all flap gates / movable discharge pulley in the selected path will glow steadily. Therefore, from the selected flow stream path of the flap gates / movable discharge pulley (if applicable), the operator will come to know the conveyors and equipment to be started for the selected path/stream. After a conveyor/equipment is started, the status indications against that conveyor / equipment will change to steady glow indicating that it is running. Graphic display status indicators associated with a particular motor/equipment shall flicker fast in case of fault / trip. In addition, emergency stop push button on the control desk for immediate shut down of complete plant shall be provided. For changeover of feed from one row of Bunkers to another row of Bunkers without stopping of the CHP, provision shall be made for interlock bypass on the control desk for flap gates of all conveyors in Boiler area for a pre-set period. If the changeover, in the above specified time, is not completed then the entire CHP shall stop. (i) Lamp test facilities will be provided for the annunciation and mimic lamps.			
	Conveyor System			
	(a)	Normally the operation of the apron feeders feeding coal from the wagon Tippler hopper to the coal conveyor shall be controlled from wagon tippler control room and also from main control room.		
	(b)	Approach of a Railway wagon rake to the plant shall be signalled (visual and audible) in Wagon tippler Control room as well as to the main coal handling plant control room, as soon as the rake come within 100 meters distances from the Wagon tippler. Provision shall be made for the same by the Contractor in control desk.		
	(c)	Each conveyor shall be protected against damage to the edge of the belt due to excessive sideways movement by providing an adequate number of belt sway switches. In addition, each conveyor shall be provided with one (1) No. speed detection device (zero speed switch). The zero speed switches shall be designed to sense belt speed. In case of speed of belt goes below 85% of rated speed, it shall trip the conveyor.		
	(d)	All the conveyors shall be protected from reverse running due to power failure by providing mechanical or electrical locking system.		
	(e)	The starting sequence of the conveyors shall follow a direction opposite to that of flow of material i.e. :		
	(1.)	In case of direct conveying of coal to boiler bunkers, start from bunker conveyor and end up with reclaim conveyors below Wagon Tippler.		
	(2.)	In case of direct conveying of coal to boiler bunkers, start from bunker and end up with conveyors below track hopper.		
	(3.)	In case of stacking of coal in stock yard, start from yard conveyor and end up with reclaim conveyors below wagon tippler hopper. However, for yard conveyor to start, the stacker-cum-reclaimer shall be in operation.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
Page 91 of 122				

CLAUSE NO.	TECHNICAL REQUIREMENTS	
(4.)	In case of stacking of coal in stock yard, start from yard conveyor and end up with reclaim conveyors below track hopper.	
(5.)	In case of reclamation of coal from stock yard, start from bunker conveyors and end up with yard conveyor along with Stacker/ Reclaimer.	
(6.)	The starting of apron feeders and wagon trippers shall be interlocked with operation of the reclaim conveyors below wagon tippler hopper.	
(7.)	The starting of mobile trippers shall be interlocked with operation of the bunker bay conveyors.	
(8.)	Inter locking of yard conveyor with stacker-cum-reclaimer boom conveyor shall be provided.	
(9.)	Any individual equipment (belt conveyor etc.) should not be allowed to start unless the equipment immediately following the same in the direction of flow of material is already in operation.	
(10.)	Stop/tripping of any equipment from running condition shall trip all preceding equipment in the system, except crushers but shall not effect succeeding ones which shall continue to operate.	
(11.)	Adequate number of pull-cord switches shall be provided at suitable intervals along the length of each belt conveyor, which shall enable the respective conveyor to be stopped immediately. Each pull chord switch shall be identified by a specific number on HMI in the main control room. Each belt sway switch shall also be identified by a specific number on HMI in control room.	
(f)	Means shall be provided to pre-warn personnel working nearby when starting any conveyor, stacker-cum-reclaimer, reclaimer, wagon tippler and mobile tripper.	
(g)	Interlocking of various conveyors shall be achieved with Flap Gate, discharge pulleys, Rack & Pinion gate, limit switches and zero speed switches.	
(h)	Suitable indication for paddle wheel rpm shall be provided on the local panels. Manual facility to control the cutting rate of paddle feeder shall also be provided.	
(i)	Motors shall start only when the brake/rail clamp if-provided, is in "not applied" condition. This signal shall be obtained from limit switch provided for that purpose.	
(j)	Ring granulators shall be provided with speed and vibration monitoring instruments. Ring granulators shall trip in case speed/ vibration is going beyond tolerable limits of design. Temperature sensing devices shall be installed on all bearings of each of the ring granulator to trip the ring granulator in case of temperature goes beyond limit. Audio-visual annunciation shall be provided in main control room and locally also.	
(k)	Once a conveyor trips, flap gate directing coal from this conveyor shall change over its position with a time delay and shall come back to the original position again. This is to prevent jamming of gate.	
(l)	Tripping of the respective conveyor shall be provided in case any of paddle feeders and mobile trippers starts running along with conveyor belt at speed higher than their rated speed by providing an over speed sensing device on the equipment.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001
SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant		Page 92 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS				
4.07.00	(m)	It shall be possible to trip bunker conveyor from mobile tripper, yard conveyor from stacker & reclaimers respectively.			
	(n)	Where ever scoop type coupling provided for HT motors, the coasting time of respective conveyor, thrustor brake, actuator selection and the chute size and skirt size shall be so selected such that there is no spillage of coal from any downstream conveyors during next start.			
	(u)	Wherever the conveyor/belt feeder is provided with the movable discharge pulleys in place of flap gates, the starting of the conveyor/belt feeder will be interlocked with the position of the movable discharge pulley.			
	(v)	Control System shall envisage bending of coal. For this bending can be considered by suitably mixing coal from reclaim path & direct path (wagon tippler).			
	(w)	Coal flow rate and coal integrator readings of belt scales shall be replaced at stacker reclaimers & wagon tipplers control room for blending.			
	Interlocking				
	(a.)	The following conveyors / equipment will come under interlock scheme :-			
	(1)	All conveyors			
	(2)	All flap gates			
	(3)	Belt feeders/pulleys			
	(4)	Rack & Pinion Gates			
	(5)	Metal detectors			
	(6)	Magnetic Separators and suspended Magnet			
	(7)	Crushers			
	(9)	Belt scale			
	(10)	Mobile Trippers			
	(11)	Stacker-cum-Reclaimer			
(12)	Wagon tipplers				
(13)	Apron feeders & dribble Conveyors				
(14)	Belt feeder/Chain feeder				
(15)	Paddle feeder (As applicable)				
(16)	Bucket Elevator				
(17)	BRU/Surface Feeder/Truck Unloading etc.				
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant	
Page 93 of 122					

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(b.) The following equipment will not come under interlock of the conveyor scheme. (1.) All dust suppression systems & service water system. (2.) Ventilation systems (c.) All conveyors and equipment will have local push button stations each consisting of : (1.) Pos - I, Pos - II & stop button for flap gate and R & P gate (2.) Emergency stop push button (Red) for other equipment (d.) Belt scale shall be started when relevant conveyors are started. (e.) The dust suppression systems will be energized as soon as the conveyors are energized. (f.) Coal & Biomass handling plant shall be tripped in case of detection of fire. (g.) Interlock for H.T. Motor : H.T. motors used will continue to run on no load by disengaging the fluid coupling in case of failure of any process interlock. The H.T. motors will however be tripped in case of any motor fault like O/L, high motor winding temperature etc. In addition, in case of normal stop command, after running of the system, motors will stop. (h.) The following are the various safety interlocks for the conveyors and other equipment. This list is indicative only and the Contractor shall develop a comprehensive interlocking scheme.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant	Page 94 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Conveyors a). Pull - Chord switch - not operated b). Belt sway switch - not operated c). Under speed switch - closed at 90% speed of the conveyor within designed accelerating time. d). Motor protection - not tripped e). Local stop PB – reset f). Chute Block switch - not operated. g). Brakes for conveyor – not operated. h). Trip circuits healthy. i). Temp. of fluid coupling oil - not high Travelling Tripper a). Stop PB in Local control station - reset b). Motor O/L not tripped. c). Over Travel Limit switches - not tripped. Magnetic Separators / Metal Detectors / Suspended Magnets a). O/L / fault relay - not tripped. b). Stop PB (Local & Remote) reset. c). Metal detector reset d). Oil temperature - not high Flap Gates/ R & P Gates: a). End of travel limit switches - reset. b). Torque limit switches - reset. c). Local stop - reset.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
Page 95 of 122				

CLAUSE NO.	TECHNICAL REQUIREMENTS				
4.07.01	Ring Granulator				
	a).	Zero speed - not operated			
	b).	Temp. of fluid coupling oil - not high.			
	c).	Local stop push button reset.			
	d).	Temperature of bearings – not high.			
	e).	Cooling water flow switch – reset			
	Wagon tippler				
	a)	Motor O/L – not tripped			
	b)	Local E-Shop PB-reset			
	c)	Shop PB in main CHP Control Room reset.			
4.07.02	d)	All limit switches - reset			
	e)	All limit Switches – not tripped.			
	Apron feeder				
	a)	Motor O/L – not tripped.			
	b)	Local stop PB – rest			
	c)	Dribble Conveyor – not tripped.			
	The lists of indications and audio-visual annunciation given in subsequent clauses are indicative only and the same shall be finalized during detail engineering.				
	Status indications in Large Video Screen				
	Following individual status indications shall be provided in LVS with individual ON/OFF/TRIP indications on CRT.				
	(a.)	Conveyor 'ON'			
4.07.03	(b.)	Flap Gate/Rack and Pinion.			
	(c.)	Belt scale flow rate indication and totalizer.			
	(d.)	Belt sway switch operated for each conveyor (individual switch indication on CRT).			
	(e.)	Pull cord switch operated for each conveyor (Individual switches indication on CRT).			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant	Page 96 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS			
(f.) (g.) (h.) (i.) (j.) (k.) (l.) (m.) (n.) (o.) 4.08.00	Zero speed switch operated for each conveyor			
	Not Used			
	Travelling tripper position.			
	Crusher ON			
	MD/ ILMS/ SM/ CSU ON			
	DS/ SW/PW/CW/DE/ Vent ON (System wise)			
	Stacker-cum-reclaimer / Reclaimer ON (any travel position)/stacking/reclaiming			
	Unit wise MW indication, total coal flow & Bunker level.			
	Wagon Tippler– ON			
	Apron feeder - ON			
Further Mimic lamps for HT and LT SLDs shall be provided on the control desk.				
Annunciation System:				
DDCMIS/Control desk shall be provided with adequate number of facia type annunciation windows operating through DDCMIS for the following audio-visual fault annunciation purposes.				
Wherever group annunciation is provided, alarm status of individual equipment shall be provided on OWS.				
(a) 3.3 kV Breaker Trip (Group wise for each board)				
(b) 415 V MCC Breaker Trip (MCC wise)				
(c) Bus under voltage for each LT MCC & HT switchgear buses.				
(d) Following group wise annunciation shall be provided for transformers :				
(1.) Buchholz alarm				
(2.) Winding/oil temperature high alarm				
(3.) Oil level low alarm				
(4.) Buchholz trip				
(5.) Winding/oil temperature high trip				
(e) A.C Control Supply failure.				
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
				Page 97 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	(f) D.C. Control Supply failure. (g) Annunciation supply failure. (h) Both CPU fail (i) Stand by CPU in service (j) H.T. motor overload alarm (individual) (k) HT motor bearing/ winding temp. high alarm (group) and trip (group) (l) HT motor trip on electrical fault (Group) (m) LT motor overload tripped (Group). (n) Crusher vibration monitor alarm (Group). (o) Belt sway switch operated (Group) (p) Pull cord switch operated (Group) (q) Zero speed switch operated. (Group) (r) Chute plugged (Group) (s) Wagon rake arrived. (t) Tripper over speed tripped (group) (u) Stacker-reclaimer / reclaimer tripped (group) (v) Magnetic separator fault and cleaning belt trip. (w) (i) Metal Detector fault (Group) (ii) Metal detected / MD not reset (Group) (x) Belt Scale fault (Group) (y) Sampling system faults and trips (Group) (ab) Dust suppression/service water system faults and trips (system wise) (ac) Water level low in tanks (group) (ad) Oil temperature of fluid coupling high (ae) Crusher low speed & crusher bearing temperature – high. (af) Wagon tippler tripped (group) (ag) Apron feeder tripped	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
		Page 98 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS																																				
	(ah) 20% spare window For identification of the fault for a particular conveyor or equipment, status indication against that conveyor / equipment in the mimic will start fast flickering and the annunciation window will be blinking against that particular fault. In addition, a buzzer (alarm) will start sounding. After acknowledgement of the fault, the buzzer will stop, but the fast flickering on the mimic and the steady glow on the annunciation window will continue until the fault is cleared and the Reset push button is pressed. When the fault is cleared and the Reset push button is pressed, the status indication of that conveyor / equipment on the mimic will start slow blinking if it is on selected path otherwise it will go off and the steady glow in the annunciation window will go off. However, pressing of the Reset push button before clearance of the fault, will have no effect on the lamps. At the time of a fault, the faulty conveyor / equipment, as well as the preceding conveyors / equipment in the interlock sequence, will stop except H.T. motors for which only scoop coupling will be disengaged and motor will continue to run for process fault. In case of motor fault, H.T. motor will trip but the succeeding conveyors / equipment will continue to run. The status indication against the preceding conveyors / equipment will start slow blinking while the faulty conveyor / equipment will be fast blinking. Start command shall not be initiated unless reset button in pressed after clearance of fault. The sequence of operation of the annunciation system shall be as follows: - <table><tr><th colspan="2">CONDITION</th><th>STATUS</th></tr><tr><td rowspan="4">Normal :</td><td>Ann. Window</td><td>Off.</td></tr><tr><td>Status indication</td><td>Steady glow</td></tr><tr><td>Buzzer</td><td>Off.</td></tr><tr><td>Ann. Window</td><td>Blinking.</td></tr><tr><td rowspan="4">Fault :</td><td>Status indication</td><td>Fast blinking</td></tr><tr><td>Buzzer</td><td>Sounding.</td></tr><tr><td>Ann. Window</td><td>Steady glow.</td></tr><tr><td>Status indication</td><td>Fast blinking</td></tr><tr><td rowspan="2">Press Accept. PB.</td><td>Buzzer</td><td>Off.</td></tr><tr><td>Status indication</td><td>Fast blinking</td></tr><tr><td rowspan="4">Press Reset PB (When Fault is cleared):</td><td>Ann. Window</td><td>Off.</td></tr><tr><td>Status indication</td><td>i) Steady blinking (if on selected path)</td></tr><tr><td>Buzzer.</td><td>ii) Off (if not on selected path)</td></tr><tr><td></td><td>Off.</td></tr></table>	CONDITION		STATUS	Normal :	Ann. Window	Off.	Status indication	Steady glow	Buzzer	Off.	Ann. Window	Blinking.	Fault :	Status indication	Fast blinking	Buzzer	Sounding.	Ann. Window	Steady glow.	Status indication	Fast blinking	Press Accept. PB.	Buzzer	Off.	Status indication	Fast blinking	Press Reset PB (When Fault is cleared):	Ann. Window	Off.	Status indication	i) Steady blinking (if on selected path)	Buzzer.	ii) Off (if not on selected path)		Off.	
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant																																			
		Page 99 of 122																																			

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.09.00	Dust Suppression System			
(a.)	Conveyors / Equipment			
(1.)	It shall be possible to operate the dry fog/Cold Fog/Plain water dust suppression system on to coal stream only when corresponding conveyors/equipment are running with material at spray application points.			
(2.)	If a running pump trips stand-by pump shall start automatically. It shall be possible to select any of the pumps as auto standby from main CHP control room.			
(3.)	Pump/pumps shall trip with a time delay, if discharge valves fail to open. Suitable pressure/flow switch shall be provided to sense this condition.			
(4.)	Pumps shall trip in case of low level of water in tank.			
(5.)	All feeding pumps to tank shall trip in case of high pressure & no flow by pressure switch.			
(6.)	Motorized inlet valve to Dust Suppression tanks shall close in case of High-High level & open in case of low level.			
(7.)	Pumps shall be started manually or from DDCMIS. If any of the pump/pumps trips, stand-by pump/pumps shall start automatically. It shall be possible to select any of the pumps as auto stand - by.			
(8.)	Following annunciation's shall be provided at local control panel.			
(i)	Motor electrical protection operated (Group)			
(ii)	Discharge water pressure low (Group)			
(iii)	Water level low in tank (Individual)			
(9.)	Following individual indications shall be provided at local control panel.			
(i)	Motor ON/OFF/TRIP			
(ii)	Discharge pressure healthy			
(v)	Water level high in tank.			
(10.)	Pumps shall be started manually or from DDCMIS. If any of the pump/pumps trips, stand-by pump/pumps shall start automatically. It shall be possible to select any of the pumps as auto stand - by.			
(11.)	Pumps shall trip in case of low level of water in tank.			
(12.)	Following annunciation's shall be provided at local control panel.			
(j)	Motor electrical protection operated (Group)			
(ii)	Discharge water pressure low (Group)			
(iii)	Water level low in tank (Individual)			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
Page 100 of 122				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
(13.)	The following individual indications shall be provided at local control panel.			
(i)	Motor ON/OFF/TRIP			
(ii)	Discharge pressure healthy			
(iii)	Water level high in tank.			
(c)	Stock yard Dust suppression system			
(1.)	Water supply pumps shall be started in Manual mode from Main CHP control room. Controls shall be through DDCMIS.			
(2.)	If any of the running pump/ pumps trip, standby pump/ pumps shall start automatically (pressure switch signal shall not be used for this purpose).			
(3.)	Pumps shall trip in case of low level of water in tank.			
(4.)	All feeding pumps to tank shall trip in case of high level in tank			
(d)	Wagon unloading (At Wagon Tippler Hopper)			
(1.)	System shall be operated from local control panel. However, the controls shall be through DDCMIS.			
(2.)	Dust suppression shall be provided to cover W.T. hopper. Push button shall be located at convenient location.			
(3.)	Pumps shall be started manually or from DDCMIS. If any of the pump/pumps trips, stand-by pump/pumps shall start automatically. It shall be possible to select any of the pumps as auto stand - by.			
(4.)	Pumps shall trip in case of low level of water in tank.			
(5.)	Following annunciation's shall be provided at local control panel.			
(i)	Motor electrical protection operated (Group)			
(ii)	Discharge water pressure low (Group)			
(ii)	Water level low in tank (Individual)			
(6.)	Following individual indications shall be provided at local control panel.			
(i)	Motor ON/OFF/TRIP			
(ii)	Discharge pressure healthy			
(iii)	Water level high in tank.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
Page 101 of 122				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.10.00	Metal detectors			
(a)	It shall be possible to start the conveyors only after energizing the metal detector and ‘Metal detector reset’ condition. Once the metal is detected, the corresponding conveyor shall trip.			
	It shall be possible to restart the conveyors, after local resetting of metal detector and putting back the marker bag in position. Metal detector ON/OFF push buttons shall be provided in main control room also.			
(b)	In case of tripping of conveyor system, metal-detector shall get de-energized after a time lag.			
(c)	Following individual indications shall be provided on local control panel.			
(1)	Metal detector ‘ON’			
(2)	Metal detected			
(3)	Metal detector ‘reset’.			
(4)	Metal detector faulty.			
4.11.00	Sump Pumps			
(a)	Sump Pumps shall start and stop by the level switches in the sump automatically. Further manual override start / stop push button shall be provided locally on ground level.			
(b)	Any of the pumps can be selected as auto-standby.			
(c)	If the sump level continues to be high even after the first pump is under operation second pump shall start automatically.			
(d)	The following indications for sump pumps shall be provided on local Control Panel.			
(1.)	Water level high			
(2.)	Motor ON/OFF/TRIP.			
4.12.00	Coal Sampling system			
(a)	Coal Sampling Unit shall be controlled through main coal handling plant DDCMIS. Controls and interlocks for proper material flow shall be provided similar to conveyor system. Mimic shall be provided in the Operator Work Station (OWS) at main CHP control room.			
(b)	Only one start/stop push button along with selector switches for various modes of operation of coal sampling system shall be provided for automatic operation of complete coal sampling system. This control facility shall be provided at main CHP control desk as well as locally. In any case, local push button stations shall be provided for all individual equipment of coal sampling system near the equipment.			
(c)	All necessary automatic controls shall be provided for meeting the requirements of IS: 16143 (Part 2) & IS: 16143 (Part 4).			
(d)	Following indications shall be provided on local control panel			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
Page 102 of 122				

CLAUSE NO.	TECHNICAL REQUIREMENTS	
(1.)	System ON/OFF/TRIP	
(2.)	Primary cutter stuck up between parking positions.	
(e)	In case of primary cutter getting stuck between parking positions, preceding conveyor shall trip and annunciation shall appear at Main CHP Control room.	
(f)	There shall be protection in the primary coal sampler to trip the conveyor belt in case primary sampler falls on running conveyor due to coupling failure etc.	
	Individual motor ON/OFF/TRIP indications shall be provided at main CHP control room.	
4.14.00	Travelling Trippers	
(a)	Mobile tripper unit shall be locally controlled from the operating platform suitably located with the unit as per instructions given from main CHP control room.	
(b)	End travel limit switches shall also be provided.	
(c)	Travel drive motor shall start only when brake and rail clamps are in disengaged condition.	
(d)	It shall be possible to trip the bunker Conveyors from tripper.	
(e)	When the last bunker is full, it shall not be possible to change over the tripper flap gate from bunker feeding position to last bunker feeding position.	
(f)	As soon as the bunker conveyor trips, tripper flap gate shall change over its position after a time lag.	
(g)	Two nos. emergency stop button one on each side shall be provided on tripper to stop the machine at any position. The control unit on tripper shall be provided with start / stop push button and indication lamp for travel / gate. The tripper brakes and rail clamps shall be energised (and released) when the tripper motors are ON and the brakes will be applied when the travel motors are OFF. Two travel limit switches shall be provided at either end of tripper carriage for limiting the travel drive between two ends of the track. The first one shall be normal limit and the second one for over travel limit. In addition to above, position indication for bunker position of tripper will be provided in Main control room. Necessary position encoders/limit switches shall be provided.	
(h)	Following individual indications shall be provided on local control panel	
(1.)	Motor ON/OFF/TRIP	
(2.)	Brakes applied	
(3.)	Rail clamps applied	
(4.)	Flap gate position	
(i)	Indication of tripper flap gate positions shall be given in the main CHP control room.	
(j)	It shall be possible for operator to manually trip the coal feeding eqpt. viz. stacker / reclaimers & Reclaimer from the tripper.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001
SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant		Page 103 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.19.0	Stacker/ Reclaimer & Reclaimer			
(a)	Stacker cum reclaimer shall be controlled from the operator's cabin in the machine through PLC system of stacker cum reclaimer & reclaimer shall be controlled from the operator's cabin in the machine through PLC system of reclaimer.			
(b)	Slew speed shall be controlled through Power transducers on Bucket wheel drive motor for uniform feeding. Setting of Power transducer shall be done from operators cabin.			
(c)	Slew reversal shall be automatic through			
(1.)	Power transducer on Bucket wheel and/or			
(2.)	Extreme end limit switches and/or			
(3.)	Manual command.			
(d)	At the end of Slew Pass Stacker - Cum - reclaimer & Reclaimer drive shall advance automatically to required depth of cut. Depth of cut shall be controlled through the setting of power transducer on Bucket wheel. It shall also be possible to set the depth of cut through a separate setting knob in operator cabin.			
(e)	All controls shall be based on feedback signals from field equipment.			
(f)	All electronic circuitry shall have self-diagnostic features.			
(g)	Operator's cabin shall maintain horizontal level automatically as per Boom Conveyor position.			
(h)	For all drives, zero speed shall be ensured before affecting reversal, by providing suitable speed sensing device.			
(i)	Motors shall start on when the Brake and/or rail clamp, is in "Not Applied condition". This signal shall be obtained from limit switch provided for that purpose.			
(j)	If wind velocity is high, it shall cut off power supply to stacker - cum-reclaimer & Reclaimer with a time delay, after giving sufficient time to operator to bring the Boom in minimum wind pressure direction/ position.			
(k)	All sequential interlocks for proper material flow shall be provided.			
(l)	It shall be possible to operate the lubrication system from operators cabin.			
(m)	Manual - Local. With the selector switch in this position all drive functions on the stacker - cum - reclaimer & Reclaimer can be operated by push buttons local to the drives. All other operation initiating devices shall be locked out.			
(n)	Manual – Remote Manual controls facility shall also be provided in control desk and keyboard (operator's cabin) as below:			
(1.)	Individual controls shall be provided for each equipment.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
Page 105 of 122				

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	(2.) Manual slew speed variation and depth of cut setting facilities shall be provided. (o) Following minimum audio-visual annunciation shall be provided through integral type annunciation system in operators cabin in stacker - reclaimer. & Reclaimer Annunciation system shall meet the requirements specified in the relevant electrical sections. (1.) Wind velocity high (2.) Lubrication system trouble for slew drive (3.) Lubrication system trouble for bucket wheel drive. (4.) Hoisting system trouble. (5.) Chute plugged (6.) Coal flow rate high (7.) Belt sway switch operated (8.) Zero speed switch operated (9.) Pull chord switch operated (10.) Motor electrical protection operated (Individual) (11.) For L.T. transformer Wind temp. high alarm and trip. (12.) LT breaker tripped (13.) HT switch tripped (14.) 20% spare windows. (15.) Rail clamps of stacker reclaimer /Reclaimer not engaged. (p) Following individual indications shall be provided in operator's cabin and CRT (1.) Motor ON / OFF / TRIP (2.) Control supply healthy (3.) All necessary position/motion/level indications (q) Ammeters shall be provided in control desk for all the motors. (r) Wind velocity indication shall be provided in operator's cabin. (s) Contractor shall provide a comprehensive interlock and protection scheme and include a block logic diagram and write up on the scheme proposed. The final scheme shall be subject to approval of Employer. Sequential interlocking as applicable shall be provided. This shall be a part of main interlock scheme /writeup for the entire Coal Handling Plant.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
		Page 106 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(t)	Boom conveyor shall be interlocked in such a way that it cannot start in reclaiming mode unless yard conveyor is running. In addition, yard conveyor would not start unless boom conveyor is running in stacking mode (with CHP in stacking mode). Following indications shall also be provided in operator's cabin.		
	(1.)	Boom conveyor stacking		
	(2.)	Boom conveyor reclaiming		
		For indications/interlocks indicated above, and for communication system between stacker/reclaimer and main control room, contractor shall provide all necessary control cables.		
	(u)	Boom conveyor of reclaimer for blending purpose shall be interlocked in such a way that it cannot start unless dedicated yard conveyor is running. Boom conveyor reclaiming indications shall also be provided in operator's cabin.		
		For indications/interlocks indicated above, and for communication system between reclaimer and main control room, contractor shall provide all necessary control cables		
	(v)	It shall be possible to trip reclaimer from main CHP control room also.		
	(w)	A push button shall be provided in operator's cabin to trip the dedicated yard conveyor.		
	4.20.00	Wagon Tippler		
		Wagon tippler/Twin Tippler shall be controlled from the local control panel suitably placed. Requirement of operation as described elsewhere in the specifications shall be complied with. Following indications shall also be provided on the local control panel:		
	(a)	Motor On/OFF		
	(b)	Motor O/L protection operated		
	(c)	Brakes applied (if provided)		
	(d)	Hydraulic power Pack indications as applicable.		
	(e)	Dribble Conveyor		
	Main Hydraulic pressure of champing drive system to be reduced to minimum through its control circuit during each tripping of main drive motor.			
4.21.00	Summary of control philosophy			
	Contractor shall furnish summary of control philosophy indicating permissive, trip and interlock conditions for each drive/equipment. It shall clearly list all permissive conditions (conditions required to start the drive), all the trip/protection conditions and each auto start/open and auto stop/close condition for each drive/equipment.			
	The sequential start-up and shut-down steps for a group of drive/equipments shall also be described clearly.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
Page 107 of 122				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	The above summary conditions shall be comprehensive to include all process conditions and shall be elaborated in clear and unambiguous way and shall include tag numbers of devices and equipments. A centralized main CHP control room (DDCIMS based) shall be provided to control and monitor the operations of the internal coal handling system and shall be linked to the control system of external coal handling plant. . Remote IO rooms adjacent to MCC's shall also be provided, which shall be finalised during detailed engineering. <u>Logic Diagram</u> The contractor shall furnish a comprehensive logic diagram showing all interlock, protection, sequence and alarm requirements of complete system to the employer during detail engineering stage. In this logic diagram, tag numbers corresponding to I/O list and drive list shall be clearly indicated. The format of this logic diagram shall be informed by employer during detail engineering. The recommended logic and write-up shall match fully			
4.22.00				
4.23.00				
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant	Page 108 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	A-01: SAFETY MODULE			
1.00.00	GENERAL			
1.01.00	All equipment furnished by the Contractor shall be complete in every respect, with all mountings, fittings, fixtures, and standard accessories normally provided with such equipment and/or those needed for erection, commissioning, and safe operation of the equipment and for the safety of the operating personnel, as required by applicable codes.			
1.02.00	CODES AND STANDARDS			
	Technical specification stipulates compliance to applicable statutory regulations and safety codes of India as well as of the locality where those will be installed. In particular, the CHP shall conform to the latest edition of the following standards.			
	▪ ASME B20.1 "Safety Standard for Conveyors and Related Equipment". ▪ ASME Standard B15.1 "Safety Standard for Mechanical Power Transmission Apparatus" ▪ IS:7155: Codes of Practice for Conveyor Safety. ▪ NTPC Safety Rules for Construction and Erection ▪ NTPC Safety Policy ▪ ISO 7149, "Continuous handling Equipment-Safety Code-Special Rule" ▪ CEMA Publication No. 201, "Safety Label Brochure"			
2.00.00	GENERAL SAFETY REQUIREMNT FOR COAL HANDLING PLANT			
2.01.00	CONVEYING SYSTEM			
	Belt conveyors' safety generally begins with sound design that, as far as is practical, avoids foreseeable dangers and hazards. Diligence in safety considerations must be applied during the course of design, engineering, manufacture, installation, and establishment of operation and maintenance policies and procedures. Important aspects of conveyor safety are elaborated as follows:			
2.01.01	Safety devices- Pull cord switches, belt sway switches, zero speed switches, and plugged chute switches are to be provided on conveyors to provide maximum protection to both personnel and equipment.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
Page 109 of 122				

CLAUSE NO.	TECHNICAL REQUIREMENTS	
2.01.02	Conveyor Take up- Two (2) meter safety fencing along with suitable gate and locking arrangement shall be provided around gravity take-up at the base level / ground level. In the case of double stream conveyors, a partition of 3.15 mm steel plate shall be provided between the two take-up pulleys along entire travel zone of take-up pulleys. Intermediate platforms shall be provided in the take-up zone for maintenance of take - up pulleys / counterweight.	
2.01.03	Pulleys- Suitable guards shall be provided for all tail pulleys and bend pulleys for the safety of operating personnel.	
2.01.04	Conveyor Bridges- Seal plates throughout the length of the conveyor gallery to be provided in such a way that complete gallery's bottom surface area forms a single waterproof floor, and no water / coal falls from conveyor gallery. Safety Handrails are to be provided all along walkways along with a toe guard. In case of conveyor angle is more than 10 deg, stepped walkways are to be provided along the conveyor.	
2.01.05	Fire Fighting- Structures and floors shall be so designed as to provide suitable space for routing of firefighting pipe with water, cables, and conduits. Firefighting arrangement is to be provided as specified elsewhere in technical specification. Fire escape provision along with cage ladder to be provided on each trestle.	
2.01.06	Movable discharge pulleys and movable belt feeders, wherever allowed- The complete discharge pulley movement area shall be covered with proper sealing arrangement. The discharge chute opening shall be provided with proper handrails for safety purposes. Suitable rotating strobe lights and sirens on mobile equipment shall be provided to warn personnel at the time of operation.	
2.01.07	Hooter alarm is to be activated before the start of conveyor/ equipment. The operating staff is cautioned and should stay away from the vicinity of conveyor. The beacon lamp is activated simultaneously with the starting of conveyor. The same is to be incorporated in control philosophy.	
2.01.08	All movable parts giving access through mechanical handling equipment shall be designed so that they cannot be opened whilst the equipment is working.	
2.01.09	All the lubrication points used frequently shall be accessible without it being necessary to remove the guards.	
2.01.10	It is recommended that equipment be so designed that cleaning is facilitated.	
2.01.11	Overhead gantry portion of road and rail crossings, walkways, galleries, workplaces under the overhead conveyors used by the personnel, shall be protected by means of suitable covering such as plates/steel sheet covers to prevent falling of the material/objects over such areas/personnel.	
2.01.12	Stone Picking Zone:- Proper platforms should be made for stone-pickers on either side of conveyor and they should use full body safety harness while performing this job. Minimum three persons per location shall be deployed in a row for effective and safe operation of stone picking. Arrangement of suitable lighting shall be provided at stone picking locations. Also, one pull cord switch/EPB must be provided in vicinity of each stone picker. Stones should be disposed off through specially fabricated chute openings below the walking platform.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001
		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
		Page 110 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	The stone disposing area below walking platform should be properly fenced.	
2.02.00	CHP/BHP BUILDINGS The design and construction of CHP Buildings shall comply with all the currently applicable statutes, regulations, and safety codes in the locality where the equipment is to be installed.	
2.02.01	All CHP buildings shall have sufficient space to accommodate all equipment and ample space shall be provided for maintenance purposes. The clear space around equipment to be maintained minimum 1200 mm for ease of maintenance and man movement safely.	
2.02.02	Openings in the floors of CHP buildings (i.e., TPs/CH etc.) shall be provided with curb of 100 mm high along with handrails for safety purposes.	
2.02.03	Necessary facilities for ventilation of tunnels, underground buildings, control/MCC rooms, WT control room and bunker bay should be provided as specified elsewhere.	
2.02.04	External fire escape staircase along with internal staircase shall be provided for all MCC/ control rooms & Crusher house. External staircases shall be provided for all transfer points. All buildings shall have fire protection provisions to meet TAC and IS – 3034 regulations.	
2.02.05	All stairs of over and underground portion of transfer houses & crusher house shall be of minimum 1200 mm wide and maximum rise should not be more than 180 mm with safety Handrails of 1500 mm all along the flight to protect fall protection. Numbers and arrangements (including enclosures etc.) of staircases shall be such as to meet the fire safety requirement as per guidelines of statutory regulatory bodies. Minimum headroom in all staircases and all levels shall be 2200 mm from floor finish level.	
2.02.06	Proper Access and approach for maintenance of all equipment to be provided. Clear headroom of 2200 mm on all maintenance platforms to be provided. Handrails are to be provided around maintenance platforms.	
2.02.07	Safety chain or handrails or side sheeting to be provided up to working safe level near Monorail doors at sides of Transfer towers/VGTU's.	
2.02.08	Monorail Hoist for handling of equipment weighing more than 500 kg is to be provided.	
2.03.00	WAGON TIPPLER & ASSOCIATED SYSTEM	
2.03.01	Safety requirement of Wagon Tipplers: Notwithstanding anything contained in various statutory regulations, safety requirement for tipplers, divided into the following stages, shall be followed:	
2.03.02	Construction stage:	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001
		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
		Page 111 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	The design of the tippler shall avoid as far as possible any spillage of the material handled by the wagons. Devices shall be built-in for spotting of wagons on the tippler table, so as to the discharge the material takes place in hoppers. Devices shall be built-in to prevent any overrunning of the wagons in either direction. The tippler shall be designed so that the wagon is securely held in all operating positions. i. Automatic devices shall be provided to hold the tipplers securely in any position in the event of failure of the drive unit. All tipplers shall have means to limit the angle of tipping. ii. Arrangement shall be made on tipplers to prevent feet being trapped between the platform and the base of the tippler. iii. Whenever possible, mechanical, or electrical devices shall be built-in to ensure that all the conditions allowing wagon tipping are coordinated. iv. Additionally, a device shall be provided to prevent an empty wagon from being released until the tippler is back in its original position. v. A device shall be provided to automatically detect and prevent the entry of a non-scheduled wagon and bulge scheduled Wagons into a tippler. vi. Sharp edges and corners in all working spaces shall be avoided. vii. The parts projecting into working spaces shall be as small as possible. viii. All the frequently used lubrication points shall be accessible without it being necessary to remove the guards. ix. It is recommended that equipment should be so designed that maintenance and cleaning is facilitated. x. Fully integrated controls should be provided for the wagon positioning system, wagon holding devices and wagon tippler. The controls should be interlocked so that there is no chance of accident due to error in sequence of operation.			
2.03.02	Installation stage All tippler installations shall be marked permanently and legibly in a clearly visible space, with the following information: a) Maximum capacity of the Wagons & the type of Wagons to be tipped. b) If locomotives are required to be run over the tippler, the maximum permissible mass, axle loading, height, and speed. c) Maximum speed of the wagon passing through the tippler.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
Page 112 of 122				

CLAUSE NO.		TECHNICAL REQUIREMENTS			
2.03.03	d)	An instruction forbidding the tippler to be operated as long as the wagon is not held on the platform in its tipping position. This instruction shall also state that the tippler shall be held in appropriate position before an attempt is made to remove the empty Wagon.			
	e)	All starting and stopping devices shall be clearly indicated and easily accessible and shall be painted or printed as a standard pattern.			
	f)	The emergency stop controls shall be provided adjacent to the wagon tipplers in the readily accessible positions.			
	g)	Gangways, handrails, staircases, ladders, guards, etc., wherever provided shall be erected before installation is put into service.			
	Wagons & Train holding devices (Safety devices)- Wheel grippers and wheel chockers are to be provided as specified elsewhere.				
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001		SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant	Page 113 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS		
2.03.04	Safe Positioning system for Wagons Wagon tippers shall be provided with a side arm charger for safe positioning of wagons on the tippler. The emergency stop controls for the Side Arm Charger shall be provided adjacent to the wagon de-coupling location with readily accessible approach.		
2.03.05	Wagon Tippler Wagon Tippler complex shall have following features w.r.t. safe operation of the Wagon Tippling system. - Safety guards shall be provided for all the movable parts. - Kerb wall with hand railing shall be provided around all openings. - Wagon Tippler; SAC operation shall be visible from the local WT control Room. For clear visibility proper, approachable cleaning access of the Glass from outside of the control room shall be provided. - Hooter shall be provided during tippling operation & SAC operation. - Adequate Space shall be provided for safe movement of Front Loader/Pay-loader above the Grating & around the Tippler complex for shifting of big size stone & boulders, for Side discharge type Tippler. Clear access shall be provided for movement of skid steer loader (BOBCAT/Equivalent) on the hopper grating of wagon tippers. Gratings over twin wagon tippler hopper shall be placed and designed accordingly. - Operation of front loader/Pay-loader shall be visible from WT control room. - Proper lighting shall be provided all along the Tippler area, including underground equipment. - A proper approach & clear space shall be provided for the operation & maintenance of Apron feeder area.		
2.03.06	It is recommended that equipment be designed so that cleaning is facilitated.		
2.05.00	STOCKYARD AREA		
2.05.01	Stacker Reclaimer: - Protective guards to be provided on all the drives. A maintenance platform to be provided for the drives with combination of handrail and dog chain all around it. The lowering and raising system shall be fitted with a safety device to prevent accidental lowering or lifting of the boom, and to prevent any collision of boom structure with the Stockpile.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
			Page 114 of 122

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	Operator's cabin to be located as to enable the operator to get clear vision of both sides of the track and the cutting of coal by buckets. The cabin shall be suitable for operation in monsoon and tropical conditions and the inside ambient temperature shall be maintained at 270C. For operation in winter/rainy conditions, fog lights, in addition to normal lighting, outside cabin for clear view of stockpiles from cabin to be provided. The cabin shall be provided with toughened glass with wipers and the arrangement shall be such that glasses can be cleaned from outside without any scaffolding, Cabin door shall be provided with hydraulic door closers. The cabin shall be kept in horizontal position through hydraulic cylinders irrespective of the angle of inclination of the boom conveyor.		
2.06.00	Tripper Floor		
2.06.01	Provision shall be kept for automatic tripping of bunker bay conveyor in the event of travelling tripper getting dragged (i.e., travel speed in excess of rated speed). Emergency push button to be provided on tripper floor.		
2.06.02	Wheels or rollers of travelling conveyors and of additional travelling equipment shall be guarded at points accessible to personnel under normal working conditions.		
2.06.03	Whenever an operator remains on the travelling equipment, a platform shall be provided and be so designed as to prevent any accidental contact with mobile components or any part of the fixed installation.		
2.06.04	When mobile appliances or equipment travel, warning devices, audio as well as visual, shall be provided.		
3.00.00	Safety Labels: Safety Labels and Placement Guidelines to be provided Prior to operating the conveyor or any of the associated accessories or equipment, all safety markings, guards, and warnings must be in place in accordance with governmental regulations and site-specific requirements. Some of safety labels are indicated below: To be placed on removable guards to warn that operation of the machinery with guards removed would expose chains, belts, gears, shafts, pulleys, couplings, etc. which create hazards  To be located on conveyors where there are exposed moving parts which must be unguarded to facilitate function, i.e. rollers, pulleys, shafts, chains, etc.  LOCATE ON INSPECTION DOOR (S)		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant	Page 115 of 122

CLAUSE NO.	Annexure to Wagon Tippler Stress Measurement System			
1.00.0	GENERAL 1.01.0 The Contractor shall be responsible for design, manufacture, engineering, material procurement, fabrication, programming, testing, packing, unloading, storage, shipping, installation & commissioning of a complete Wagon Tippler Stress Measurement system with all related services in accordance with intent and requirements of the specification. The Contractor shall provide all systems, equipment, accessories and associated equipment, which are included in Contractor's scope, in a fully operational condition acceptable to the Employer. The Contractor shall provide all material, equipment and services so as to make a totally integrated System together with all accessories, auxiliaries and associated equipments ensuring operability, maintainability and reliability. The work shall be consistent with modern practices and shall be in compliance with all applicable codes, standards, guidelines and safety requirements in force on the date of award of the contract. 1.02.0 The Contractor shall also provide all the instruments along with cables, JB etc. for equipments and services which may not be specifically stated in this specifications but are required for completeness of the system shall be furnished by the Contractor and for meeting the intent and requirements of these specifications. All instruments/ equipment etc. shall be suitable for highly dusty environment prevalent in the power plant. 1.03.0 It is intended to provide the brief scope only, any other equipment/system required for ensuring the safe, reliable and trouble free operation of the system under the present scope of the work shall be provided by the contractor. The detailed technical specifications is given below. However Contractor to ensure the functionality & operability of the complete system in all regimes of operation. 1.04.0 The interpretation of the Employer in respect of the scope, details and services to be performed by the Contractor shall be binding, unless specifically clarified otherwise by the Employer in writing during the bidding stage. 2.00.0 BASIC DESIGN CRITERIA Permanent type Wagon tippler stress measurement system is to be designed and implemented for the stress measurement of various mechanical parts of wagon tippler in which sensors will be permanently mounted on Wagon Tippler structure and			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant	Page 116 of 122	

CLAUSE NO.	Annexure to Wagon Tippler Stress Measurement System			
	electronic rack/PC located in Wagon Tippler control room. This system shall be based on bolt on type strain gauge sensors for measuring the stress at various parts prone for failure due to stress. The strain gauges shall measure the stress & strain levels at all the identified points and this system shall provide the complete stress analysis of the mechanical structure.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant	Page 117 of 122	

CLAUSE NO.	Annexure to Wagon Tippler Stress Measurement System			
	Sufficient numbers of strain gauge sensors of suitable measuring range along with all the required electronics/ racks/ PC/ Software shall be provided. The exact number of sensors and locations of mounting of these sensors shall be approved by Employer during detailed engineering considering Finite Element Analysis and other design aspects of Wagon Tippler. The analysis produced by this system should be such that it can be co-related with Finite Element Analysis / any other relevant technical analysis. If any discrepancy is observed in the analysis produced by this system, then suitable corrective actions shall be taken by contractor, like shifting of sensor location, explaining the reason of discrepancy/ difference to the satisfaction of the Employer. This system shall be capable of providing the stress reading of all the points which can be connected to DCS/ PLC for further monitoring and alarms. 3.00.0 SPECIFICATION OF STRAIN GAUGE SENSORS In wagon tippler suitable strain gauges/ Strain sensor like Strain Gauge Rosette (three axis)/ Strain gauge single axis shall be provided in the identified locations. Strain gauges shall be highly sensitive and thermally stable semiconductor type with bolt-on technology for measuring the stress of a wide range of mechanical system. It should be hermetically sealed and should be designed for rugged and dusty outdoor applications with minimum protection class of IP 65. Operating temperature for Strain gauge sensors shall be min. 0-60 Deg C. 4.00.0 SYSTEM HARDWARE REQUIREMENT 1. System shall be modular in nature and shall have online expansion capability. 2. Electronic modules for this system shall have additional 20% spare capacity for future expansion.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant	Page 118 of 122	

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	3. It should have 4-20 mA galvanically isolated analog outputs corresponding to each of the sensors for wiring to Wagon Tippler PLC. 4. It should have adequate nos. of assignable potential free Digital outputs for alarms which shall be connected to Wagon Tippler PLC/ Alarm system. 5. Operating temperature for Electronic system shall be 0-50 Deg C. 6. It should have inbuilt LCD display for system configuration, parameterization and display of values/ trends etc.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
		Page 119 of 122

CLAUSE NO.	Annexure to Wagon Tippler Stress Measurement System		
5.00.0	SOFTWARE FEATURES Stress measurement system shall have PC based monitoring and analysis software with latest hardware specifications. All necessary software to achieve all functionalities shall be provided and shall meet following requirements: a. All software required to achieve complete functional requirements shall be included in the scope of this package and shall be provided to Employer with lifetime licenses in CD/DVD media or any other downloadable format. b. The software licenses shall not be hardware/machine-specific. That is, if any hardware/machine is upgraded or changed, the same license shall hold good and it shall not be necessary for Employer to seek a new license/renew license due to up gradation/change of hardware/machine. Further, software shall be suitable for life time of the plant. c. The offered software should utilize latest hardware and software versions. The operating system should also be latest available like Windows 10. d. Software updates including new releases, versions, fixes, patches etc. shall be provided as and when released by the contractor without any additional cost to THDC during the warranty period and also during the AMC period. These shall include operating system patches, antivirus software/signatures, firewall software/signatures. e. In case, the version available at the time of supply and commissioning is not compatible to latest OS version, then the Contractor should upgrade all the software to latest OS version, when the same is available, without any additional cost before the end of warranty period. f. The software shall support advanced security methods to provide protection against unauthorized access, disclosure, modification, and use. The Contractor shall describe the security provided by the software for user login and roles. g. System software provided along with the system shall have following minimum features: 1. Visualization/ trending of measured data. 2. Import and export of data in various formats. 3. Online analysis of Stress and comparison with baseline data 4. Data Storage, analysis and reporting of online as well as archived data.		
6.00.0	SCOPE OF WORK		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
			Page 120 of 122

CLAUSE NO.	Annexure to Wagon Tippler Stress Measurement System			
	1. Supply of complete system including sensors, electronic system, PC & peripherals, 2. Suitable protecting cover shall be provided for strain gauge assembly, cables, Junction Boxes, Glands, Sub-trays, conduits etc. on as required basis.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant	Page 121 of 122	

CLAUSE NO.	Annexure to Wagon Tippler Stress Measurement System	
	3. Suitable enclosure/ Panel for the electronics to be provided in the control room. 4. Furniture for placement of PC, Printer etc. shall be provided as on required basis. 5. Special cables as required for strain gauge sensor connection in this application shall be as per system supplier's standard and proven practice and the same shall be supplied on as required basis. 6. All other instrumentation, power supply, control, FO cables required for completeness of the system shall be in contractor's scope. 7. The cables which are laid outside control room shall be armoured or suitably protected with conduits and shall be supplied on as required basis. 8. Installation of Junction Boxes, cabling, laying and termination for complete installation of the system. 9. Electronic system setup, parameterization, configuration and commissioning of complete system. 10. Supply & erection and commissioning of complete system including cabling and termination from Stress measurement system to PLC/ Alarm system shall be in the scope of contractor. 11. Power supply stabilization and conversion system shall be provided by the contractor as per their system requirement. 12. Soft Link connectivity based on industrial protocol like OPC/ Modbus TCP/ Modbus RTU etc. shall be provided with Wagon Tippler PLC for all the data transfer from Stress measurement system to PLC. Contractor shall collect all the required information of PLC during site visit. Mandatory Spares a) Field Sensor -20% or min two nos. of each type and model. b) Electronic Modules -10% or 1 no. of each type and model	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.: CW-CM-11159-C-O-M-001	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant
Page 122 of 122		



SUB-SECTION–A-21

ASH HANDLING PLANT (AHP)

**SINGARENI THERMAL POWER PROJECT
STAGE-II (1X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC NO.:CW-CM-11159-C-O-M-001**

CLAUSE NO.	TECHNICAL REQUIREMENTS 																																																																		
1.01.00	DATA SHEETS Water Impounded Bottom Ash Hopper Data Sheet <table border="1"> <tr> <td>a)</td><td>Type of Hopper</td><td>:</td><td>Water Impounded self supporting, triple V type.</td></tr> <tr> <td>b)</td><td>Location</td><td>:</td><td>Directly beneath the boiler furnace.</td></tr> <tr> <td>c)</td><td>Minimum effective ash storage capacity</td><td>:</td><td>5 hours of maximum furnace bottom ash collection.</td></tr> <tr> <td>d)</td><td>Maximum allowable ash level in bottom ash hopper</td><td>:</td><td>600 mm below the maximum water level</td></tr> <tr> <td>e)</td><td>TSS of overflow water</td><td>:</td><td>< 100 PPM. Bidder to give details of chemical treatment/filtration/clarification to achieve TSS of 100 ppm.</td></tr> <tr> <td>f)</td><td>Capacity of Make-up system</td><td></td><td></td></tr> <tr> <td>i)</td><td>of hopper</td><td>:</td><td>To fill up hopper (empty condition to maximum water level) in one hour.</td></tr> <tr> <td>ii)</td><td>Of seal trough</td><td>:</td><td>To maintain required water level in the trough during flushing.</td></tr> <tr> <td>g)</td><td>Minimum angle between hopper wall & horizontal</td><td>:</td><td>45°C</td></tr> <tr> <td>h)</td><td>Seal trough</td><td>:</td><td>It shall be sized to maintain clearance between the seal plate and the trough during any vertical downward, side to side & front to rear expansion of boiler.</td></tr> <tr> <td>i)</td><td>i) Temp. of bottom ash for calculating cooling water requirements</td><td>:</td><td>1050°C</td></tr> <tr> <td></td><td>ii) Available cooling water temperature</td><td>:</td><td>40°C</td></tr> <tr> <td></td><td>iii) Quantity of bottom ash for calculating cooling water requirements</td><td></td><td>15% of the ash produced at BMCR with worst coal</td></tr> <tr> <td>j)</td><td colspan="3">No pits in the boiler bottom are allowed to accommodate bottom ash handling equipment.</td></tr> <tr> <td>k)</td><td colspan="3">Thermal shock of exposed refractory to be prevented. A cooling water distribution header with deflection shield shall be provided all round the top of ash hopper, for cooling the portion of refractory all round the top of ash hopper.</td></tr> <tr> <td>l)</td><td colspan="3">To assist in the hopper emptying process, flushing nozzles shall be provided in the inclined section of the hopper walls.</td></tr> </table>			a)	Type of Hopper	:	Water Impounded self supporting, triple V type.	b)	Location	:	Directly beneath the boiler furnace.	c)	Minimum effective ash storage capacity	:	5 hours of maximum furnace bottom ash collection.	d)	Maximum allowable ash level in bottom ash hopper	:	600 mm below the maximum water level	e)	TSS of overflow water	:	< 100 PPM. Bidder to give details of chemical treatment/filtration/clarification to achieve TSS of 100 ppm.	f)	Capacity of Make-up system			i)	of hopper	:	To fill up hopper (empty condition to maximum water level) in one hour.	ii)	Of seal trough	:	To maintain required water level in the trough during flushing.	g)	Minimum angle between hopper wall & horizontal	:	45°C	h)	Seal trough	:	It shall be sized to maintain clearance between the seal plate and the trough during any vertical downward, side to side & front to rear expansion of boiler.	i)	i) Temp. of bottom ash for calculating cooling water requirements	:	1050°C		ii) Available cooling water temperature	:	40°C		iii) Quantity of bottom ash for calculating cooling water requirements		15% of the ash produced at BMCR with worst coal	j)	No pits in the boiler bottom are allowed to accommodate bottom ash handling equipment.			k)	Thermal shock of exposed refractory to be prevented. A cooling water distribution header with deflection shield shall be provided all round the top of ash hopper, for cooling the portion of refractory all round the top of ash hopper.			l)	To assist in the hopper emptying process, flushing nozzles shall be provided in the inclined section of the hopper walls.		
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION: A-21 ASH HANDLING PLANT	PAGE 1 OF 45																																																																

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.01.01	m)	The areas of hopper subjected to severe abrasion & erosion shall be suitably protected by wear plates. The protection is mandatory requirement for outlet opening of BA hopper.		
	n)	Each hopper section shall include a hinged access door. Circular doors shall have a diameter or not less than 750 mm, whilst rectangular access doors shall have dimensions of at least 900 x 600 mm. Each hopper section shall also be provided with two (2) nos. 150 mm size inspection windows for viewing both the slopes.		
	o)	The seal trough shall incorporate an overflow system, make-up system, drainage system and high pressure water nozzles to facilitate complete flushing of the seal trough.		
	Material of Construction			
	a)	Hopper Body	:	Tested quality mild steel plates of thickness not less 10 mm (IS 2062) and suitably stiffened with rolled steel section. The top 1100 mm of the hopper including seal trough shall be constructed of 6 mm thick SS:316. The entire inner walls shall be lined with castable refractory.
	b)	Refractory anchors	:	Stainless steel AISI 316
	c)	Sluicing/ Arch Breaking /wash nozzles	:	Body: Cast Iron/MS; Nozzle tip : - Anti corrosive tool steel or SS of hardness not less than 550 BHN.
	d)	Cooling water header	:	Stainless steel
	e)	Seal trough	:	It shall be integral construction stainless steel.
	f)	Refractory	:	Castable refractory of min. 230 mm thicknesses. Protection measures such as embedded impact bars shall be provided, to prevent damages to the refractory in areas of clinker impact.
1.02.00	Bottom Ash Water Impound Hopper Discharge Gates			
	a)	Quantity / Nos.	:	Six (6) per unit, one on each sloping face of each hopper section.
	b)	Size	:	900 mm x 900 mm (min.)
	c)	Capacity of Each Gate	:	Shall be capable of discharging 100% of the contents of one hopper section, within specified
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION: A-21 ASH HANDLING PLANT PAGE 2 OF 45

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
1.03.00			time.
	d) Drive of Feed Gate	:	Air oil operated, to ensure smooth & guided opening/closing to limit friction & wear.
	e) Adjustment of ash gate seal	:	From outside the gate housing
	f) Inclination of feed gate	:	Same as that of BA hopper.
	g) Wear protection liners	:	Shall be provided on gates, inside of gate housing & sliding surface coming in contract with gate.
	h) Accessories of Ash gate housing	:	yes
	i) Access door	:	450 mm dia
	j) Lancing or poke door	:	yes
	k) Venting system	:	yes
	l) Ash observation window with light	:	All joints, door accessories etc. shall be water tight.
	m) Flushing nozzles on either side of feed gate	:	yes
	n) Flushing & drain connections along with valves for sump of ash gate housing.	:	yes
	o) Material of Construction		
	p) Gates	:	Cast Iron IS:210, Gr. FG-260.
	q) Gate wear liners	:	6 mm thick SS:316
	r) Housing wear plates/impingement plates	:	25 mm thick Cast Iron IS:210, Gr. FG-260
	s) Housing	:	10 mm thick (min.) Mild Steel IS:2062
	Jet Pumps		
	a) Quantity	:	Six (6) nos per unit
	b) Rated Capacity (M ³ /hr)	:	Three (3) nos. pumps shall evacuate 4 hr. collection of bottom ash in 85 minutes. incl. 5 minutes time for start/stop/changeover/flushing etc. with a minimum 25 mm wear on the diameter of throat.
	c) Nos. Working	:	Three (3) nos. per unit
	d) Nos. Standby	:	Three (3) nos. per unit
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	
SUB-SECTION: A-21 ASH HANDLING PLANT		PAGE 3 OF 45	

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.04.00	e)	Features	:	Jet pump shall allow for the easy and quick inspection, removal & replacement of the jet pump sections that are subject to wear.
	f)	Construction Details	:	A Jet pump should comprise an inlet section, a high-pressure water supply connection through a converging nozzle, a mixing zone & a diverging discharge section to the slurry pipe system.
	g)	Material of Construction	:	
	h)	Inlet section, throat & discharge/tail piece	:	Alloy cast iron as per IS4771 type 1 (a) min. 4.5% Nickel with min. hardness of 500 BHN.
	i)	Nozzle Inlet	:	CI Grade FG-260 as per IS 210
	j)	Nozzle Tip	:	Ceramic lined stainless steel/tungsten carbide.
	DATA SHEET FOR SLURRY LINE VALVES			
	1.0	Type of Valves:	(i)	For working pressure up to 10 Kg per cm ² (g) – Metal to metal seated knife gate valve
				OR
				100% percent) tight shut off rubber lined knife edge gate valve
		(ii)	For working pressures above10 Kg per cm ² (g) .	
			100% (Percent) tight shut off rubber lined knife edge gate valve	
2.0	Numbers required	(i)	Two (2) nos. for each bottom ash slurry disposal pump, one (1) no. at suction and one (1) no. at discharge	
		(ii)	2 Nos. for each BA overflow water pump, 1 no. at suction and 1 no. at discharge	
		(iii)	2 Nos. for each sludge pump, 1 no.at suction & 1 no.at discharge	
3.0	Size of valves	:	Same as parent pipe size.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION: A-21 ASH HANDLING PLANT
PAGE 4 OF 45				

CLAUSE NO.	TECHNICAL REQUIREMENTS				
	4.0	Method of operation	:	Motor operated or Solenoid operated pneumatically actuated with provision of handwheel pneumatically actuated with provision of handwheel for manual operation for manual operation.	
	5.0	Material of Construction			
	5.1	Body/Cover:	:	Cast iron FG-260 to IS:210(min. 10 mm thickness) with alloy C.I./S.S Deflection cone (minimum 400 BHN hardness) for knife edge gate valves	
				OR	
			:	Carbon steel to ASTM – A – 216 Gr WCB (0.3% carbon max.) for WCB for plug valves.	
	5.2	Gate/Plug	:	Stainless steel with min. 400 BHN Hardness on wear surface for knife edge gate valves	
				OR	
			:	Carbon steel to ASTM-A-216 Gr. WCB with hardness of 400-450 BHN suitably impregnated for low friction.	
				OR	
	5.3	Stem	:	Stainless steel (SS-316) for knife edge gate valves	
			:	OR	
			:	IS:1875 Class C made out of ASTM-A-105 (forged carbon steel) and will be suitably impregnated for low friction.	
	5.4	Sleeve/Yoke	:	Bronze	
	5.5	Gland Packing	:	To suit service requirements	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION: A-21 ASH HANDLING PLANT	PAGE 5 OF 45

CLAUSE NO.	TECHNICAL REQUIREMENTS				
1.05.00	Dry Type Bottom Ash Hoppers cum Transition Chute				
1.05.01	Data Sheet (For submerged scraper chain conveyor system)				
	a)	Minimum effective ash storage	:	Three (3) hours of maximum furnace bottom ash collection	
	b)	No. of hopper cum-transition chute segments/sections per boiler	:	Four (4) nos. minimum	
	c)	Function	:	To store Bottom Ash during on load maintenance of scraper conveyors and act as a transition chute for falling bottom ash during normal working.	
	d)	Number and type of isolation gates	:	One (1) in each segment i.e. 4 nos. (min.) hydraulic cylinder operated sliding type.	
	e)	Maximum ash level in bottom ash hopper	:	300 mm below the maximum water level	
	f)	Minimum acceptable valley angle	:	45°	
	g)	Maximum allowable temp. on exposed surface of BA hopper	:	60°C; In case it exceeds 60°C, it shall be thermally insulated.	
	h)	Castable refractory lining inside bottom ash hopper	:	It shall withstand radiant heat from boiler furnace.	
	i)	Water seal trough	:	It shall be installed around the top of BA hopper to provide a seal for boiler furnace section.	
	j)	A	Seal trough sizing	:	Seal trough shall be sized to maintain clearance between the seal plate and the trough during any vertical downward, side to side, and front to rear expansion of the boiler.
		b)	Seal trough make up system	:	To maintain required water level in the through during flushing of trough.
	k)	B.A. hopper support		:	BA hopper shall be supported independently on steel columns.
	l)	The design of ash outlet gates when closed should ensure complete safety of the plant personnel working in the furnace bottom area. Such features shall be elaborated in the bid.			
	m)	Blanket spray type quench nozzles shall be provided alongwith its own isolation & regulation valve, to ensure adequate cooling of all refractory surfaces. Nozzles			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION: A-21 ASH HANDLING PLANT PAGE 6 OF 45	

CLAUSE NO.	TECHNICAL REQUIREMENTS						
	shall lend themselves for easy removal from outside.						
	n)	Slag/Clinker build up on hopper wall to be prevented and cleared. These features to be elaborated in the bid.					
	o)	Bidders shall provide for prevention of clinker formation in the hopper during periods of storage and prevention of sudden surge discharge of stored bottom ash at the end of storage periods when outlet gates are opened. If required flushing nozzles to clear any deposits on hopper, to be provided.					
	p)	Accessories					
	a)	For BA hopper	:	i)	Access doors/manholes Size:750 mm dia. circular		
					or		
					900 mm x 600 mm. if rectangular		
				ii)	Inspection window 150 mm dia (min.)		
				iii)	Poke holes		
				iv)	Operating platforms on either side		
		b)	For Seal trough	:	Overflow make-up systems, drainage system & high pressure water nozzles to facilitate complete flushing out of seal through.		
	q)	Seal trough and B.A. hopper			:	Shall be preferably of integral construction.	
	r)	Material of construction			:		
s)	Hopper body and seal trough			:	Tested quality mild steel plates of thickness not less than 10 mm (IS:2062) and suitably stiffened with rolled steel sections. The top 1100 mm of the hopper including seal trough shall be constructed of 6 mm thick SS:316.		
t)	Refractory Anchors			:	Stainless steel, AISI-316		
u)	Quenching/sluicing/Arch breaking/wash nozzles			:	Body : Cast Iron/Mild Steel		
			:	Nozzle tip : anti corrosion tool steel or stainless steel of hardness not less than 550 BHN.			
v)	Dip pieces			:	Heat and corrosion resistant steel, minimum 10 mm thick.		
w)	Outlet gates			:	6 mm thick Carbon steel with stainless steel liners.		
x)	Refractory			:	Castable Refractory of min. 230 mm		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001			SUB-SECTION: A-21 ASH HANDLING PLANT	PAGE 7 OF 45	

CLAUSE NO.		TECHNICAL REQUIREMENTS			
1.06.00 1.06.01				thickness. To prevent damage of the refractory in the areas of clinker impact, suitable measures like provision of impact bars embedded in the refractory shall be provided.	
	Submerged Scraper Chain Conveyor				
	Data Sheet				
	1)	Function	:	To convey bottom ash, from bottom ash hopper to clinker grinder.	
	2)	Location	:	Under the boiler furnace.	
	3)	No. of submerged scraper chain conveyor	:	Four (4) nos. per boiler (two working and two standby)	
	4)	Capacity of SCC	:	It shall be designed for continuous removal of bottom ash.	
	5)	Continuous normal operating capacity of each SCC	:		As required to meet the B.A. removal rates
	6)	Continuous maximum operating capacity of each SCC (during soot blowing)	:		At least 125% of Continuous normal operating capacity of each SCC
	7)	Linear speed of chain at continuous normal operating capacity specified at item (5) above.	:	2 meters/min. (maximum)	
	8)	Linear speed of chain is fixed or variable	:	Variable	
	9)	Minimum operating depth of water in upper trough	:	2.0 meters	
	10)	Operating water temp. to be maintained in upper trough	:	Max. 60°C	
	11)	Available cooling water temperature	:	40°C	
	12)	i) Temp. of bottom ash for calculating cooling water requirements	:	1050°C	
		ii) Quantity of bottom ash for calculating cooling water requirements	:	15% of the ash produced at BMCR with worst coal	
	13)	Total suspended solids of overflow water from the upper through	:	100 ppm (max.); Bidder to give details of chemical treatment/filtration/clarification to achieve TSS of 100 ppm.	
14)	Drive of each SCC	:	Hydraulic (without gearbox)		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION: A-21 ASH HANDLING PLANT	
				PAGE 8 OF 45	

CLAUSE NO.	TECHNICAL REQUIREMENTS			
			Entire drive assembly to be mounted on the scrapper conveyor trough.	
15)	Chain tensioning arrangement		Hydraulic power pack for each SSC	
16)	Submerged scraper conveyor (SCC) will be required to handle a very high quantity of highly abrasive ash continuously. So all components of SCC shall be of proven design having a track record of trouble free-operation in order to avoid problems of frequent stoppages due to chain elongation, Chain failure, Chain slippage from sprockets, drive train failure etc. The chain shall be sized with factor of safety of min. five (5) on the require chain pull during start up condition with upper trough full of ash up to max. water level.			
17)	Scraper conveyor chain & associated components like chain couplings, sprockets, scraper bar connectors, guide rollers etc. shall be of RUD (Germany) /HEKO make or equivalent.			
18)	To prevent a boiler shutdown in the event of breakdown of the working conveyor, the overall design should allow interchanging the working and standby scrapper conveyor and to take out the working unit for maintenance and bring into service the standby unit even with the boiler on load.			
19)	Bidders are required to provide a simple, safe and effective arrangement for easy shifting of the scraper conveyors. The complete assembly of the scraper conveyor unit shall be mounted through supporting structure on a set of wheels resting on steel rails, to facilitate the shifting. A suitable motorized self-propulsion arrangement shall be provided for shifting the scraper conveyor. This drive shall be properly protected against overflow water, clinker etc. The design shall take into account the fact that he scraper conveyor units are not expected to be shifted frequently and therefore the effectiveness of the shifting arrangement should not be sensitive to long period of non-operation.			
20)	The water and electrical connections for the scraper conveyors shall be so provided as to allow fast disengagement and reconnection during conveyor shifting. Plug type socket arrangement can be provided for electrical connections. An arrangement shall also be provided for fast draining of the scraper conveyor bath so as to reduce the total weight to be handled during conveyor shifting and to make the chain and other components accessible for maintenance. The conveyor bath shall be drained to the bottom ash slurry sluiceway.			
21)	Excessive height and slope of the scraper conveyor inclined portion may create problem of access for maintenance and difficulty in preventing chain swinging leading to chain derailment. Accordingly, Bidder shall reduce the height and slope of the inclined portion as much as possible.			
22)	The design of the scraper conveyor and its drive arrangement shall permit starting of the conveyor with the upper trough full of ash up to maximum water level. The supporting design calculations shall be submitted along with the bid. For design of drive the ambient temperature shall be taken as 60°C			
23)	Adequate free board shall be kept over the maximum water level, in the upper water filled trough, to prevent splashing of water due to falling clinker.			
24)	The scraper bars (Flights) shall be of proven design and it shall be possible to invert them to equalize wear. The bars shall be preferably connected to the chains by means of plug-in type arrangement. The bar connections shall ensure against turning of the bars while in motion and shall also permit easy replacement of scraper bars.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION: A-21 ASH HANDLING PLANT
PAGE 9 OF 45				

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
1.06.02	25)	The chain guide pulley/rollers shall be of the grooved type. Chain guide rollers and sprockets shall be fitted with lip seal type bearings to prevent ingress of ash. All the bearings shall be grease packed with facility of recharging from outside. The guide roller movement should be visible from outside.	
	26)	Reliable and proven hydraulic auto take up arrangements, with facility of independent adjustments of tension of two chains as also the facility for equalizing the tensions in two chains as required, shall be provided. The chain tension assembly shall be designed to absorb any momentary shock loading.	
	27)	The entire scraper conveyor chain path shall be totally enclosed with the sides on lower trough open, to allow for visual inspection of the wearing surfaces.	
	28)	The chain sprocket shall consist of a center box with a bolted toothed disc in suitable segments for easy replacement.	
	29)	Accessories :	
	i)	Upper trough	: Quick fill, make up, overflow box with overflow pipe and adequately sized drain connection.
			: Spray cleaning nozzles shall be provided at the top of inclined section to clean the conveyor chain links.
	ii)		: Maintenance platform with proper approach ladder shall be provided for drive assembly.
	30)		: It shall be possible to carry out maintenance/replacement of bearings from outside.
	31)		: All the equipment shall be located above ground level. No pits are allowed.
	Material of construction of SCC conveyor components		
	a)	Trough (upper & lower)	: Tested quality MS to IS:2062 (min. 10 mm thick).
	b)	Liners	
	i)	Upper Trough	: Replaceable type alloy C.I. or abrasion resistant steel plates, Minimum 25 mm thick. and 300 BHN hardness.
	ii)	Lower Trough	: Min. 20 mm thick basalt liners.
	c)	Scraper bar (Flights)	: Manufactured out of ISMB and 10 mm thick MS end cover plates.
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION: A-21 ASH HANDLING PLANT PAGE 10 OF 45

CLAUSE NO.	TECHNICAL REQUIREMENTS				
1.07.00 1.07.01				Should the Bidder wish to recommend a different type and material of construction of the bars the same shall be offered as an alternative.	
	d)	Chain Associated components e.g. sprocket, pulleys flight connectors etc.	:	As per the recommendations of Chain manufacturer	
	e)	Chain	:	RUD/HEKO (Germany) make or equivalent.	
	Clinker Grinder /Ash Crusher				
	Data Sheet				
	a)	Function	:	To reduce bottom ash clinkers to a suitable dimension to facilitate pumping through the proposed slurry pipe lines.	
	b)	Location	:	B.A. hopper discharge gates housing in case of jet pump system/discharge chute of Scraper conveyor.	
	c)	Crushing Capacity	:	Compatible with guaranteed ash extraction/discharge rate.	
	d)	Grinder speed	:	Not to exceed 40 RPM.	
	e)	Bearings of clinker grinder	:	Grease lubricated, heavy duty roller bearings. Clear water sealing to be provided at gland seals. (TSS of clear water < 40 ppm).	
	f)	Type	:	Single or double roll; Rolls shall be suitable for rotation in both directions.	
	g)	Drive Arrangement	:	Electric reversible drive motor, fluid coupling and gear box. Drive motor speed not to exceed 1000 rpm & shall be sized for frequent start stop-reverse-stop & start duty.	
	h)	Numbers working			
	- Jet pump system	:	Three (3) nos. per unit		
	or		or		
	- Submerged scraper system	:	Two (2) nos.		
i)	Numbers standby				
	- Jet pump system	:	Three (3) nos. per unit		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION: A-21 ASH HANDLING PLANT	PAGE 11 OF 45

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.08.00		or		or
		- Submerged scraper system	:	Two (2) nos
	j)	Reversing mechanism	:	Reversing mechanism shall reverse the direction of grinder rolls, in case of any obstruction stall the grinder.
	k)	Safety Feature	:	Grinder motor shall not start till sufficient pressure is obtained in seal water connections.
	l)	Wear plates	:	Wear plates shall be provided on clinker grinder inlet and other wearing surfaces of the grinder chamber.
	m)	Base Frame	:	Common steel fabricated base frame for motor and drive shall be furnished.
	n)	Material of Construction	:	
		a) Grinder Chamber	:	Carbon steel I(IS:2062) 10 mm thick.
		b) Wear Plates	:	12-14% Mn. Austenitic steel plates to IS:276 10 mm thick.
		c) Grinder Rolls & teeth	:	Hadfield's Manganese steel (ASTM A128, 12-14% Mn) casting shop hardened to 300-BHN at all working surfaces and work hardened to 400 BHN at site.
		d) Grinder shaft	:	Stainless Steel 304/EN-8.
		e) Shaft Sleeve	:	Hardened stainless steel 410/416.
		f) Clinker outlet chute	:	10 mm thick mild steel (IS:2062) lined with wear resistant liners as above.
	DATA SHEET FOR FLUSHING BOXES			
	1.0	Numbers required	:	As per the scope
	2.0	Capacity	:	As per design criteria for Economizer, Eco duct/ APH/Duct hoppers For Economizer Hopper: - 5 TPH (Min.)
	3.0	Material of Construction		
3.1	Body	:	10 mm thick M.S. to IS:2062	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION: A-21 ASH HANDLING PLANT
PAGE 12 OF 45				

CLAUSE NO.		TECHNICAL REQUIREMENTS				
1.09.00	3.2	Liners	:	8 mm thick replaceable stainless-steel liners of hardness 300-350 BHN.		
	3.3	Nozzles	:	Body: Cast Iron/Mild Steel		
			:	Tip: Anti corrosive tool steel / stainless steel of hardness not less than 550 BHN.		
	3.4	No. of nozzles per flushing apparatus	:	Min 4 Nos. Minimum Two (2) no separate pipelines to be provided from discharge of economizer flushing boxes up to BA Hopper.		
	EXPANSION JOINT FOR ECONOMISER/ECO DUCT SYSTEM/APH/DUCT HOPPER					
1.10.00	1.0	Number	:	As per Scope		
	2.0	Location	:	Below hoppers. Necessary make up water connections shall be provided in the expansion joints. (If applicable)		
	3.0	Type	:	water seal type construction		
	4.0	Material of construction of component parts	:	10 mm thick MS to IS:2062		
	5.0	Adequate sealing shall be provided to prevent ingress of air into the hoppers. Approximately 350 mm seal will be maintained.				
1.10.01	FEEDER EJECTOR BELOW APH, DUCT HOPPER & INTERMEDIATE SILOS					
Feeder ejectors is employed to extract the dry fly ash from air preheater, duct ash collecting hoppers (if applicable) & Intermediate Silos (if applicable), mix it in a consistent slurry form and the resultant slurry will be discharged into intermediate ash slurry tank located in Boiler area. Each feeder ejector shall be designed to extract the fly ash from air preheater, duct hoppers, Intermediate Silos at a rate not less than as specified at Equipment sizing criteria chapter. The feeder ejectors shall be designed to extract the ash at the above specified rates, for a minimum of 25 mm wear on the throat without changing the input water parameters. Each ejector shall be provided with access plugs for inspection with necessary rodding ports for clearing the blocked ash, if any. The feeder ejector shall be compact in design and easy to dismantle. The ejector shall be supplied as a complete assembly with two flanged connections of the required pressure rating for connecting the inlet ash and water lines. The ejectors shall be provided with suitably sized air inlet port for air entry as may be required for necessary assistance to ensure the extraction and feed of ash to the ejectors during the ejectors operation as also to ensure safe operation of the equipment during abnormal events such as sudden drop of water pressure to ejectors nozzles.						
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION: A-21 ASH HANDLING PLANT		PAGE 13 OF 45

CLAUSE NO.	TECHNICAL REQUIREMENTS				
1.10.02	Data Sheet				
	1.0	Numbers required	:	As per scope	
	2.0	Capacity	:	As required	
	3.0	Material of Construction			
	The material of construction of the parts of the feeder ejector shall be as follows:				
	(i)	Inlet Liner	:	Chrome Alloy C.I., Hardness 400 BHN (min.)	
	(ii)	Ejector Water Head If coming in contact with slurry If not coming in contact with slurry	:	Chrome Alloy C.I., Hardness 300 BHN (min.) C.I. Gr. FG.260 IS-210	
	(iii)	Nozzle tip	:	Tungsten Carbide/Ceramic Tips, Hardness 550 BHN (min)	
	(iv)	Ejector Throat	:	High Chrome Alloy C.I., Hardness 550 BHN (min.)	
	(v)	Tail Pipe	:	High Chrome Alloy C.I., Hardness 550 BHN (min.)	
1.11.00	(vi)	Discharge pipe from Ejector outlet	:	M.S. pipes of thickness 9.5 mm.	
	BA Hopper Cooling Water Overflow Tank				
	a)	Effective storage capacity	:	Minimum ten (10) minutes of B.A. hopper overflow.	
	b)	Density of Stored contents	:	1 T/m ³ (For volumetric calculations) 1.1 T/m ³ (for load calculation)	
	c)	Accessories	:	i) Make up, drain, overflow and other associated piping & valves. ii) Two (2) discharge outlets two (2) nos. inspection windows.	
	d)	Tank	:	Shall be of self-supporting type.	
	e)	Material of Construction	:	Tested quality mild-steel plates of thickness not less than 10 mm (IS:2062) and suitably stiffened with rolled steel sections for jet pump system/ RCC tank for Scrapper conveyor system.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION: A-21 ASH HANDLING PLANT	PAGE 14 OF 45

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.12.00	DEWATERING BINS			
	1.0	Numbers required	:	As per Tender drawings
	2.0	Capacity of each Bin	:	As per design criteria (Minimum 8 hours generation of Bottom ash, economizer ash, air preheater ash, duct ash (as applicable) while firing worst coal
	3.0	Each dewatering storage bin shall be provided complete with serrated overflow weir, bar screen, underflow baffle, decant system, cylinder operated discharge gate assembly complete with water tight housing and vibrating feeder etc.		
	4.0	The bidder shall indicate the data of various elements of bins in his offer and a decanting system designed to drain off water with a maximum head of 4m.		
	5.0	The Dewatering Storage Bins shall be designed to provide a clear access of 6.0m for a road tanker to come under the Bin and receive the ash from the retractable chutes.		
	6.0	Each retractable chute shall include a shut off device at the chute outlet, a level probe to determine the level of ash within the road tanker, and vent air systems, and a motor operated winch system to lower/raise the chute. Retractable chute shall be sourced from reputed manufacturer(s), whose bulk loading spouts / retractable chutes have established field provenness. Material of dewatering bin, settling tank & surge tank: MS,IS :2062 and minimum 10 mm thickness .All perforated plate of Decanters (center and sides) shall be of SS 316 L. The structures at Top from where Dewatering Bins shall hang should be with suitably structural design and all bolts should be of HT SS.		
1.13.00	VIBRATING FEEDER (BELOW DEWATERING BINS)			
	(i)	Requirement	For uniform feeding of dewatered bottom ash onto conveyors/crushers/ Open Trucks	
	(ii)	DESIGN & CONSTRUCTION REQUIREMENT		
	(a)	Type	Mechanical vibrator	
	(b)	Inclination	Suitably selected to	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION: A-21 ASH HANDLING PLANT PAGE 15 OF 45

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
1.14.00			ensure proper flow ability of dewatered ash without any hindrance.
	(c)	Pan width	To match with ash transporting conveyor section without deflector plates
	(d)	Liners on vibrating deck	
		- Type, Material	Replaceable, Tiscral or eqvt.
		- Thickness	10 mm minimum.
	(e)	Support	Helical springs only
	(f)	Bearings	
		(i) Type	Double spherical roller suitable for vibrating feeders.
		(ii) Lubrication	Grease
		(iii) Life	8,000 hours Min.
	g	Sealing arrangement between Feeder and stationary structure	Required
	BELT CONVEYOR (if applicable)		
	1.0	Carrying idler	: Three roll, 35 degree troughing, 2 degree forward tilt
	2.0	return idler	: Single Roll, For conveyors upto 400 m c/c length. Two roll with 10 degree angle for conveyors more than 400 m c/c length
	3.1	carrying idler bearing	: Ball Bearings of deep groove type or seize resistance type of min. 35 mm size, lubricated for life.
	3.2	return idler bearing	: Ball Bearings of deep groove type or seize resistance type of min. 25 mm size, lubricated for life.
	3.3	Belt scrapper	: required at discharge and tail end
	3.4	Take up type	: .Automatic Gravity Type.
	3.5	drive pulley lagging	Hot lagged with vulcanised natural rubber
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	
SUB-SECTION: A-21 ASH HANDLING PLANT		PAGE 16 OF 45	

CLAUSE NO.		TECHNICAL REQUIREMENTS		
1.15.00		Lagging thickness		Min. 12 mm thick grooved in diamond pattern with grooves 6 mm wide x 6 mm deep
		other pulley lagging		Hot lagged with vulcanised natural rubber
		lagging thickness		Min. 12 mm thick plain
	3.6	Pulley Material		Mild steel conforming IS:226 / IS : 2062
		Shaft Material		Forged Steel shaft EN-8 or equivalent material.
	3.7	Belt Protection Equipment		pull chord switches,belt sway switches,Zero speed switches.
	3.8	self aligned idler		required at appropriate interval
	CHUTES AND HOPPERS			
	1.0.0	GENERAL		
	2.0.0	DESIGN & CONSTRUCTION		
	2.1.0	Chutes & Hoppers		
	2.1.1	Minimum Valley Angle		70 degrees
	2.1.2	Material :		
	(a) Chute work			
	(b) Sliding zones & adjacent sides		20 mm thk. TISCRA / equivalent	
2.1.4	Inspection Doors		Hinged & leak proof construction	
2.1.5	Chute Construction			
	(a) Corners		One face of removable bolted flange connection	
	(b) Joints Bolted		Flange joints of dust tight construction	
2.2.0	Skirt Boards			
	Side plate		Min. 10 thk TISCRA/equivalent	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION: A-21 ASH HANDLING PLANT PAGE 17 OF 45

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
2.00.01		Top cover	6 mm thk M.S.
	2.3.0	Flap Gate	
	2.3.1	Type	Linear actuator operated, 2 position
	2.3.2	Travel	60 to 70 deg. (with limit switches on both sides).
	2.3.3	Automatic operation	
		(i) Drive	Dust tight motor driven with suitable linkages
		(iv) Protection	Travel and Thrust dependent limit Switches.
	2.4.4	Manual Operation	
		(a) Maximum effort	Convenient for single operator by declutchable hand wheel regardless of electrical power.
		(b) Minimum Handwheel Diameter	500 mm
	DATA SHEET FOR GEAR BOXES		
	1.0	Type	: Totally enclosed and lubricated type.
	2.0	Location (wherever applicable)	: In the drive arrangement of compressors, blowers, crushers, clinker grinders, bottom ash slurry disposal pumps, BA overflow pumps, scraper conveyors, dry ash conveyors etc
	3.0	Gear Types	: Helical
	4.0	Rating of gear box	(a) Gear box shall be designed for heavy shock loads and while selecting a gear box a service factor of minimum 2.0 shall be considered. (b) The nominal mechanical KW rating of each gear box shall not be less than the name plate KW rating of the selected drive motor. (c) Thermal rating of each speed reduction gear box at 50°C ambient temperature shall not be less than the name plate KW rating of the selected drive motor. For calculating thermal rating of Gear box, temperature rise of 30 degree (Maximum) shall be considered. (d) For cooling of gear box, in case thermal capacity without auxiliary fan is not sufficient to meet the thermal rating of gear box, necessary auxiliary cooling fan shall be provided. Cooling coil for this purpose is not acceptable. (e) The selection of gear box shall be subject to Owner's approval. The Bidder shall furnish necessary calculations
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION: A-21 ASH HANDLING PLANT PAGE 18 OF 45

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.00.02				and selection charts for this purpose for Owner's review and approval.
	5.0	Material of Construction	:	To suit the rating of gear box.
	Fluid Couplings			
	The fluid coupling for LT motors shall be of traction type and for HT motors, shall be of scoop tube type. Suitable electrically operated actuators shall be provided for scoop tube operation from local as well as remote. Manual operation shall also be provided. Separate pump with motor or integral shaft driven oil pump shall be provided for circulating the fluid coupling oil through oil cooler. Forced cooling water supply to oil cooler shall be provided for which cooling water pumps to be provided for group of scoop couplings. Suitable interlock using flow switches shall be provided in both oil as well as water lines to trip the drive motor in the event of flow in either line falling below acceptable levels. Alternatively, Air cooled type scoop coupling is also acceptable for drives with HT motors. Suitable pressure indicators and flow indicators shall be provided in the cooling water lines along with all-relevant valves, and accessories. Necessary isolation valves shall be provided in the oil / water line for maintenance of any equipment in the line. Necessary interlock shall also be provided so that the HT motor cannot be started from remote / local unless position of scoop tube permits no load start of the motor. Tripping of downstream equipment while the system is under normal operation shall result in scoop tube re-positioning to permit no load run of the concerned HT motor. Temperature switch shall be provided in the oil circuit and shall trip the system in case of high oil temperature. The scoop tube operation must be such so to ensure draining of oil from the operating circuit by providing a double speed motor.			
	2.01.00 Fly ash collection chute isolation valves			
	Body	:	Cast Iron FG 260 hardened to 180-200 BHN.	
	Gate	:	10 mm thick MS with 10-15 microns of hard chrome plating on both side of plate. The chrome plating hardness shall be equivalent to 300-350 BHN.	
	Seat	:	Replaceable stainless steel hardened & smooth finished (250 BHN min.).	
			Or	
			Alloy CI with seat hardness equivalent to 250 BHN min.	
2.02.00	Data Sheets for Expansion Joints			
	1.0	Number	:	As per Scope
	2.0	Location	:	In the Fly Ash Handling system. Exact location is to be advised by the Bidder
	3.0	Type	:	Metallic Bellows type with replaceable liners
	4.0	Material of construction of component parts		
	4.1	Bellows	:	To suit the duty conditions and meeting the requirements of EJMA standard.
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION: A-21 ASH HANDLING PLANT PAGE 19 OF 45

CLAUSE NO.	TECHNICAL REQUIREMENTS				
2.03.00	4.2	Replaceable liner	:	Appropriate abrasion resistant material with a minimum hardness of 300 –350 BHN	
	Vacuum Pumps				
	Type	:	Low speed liquid ring type driven by electric motor.		
	Nos. working and standby sizing criteria	:	As per Scope of supply. To cater to the ash removal rates specified i.e. removal of 8 hrs. collection of ash as per design ash collection rates in 6 hours time. A margin of 10% in capacity shall be kept. In case the first field of ESP goes out of service the second field shall collect the ash of first field and so on. The design shall take care of this aspect.		
	Max. tip speed of impeller	:	15 m/s		
	Material of Construction	:			
	Casing	:	Cast Iron		
	Shaft	:	Carbon steel EN 8		
	Impeller	:	Stainless steel		
	Shaft sleeves	:	Stainless steel		
	Location	:	outdoor		
	Duty	:	Continuous		
	Motor rating at 50 Deg. C	:	Continuous motor rating shall have atleast 10% margin over the maximum load demand in the entire operating range.		
	2.04.00	Fly Ash Feed valves/ Fly Ash Branch Separation Valves			
		a)	Vacuum system	:	
			Type	:	Swing type or slide plate type or dome type
			Material of Construction	:	
			Body	:	Alloy Cast Iron, 250 BHN (min.) hardness.
			Plate/Disc	:	Stainless steel 3 mm thick with 300-350 BHN for fly ash segregation valve and 10 mm thick. 300-350 BHN SS for fly ash feed valves.
		Seat	:	Replaceable type alloy CI. or SS smooth finished with hardness 250 BHN.	
		Method of operation	:	Solenoid operated pneumatically actuated with provision of manual override facility.	
b)		Pressure system	:		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE					
TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001					
SUB-SECTION: A-21 ASH HANDLING PLANT					
PAGE 20 OF 45					

CLAUSE NO.	TECHNICAL REQUIREMENTS				
		Type	:	Plate type / butterfly / dome type/cone type.	
		Material of construction	:		
		Body	:	Alloy Cast Iron, 250 BHN(min.) hardness.	
		Plate/Disc/Dome/Cone	:	Minimum 10 thick SS/Alloy C.I-300-350BHN.	
		Seat	:	Replaceable type alloy CI. Or SS smooth finished with hardness 250 BHN.	
	2.05.00	Data Sheet for Vacuum Breakers			
		1.0	Type of Vacuum Breaker	:	Slide plate type / POP type
		2.0	Numbers and size	:	As per system requirements and as specified.
		3.0	Method of operation	:	Automatic.
	4.0	Material of Construction			
	4.1	Body	:	Alloy Cast Iron with a hardness of 250 BHN (min.)	
	4.2	Plate	:	Min. 3 mm thick Stainless steel of, 300-350 BHN Hardness.	
2.06.00	Data Sheet for Air Intake Valve				
	1.0	Type of Valves	:	Spring loaded or check type	
	2.0	Numbers required	:	As per system requirement	
	3.0	Size of valves	:	As per system requirements	
	4.0	Material of construction			
	4.1	Body	:	Cast Iron/Gun Metal/Cast Steel	
	4.2	Disc	:	Stainless Steel/Gun Metal.	
2.07.00	Pneumatic Ash Extraction and Transportation Pipelines				
	Material of construction	:			
	Pipelines	:	CI pipelines conforming to IS:1536 / BS:1211 with minimum thickness conforming to class D. In case of pressure conveying system MS pipes to IS:3589 of 9.5mm wall thickness is also acceptable for conveying pressure greater than 3.5 kg/cm2 (g).		
	Fittings	:	Ni-hard / chrome alloy cast iron or equivalent. Minimum hardness 400 BHN. Wear back thickness 20 mm.		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION: A-21 ASH HANDLING PLANT	
PAGE 21 OF 45					

CLAUSE NO.	TECHNICAL REQUIREMENTS			
			Or	
		:	20 mm thick cast basalt line MS fittings. (Thick of MS 6 mm.)	
	Type of joint	:		
	Pipe to pipe	:	Sleeve coupling / flanged.	
	Pipe to fittings	:	-do-	
	Pipe to valve and valve to fitting. Fitting to fitting.	:	-do-	
	Properties for cast basalt			
	Hardness	:	8 mhos (min.	
	Bending strength	:	300 kg./cm ² (min.)	
	Compressive strength	:	4500 kg./cm ² (min.)	
	Density	:	2.8 – 3.1 g./cm ³	
	Spool Pieces	:	Spool pieces (Alloy C.I. or basalt lined as the case may be) of minimum 1.5 m length shall be provided at the discharge of every fitting having an angle of 45 o or above.	
2.08.00	Data Sheet for Dry Fly Ash Buffer/ Intermediate Hoppers			
	1.0	Number	:	As per scope
	2.0	Material of construction	:	10 mm thick M.S. to IS:2062 with 20 mm thick abrasion resistant Alloy C.I./ 10 mm thick SS liners of 300-350 BHN hardness at sloping surfaces and outlet area.
	3.0	Discharge	:	To pump tanks/air lock system as specified.
2.09.00	Air locks/pump tanks			
	Design pressure	:	1.5 times the rated pressure of air mover.	
	Material of construction	:	Tested quality MS as perIS:2062, 10 mm thick	
	Liners	:	Wear resistant alloy CI liners (min 350 – 400 BHN.) (if applicable)	
	Quantity	:	As per scope	
2.10.00	Bag Filters			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION: A-21 ASH HANDLING PLANT PAGE 22 OF 45

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.11.00	Design	:	To achieve a sustained dust emission at outlet not exceeding 50 mg/NM ³	
	Special features	:	i) It should be possible to carry out the maintenance and replacement of bags without affecting the performance of the system.	
			li) The performance of bag filter shall not get affected with 10% of bags plugged. Air to cloth ratio taken for bag selection shall be maximum 0.8 m/min.	
			(iii) Bag filter shall be supplied with automatic bag filter pulse jet cleaning equipment including controller.	
	Air compressor for conveying/ transportation			
	Applicable codes	:	BS: 1571	
		:	IS : 6206	
		:	IS ; 5757	
			ASME power Test code PTC 9.	
	Duty	:	Continuous	
	Design requirement	:	Oil and moisture free air discharge at the required pressure and quantity. A 10% margin shall be provided on compressor capacity over and above the maximum flow requirement.	
	Dryness of air at outlet	:	Dry air with dew point of (-) 20°C. at 1 ata pressure or +2 Deg Celsius of Pressure Dew Point	
	Type of Cooling	:	Air/Water	
	Nos. provided	:	As per scope	
	Type	:	Indoor screw type compressor with refrigerant type air drier.	
	Design ambient conditions	:	50°C, 100% RH	
	Drive motor rating	:	Continuous motor rating at 50 °C shall be at least 10% above the maximum load demand of the compressor in the entire operating range.	
	Classifier Silo/Intermediate FA Silo			
	Number	:	As per scope of work	
	Type	:	Flat bottom/Conical type with proven design with respect to Flowability of ash.	
	Storage capacity	:	As specified elsewhere	
	Material of construction	:	MS plates, IS:2062 min 10mm thick. Min 3 mm thick SS liner as per SS 409 M/410 at conical portion of silo	
	SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION: A-21 ASH HANDLING PLANT	PAGE 23 OF 45

CLAUSE NO.	TECHNICAL REQUIREMENTS																										
2.13.00	Weigh bridges <table><tr><td>Number</td><td>:</td><td>As per scope</td></tr><tr><td>Type</td><td></td><td>Pit-less type</td></tr><tr><td>capacity</td><td>:</td><td>100 tonnes</td></tr><tr><td>accuracy</td><td></td><td>+/- 2%</td></tr><tr><td>Platform size</td><td></td><td>24m x 3m (approx.)</td></tr><tr><td></td><td></td><td>Weigh bridge should take care of locomotive (weighing up-to 150T) moving over weigh bridge at a speed of 8 Kmph. (For weigh bridges on the rail lines)</td></tr></table>			Number	:	As per scope	Type		Pit-less type	capacity	:	100 tonnes	accuracy		+/- 2%	Platform size		24m x 3m (approx.)			Weigh bridge should take care of locomotive (weighing up-to 150T) moving over weigh bridge at a speed of 8 Kmph. (For weigh bridges on the rail lines)						
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2.14.00	For specification of Passenger cum Goods elevator of Ash Handling System, Bidder to refer clause No- 4.17.00, Sub-section A- 20, Part-B of Technical Specification.																										
2.15.00	Following are MOC for the parts of DAES valves:- <table><tr><th>Sl</th><th>Item description</th><th>Technical Specification requirements</th></tr><tr><td>1.</td><td>Buffer hopper RSV Gate & seat /Air lock tank inlet & outlet valve seat& disc</td><td>MOC: ASTM-A532-82 CLASS-III TYPE-A, Hardness-600BHN(Min) stress relieved. Lap finish. This is not applicable for Dome Valves</td></tr><tr><td>2.</td><td>Pressure equalizing valve seat</td><td>MOC: AISI:8620, Hardness - 500-550 BHN (Min),stress relieved. Lap finish</td></tr><tr><td>3.</td><td>Pressure equalizing valve disc</td><td>MOC: ASTM-A532 CLASS-III TYPE-A, Heat Treated: To achieve 600BHN(Min.) & stress relieved. Lap finish</td></tr><tr><td>4.</td><td>MHV (material handling valve) slide /ESP outlet valve slide</td><td>MOC: SS 410; HARDNESS:325BHN(Min). Lap finish</td></tr><tr><td>5.</td><td>MHV (material handling valve) seat /ESP outlet valve seat</td><td>MOC: As per IS:4771-1985, Type-1A; Hardness:500BHN(Min), Ni/Cr=30/500. Lap finish</td></tr><tr><td>6.</td><td>Branch Segregating valve slide gate</td><td>MOC: SS-410, Hardness-325BHN(Min.) Surface finish at both the faces= 16 micron</td></tr><tr><td>7.</td><td>Branch Segregating valve seat</td><td>Ni/Cr 30/500 AS PER IS 4771-1985 TYPE 1A (300BHN MIN.) Lap finish</td></tr></table> In case of any conflict with other clauses, 2.15.00 shall supersede over other clauses			Sl	Item description	Technical Specification requirements	1.	Buffer hopper RSV Gate & seat /Air lock tank inlet & outlet valve seat& disc	MOC: ASTM-A532-82 CLASS-III TYPE-A, Hardness-600BHN(Min) stress relieved. Lap finish. This is not applicable for Dome Valves	2.	Pressure equalizing valve seat	MOC: AISI:8620, Hardness - 500-550 BHN (Min),stress relieved. Lap finish	3.	Pressure equalizing valve disc	MOC: ASTM-A532 CLASS-III TYPE-A, Heat Treated: To achieve 600BHN(Min.) & stress relieved. Lap finish	4.	MHV (material handling valve) slide /ESP outlet valve slide	MOC: SS 410; HARDNESS:325BHN(Min). Lap finish	5.	MHV (material handling valve) seat /ESP outlet valve seat	MOC: As per IS:4771-1985, Type-1A; Hardness:500BHN(Min), Ni/Cr=30/500. Lap finish	6.	Branch Segregating valve slide gate	MOC: SS-410, Hardness-325BHN(Min.) Surface finish at both the faces= 16 micron	7.	Branch Segregating valve seat	Ni/Cr 30/500 AS PER IS 4771-1985 TYPE 1A (300BHN MIN.) Lap finish
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3.01.00	DATA SHEET: HOISTS AND MONORAILS (AS APPLICABLE) <table><tr><td>1.0.0</td><td>GENERAL</td><td></td></tr><tr><td>1.1.0</td><td>Functional Requirement :</td><td> To handle (i) vacuum pumps, buffer hopper aeration blowers and its drives located near the first row column of ESP of each unit. To handle (ii) bag filter, vent filter, vent fan, drain pumps etc for intermediate silo, Main storage silo, HCSD Silos , of the classifier block, Dewatering Bins etc. </td></tr></table>			1.0.0	GENERAL		1.1.0	Functional Requirement :	To handle (i) vacuum pumps, buffer hopper aeration blowers and its drives located near the first row column of ESP of each unit. To handle (ii) bag filter, vent filter, vent fan, drain pumps etc for intermediate silo, Main storage silo, HCSD Silos , of the classifier block, Dewatering Bins etc.																		
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION: A-21 ASH HANDLING PLANT	PAGE 24 OF 45																							

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
			To handle (iii) Bottom ash overflow pumps, BA metallic conveyor drives, clinker grinders complete with drive motors, rails, fluid coupling, gear reducers and accessories located in bottom ash area. To handle (iv) HCSD charge pump, silo area drain pump, agitator tank motor & gearbox and other accessories located in between HCSD pump House and HCSD silo area. To handle (v) other miscellaneous fans, blowers, compressors, pumps, couplings, gearboxes and other accessories of more than 500 kgs.
	2.0.0	DESIGN & CONSTRUCTION REQUIREMENT	
	2.1.0	Hoists	
	2.1.1	Maximum trolley travel speed for electric hoists	15m/min
	2.1.2	Maximum Hoisting speed for electric hoists	6 m/min
	2.1.3	Drive Motors	SQIM, Separate for travel & lift
	2.1.4	No. of starts for drive motor	150 starts/hr at 40% CDF
	2.1.5	Wire Rope	
		(i) Type/Construction	Pre-formed type, hemp cored, regular lay 6/36 construction
		(ii) Breaking Strength	160-175 kgf/sq. mm
	2.1.6	Bearing	
		(i) Type	Ball/Roller bearing
		(ii) Life	20 years
	2.1.7	Brake	Electro Mechanical type with asbestos lining.
	2.1.8	Load Hook	Swiveling type forged circular shank section.
	2.1.9	Duty	Class –2
	2.2.0	Monorail location/layout	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION: A-21 ASH HANDLING PLANT
PAGE 25 OF 45			

CLAUSE NO.	TECHNICAL REQUIREMENTS				
3.02.00	2.2.1	Cross section		I beam	
	2.2.2	Distance between C/L of monorail & C.G. of equipment to be lifted		Maximum 500 mm	
	2.2.3	Power Cables Support		Festoon type arrangement	
	DATA SHEET FOR WATER AND AIR PIPING, FITTINGS AND ACCESSORIES				
	1.0	Type of Pipes	a)	Upto including 150 NB &	MS, ERW pipes to IS:1239 Heavy grade
			b)	200 NB to 450 NB	MS ERW to IS 3589.
					OR
				SAIL or equal make	ERW commercial quality pipes.
			c)	500 NB and above	Rolled and welded from MS plate to IS:2062 Dimensional tolerance as per IS 3589
					OR
					SAIL Equal make spiral welded pipes.
					Dimensional tolerance as per IS: 3589.
	2.0	Pipe Sizes		As required.	
	3.0	Thickness of Pipes	a)	Pipe specs. as per IS:1239	Pipe thickness shall be of Heavy grade.
			b)	Pipe spec. as per IS:3589	Min 7.1 mm thick for 200 NB to 450 NB
			c)	Pipe spec. as per IS:3589 for pipe sizes above 450NB	Min. 8.8 mm thick
				(ERW) from IS:2062 plates	
				(spiral welded)	
	4.0	Type of Line joints.	a)	50 NB and below	Socket welded to ANSI: B 16.11
			b)	65 NB and above.	Butt welded to ANSI: B16.25.
	5.0	Quantity		As required	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION: A-21 ASH HANDLING PLANT	PAGE 26 OF 45

CLAUSE NO.	TECHNICAL REQUIREMENTS 				
	6.0	Fittings (Bends)	a)	For sizes upto & including 65NB	1.5D radius bends and material same as that of parent pipe.
			b)	For sizes 80 NB to 300 NB	SR & LR elbow and material same as that of parent pipe.
			c)	350 NB & above.	Miter bends with Miter angle not exceeding 22.5°. Material shall be same as that of parent pipe and dimensional tolerance shall be as per BS : 534.
	7.0	Flanges			Slip on flat face type with drilled and pressure rating as per valve and other specialties. Material of construction shall be IS:226 upto 20 mm thickness and IS:2062 for higher thickness.
	8.0	Bolts			As per IS:1367 Clause 4.6 or ASTM-A-307-Gr.B.
	9.0	Nuts			As per IS:1367 Clause 4.0 or ASTM-A-307 Gr.B.
	10.	Gaskets			Wire inserted Red rubber. Thickness shall be 1.6 mm for sizes upto and including 250 NB and 3.2 mm for higher sizes.
	II.	AIR PIPES			
	1.0	Type of Pipe			a) ERW pipe as per IS:1239, heavy grade with galvanising as per IS:4736 for pipes upto & including 150 NB. For pipes of sizes above 150 NB it shall be as per Cl. I (1.0, b) & Cl. No. I (3 b) above.
	2.0	Pipe Sizes			As required.
	3.0	Thickness of pipes			For pipe size upto & including 150 NB, pipe thickness shall be of heavy grade as per IS:1239 and for pipes of higher sizes the thickness shall be as per Clause No.I (3.0) b & c mentioned above for water pipes
	4.0	Type of Line joints	(a)	65 NB and below.	Screwed
			(b)	80NB and above	Sleeve welded. However valve etc. shall be screwed and with flange
	5.0			Quantity	As required.
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION: A-21 ASH HANDLING PLANT	PAGE 27 OF 45

CLAUSE NO.	TECHNICAL REQUIREMENTS 				
3.03.00	6.0	Fittings/ (Elbows)			As per ASTM-A-234 Gr. WPB.(GI)
	7.0	Flanges			Raised face type G.I. screwed and pressure rating as per valve and other specialities. Material of construction on shall be IS:226 upto 20 mm thickness and IS:2062 for higher thickness.
	8.0	Bolts, nuts & Gaskets.			Same as for water pipes.
	DATA SHEET FOR WATER AND AIR LINE VALVES				
	1.0	Type of valves	a)	For isolation purpose	Gate/Plug /Ecentric plug/ Butterfly (double flanged or wafer type).
			b)	For Regulation purpose	Globe/butterfly(double flanged or wafer type)
			c)	For non return service	Check type
	2.0	Size of valves	:	Same as parent pipe size.	
	3.0	Pressure class		To suit service conditions of flow, valves temperature and shut off pressure.	
	4.0	Numbers required		As per system needs.	
	5.0	Method of operation	:	Manual/Solenoid operated and pneumatically actuated or motor operated as per system requirements.	
	6.0	Fluid to be Handled	:	Water and Air	
	7.0	Material of construction	:		
	7.1	For sizes below 50 mm and working pressure or shut off pressure (whichever is higher) is upto 15 Kg per cm ² (g) or upto 10 Kg per cm ² (g) for Plug valves			
		Body/Wedge/Disc	:	Gun Metal	
		Trim & Stem		Gun Metal	
	7.2	For sizes 50 mm and above and working pressure or shut off pressure (whichever is higher) upto 15 Kg per cm ² (g).			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION: A-21 ASH HANDLING PLANT	PAGE 28 OF 45

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
3.04.00		Body/Wedge/Disc	:	C.I. to IS 210 Gr. FG 220
		Trim & Stem		Brass/ Gun Metal
	7.3	For all sizes and working pressure or shut off pressure (whichever is higher) is above 15 Kg/cm ² (g) (Above 10Kg/cm ² for plug valves).		
		Body/Wedge/Disc	:	Cast/Forged carbon steel
		Wedge/Disc/Plug	:	Cast carbon steel with 13% Cr
		Trim and Stem	:	Stainless steel
	8.0	Quantity	:	As required.
	DATA SHEET FOR ASH SLURRY SUMP ISOLATION PLUG VALVES, SUMP/TRENCH LINERS, AND TRENCH JETTING/ SUMP AGITATING NOZZLES			
	1.	SUMP ISOLATION VALVE		
	1.	Type	:	Plug type, manually operated, suitable for outdoor, duty.
	2.	Numbers	:	As per scope
	3.	Size of valves	:	As required.
	4.	Material of	:	Corrosion and abrasion resistant construction materials to suit the service requirements.
	II.	TRENCH/SUMP LINERS		
	1.	Quantity	:	As required
	2.	Thickness	:	Trench: Minimum 30 mm thick on side walls and 35 mm thick at bottom.
			:	Sump: Minimum 20 mm thick.
	3.	Material of construction	:	Trench : Cast Iron (IS:210, FG:260)
			:	Sump: Alloy C.I. with minimum 350 BHN hardness.
	III.	TRENCH JETTING/SUMP AGITATING NOZZLES		
	1.	Quantity	:	As required.
	2.	Material of construction		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION: A-21 ASH HANDLING PLANT
PAGE 29 OF 45				

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
3.05.00	2.1	Body	:	MS/Cast iron.
	2.2	Nozzles Tip Type	:	Anti-corrosion tool steel or stainless steel of hardness 500-550 B HN.
	Aeration blowers for buffer hoppers and silos			
	Purpose		:	For fluidizing the ash in buffer hoppers and silos.
	Design		:	Positive displacement type to meet the aeration air requirements of buffer hoppers and silos. A 10% margin on capacity shall be provided over and above the maximum requirement.
	Design ambient condition		:	Temp. 50°C, RH-100%
	Heaters		:	To be provided to maintain the discharge temperature of the air at least 130 deg.C.
	Duty		:	Continuous, indoors
	Material Construction	of	:	Casing Shaft Rotors Piping CI EN-8 CI Galvanized steel, insulated to limit surface temperature to 60 °C.
3.06.00	Instrument air compressors and air drying plant			
	Applicable Codes		:	BS:1571
			:	IS:6206
			:	IS:5456
			:	ASME PTC 9
			:	IS:3401
	Type		:	Oil free screw type
	Design ambient conditions		:	50 Deg. C, 100% RH
	Duty		:	Continuous
	Design requirement		:	Instrument quality air as per instrument society of America standard S 7.34
	FAD of each set of working compressor at ambient condition			1200 m ³ /hr (min.). Bidder to justify the same during detailed Engg.
	Discharge pressure			8 Kg/cm ² (g)
	Dryness of air required		:	Dry air with a dew point of (-) 40 deg. C at 1 ata pressure.
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION: A-21 ASH HANDLING PLANT PAGE 30 OF 45

CLAUSE NO.	TECHNICAL REQUIREMENTS																											
3.07.00	<table><tr><td>Drive motor rating</td><td>:</td><td colspan="2">Continuous motor rating at 50 deg. C shall be at least 10% above the maximum load demand of the compressor in the entire operating range.</td></tr><tr><td>Air drying plant</td><td>:</td><td colspan="2"></td></tr><tr><td>TYPE</td><td>:</td><td colspan="2">Blower reactivated desiccant type</td></tr><tr><td>Design requirement</td><td>:</td><td colspan="2">To provide dry air as above with compressed air saturated with moisture at inlet to air drying plant.</td></tr><tr><td>Quantity</td><td>:</td><td colspan="2">One per compressor.</td></tr></table>				Drive motor rating	:	Continuous motor rating at 50 deg. C shall be at least 10% above the maximum load demand of the compressor in the entire operating range.		Air drying plant	:			TYPE	:	Blower reactivated desiccant type		Design requirement	:	To provide dry air as above with compressed air saturated with moisture at inlet to air drying plant.		Quantity	:	One per compressor.					
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	Sump drainage pumps:																											
	<table><tr><td>Type</td><td>:</td><td colspan="2">Vertical, centrifugal, single stage, semi-open or open (non-clog) type impeller with no bearing inside sump.</td></tr><tr><td>Duty</td><td>:</td><td colspan="2">Intermittent but to be designed for continuous operation.</td></tr><tr><td>Design requirement</td><td>:</td><td>a)</td><td>To transfer silo (BA & FA) area (with 30% ash by weight) up to ash slurry sump/HCSD system mixing tanks.</td></tr><tr><td>Capacity & head</td><td>:</td><td colspan="2">For silo area drainage pump, 80 m3/hr @ required head shall be suitably selected to pump the drain back to waste service water sump. 80 m3/hr @ required head for BA/Combined slurry pump house, ESP area / vacuum pump drain to HCSD Mixing tanks/Ash slurry sump as applicable.</td></tr><tr><td>Speed</td><td>:</td><td colspan="2">Max. 1500 rpm.</td></tr><tr><td>Type of coupling between pump & motor</td><td>:</td><td colspan="2">Directly driven through flexible/rigid coupling or V-belt driven.</td></tr></table>				Type	:	Vertical, centrifugal, single stage, semi-open or open (non-clog) type impeller with no bearing inside sump.		Duty	:	Intermittent but to be designed for continuous operation.		Design requirement	:	a)	To transfer silo (BA & FA) area (with 30% ash by weight) up to ash slurry sump/HCSD system mixing tanks.	Capacity & head	:	For silo area drainage pump, 80 m3/hr @ required head shall be suitably selected to pump the drain back to waste service water sump. 80 m3/hr @ required head for BA/Combined slurry pump house, ESP area / vacuum pump drain to HCSD Mixing tanks/Ash slurry sump as applicable.		Speed	:	Max. 1500 rpm.		Type of coupling between pump & motor	:	Directly driven through flexible/rigid coupling or V-belt driven.	
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Speed	:	Max. 1500 rpm.																										
Type of coupling between pump & motor	:	Directly driven through flexible/rigid coupling or V-belt driven.																										
3.08.00	Dry Ash unloader, Conditioned Ash unloader, Telescopic chute																											
	<table><tr><td>1</td><td>Qty</td><td>:</td><td>As per scope</td></tr><tr><td>2</td><td>Capacity range</td><td>:</td><td>40-100 TPH during open Truck/Bulker loading through Condition ash unloader 40-300 TPH for Truck/Bulker/Rail Wagon Loading through Dry Ash unloader</td></tr></table>				1	Qty	:	As per scope	2	Capacity range	:	40-100 TPH during open Truck/Bulker loading through Condition ash unloader 40-300 TPH for Truck/Bulker/Rail Wagon Loading through Dry Ash unloader																
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Suitable arrangement for Control of movement of Telescopic spout shall have to be provided in all three X-Y-Z directions to facilitate loading of ash into BOXN, BCFC, BCCW and BTAP Wagons during loading of Ash and to facilitate simultaneous loading into Wagons from all the Silos and into Wagons in between two Silos.																												
3.09.00	INTERMEDIATE ASH SLURRY TANK																											
3.09.01	The tank shall be of self-supporting type and the shape of the tank shall be to employer's approval.																											
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION: A-21 ASH HANDLING PLANT																								
PAGE 31 OF 45																												

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.09.02	The transfer tank shall be provided for two discharge outlets complete with pneumatically actuated slurry line valves as indicated in the tender drawings. The tank shall be provided two (2) nos. inspection windows, H.P. water connections, jetting nozzles, 200 NB overflow connection and operating platform at suitable elevation. Each transfer tank shall have an effective storage capacity equivalent to 10 minutes of storage of ash slurry transportation rate. For volumetric calculations the density of stored contents shall be taken as 0.8 T/m³ and for load calculations the density of stored ash shall be considered as 1.6 T/m³. The tanks shall be constructed of tested quality mild steel plates for minimum 10 mm thickness and shall be gunnited with 50 mm thick gunniting. The tank shall be complete with all make-up, drain, overflow and other associated piping and valves.			
	Data Sheet			
	1.0	Numbers of tanks	:	Two (2) per unit
	2.0	Effective storage capacity	:	Equivalent to 10 minutes of storage of ash slurry transportation rate.
	3.0	Tank Body	:	Tested quality mild steel plates of thickness not less than 10 mm (IS: 2062) and suitably stiffened with rolled steel sections.
4.0	Nozzles	:	Body: Cast Iron/ Mild Steel Tips: Anti corrosive tool steel / stainless steel of hardness not less than 550 BHN.	
4.00.00	ASH SLURRY DISPOSAL PIPING AND ACCESSORIES			
	Location	:	i)	For BA transportation from boiler area upto slurry sump of BA slurry disposal pump house. For BA transportation from jet pump discharge upto bottom ash slurry sump.
			ii)	From the ash slurry disposal pump discharge upto disposal point at the Dewatering Bins/ upto Ash Dyke
	Type	:	a)	20 thk. Cast basalt lined MS (MS shell of 6.00 mm thick) piping for BA slurry transportation from boiler area up to slurry sump of BA slurry pump house and slurry disposal pipes with ash slurry pump house. From ash slurry disposal pump discharge upto disposal point at the Dewatering Bins, & in culverts/trenches at rail/road crossings.
	Type joint	:		Sleeve type coupling joint in straight sections flanged joints at fittings, bends, and elbows. laterals etc.
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION: A-21 ASH HANDLING PLANT
				PAGE 32 OF 45

CLAUSE NO.	TECHNICAL REQUIREMENTS				
4.01.00	Maximum spacing between sleeve type coupling shall be		50 Meter		
	Ash slurry concentration		:	Not more than 28% (w/w)	
	Flow velocity		:	Not to exceed 2.8 m/sec.	
	Pipe fitting (Bends, elbow, lateral etc.).				
	Type	:	i) Ni-hard/chrome alloy C.I. or equivalent of minimum 400 BHN. Integral wear back of minimum 20mm thickness. OR ii) 20 mm thick cast basalt lined MS fitting (MS shell of 6 mm thickness)		
	Properties of cast basalt		:	(Pipes & fittings)	
	Hardness		:	8 mhos. (min.)	
	Bending strength		:	300 kg/cm2 (min.)	
	Compressive strength		:	4500 kg/cm2 (min.)	
	Density		:	2.8 – 3.1 gm/cm³	
	Thickness				
	MS Shell		:	6 mm (min.)	
	Basalt lining		:	20 mm +/- 2 mm	
	Integral wearback for alloy CI		:	20 mm (min)	
	Couplings				
	Type	:	Sleeve type couplings with minimum 9.0 mm thick sleeve.		
	ASH WATER PIPING				
	Location		a) Upto & including 150 NB	MS. ERW pipes to IS:1239 Heavy grade.	
			b) 200 NB to 450NB	MS ERW to IS 3589.	
				OR	
				SAIL or equivalent makes ERW commercial quality pipes.	
				Dimensional tolerance as per IS:3589	
			c) Above 450 NB	Rolled and welded from MS plate to IS:2062.	
				Dimensional tolerance as per IS:3589	
				OR	
				SAIL or equivalent make ERW commercial quality pipes.	
	SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION: A-21 ASH HANDLING PLANT
	PAGE 33 OF 45				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
				Dimensional tolerance as per IS:3589
	Pipe Sizes		As required	
	Thickness of pipes	a)	Pipes specs as per IS:1239	Pipe thickness shall be of Heavy grade.
		b)	Pipe spec. as per IS:3589 (ERW)	Min 7.1 mm thick for pipes upto 450NB and min. 8.8 mm thick for pipes above 500NB
	Type of line joints			
		a)	50 NB and below	Socket welded to ANSI:B16.11.
		b)	65 NB and above	Butt welded to ANSI: B16.25/ Flanged to ANSI 16.5
5.01.00	HORIZONTAL CENTRIFUGAL PUMPS			
	Type			
	This specification shall cover the horizontal centrifugal pumps to be used for various applications in the ash handling system such as ash water pumps, ash slurry disposal pumps, Dust suppression pumps, seal water pumps etc.			
	The pump shall meet the following criteria:			
	1.	Description	Bottom/Combined ash slurry disposal pumps, BA slurry transportation pumps (if applicable), B.A. overflow water transfer pumps, Sludge pumps, coarse ash slurry transportation pumps	BAHP, BALP, FAHP, Flushing water, Seal water, eco ash water pump and other water pumps.
	2.	Duty	Continuous	Continuous
	3.	Parameters Flow Head	To be decided by Bidder. Ash slurry disposal pumps shall be sized for the maximum level of ash dyke/Mine void area. 10% margin shall be considered over and above the total straight pipe length and bends loss.	To be decided by Bidder. In case of seal water pumps, sealing requirements during flushing of standby slurry disposal stream shall also be considered when determining pump capacity. 15% margin shall be provided in the pump capacity for all water pumps excepting BA overflow water pump & flushing water pump which shall have no margin.
	4.	Nos. operating	As specified in Tender Drawing	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION: A-21 ASH HANDLING PLANT
				PAGE 34 OF 45

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	5.	i) Pump speed (max.)	1000 rpm. However, for sludge pumps the maximum pump speed shall be 1500 RPM.	1500 rpm.
		ii) Impeller tip speed	1676 meters/min. (max.)	-
	6.	Type of coupling	Variable speed Hydraulic coupling with speed reduction by means of speed reduction gear box in first stage. Speed variation +10%/ - 45% with respect to rated design point in case of ash slurry disposal pumps and $\pm$ 20% in case of B.A. slurry transportation pumps and B.A. over flow water transfer pumps.	Directly driven through coupling.
			Through belt drive for the subsequent ash slurry disposal pump stages.	
	7.	Material of construction		
		i) Casing	Outer casing shall be of cast steel to ASTM-A216 or spheroidal Graphite Ductile iron to ASTM-A536, 65-45-12. Inner casing (Volute liners) shall be of chrome nickel cast iron (composition to NI hard-IV) of 550 BHN	2-2.5% Ni-cast Iron to IS:210, Grade FG-260.
			or	
			24% chromium cast iron of 550 BHN.	
		ii) Impeller	Chrome nickel cast Iron (composition to NI-hard IV) of 550 BHN	Bronze Gr. I to IS : 318.
			or	
			24% chromium cast iron of 550 BHN.	
		iii) Wear plate/liners wear rings	- do -	Bronze Gr. 2 to IS:318 or equivalent
		iv) Shaft	Carbon steel to AISI C-1040/EN-8	Carbon steel to AISI C-1040/EN-8
		v) Shaft sleeve	Hardened and ground stainless steel (550 BHN)	As per manufacturer's std.
		vi) Base plate	Steel to IS:2062	
	8.	Drive Motor		
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION: A-21 ASH HANDLING PLANT PAGE 35 OF 45

CLAUSE NO.	TECHNICAL REQUIREMENTS					
6.00.00						
		i)	Rating	20% margin over and above the maximum load demand in the entire operating range of pump at 50°C.	10% margin over and above the maximum load demand in the entire operating range of pump at 50°C.	
		ii)	Speed	1500 rpm.		
	9.	Ash slurry pump efficiency		To be selected by bidder. However, for the purpose of evaluation no credit shall be given for pump efficiency in excess of 70% while handling ash slurry for ash slurry disposal pumps, bottom ash slurry transportation pump and BA overflow pump.	---	
	Note:- The ash slurry disposal pumps shall also be required to handle clarifier sludge from the water treatment plant and DM plant effluent and the same shall be taken into consideration while sizing the pumps					
	High Concentration Ash Slurry Disposal System					
	i) Fly ash from HCSD cum storage silos shall be fed to rotary feeders and ash conditioners and to mixing tank/ retention tank through weighting unit. Further water is added in the mixing tank/retention tank and the entire ash is blended to a uniform consistency by mixer.					
	ii) The HCSD pumps shall also be suitably designed for high concentration disposal system considering minimum static lift and necessary pulsation dampeners/accumulator immediately after slurry pump discharge and/or on discharge lines to minimize pressure fluctuation ($\pm$ 5%) shall be provided.					
iii) No interconnection between the HCSD pipelines is to be provided.						
iv) Provision shall be kept to supply water at each of the slurry disposal pump stream suction for flushing the disposal line by running the slurry disposal pumps stream (series) prior to shut down of a pump stream. For supplying water at the suction of HCSD pumping stream for flushing, fly ash water pump shall be used and the water connection shall be made on downstream of the suction valve of the slurry pump series alongwith necessary piping and valves.						
v) Bidder should ascertain the slurry rheological characteristics to design ash slurry pumping system. Chemical treatment if required for HCSD slurry formation shall be provided. No extra claim shall be entertained for system modifications at later date on account of the same.						
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE			TECHNICAL SPECIFICATION SECTION– VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION: A-21 ASH HANDLING PLANT PAGE 36 OF 45	

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	vi) Fly ash in high concentration form shall be disposed off in the ash disposal area earmarked for stacking ash slurry and routing of HCSD pipes inside ash dyke including garlanding of dyke and routing of ash pipeline inside the disposal area is in bidder's scope.			
	DATA SHEET FOR HIGH CONCENTRATION SLURRY DISPOSAL SYSTEM			
	1.0	High concentration slurry disposal pump		
	1.1	Type of pump	: Positive displacement, hydraulically actuated variable frequency drive operated.	
	1.2	No. of pumps	: As per scope	
	1.3	Operating range of pump	: 10% to 100% of rated slurry flow rate.	
	1.4	a) Drive motor 1500 rpm b) Method of cooling c) Minimum margin	: Motor with variable frequency drive : 10 to 100% of rated slurry flow rate : Air cooled : 15 percent	
	1.5	Maximum allowable pulsation in discharge pressure	: (+) 5% operating pressure	
	1.6	Capacity required	: To suit to one (1) unit BA and fly ash generation. Considering 2X50% working pump per unit.	
	1.7	Head required	: As required.	
	1.8	Liquid to be handled	: Combined BA and Fly ash slurry of concentration 60% by weight	
	1.9	Range of slurry concentration to be handled by pump	: 55 to 65% by weight	
	2.0	Mixing & Retention Tank		
	2.1	Nos.	: 1 no. for each HCSD pump	
	2.2	Capacity	: Storage capacity equivalent to minimum 30 minutes discharge capacity of HCSD pump.	
	2.3	Material of construction	: Minimum 10 mm thick carbon steel as per IS:2062	
	2.4	Lining	: Minimum 6 mm thick rubber lining	
	2.5	Type of mixer	: Vertical spindle with at least two sets of agitators blades.	
	SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION: A-21 ASH HANDLING PLANT
				PAGE 37 OF 45

CLAUSE NO.	TECHNICAL REQUIREMENTS				
	3.0	Ash Conditioner	:		
	3.1	Nos.	:	As per scope	
	3.3	Capacity	:	To suit the system requirement	
	4.0	Rotary Feeder	:		
	4.1	Nos.	:	As per scope	
	4.2	Drive	:	Motor with VFD	
	4.3	Capacity	:	To suit the system requirement	
	5.0	HCS D Pipes	:		
	5.1	Type	:	Seamless carbon steel pipes according to Schedule -80	
	5.2	End style of Pipes	:	Plain end	
	5.3	Maximum velocity inside pipeline	:	1.9M/Sec. @ rated duty point	
	5.4	Length	:	As per SCOPE	
	5.5	Pipe Fittings	:	Minimum 3D radius of seamless carbon steel pipes (Schedule -80) with 10mm addition thick plate at the back of fittings.	
	7.00.00	Layout Requirements			
	7.01.00	While deciding the layout of buildings namely Ash water pump house, Transport air compressor house, Conveying air compressor house, combined Ash slurry pump house, Silo utility building and other pump houses the Bidder shall consider the following parameters. (a) Minimum clear working space around the equipment shall be 1200 mm: (i) In case of vertical suction / discharge pumps, the clear space shall be distance between edges of pedestals of adjacent pumps & the same shall be 1200 mm. (ii) In case of horizontal/suction discharge pumps distance between outer of suction pipe of one pump & outer of discharge pipe of another pump shall be 1200 mm minimum. (iii) Distance between inside face of column to edge of pump/pedestal shall be 1200 mm minimum.			
7.02.00	Suction & discharge header shall be routed inside/outside the building.				
7.03.00	In case of two (2) rows of pumps/equipment located in parallel, minimum distance between the equipment shall be meet the following criteria. (a) Clear distance between edge of pedestals/motors of pump located parallel shall be 2000mm.				
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION: A-21 ASH HANDLING PLANT	
PAGE 38 OF 45					

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(b) In case of space provided is acting as the handling space for the equipment by overhead crane the space shall be maximum size of equipment being handled plus the clearance of 500 mm minimum on either side with the stationary equipment. (c) Withdrawal spaces of equipment.			
7.04.00	Provision of minimum 550 mm clear walkway at crane rail level on both the side of the building.			
7.05.00	Building height shall take care of the following parameters (a) Head room for the piping/cablings shall be 2500 mm (minimum). (b) In case of handling of the equipment one over the other, the clearance between moving & stationary equipment shall be 500 mm (minimum). (c) In case of handling of the equipment on the side of the other equipment, ground clearance of moving equipment shall be 2500 mm (minimum). (d) Head room of 2100 mm over EOT crane rail level walkways. Pipes & cables shall be routed over ground inside/outside the building.			
7.06.00	No pipe trenches are to be routed inside or outside the building. However, cable slits can be provided for routing of cables from the overhead cable trays to the respective motor of the equipment cable slits shall be finished to surrounding floor level with adequate cushioning of sand.			
7.07.00	One maintenance bay of 6m (minimum) x the width of the building shall be provided.			
7.08.00	Two (2) nos. of rolling shutter of size 4000 x 4000 mm (min) shall be provided one at the entrance and the other at exit of maintenance bay. In case entrance & exit of maintenance bay is common i.e. on the same side, only one rolling shutter of size 4000 x 4000 can be provided.			
7.09.00	Valves shall be located such that they are accessible from the regular floor of the building, as far as possible. Valve operating platform's alongwith approach ladder/cage ladder shall be provided for the valves which are not accessible from the floor of the building.			
7.10.00	Each equipment room shall be provided with alternative exits in case of fire/accidents as per requirement of factories act and statutory bodies/insurance companies.			
7.11.00	Hoist maintenance platforms along with approach ladder shall be provided, preferably at the end of the building. Any maintenance platforms/supporting structure required for ash handling facilities in the boiler envelope shall also be provided by the contractor.			
7.12.00	BUILDING/PUMP HOUSE DETAILS (A) ASH WATER PUMP HOUSE i) Sump shall be along the entire length of the building. Hand railing shall be provided all around the sump top. ii) Ash water sump shall be clear of intermediate columns. Further the sump house shall also be provided with columns only at periphery without any intermediate columns. iii) Two (2) nos. 1200 MM wide staircase shall be provided on either side of the sump, to reach on the top of the sump. iv) Two (2) number access ladders 600 MM wide shall be provided to access bottom of the sump. v) The ash water pump house shall be open type.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION: A-21 ASH HANDLING PLANT	PAGE 39 OF 45

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	vi) For handling of equipments of the ash water pump house, mobile crane shall be used. This mobile crane is not in the scope of the bidder. Proper access & approach for the mobile crane up to all the equipments shall be ensured by the Bidder. B) ASH SLURRY PUMP HOUSE i) The Combined Ash slurry pump house shall be shed type. Sump wall on Pump House side shall be raised by 300 mm above EL 0.0 M to prevent slurry inflow into PH. Beyond that cladding is to be provided. Other three side of PH shall be kept open. ii) For maintenance of the equipments in the pump house pendent controlled electrically operated overhead traveling crane shall be used. C) TRANSPORT AIR/ CONVEYING AIR/ CLASSIFIER AIR COMPRESSOR HOUSE i) The compressor houses shall be shed type with side sheeting. ii) For maintenance of the equipments in the compressor house pendent controlled electrically operated overhead traveling crane shall be used. D) SILO AREA UTILITY BUILDING i) The silo area utility building shall be RCC building. ii) For maintenance of the equipments in the silo utility building pendent controlled electrically operated overhead traveling crane shall be used. E) VACUUM PUMP AND BLOWERS i) Vacuum pumps shall be installed below ESP. ii) Fluidizing blowers for buffer hoppers shall be located below the ESP near 1st row. iii) Monorails and hoists for vacuum pumps (if applicable) and Buffer hopper aeration blowers and its drives shall be located near first row of ESP. F) HCSD PUMP HOUSE i) The HCSD pump house shall be shed with profiled pre-painted metal sheeting for Sides. ii) For maintenance of the equipments in the pump house pendent controlled electrically operated overhead traveling crane shall be used. G) GENERAL a. Bidder shall provide grating to cover the complete sump for all sumps including sumps in the Ash water pump house and silo area. Further the grating platforms required in any of the buildings housing ash handling system equipments shall also be supplied by the bidder including the structural steel supports. The exact details of these platforms shall be decided during detailed engineering. b. All the buildings shall be provided with columns only at periphery without any intermediate columns. c. Barrier of minimum 3 m height along with supports etc, shall be provided to protect vacuum pumps, etc located near ESP first field, from ash dumped from ESP hoppers.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION: A-21 ASH HANDLING PLANT
		PAGE 40 OF 45

CLAUSE NO.	TECHNICAL REQUIREMENTS			
8.03.05	Ash slurry disposal pumps, associated makeup and slurry valves shall be operated from the OWS of DDCMIS. The operating status of bottom ash slurry disposal pumps and various valves shall be reflected in the mimic diagram of ash handling system. Silo Area: One (1) no. silo local panel for each silo shall be provided for controlling the unloading of ash from silos. All the commands from this panel shall be routed through DDCMIS. Operating status of various equipments shall be reflected in the mimic diagram of the ash handling system.			
8.03.06	The above is only a general description of operational philosophy. The Bidder shall include in his proposal a detailed description of the operation philosophy as offered by him and as required for safe operation of the system, complete with block logic diagram, schemes etc.			
8.04.00	Protective Interlock Arrangement for Ash Handling System			
8.04.01	To ensure safe operation of the equipment connected with handling system of bottom ash and fly ash, the following minimum protective features and safety interlocks shall be included in Bidder's scope of supply.			
8.04.02	(a) It shall not be possible to start the Bottom Ash overflow water pump and bottom ash slurry disposal pump/combined ash slurry disposal pump unless the following conditions are satisfied: (1) Pre-set gland seal water pressure is available. (2) One stage of pumps shall start only if other stage/stages in the upstream side of this stage is running. (Applicable to series pumping only). (3) Suction valve is open (4) Combined ash slurry sump/Bottom ash slurry sump and BA overflow water tank level is at or above in the preset safe operating level. (5) In case of series pumping the sequence of starting of each series of slurry disposal pumps shall be suction valve first, 1st stage pump (closest to suction valve) next, followed by 2nd stage pumps so on and finally discharge valve. (6) By using a suitable device, the interlock requiring the last stage is tripped when discharge valve is closed is to be suitably by passed during a normal starting. However, the pump shall automatically trip if the discharge valve fails to open within a preset time after starting of the last stage pump. (b.) The BA overflow water pump and Combined/Bottom ash slurry disposal pumps shall trip in the event of the following emergency conditions. (i) Seal water pressure falls below a preset value (for any stage of pumping). (ii) Combined ash slurry sump/Bottom ash slurry sump and BA overflow water tank level falls at or below preset danger (low) level. (iii) If for any reasons one pump stage in a series trip, the other stages of the series shall also trip. (Applicable to series pumping). (iv) Suction/discharge valve is closed. (c.) The discharge valve of BA overflow water pumps, combined ash slurry disposal pump /Bottom ash slurry disposal pumps shall close as soon as the slurry pump/last pump stage in the series has tripped. Discharge valve will open after running of common bottom ash slurry pump stream.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION: A-21 ASH HANDLING PLANT
PAGE 42 OF 45				

CLAUSE NO.	TECHNICAL REQUIREMENTS	
8.04.03	It shall not be possible to start the clinker grinder motor unless the preset gland water pressure for the grinder is available and preset water pressure is available at jet pump. 1. In the event of gland seal water pressure falling below preset value, the running grinder motor shall trip and the corresponding hopper gate closed. 2. In the event of an overload on the grinder, the grinder motor shall trip. In such a case, subject to availability of preset gland seal water pressure, the grinder motor shall reverse in short impulses to remove materials jammed in the grinder. After pre-determined cycles, in case jamming is not cleared, the grinder motor shall trip. 3. It shall not be possible to open the hopper discharge gate unless clinker is started and running.	
8.04.04	Protective interlocks on fly ash handling system: Evacuation initiation and status monitoring check shall include: - Air pressure/vacuum and flows - Valves status - Buffer hoppers/storage silos levels/ESP hopper ash, APH hopper etc & Blow Tank Level	
8.04.05	Protective Interlock Arrangement for Ash Water Pumps a) It shall be possible to keep any one Ash Water Pumps as standby. Ash Water Pump shall be arranged to start automatically when any one of the working Ash Water pumps trips of Ash Water Line Header pressure falls below pre-set value. b) Level Detection Equipment for Combined Ash Slurry Sump, Ash Water Sumps, Drain Sumps and Settling Tanks of BA overflow water system, BA overflow tank etc..	
8.05.00	Level Indicators Level indicators to be provided as per P&ID's.	
8.06.00	Tank/Sump Make-up Water Valve The Bidder shall supply adequate size valves for installation in the make-up water line to tanks. These valves shall be complete with device for operation from OWS. The valves shall be ON-OFF type.	
8.07.00	Seal Water Pump Control (i) It shall be possible to start the seal water pumps only if preset suction pressure is available. (ii) The seal water pump shall trip in the event of suction pressure dropping below preset value. (iii) During normal operation, any one of the two seal water pumps shall be working. On seal water discharge pressure falling below a preset value, the standby pumps shall be automatically switched on subject to availability of preset suction pressure. Starting of this standby pump shall be annunciated in the main control panel. It should also be possible, by means of selector switch provided in the main control panel, to keep any one of the pumps as normally working and other as standby.	
8.08.00	Sump Drainage Pump Controls Either of the two (2) sump pumps shall be automatically switched on if the level in the sump rises above a preset level. The second pump shall automatically start if the first pump fails to start when level is high or if the level continues to rise. The operating pump shall trip in case the sump level goes below a preset level.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001
SUB-SECTION: A-21 ASH HANDLING PLANT		PAGE 43 OF 45

CLAUSE NO.	TECHNICAL REQUIREMENTS			
8.09.00	Make up valves of ash water sump The control and operation of ash water sump make up valves shall be included in the ash handling control system.			
8.10.00	Fly ash transportation system All process control for fly ash transportation of each unit shall be obtained from the OWS. The operator will normally pre-set-up the required transportation routing and sequence to management instructions. Subject to completion of the necessary permissive and sequence interlocks operator "Start" initiations of the appropriate lines would automatically select and start the service plant for commencement of de-ashing. a) Once started, the systems, will continue in automatic operation as programmed. It shall be possible for the operator to make on-time adjustments to timings, routings, selections etc. with appropriate 'selection checks' before "Command" initiation. Also programme interruption shall be possible to effect unscheduled or out of sequence extraction before return to the original programme. b) The emptying of the buffer hoppers/ESP Hoppers to Main storage silos or to slurry sump through Ejectors will be performed in automatically. The command signal for automatic switching over from Dry to Wet mode or reverse shall be given by the operator. Necessary valve system shall be provided with automatic control to direct the fly ash from buffer hopper to either in Combined Slurry Sump or Dry Ash silos near plant boundary			
8.13.00	Logic Diagram: - The contractor shall furnish comprehensive logic diagram showing all interlock, protection, sequence and alarm requirement of complete system to the Employer during detailed engineering stage. In this logic diagram, tag no. corresponding to I/O list and drive list shall be clearly indicated. The format of this logic diagram shall be informed by Employer during detailed engineering. The recommended write up and logic diagrams shall match fully. The above is only a general description of operational philosophy. The Bidder shall include in his proposal a detailed description of the operation philosophy as offered by him and as required for safe operation of the system, complete with block logic diagram, schemes etc.			
9.00.00	GENERAL INSTRUMENTATION REQUIREMENTS FOR ASH HANDLING SYSTEM			
9.01.00	All the instruments including transmitters, temp elements etc., which are required for safe and reliable control, monitoring and remote operation of the equipment / plant/ systems, are to be provided by the contractor. These shall also include all instruments required to implement the control philosophy and as finalized during detailed engineering stage.			
9.02.00	Further, redundant electronic transmitters for control & remote monitoring shall be provided as a minimum for following measurements as applicable:- 1) Ash water sump level measurement (3 nos. LT), Ash slurry sump level measurement - using Ultrasonic type level transmitter, 2) Vacuum measurements of each line, Conveying / transportation line pressure measurement, Instrument air compressors discharge header pressure. 3) HP water pressure measurement at each BA jet pump line. 4) Discharge headers of BAHP pumps, BALP pumps, FA HP pumps, seal water pumps, and economizer water pumps.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION: A-21 ASH HANDLING PLANT
PAGE 44 OF 45				

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	Also, electronic transmitters for control & remote monitoring shall be provided as a minimum for following measurements as applicable. 1) BA overflow transfer hopper / tank level measurement, Seal water tank level measurement, Silo level measurement, over ground water tank silo area level measurement - using Ultrasonic type level transmitter. 2) Discharge headers of BA overflow water pumps, sludge pumps, flushing water pump, ash conditioning water pumps. 3) Seal water pressure measurement at each clinker grinder. 4) Instrument Air pressure measurement at Bottom ash area and FAE tower area of each unit as well as at silo area. 5) Cooling water supply pressure of each TAC. 6) One no. Dew point meter for each TAC. 7) Fluidizingcsd blower discharge pressure.	
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION: A-21 ASH HANDLING PLANT
		PAGE 45 OF 45



SUB-SECTION–A-22

MILL REJECT HANDLING SYSTEM

**SINGARENI THERMAL POWER PROJECT
STAGE-II (1X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC NO.:CW-CM-11159-C-O-M-001**

CLAUSE NO.	TECHNICAL REQUIREMENTS																																																																							
1.00.00	MILL REJECT HANDLING SYSTEM																																																																							
	Mechanical conveying system shall be employed for handling of the mill rejects. Each mill reject discharge hopper shall be fitted with Feeder which shall discharge the mill rejects through Mechanical Conveyors to a storage Silo. The transmitting vessel shall operate on level probe mode with timer back-up.																																																																							
2.00.00	MILL REJECT HANDLING SYSTEM OF MECHANICAL TYPE MEETING THE FOLLOWING REQUIREMENT SHALL BE PROVIDED:																																																																							
	The discharged rejects from coal mill shall be collected in a dedicated pyrite hopper. Each pyrite hopper shall be provided with cylinder operated knife gate valves at inlet and outlet. Material from pyrite hoppers shall be removed by Mechanical conveyor and fed to main conveyor for further conveying. The main conveyor shall feed to a bucket elevator which in turn will feed to main storage silo.																																																																							
2.01.00	<table><tr><td>1.</td><td>Pyrite Hopper</td><td></td><td></td></tr><tr><td>a)</td><td>Minimum effective storage</td><td>:</td><td>30 minutes of maximum specified mill reject collection</td></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td>b)</td><td>No. pyrite hopper</td><td>:</td><td>One (1) for each mill, supported independently on steel columns</td></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td>c)</td><td>Function</td><td>:</td><td>To store mill reject on load maintenance of conveyors and act as a transition tank for falling mill rejects during normal working.</td></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td>d)</td><td>Number and type of isolation gates</td><td>:</td><td>Cylinder operated sliding type gates reject feeding at inlet and outlet of pyrite hopper.</td></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td>e)</td><td colspan="3">Accessories</td></tr><tr><td></td><td>Pyrite hopper</td><td>:</td><td>Access doors/ manholes /Inspection windows/ Poke holes Size: 300 mm dia circular or 300 mm x 300 mm, if rectangular or</td></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td>2)</td><td>Material of construction</td><td>:</td><td></td></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td>a)</td><td>Pyrite hopper</td><td>:</td><td>Tested quality mild steel plates of thickness not less than 10 mm (IS: 2062) and suitably stiffened with rolled steel sections.</td></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td>b)</td><td>Slide gates</td><td>:</td><td>Carbon steel</td></tr></table>				1.	Pyrite Hopper			a)	Minimum effective storage	:	30 minutes of maximum specified mill reject collection					b)	No. pyrite hopper	:	One (1) for each mill, supported independently on steel columns					c)	Function	:	To store mill reject on load maintenance of conveyors and act as a transition tank for falling mill rejects during normal working.					d)	Number and type of isolation gates	:	Cylinder operated sliding type gates reject feeding at inlet and outlet of pyrite hopper.					e)	Accessories				Pyrite hopper	:	Access doors/ manholes /Inspection windows/ Poke holes Size: 300 mm dia circular or 300 mm x 300 mm, if rectangular or					2)	Material of construction	:						a)	Pyrite hopper	:	Tested quality mild steel plates of thickness not less than 10 mm (IS: 2062) and suitably stiffened with rolled steel sections.					b)	Slide gates	:	Carbon steel
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SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION-A-22 MILL REJECT HANDLING SYSTEM																																																																				
PAGE 1 OF 3																																																																								

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.02.00	Metallic Conveyors			
2.03.00	Data Sheet			
	1)	Function	:	To convey mill rejects, from pyrite hopper to main storage silo.
	2)	Location	:	Under the coal mill, and up to main mill reject storage silo in each unit/ bucket elevator.
	3)	No.	:	one (1) no. working set of conveyors per row of mills per boiler
	4)	Capacity	:	It shall be designed for continuous removal of mill rejects.
	5)	Continuous normal operating capacity	:	To meet the mill rejects removal rates specified.
	6)	Continuous maximum operating capacity	:	At least 25% margin on normal operating capacity.
	7)	Tensioning arrangement		Hydraulic/pneumatic
	8)	Metallic belt conveyor/Chain Flight Conveyor will be required to handle highly abrasive rejects continuously. So all components shall be of proven design having a track record of trouble free-operation in order to avoid problems of frequent stoppages. The conveyor shall be sized for startup with load.		
	9)	The conveyor shall be fully enclosed in casing.		
	10)	Separate conveyor(if applicable) shall be provided to remove fines. The conveyor may operate continuously/intermittently.		
	11)	The conveyor/rollers bearings shall be grease packed with facility of recharging from outside		
	12)	Reliable and proven hydraulic/pneumatic auto take up arrangements, with facility of adjustment of tension. The tension assembly shall be designed to absorb any momentary shock loading.		
	13)	800 mm walkway along both sides of conveyor for Maintenance shall be provided.		
	14)	Suitable clean (if applicable) out conveyor shall be provided for removal of spillage/fines.		
2.04.00	Material of construction of conveyor components			
	a)	conveyor	:	Heat resistant stainless steel /Stainless steel / alloy carbon steel / carbon steel, suitable for 200 deg C (minimum). Any other suitable material of construction of proven design
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION-A-22 MILL REJECT HANDLING SYSTEM
PAGE 2 OF 3				



SUB-SECTION-A-23

LP DOSING AND OXYGENATED TREATMENT SYSTEM

**SINGARENI THERMAL POWER PROJECT
STAGE-II (1X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC NO.:CW-CM-11159-C-O-M-001**

CLAUSE NO.	TECHNICAL REQUIREMENTS															
	LP DOSING AND OXYGENATED TREATMENT SYSTEM															
1.00.00	General															
1.01.00	Employer proposes to maintain chemistry of boiler feed water using Combined Water Treatment (CWT) using Oxygen Dosing in the feed water, generally as per the guidelines of EPRI, USA / VGB, Germany / CEGB, UK / relevant Japanese standard. The following parameters of feed water are proposed to be maintained: <table><tr><td>Cation Conductivity</td><td>≤ 0.2 micro siemens / cm</td></tr><tr><td>pH value (25 deg. C)</td><td>8-8.5</td></tr><tr><td>Oxygen</td><td>20-200 ppb</td></tr><tr><td>Iron</td><td>≤ 10 ppb</td></tr><tr><td>Copper</td><td>≤ 2 ppb</td></tr><tr><td>Silica</td><td>≤ 20 ppb</td></tr></table>				Cation Conductivity	≤ 0.2 micro siemens / cm	pH value (25 deg. C)	8-8.5	Oxygen	20-200 ppb	Iron	≤ 10 ppb	Copper	≤ 2 ppb	Silica	≤ 20 ppb
Cation Conductivity	≤ 0.2 micro siemens / cm															
pH value (25 deg. C)	8-8.5															
Oxygen	20-200 ppb															
Iron	≤ 10 ppb															
Copper	≤ 2 ppb															
Silica	≤ 20 ppb															
1.02.00	However, during startup or chemistry excursions, All Volatile type of Treatment (AVT) using ammonia dosing shall be used. The following parameters shall be maintained in case of AVT. <table><tr><td>Cation Conductivity</td><td>≤ 0.25 ms / cm</td></tr><tr><td>pH value (25 deg. C)</td><td>9.0-9.6</td></tr><tr><td>Oxygen</td><td>≤ 7 ppb</td></tr><tr><td>Iron</td><td>≤ 10 ppb</td></tr><tr><td>Copper</td><td>≤ 2 ppb</td></tr><tr><td>Silica</td><td>≤ 20 ppb</td></tr></table>				Cation Conductivity	≤ 0.25 ms / cm	pH value (25 deg. C)	9.0-9.6	Oxygen	≤ 7 ppb	Iron	≤ 10 ppb	Copper	≤ 2 ppb	Silica	≤ 20 ppb
Cation Conductivity	≤ 0.25 ms / cm															
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Copper	≤ 2 ppb															
Silica	≤ 20 ppb															
1.03.00	Sodium and Chloride limit in case of both CWT & AVT feed water shall be maintained upto 2 ppb each at Condensate Polishing Plant outlet. The proposed design features of the Condensate polishing plant is indicated in Sub Section A-2 (Equipment Sizing Criteria) of Part B, Section VI, book 1 of 5 of technical specification and considering the above the Boiler Feed Water Treatment System shall be designed, supplied and installed by the Contractor.															
1.04.00	The chemical regime given above is indicative only. Bidder shall furnish in his offer the appropriate chemical regime as per the practice, which shall be discussed & finalised in case of award.															
2.00.00	Oxygen Dosing System															
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION- A – 23 LP DOSING AND OXYGENATED TREATMENT SYSTEM	PAGE 1 OF 4												

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Complete Oxygen Dosing System shall be supplied and installed by the Bidder. It is proposed to dose Oxygen at two (minimum) locations in the Condensate and in Feed water circuit of each unit. i.e. one at outlet of condensate polishing Plant and another at the outlet of deaerator (suction line to feed water pumps). Additional dosage points if required as per manufacturer's standard practice shall also be included by the Bidder. Each of the dosing locations shall be provided with a set of Oxygen cylinders with required cylinder isolation/check valves, cylinder manifolds, isolation valves in the common manifold, piping from manifold, dosing (automatic type) valves of regulating valve, check (non-return type) valve, Instruments for measurement of oxygen & conductivity of condensate & feed water lines at the downstream of dosing locations, associated control system etc. The dosing rate shall be regulated automatically by control system based on the quality of condensate water and feed water quality as the case may be. The control system shall facilitate selection of oxygen dosing locations. Regulating type valves shall be provided with isolation valves at upstream & downstream end to facilitate replacement/repair of regulating valve. At each dosing locations, system shall be designed for a maximum dosage rate of 150 ppb and number of oxygen cylinders to supplied and installed by the Contractor shall cater for one-month requirement. However, the dosing facilities shall have redundancy of 100% for each location per unit. For each dosing location per unit, the skid containing equipment required for dosing like isolation/ check valves, cylinder manifolds, regulating valves, instruments shall be redundant (2 nos. for each location of one unit), so that problem in one dosing skid of one location shall not hamper dosing process at that location. A minimum number of five (05) oxygen cylinders shall be connected to each cylinder manifold. The condensate and feed water flow shall be of the order of 1500 CU.M/hr for each unit or actual design flow whichever is higher.			
3.00.00	All Volatile Treatment (AVT)			
3.01.00	For AVT, Bidder shall include in his scope all necessary hardware including storage tanks, measuring tanks, mixing arrangement, metering pumps, strainers, valves etc.			
	However, minimum details for AVT are given below:			
3.02.00	Tanks			
	Vertical and cylindrical design with dished/conical ends, SS-304 material of construction, shell thickness 3 mm for the tanks.			
3.03.00		Ammonia Measuring tank	Ammonia Mixing / storage tank	
	i)	Storage capacity (in liters)	125	2300
	ii)	Nos.	1 No. / skid	1 No. / skid
3.04.00	iii) Concentration of aqueous ammonia solution shall be 29.4%			
	Transfer pumps			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001		SUB-SECTION- A – 23 LP DOSING AND OXYGENATED TREATMENT SYSTEM
PAGE 2 OF 4				

CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.05.00	<u>Item Description</u>	<u>Ammonia pump</u>	
	Material (Pump internals in contact with chemicals)	SS-304	
	Capacity	To suit requirement	
	Nos. required	1 no. (1x100%) per unit	
	Concentration	30% concentration	
	Type of pump	Hand pump	
	Metering pumps		
	<u>Item Description</u>	<u>Ammonia pump</u>	
	Material (Pump internals in contact with chemicals)	SS-304	
	Capacity (LPH)	0-50	
3.06.00	Nos. required	2nos. (2x100%) per skid	
	Rated pressure	45 Kg/sq.cm(g)	
	Type of pump	Reciprocating Pump	
	CHEMICALS TO BE HANDLED		
	Normal	3% conc. Ammonia solution	
	Wet Laying	15% conc. Ammonia solution	
	MATERIAL FOR PIPING & FITTINGS		
	<u>Item Description</u>	<u>Ammonia pump</u>	
	Piping	SS-304 /316	
	Fittings	A 182 GR.F304/316	
3.07.00	VALVES	A182 GR.F304/316	
	END CONNECTION	SW / ANSI B16.11	
	Note: Capacity of various tanks & pumps etc. are tentative minimum. It is contractor's responsibility to design/size these tanks & pumps depending upon system requirement / design and submit the same to Employer for approval. The minimum storage capacity for storage tanks of Ammonia shall be for 48 hours requirement.		
	Each unit shall be provided with a skid of ammonia dosing comprising of metering pumps (2x100%), strainer (2x100%), piping, valves, instrumentation etc. for both normal operation dosing as well as dosing required for wet laying of boiler. The Ammonia dosing point shall be located at a minimum distance of 150-200 mm downstream of the SWAS sampling line at CPU outlet. The capacity of tanks and parameters of pumps given are indicative & minimum. Final parameters shall be as per system requirements.		
	Safety shower arrangement shall be provided in close proximity to the Ammonia dosing skid.		

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.09.00	Control and Instrumentation Requirements			
3.09.01	The bidder shall supply all necessary Control & Instrumentation for satisfactory operation of dosing system. The control of system shall be through BOP C&I part of DDCMIS.			
3.09.02	The bidder shall supply all field instruments, devices as per the approved schemes as a minimum. These field instruments should confirm to requirements specified in the control and instrumentation section of this volume.			
3.09.03	It is intended to control dosing system from BOP C&I part of DDCMIS, including ON/OFF command of individual pumps. However, Bidder shall provide local prewired control panel complete with i) Start/stop push buttons ii) Indicating lamps iii) Local/Remote selection iv) Stroke position indicator v) Rise/Lower push buttons for stroke position vi) Local LED based annunciation driven by DDCMIS vii) Stroke position indicator on the panel.			
3.09.04	The normal mode of operation of dosing system shall be through BOP C&I part of DDC MIS. Local/Remote selection is to be done from Remote (CR) and indication for the same is to be provided on local panel.			
3.09.05	The ON/OFF commands for individual pumps from local push buttons shall act on the respective drives through BOP C&I part of DDC MIS.			
3.09.06	The stroke position and adjustment will be done by 4-20 mA D.C. signal from BOP C&I part of DDCMIS and the pumps stroke actuation should be suitable for accepting 4-20 mA D.C. signal. The pumps are to be provided with 24 V DC, two-wire LVDT type position feed back transmitter which will generate 4-20 mA signal indicating stroke position.			
SINGARENI THERMAL POWER PROJECT STAGE-II (1X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION- VI, PART-B BID DOC NO.:CW-CM-11159-C-O-M-001	SUB-SECTION- A – 23 LP DOSING AND OXYGENATED TREATMENT SYSTEM	PAGE 4 OF 4



SUB-SECTION–A-24

ELEVATORS, CRANES AND HOISTS

**SINGARENI THERMAL POWER PROJECT
STAGE-II (1X800 MW)
EPC PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI, PART-B
BID DOC NO.:CW-CM-11159-C-O-M-001**

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.00.00 1.01.00 1.01.01 1.01.02 1.01.03 <				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
			a) Recessed fluorescent light/LED fittings on car ceiling. b) Car control station c) Emergency stop switch. d) 5/15A, 3 pin plug socket with switch on top of lift car. e) Switches with Braille characters.	
	1. AUTOMATIC RESCUE DEVICE (ARD) - (BATTERY DRIVE): Bidder to provide a modern Advanced electronic drive system of “RESCUING Passenger Trapped in a ELEVATOR”. 2. EMERGENCY SAFETY DEVICES : The lift shall be provided with safety Device attached to the lift car frame and placed beneath the car. The safety device shall be capable of stopping and sustaining the lift car up at governor tripping speed with full rated load in car. 3. Elevator shall have Floor announcement system & Braille switches			
1.02.01	All steel embedment for fixing landing doors/indicators etc. to the Elevator well shaft and fascia plate shall be supplied by the Bidder.			
1.02.02	Guide rails complete with supporting brackets for the car and counter weights. Bidder to take care of granite tiles (approx 80 kg) to be provided for cabin flooring in selecting counter weights.			
1.02.03	Elevator drive machines complete with electric motor, reduction gear unit, suspension ropes, buffers for the cars and the counter weights and other drive and control mechanism. All foundation anchor bolts, sleeves, anchoring steel and any item required to complete the job satisfactorily shall be provided by the bidder. The bidder shall also provide for the grouting of anchor bolts, sleeves, anchoring steel, etc. and other anchorages			
1.02.04	Any other steel works as well as all other accessories/components not specified in the specification but necessary for making the Elevator complete.			
1.02.05	All building work including the supply of steel items, associated with installation of equipment in the machine room hoist way, hoist way door, frames and Elevator pit, shall form part of bidders scope of service, Bidder shall also provide the Elevator-well complete with foundation and brick walls around the lit-well together with overhead machine room. The machine room will be provided with R.C.C. floor slab with necessary pockets for anchor bolts and slots. Floor of machine room shall be as specified in the chapter “D-1-5 SALIENT FEATURES & DESIGN CONCEPT” of the specification.			
1.03.00	OPERATION			
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B	SUB-SECTION-A-24 SERVICE ELEVATORS CRANE, HOIST & MONORAIL	PAGE 2 OF 6

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.03.01	Elevator shall have provisions to meet following operational requirements : a) Selective Duplex collective, automatic operation with or without attendant through illuminated push button station located inside the lift car. b) Door operating shall be automatic door operation and electronic door protection system for opening/closing of car and landing doors. c) Bidder shall provide car operating panel with luminous buttons, car position indication in car (both visual and audio) combined with direction arrows, overload warning indicator, battery operated alarm bell and emergency light and fan & hands free speaker telephone set with suitable battery, charger & controls. d) Bidder shall provide emergency indicator to indicate the location of elevator in case of elevator being stuck up between the floors through automatic flashers (both audio & visual) e) Bidder shall provide electronic door detector (Infra red curtain type). f) Two push buttons, one for upward movement and the other for downward movement at each intermediate landing and one push button at each terminal landing shall be provided in order to call the car. Digital hall position indicator at all floors, tell lights at all floors shall also be provided by the bidder. g) For facilitating the movement of visually & hearing impaired persons, hall lantern and car arrival chimes shall be provided. h) All fixtures shall be in stainless steel face plates. i) Push buttons shall be fixed in the car for holding the doors open for any length of the time required. j) All other safety/protection/operation interlocks as required by IS:14665 (latest edition).			
1.04.00	Elevator Electricals:			
1.04.01	Electric motor: The driving motors shall conform to I.S 325 and suitable for the Variable Voltage Variable Frequency (VVVF) application. All motors shall be squirrel cage induction type, suitable for operation at 415V (+/- 10% variation) , 3 phase, 3 wire, 50HZ (+3% to -5% variation) supply. Motors shall be provided with thermal class 130 (B) or better insulation			
1.04.02	Controls:			
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B	SUB-SECTION-A-24 SERVICE ELEVATORS CRANE, HOIST & MONORAIL	PAGE 3 OF 6

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.04.03	The controls shall be Variable Voltage and Variable frequency type and shall provide smooth and constant acceleration and retardation under all conditions of operation. Suitable control panel shall be provided in the machine room. Cables and wiring: All the cables except trailing cables shall be as per IS:1554-1 or IS-7098-I. the PVC outer sheath of these cables shall be flame retardant, low smoke (FRLS) type with the following FRLS properties. a) Oxygen index of min. 29 (as per IS:10810 Part-58) b) Acid gas emission of max. 20% (as per IEC-754-I). c) Smoke density rating shall not be more than 60% (as per ASTM D-2843). The circular trailing cables shall be either in accordance with IS 4289 Part-I (Elastomer insulated) or IS-4289 Part-II (PVC insulated). The flat type trailing cables if offered shall be in accordance with IEC-60227-6. All wiring / cabling between the equipments in the lift machine room and that between the machine room and equipments in the lift well and at the landings shall be wired in HDP conduits/ galvanized steel conduits to be supplied by the contractor. Alternatively armored cables may be used.			
1.04.04	Earthing: The elevator structures and all Electrical equipment, including metal conduits shall be effectively earthed with the earth conductors provided in the machine room as per IS: 3043.			
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B	SUB-SECTION-A-24 SERVICE ELEVATORS CRANE, HOIST & MONORAIL	PAGE 4 OF 6

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	DATA SHEET i) Type of services : Passenger ii) Load carrying capacity : As per specification iv) Rated speed : One (1) m/s v) Total Travel : TG hall- As per layout vi) No. of floor to be served : TG hall- To be decided during detailed engineering. vii) Method of control : Variable voltage variable frequency (VVVF) viii) Position of M/c room : Directly above lift shaft ix) Size of platform : As per IS14665 & manufacturer's standard latest. x) Size of lift well : -do- xiii) Specification code : As per IS:14665 (5 parts) (Latest Edition). xiv) Design seismic co-efficient : According to the IS 1893-1977			
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B	SUB-SECTION-A-24 SERVICE ELEVATORS CRANE, HOIST & MONORAIL	PAGE 5 OF 6

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.00.00	CRANE, HOIST & MONORAIL			
2.01.00	Suitable EOT Crane/HOT Crane/Monorail beams with hoists/Chain Pulley Blocks of adequate capacity, to meet the erection and maintenance requirements are to be provided by the vendor for the various areas/equipment. Some of the areas/equipment not covered by TG hall EOT cranes are indicated below. For balance areas/equipment, not listed hereinafter, the requirements of Specification shall be followed. (a) Feed water heaters & deaerator (Applicable Hoists/Chain pully block for maintenance purpose shall be provided). (b) Various pumps & Heat Exchangers. (c) Condenser Water Boxes (front & rear), (Applicable If hinged type water box not envisaged) (d) CW Butterfly Valves (e) Vacuum Pumps (f) Control Fluid Room (g) Auxiliary cooling water (clarified) pumps and DM cooling water pumps of ECW systems. (h) Central Lube Oil System room. (i) Any other equipment. The above requirement is indicative only, the requirement given in the respective chapter is to be adhered to.			
2.02.00	The EOT cranes shall be designed as per IS-3177 (Latest edition) class -2 duty and the monorail hoists (hand operated) shall be designed to duty class 2 to IS 3832. Electrical wire rope hoist shall be designed as per IS:3938 (latest).			
2.03.00	The design, manufacture inspection and testing of the crane shall comply with the requirement of latest version of IS:3177			
2.04.00	The stipulations of all statutory codes like Indian Electricity Act, Indian Electricity Rules, Factory Acts, Local Municipality Act etc. shall however prevail over the specification requirements, in case any conflict arises between this specification and the statutory codes.			
2.05.00	For the hoists with more than 2.0 ton lifting capacity or more than 10.0 M lift, motor operated hoist block for both long travel and lift shall be provided. Other hoist blocks shall be of hand operated type for both travel and lift. However, all monorails coming out of the building shall be provided with electric hoist block, irrespective of load and lift. For hand operated hoists, the hoists shall be suitable for operation from floor level. Hand chain shall be provided for long travel of trolley and the Hoisting mechanism. The operator shall be able to control the movement of the monorail hoist with the help of floor operated pendant. The creep speed for vertical movement shall also be provided as per the system requirement.			
SINGARENI TPP STAGE-II (1X800MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B	SUB-SECTION-A-24 SERVICE ELEVATORS CRANE, HOIST & MONORAIL	PAGE 6 OF 6