



SPECIFICATION FOR
COOLING WATER TREATMENT PLANT

SPEC.NO.ROS: 6319

REV.: 00

**BHARAT HEAVY ELECTRICALS LIMITED,
RANIPET- 632 406.**

**TECHNICAL SPECIFICATION
FOR
COOLING WATER TREATMENT PLANT**

**1X660 MW WBPDCCL-SAGARDIGHI - TPS
WEST BENGAL**

00	10.08.21	AK 	DBN 	MSM 	Fresh issue
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SECTION – 1

1.0 SCOPE OF INQUIRY/ INTENT OF SPECIFICATION

- 1.1** The specification is intended to cover design, engineering, manufacture, fabrication, assembly, inspection and testing at vendor's & sub-vendor's works, painting, spares along with spares for erection and commissioning, startup and commissioning as required, forwarding, proper packing, shipment and delivery at site, unloading, handling & transportation at site , Erection & Commissioning, trial run, on FOR site basis, preparation & submission of "As Built" drawings, PG test at site and handing over of Cooling Water Treatment Plant as per the details in different sections / volumes of this specification for 1X660 MW WBPDCI-SAGARDIGHI – TPS.
- 1.2** The contractor shall be responsible for providing all material, equipment & services, which are required to fulfill the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve them of the responsibility of providing such facilities to complete the supply, erection and commissioning of cooling water treatment plant.
- 1.3** It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material, which in his judgment is not in full accordance herewith.
- 1.4** Overall treatment program to be envisaged and implemented for the successful cooling water treatment to meet the guaranteed parameters.
- 1.5** The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items do not figure in the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items do not figure in the drawing.
- 1.6** The general terms and conditions, instructions to tenderer and other attachment referred to elsewhere in the specification are part of the tender specification. The equipment materials and works covered by this specification are subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for, and governed by all requirements stipulated herein.
- 1.7** While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting

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requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed with this specification. In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of BHEL/Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by BHEL/ Customer as and when brought to their notice either by the bidder or by BHEL/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.

- 1.8** Deviations, if any, should be very clearly brought out clause by clause in the enclosed schedule; otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification.
- 1.9** In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.
- 1.10** Unless specified otherwise, all through the specification, the word contractor shall have same meaning as successful bidder / vendor and Customer /Purchaser / Employer will mean BHEL and / or Customer (WBPDC: West Bengal Power Distribution Corporation Ltd.) including their consultant as interpreted by BHEL in the relevant context.
- 1.11** The equipment covered under this specification shall not be dispatched unless the same have been finally inspected, accepted and dispatch release issued by BHEL / Customer.
- 1.12** BHEL's / Customer's representative shall be given full access to the shop in which the equipment is being manufactured or tested and all test records shall be made available to him.

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SECTION – 2

2.0 PROJECT INFORMATION

1	Name of the Project	Sagardighi Thermal Power Station (1X660 MW) Unit-5, phase-III.
2	Station Capacity	1x660 MW (Coal Based)
3	Owner	West Bengal Power Distribution Corporation Ltd. (WBPDC)
4	Site Location	Manigram village, Sagardighi, Raghunathganj sub-division, Murshidabad District, West Bengal.
5	Latitude	24° 22' 13.7" N
6	Longitude	88° 6' 15.8" E
7	Nearest Town	Ajimganj, Jangipur, Raghunathganj.
8	Nearest railway Station	Manigram railway station on Bandel-Barhawara branch line 1 km from site.
9	Nearest Airport	240 KM Kolkata
10	Site Conditions	
	Elevation above MSL	34 m
	Temperature –Minimum	10°C during Winter
	- Maximum	42°C during Summer
	- Design Ambient	50°C
	- Ambient (performance)	26.9°C
	Average relative humidity	84 %
	Annual Rainfall - Average	1389 mm
	- Maximum	1043 mm
	- Lowest	343 mm
	Mean Wind Speed	47 m/sec
	Wind Pressure	As per the latest revision of IS 875/1987
	Siesmic Co-efficient	Zone –III, as per IS 1893 (Part-IV)
11	Source of water	The source of water for this project is the River Bhagirathi (5 km). The water from the River Bhagirathi will be transferred and stored in the five (5) nos. Plant Raw Water Reservoirs by augmentation of the Intake water transportation system.
12	Source of Coal	The Power plant shall receive coal from ECL mines. Coal is planned to be transported in rake loads through the existing Pakur- Tildanga-Dhulian-Monigram broad gauge line or through Pakur- Nalhati (proposed)–Takipara-Gosaingram-Poradanga-Monigram broad gauge line.

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SECTION - 3

3.0 SCOPE OF SUPPLY

This specification is intended to cover the Design, engineering, manufacture, assembly, inspection and testing at manufacturer's and/or his sub-contractors works, proper packing, delivery at site, transportation, unloading/handling at site, storage at site, site fabrication, site painting, erection including all civil works/ testing/ commissioning at site and performance testing of CWT plant for 1x660 MW SAGARDIGHI TPS including complete C&I and Civil Works as specified and as necessary.

1. Broad Scope of supply shall be

- a) CW treatment plant comprising of hose stations, HDPE hose connections (80mm NB), sulphuric acid unloading pumps, sulphuric acid storage tanks, day tanks, injection pumps, CPVC pipe diffuser for sulphuric acid; scale inhibitor tanks, injection pumps, SS316 pipe diffuser for scale inhibitor; corrosion inhibitor tanks, injection pumps, SS316 pipe diffuser for corrosion inhibitor; Biocide tanks, injection pumps, SS316 pipe diffuser for biocide and all other equipment and accessories required for complete CW treatment plant of Sagardighi 1x660 MW power plant.
- b) All integral and interconnected pipe works, valves, sumps, gates, all types of pipe supports, pipe racks, pipe bridges etc. for the entire system.
- c) Each atmospheric tank under chemical service (except for Sulphuric Acid) shall be of vertical cylindrical design and welded construction with bolted top flange cover. The tanks shall be provided with overflow, inlet feed funnel, discharge/outlet pipe and level gauge.
- d) For Sulphuric Acid service, the tanks shall be provided with full-length gauge glass with isolation valve and drain valves, vent as well as overflow connection.
- e) Steel platform with handrail, steel approach staircase shall be provided for access to the top of tanks of suitable non-reactive coating for respective chemicals
- f) A minimum of 300 mm freeboard shall be provided for all the units and chemical solution tanks of the Circulating Water Treatment Plant.
- g) Waste from Sulphuric Acid Injection Systems shall pass through lime pits for neutralization before discharge into CW forebay. This neutralizing pit shall be provided with sump pump. .
- h) Each pump used in Antiscalant / Corrosion Inhibitor/ Biocide Inhibitor Dosing System shall be suitably selected so that the required capacity can be delivered even at 50% pump stroke.
- i) The chemical injection pumps shall be Electro Mechanical, positive displacement, simplex, constant speed, variable stroke plunger operated reciprocating type and arranged to operate under flooded suction conditions. The pump internals meeting chemical shall be SS 316 ((except for Sulphuric Acid service where it shall be of Alloy 20) construction. The pumps shall be capable of varying the discharge over the entire range of operation. The pump stroke shall be capable of adjustment from 0 to 100% capacity and locking shall be possible while the pumps are in operation. A calibrated scale shall be provided for the above purpose. The pumps shall be capable of

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operation either intermittently or continuously. Necessary relief valves and discharge pressure gauges shall be provided. 'Y' type strainer shall be provided at the suction of each Injection pump. All the chemicals to be used in the Circulating Water Treatment Plant need to generally conform to the requirements of technical grade as applicable as per relevant IS code.

- j) Monitoring gadgets, instruments and equipment required to show demonstration parameters are in Bidder's scope
- k) Test racks (corrosion, scaling/deposit and bio fouling) with coupons / test kits with mounting accessories
- l) Safety showers shall be provided near chemical storage and handling areas.
- m) Bidder shall study the scheme; water analyses etc. contained in the specification and offer/supply the most suitable chemical(s). The chemicals proposed shall be non-toxic type. Heavy metal based chemical such as chromate, zinc etc. are not acceptable. Further, chemicals shall not have any deleterious effect on any component of the CW System. Organic polymer / organic phosphorous / organic phosphates based chemicals shall be used. Required documentation in support of the above shall be made available to customer if required

2. Electrical – Refer Electrical portion of this specification

3. Control & Instrumentation - Refer C& I portion of this specification

4. Erection & Commissioning

- a. Erection, commissioning, unloading, storage and handling at site of all the equipment of CW treatment plant including but not limited to the above list required for completion of the CW treatment plant shall be considered by Bidder.
- b. Arrangement of all instruments and lab facilities to carry out trial run, commissioning and PG test
- c. Monitoring gadgets, instruments and equipment required for maintenance (till PG test and plant handed over)
- d. All special tools necessary for proper maintenance or adjustment of the equipment packed in a suitable Tool box shall be provided by Bidder. The same shall be handed over to BHEL at the Time of unit take over
- e. Determination of corrosion rates & scale deposition at regular intervals & review on regular basis & submit fortnightly reports to the BHEL
- f. Operation of the CW treatment plant till handing over is in Bidder's scope.
- g. Complete grouting for equipment, fixing and any concreting inside the vessels and lining.
- h. All personnel required during commissioning and PG Test shall be in the scope of Bidder.
- i. Supervision of the treatment program for an initial period of 6 months. The supervision shall be extendable for another 6 months (if required by Customer) at the same rate.
- j. Performance testing.
- k. All statutory clearances required, including local Govt. body / municipal offices as applicable shall be in Bidder's scope

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- I. Material receipt, storage and issue for Erection & Commissioning shall be in Bidder's scope. Bidder shall store all high value items under lock & key, using containers /suitable storage room.

5. Painting

Supply and application of shop painting and final painting at manufacturer's works and at site for the entire system as specified.

6. Consumables

- a. All consumables, bulk chemicals (except sulphuric acid) like Scale Inhibitor, Corrosion Inhibitor, Biocide, Chlorine etc. (including passivation chemicals to ensure smooth operation of plant) required for pre-commissioning, commissioning, PG Test along with topping up required for 1-year operation shall be included in the scope. Bidder to refer to relevant clauses in the entire tender document and the most stringent clause will be considered.
- b. Chemicals shall have adequate shelf life from the date of supply to meet system requirements. Chemicals shall be supplied in a staggered way as required by Customer.
- c. Complete supply of Passivation Chemicals to ensure smooth operation of the plant till handing over shall be provided by Bidder.
- d. All consumables (lubricating oil, inhibitor for oil), recommended spares, spares required for erection and commissioning of complete system, new set of special tools and tackles, fixtures etc. required for regular operation and maintenance of the system as addressed elsewhere in the specification, if applicable.
- e. All chemicals to be used in the Circulating Water Treatment System shall generally confirm to the requirements of technical grade as applicable

7. Terminal points

- a. Inlet water line (service water/ potable water/ Sample water from CW Pump discharge) will be provided (~5m distance from plant boundary) separately: Bidder to consider required pipe length for respective CW Chemical Treatment Plant Area.
- b. Outlet Chemical Line from CW Chemical Treatment Plant up to the dosing point at CW Forebay. Bidder to refer the tender layout for piping length with 20% margin.
- c. CW water from CW pump discharge header will be made available at one point near CWT building (~5m from Plant boundary) for pH analysers. Further piping to analysers and termination at local drain leading to lime pit shall be in Bidder's scope.
- d. All drains: Common drain shall be connected to lime pit.
- e. Acid unloading: Necessary manifold including flexible unloading hose pipe (10 meter) shall be supplied by vendor.

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- f. Lime pit neutralized effluent from Lime pit/N-Pit Dewatering pump to CW Forebay. Bidder shall suitably consider the flexible hose length as per the site/layout requirement.
- g. Details with respect to terminal points are provided in Design memorandum and P&ID. However, Bidder shall provide all relevant details to integrate and ensure completeness of the CW system as a whole.

8. Exclusion

- a. All civil work including foundation of equipment by BHEL. However, complete grouting for equipment, fixing and any concreting inside vessels shall be in the scope of bidder.
- b. Pedestals for pipe supports by BHEL. However, auxiliary structure, supports components for piping is in bidder's scope.
- c. Supply of Sulphuric Acid is excluded from Bidder's scope.

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SECTION-4

4.0 GENERAL REQUIREMENTS OF SPECIFICATION

1. Approved Design memorandum (BHEL DOC NO.: 4-WT-080-01598, WBPDCI DOC NO.: RP-DC-445-WTP-A056) REV: 03
2. P& ID (BHEL DOC NO.: 1-WT-080-01915, WBPDCI DOC NO.: RP-DG-445-WTP-A057) REV: 04
3. Layout (BHEL DOC NO.: 1-WT-080-01916, WBPDCI DOC NO.: RP-DG-445-WTP-A058) REV: 01
4. Qualification requirement shall be as per tender specification PQR.
5. Sub Vendor list shall be as per attached list (**Annexure-1**). However, Bidder shall submit the list along with compliance for all the equipment during contract stage for approval by BHEL.
6. Quality plan shall be as per attached quality plan document (**Annexure-2**). Bidder shall submit Quality plan for all the equipment supplied, services & works during contract stage for approval by BHEL.
7. Minimum list of drawings shall be as per attached master drawing list (**Annexure-3**). However, bidder shall submit list of all drawings during contract stage for approval by BHEL.
8. Bidder shall submit the PG test procedure for CW treatment plant for approval and same shall be followed as specified in **Annexure-4**.
9. List of reference documents/ drawings which are part of this tender are provided as **Annexure-5**.
10. Project schedule for CW treatment plant shall be submitted by Bidder for approval.
11. Refer **Annexure-6** for Quality Assurance requirements.
12. Refer **Annexure-7** for List of Drawings & Documents to be submitted along with bid and after award of contract.
13. Bidder to refer to Protective coating and Painting Specification in **Annexure-8** for meeting the requirements of this package.
14. Bidder to refer to Health Safety and Environment plan for Site Operation by Subcontractors in **Annexure-9**.
15. Refer **Annexure-10** for Additional General Technical requirements.
16. Refer **Annexure-11** for Engineering services requirements.
17. Refer **Annexure-12** for Project Management and site services.
18. Refer **Annexure-13** for Spares, Tools, Tackles & Consumables
19. Refer **Annexure-A** for Technical Deviation format.
20. Refer **Annexure-B** for Compliance and confirmation schedule.
21. Bidder shall provide requirement of Material handling system of this package along with basis & supporting technical details. Bidder shall provide basis with support documents if the same is not considered. BHEL decision on provision of the Material Handling system is Final & binding.
22. Bidder to consider proper Packaging for shipping and storage at site and the procedure shall be duly submitted to Customer
23. Bidder shall furnish 3D model in editable format to ensure integration with overall 3D model of the Power plant.

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24. Customer approved Design Memorandum and P&ID attached with this specification is minimum requirement and shall be complied by Bidder. Bidder to design the equipment/system for safe and trouble free operation of Plant to meet the performance duty required by system.
25. The CWT plant complete with all accessories shall conform to this technical specification, Design memorandum & PID. The decision of BHEL shall be final in case of any discrepancy.
26. All the instruments shall be supplied along with necessary fittings, accessories, valve manifold, root valves, Canopy & Structural steel as required. Instrument Installation, along with hardware shall be in bidder scope.
27. The make shall be as per approved vendor list. The model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial implication in this regard shall be acceptable. In case of any conflict or repetition of clauses in the specification, the more stringent requirements among them are to be complied with.
28. Each valve/instrument shall be fitted with a stainless steel or aluminum nameplate indicating the valve/instrument service and reference number in accordance with the approved equipment coding system
29. All valves above 150NB shall be double flanged. All valves dimension standard shall be as per ASME B16.5 standards.
30. The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system shall be supplied by bidder without any technical, commercial and delivery implication to BHEL.
31. Uniformity of make and type of instruments and control components shall be followed throughout for rationalization of spares' inventory, except for certain proprietary items where this requirement cannot be met.



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SECTION- 5

5.0 PUMPS & PIPE SELECTION CRITERIA

Sl. No.	Pipe Size	Velocity in m/sec		
		Below 50mm	50mm-150mm	200mm & above
1	Pump Suction for Water	--	1.2-1.5	1.2-1.8
2	Pump Discharge for Water	1.2-1.8	1.8-2.4	2.1-2.5
3	Header for water	--	1.5-2.4	2.1-2.4
4	Compressed Air Below 2Kg/cm ² (g)	15-20	20-30	25-35
5	Compressed Air Above 2Kg/cm ² (g)	20-30	25-40	35-45
6	Suction to compressor/Blowers		7-8	
7	Pump Suction for Chemical Solution	1.0-1.2	1.1-1.3	--
8	Pump Discharge for chemical solution	1.2-1.4	1.3-1.5	--

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SECTION-6

6.0 IMPORTANT POINTS TO BIDDERS

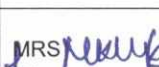
1. If the vendor has suggestions/requirements of any additional instruments/equipment over & above as shown in the P & ID drawing, the same shall be clearly indicated and suitably covered in the commercial bid also separately.
2. The specification for the instruments/equipment available in the main specification shall be taken for such additional requirements (or) Customer should be contacted.

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RANIPET- 632 406.

ELECTRICAL, CONTROL & INSTRUMENTATION
SPECIFICATION FOR
COOLING WATER TREATMENT PLANT

[SPEC No: ROS: 4290, REV: 0
Part of ROS6319, REV:0]

Applicable for Sagardighi STPP(Unit#5) project

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	Sagardhigi STPP (Unit#5)	BAP-RANIPET
	TECHNICAL SPECIFICATION FOR Cooling Water Treatment Plant (E, C & I Scope)	No: ROS: 4290, REV: 0 Part of ROS6319, REV:0

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	Sagardighi STPP (Unit#5)	BAP-RANIPET
	TECHNICAL SPECIFICATION FOR Cooling Water Treatment Plant (E, C & I Scope)	No: ROS: 4290, REV: 0 Part of ROS6319, REV:0

SECTION: A

INTRODUCTION

1. THE PROJECT

Sagardighi Thermal Power Station, Phase-III, comprising of a single extension Unit of 660 MW capacity of Super Critical technology is being implemented by The West Bengal Power Development Corporation Limited in Murshidabad district, West Bengal, India. This Power Station will generate electricity and feed into the West Bengal Transmission Grid to meet the power demand in West Bengal.

2. THE SITE

Sagardighi Thermal Power Station site is located at Manigram village, 13 KM north of Sagardighi town by the side of the SMGR (Sagardighi-Manigram-Gankar-Raghunathganj) Road at a distance 20 KM from National Highway 34 in Murshidabad District, West Bengal and around 240 KM from Kolkata, India. The nearest rail station is Manigram adjacent to the site on Bandel - Barhawara branch line and 6.5 KM from Sagardighi Railway Station on Sainthia - Azimgunj line of Eastern Railway.

3. THE SPECIFICATION AND TENDER

The accompanying Tender Specification is for the Engineering, Supply, Delivery, Erection, Testing and Commissioning of the Cooling Water Treatment Plant as specified. The Plant and materials offered must be of proven quality where reliability in service and ease of operation and maintenance are the foremost prerequisites. The completion time should be the shortest possible.

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	TECHNICAL SPECIFICATION FOR Cooling Water Treatment Plant (E, C & I Scope)	No: ROS: 4290, REV: 0 Part of ROS6319, REV:0

SECTION: B

GENERAL TECHNICAL REQUIRMENTS (ELECTRICAL):

The equipment and services to be provided by bidder under this specification shall be as detailed here below, but not to be limited to the following:

1. Services and Equipment as per "Scope Division between BHEL and CWTP Vendor".
2. Any item/ work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The bidder without any extra charge shall provide the same.
3. Supply of mandatory spares as specified in mechanical equipment.
4. Electrical load requirement for Cooling Water Treatment Plant shall be furnished as per the format in Annexure-G.2.
5. All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
6. Bidder to furnish list of makes for each equipment at contract stage, which shall be
7. Subject to customer / BHEL approval without any commercial and delivery implications to BHEL.
8. Various drawings including GA drawing, Data sheet as per required format, quality plans, Calculations, test reports, test certificates, operation and maintenance manuals, characteristic curves, wiring diagrams/schemes etc. shall be furnished as specified at contract stage. All documents shall be subject to customer / BHEL approval without any commercial implications to BHEL.
9. Motors shall meet minimum requirement of Electric motor specification (Section: F.1)
10. Vendor shall clearly indicate equipment locations and local routing lengths in their cable listing as per the format in Annexure-G.3.

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SECTION: C

GENERAL TECHNICAL REQUIREMENT (C&I)

- 1.0 Bidder shall provide complete and independent control & instrumentation system with all accessories, auxiliaries and associated equipment for the safe, efficient and reliable operation of auxiliary systems.
- 2.0 The quantity of instruments for auxiliary system shall be as per tender P & ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price implication.
- 3.0 Measuring instruments/ equipment and subsystems offered by the bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further all the instruments shall be of proven reliability, accuracy, and acceptable international standards and shall be subject to employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specification, ranges, makes/ numbers as approved by BHEL during detail engineering.
- 4.0 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/ erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments; sensors, switches etc for external connection including spare contacts shall be wired out to suitably located junction boxes. For instrument & control cable scope of supply refer "Section: E". Instrument installation drawings are to be provided by bidder. All instrument fitting and erection hardware shall be in bidder's scope.
- 5.0 When there is mismatch in specification and Customer Specific Technical Requirement, the stringent clause shall prevail.

6.0 LOCAL CONTROL PANEL

Operation & Control of CW TREATMENT System shall be from plant DCS (BHEL Scope) as well as through Local Control Panel –LCP (Bidder scope).

Local control panel will act as interface between the DCS and the field devices for commands & feedbacks. LCP shall have the provision of command (start/stop, load/unload) & feedback interface with plant DCS. For further details, bidder shall refer Drive control philosophy – DDCMIS interface for LT unidirectional drive-Contactor operated (Annexure-G.1).

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Bidder to include all the instruments (PG, LG, LIT, FI, Stroke controller or VFD etc.) required for the package along with necessary interfaces, remote chemical seal diaphragm accessories and valve manifold etc.

Every panel- mounted instrument, requiring power supply, shall be provided with a pair of easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.

Provision for separate Terminal block/ wiring diagram for power and control blocks of control panel to be ensured. LCP shall have canopy and all required MCCB/ MPCB, relay, contactor, terminals. All Push Buttons shall be illuminated type. 20% spare TB shall be provided and it shall be segregated for considering voltage level, analog, binary signal, annunciator signal etc.

BHEL shall provide 415V AC supply feeder at a single point for LCP. Further distribution to various motor through respective Start/ Stop feeder within LCP shall be in Vendor's scope. Bidder to include necessary VFD drive/ stroke controller for remote adjustment in bidder scope. Any control supplies other than the above, if required by any LCP, has to be derived by the Bidder and all necessary hardware/software for the same shall be in bidder's scope.

BHEL shall provide 230 VAC UPS redundant supply feeder at a single point for analyser instruments. Further distribution to various analysers shall be in Bidder's scope. Bidder to include necessary power distribution board in bidder's scope.

Vendor representative shall be available at BHEL Electronic Division (EDN) Bangalore during testing of DCS. Vendor representative shall be available at site at the time of commissioning of the system and Vendor to delegate/ depute their person/ experts as per owner/ consultant requirements.

7.0 FIELD INSTRUMENTS

This section provides general guidelines for field instruments and equipment to be supplied. All measuring instruments/ equipment and subsystems offered by Vendor shall be from reputed experienced manufacturer of specified type and range of equipment, whose guaranteed and trouble free operation has been established. All instruments/ equipment shall be of proven reliability, accuracy, repeatability requiring a minimum of maintenance and comply with the acceptable international standards. All instruments/ equipment and accessories shall be supplied as per technical specifications, ranges, make as approved by Owner M/s WBPDC.

7.1 Technical specification for pH ANALYSER

- A. Sensor
1. Type of Cell : Flow thru' remote mounting
 2. Range : 0-14 pH
 3. Type of measurement : Combination electrode
 4. Temp. Compensation : Manual and Automatic (Integral) 0- 100°C
 5. Process Connection : Screwed
 6. Measuring Electrode : Glass, high independence, thin electrode in one housing
 7. Pressure Rating : 10 kg/cm²

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- 8. Accessories : Vessel (SS 316) with ½" NPT connection
- 9. Cable : Upto transmitter in flexible conduct
- 10. Preamplifier : Integral or separate
- 11. Liquid Junction : Ceramic / Kyner or equivalent

B. Transmitter

- 1. Type : Microprocessor based, Single stream
- 2. Mounting : 2" pipe
- 3. Protection Class : IP-65 or better
- 4. Output : 4-20 mA DC (isolated)
- 5. Display : Digital Display in Engineering Unit, Alarm Status.
- 6. Accuracy : ± 0.2% of FSD or better
- 7. Response time : Less than 5 sec
- 8. Stability : ± 0.001 pH /week
- 9. Repeatability : ± 1% or better
- 10. Temp. Compensation : Automatic (Pt-100 sensor)
- 11. Diagnostic : Self diagnostic for "Calibration required"/ "Calibration O.K.", electrode checking etc.
- 12. Alarm : Dual set point, hysteresis and time delay adjustable
- 13. Enclosure : Die cast aluminium, epoxy coated
- 14. Cable Termination : Internal (cable entry through conduit)
- 15. Accessories : 2" pipe mounting bracket, Sensor cable with flexible conduit (as required), ½" NPT Cable Gland, SS Tag plate, , Ultrasonic Electrode Cleaner, Buffer solution tablets

7.2 Technical specification for Ultrasonic Level Transmitter

- 01. Principle : Detection of reflected ultrasonic operation pulse
- 02. Signal processing : Microprocessor Controlled Signal Processing
- 03. Type : Smart
- 04. Display : Large alpha-numeric back lit LCD/LED
- 05. Calibration & configuration : Accessible from front of panel
- 06. Diagnostic : On-line
- 07. Status : For power, Hi / Lo / V. Hi / V. Lo-level indication, fault etc.
- 08. Construction : Plug-on board
- 09. Power supply : 24V DC 2 wire
- 10. Signal Output : 4-20 mA DC - 500 Ohm load with HART protocol.
- 11. Hysteresis : Fully adjustable preferred
- 12. Output contacts : 2SPDT Potential free changeover contacts @ 5A 230V AC.
- 13. Accuracy & Repeatability : 0.25% of span or better
- 14. Resolution : 0.1% of span
- 15. Operating temp. : Transmitter- 0 to 50 DegC and Sensor 0 to 80 DegC
- 16. MOC Sensor : SS 316 in general / PTFE, PP for corrosive application.
- 17. Humidity : 1% to 95% non condensing.
- 18. Enclosure : IP-65 powder coated die cast aluminium
- 19. Cable connection : ½" NPT with cable gland

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20. Mounting : 3" flanged for sensor and Transmitter on panel / surface.
21. Accessories : Cable gland, prefab cable, mounting accessories.

7.3 Technical specification for Pressure Gauge and Differential Pressure Gauge

01. Type : Bourdon/Bellows/Diaphragm
02. MOC Sensing & Socket : AISI-316 SS
03. Movement Material : AISI-304 SS
04. Case Material : Stainless steel..
05. Bezel Material : SS 304.
06. Socket Material : SS 316
07. Enclosure : IP-65.
08. Dial Size : 150 mm
09. Scale : Black lettering on white background in 270 Deg. arc.
10. Window : Shatterproof glass
11. Range Selection : Normal process pressure – 50 ~ 70 % of range (approximately).
12. Over-range Protection : 125% of maximum range by internal stop. External stop at zero
13. Adjustment : Micrometer screw for zero adjustment. Internal micrometer screw for range adjustment. External zero adjustment for glycerine filled gauges.
14. Element Connection : Argon welding
15. Process Connection : 1/2" NPT(M) Bottom connection for local mounting, back connection for panel mounting.
16. Performance : Accuracy of +/- 1.0 % of span or better.
17. Operating ambient temperature : 0 – 50DegC
18. Safety Feature : Blow out disc./diaphragm at the back
19. Accessories : a) Snubbers and Glycerin filled for pulsating fluid applications and at pump discharge.
b) Stainless steel Diaphragm chemical seals for corrosive, viscous and solid-bearing or slurry type process fluids. Diaphragm chemical seal shall be provided with the following:
1) Top chamber : SS 304
2) Bottom Chamber: SS 316
3) Sealing fluid: Silicon DC 200
4) Diaphragm: SS 316
c) 3-way SS gauge cock/ 2-Valve SS-316 barstock manifold for pressure gauges with 1/2" NPT process connection.

7.4 Technical specification for Rotameter

01. Type : Online upto 2" and Bypass above 2" line size"
02. Metering tube : Borosilicate glass
03. Float : AISI 316-SS unless the process fluid demands some other material.
04. Body MOC : SS as per fluid condition.

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- 05. Scale : Aluminium Graduated - Engraved black on white background.
- 06. Process connection : Flanged to line size or threaded for connection size ½” or less.
- 07. Accuracy : +/- 2% of full scale detection or better for on-line type and +/- 4% of full-scale detection or better for by-pass type.
- 08. Nameplate : Tag number, service engraved in stainless steel tag plate
- 09. Accessories : Slip-on orifice plate of 316-SS and taps of / SS as per application. Applicable SS Isolation valves and SS Range Orifice – for bypass type rotameters.
- 10. Housing protection class : IP- 65

7.5 Technical specification for Magnetic Level Indicator

- 01. TYPE : Magnetically coupled level indicator
- 02. Display : Coloured flags
- 03. Chamber material : Stainless steel
- 04. Wetted part material : Stainless steel
- 05. Process connection : Side Side Flanged
- 06. Drain & Vent : Flanged
- 07. Scale : Standard, Stainless steel
- 08. Accessories : Counter flange, gaskets

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D: DOCUMENTATION

Documents of Electrical, C&I System shall be submitted to end user/ owner for approval during detail engineering. Changes, if any required, shall be accommodated by the bidder without any price and/ or time implication.

Following documents to be furnished by the bidder along with the bid:

- Duly stamped and signed copy of Quality Plan.
- Requirement of electronic earthing, if any.
- Electrical power requirement in prescribed format duly signed and stamped.
- SDDR of Enquiry documents.

Editable & PDF copy of Drawings/ Documents and data to be furnished within two months after award of the contract:

1. C&I System Design Basis Report incorporating Control philosophy.
2. GA & wiring diagram of local control panel and its Power Requirement.
3. Local control panel and field instruments quality plan. Local control panel & instruments data sheet.
4. Filled up Electrical Load data as per Attached Formats (Annexure-G.2)
5. Cable schedule, cable interconnection drawing as per Attached Formats(Annexure-G.3)
6. Instrument schedule indicating range, operating pressure, flow etc., along with selected make & model.
7. Instrument hook-up diagram.
8. Electronic Earthing schemes
9. Filled up Motor datasheets as per Attached Formats (Annexure-G.4)
10. Logic diagrams with system description / functional write-up.
11. DCS IO List
12. Motors: Detailed catalogue, part number and subassembly/assembly drawings with manufacturer's cross reference for each spare part.
 - 1) OGA drawing with terminal boxes, earthing etc.
 - 2) Arrangement drawing of terminal boxes.
 - 3) Characteristic curves:
 - i. Current vs. time at rated voltage.
 - ii. Speed vs. time at rated voltage.
 - iii. Torque vs. speed at rated voltage and minimum voltage.
For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.
 - iv. Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.
 - v. Load performance curves.

NOTE: Documents mentioned in other sections of this specification is included. Any other document decided during detailed engineering to be submitted.

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E: SCOPE DIVISION BETWEEN BHEL AND CWTP VENDOR

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	1. 415 V AC (3 Phase, 3 Wire) supply to motors, 415 V AC (3 Phase, 4 Wire) supply to other equipment etc. shall be provided by BHEL based on load data provided by vendor at contract stage for the equipment supplied by vendor as part of contract. 2. Any other voltage level (AC/DC) required will be derived by the vendor.
2	DCS System	BHEL	BHEL	
3	Local Push Button Station (LPBS) for motors	Vendor	Vendor	Located near the motor.
4	Local Control Panel (LCP)	Vendor	Vendor	Single panel including all drive motors of CWTP system and with required interfacing between field instrumentation and DCS. Also including required supply feeders for exhaust fans (16A feeders – Qty 10 Nos) of CWTP system.
5	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage. All motors shall be 415V, 3 Phase only including lime pit dewatering pumps.
6	Instruments & Fittings	Vendor	Vendor	Complete instrumentation supply , erection including site calibration of Instrument until Handover to end customer in Vendor's scope
7	Junction box for control & instrumentation cable	BHEL	BHEL	
8	Ventilation Fans	BHEL	BHEL	
	Cable, Tray & Accessories			
9	Power cables, control cables and screened instrument cables for a. both end equipment in BHEL's scope b. both end equipment in vendor's scope c. one end equipment in vendor's scope	BHEL BHEL BHEL	BHEL Vendor BHEL	1. For b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes will be done by BHEL 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor. Vendor shall provide lugs & glands in his scope.

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S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
10	Any special type of cable like compensating, co-axial, prefab, MICC, OFC etc.	Vendor	Vendor	Any special cable required for equipment, instrument etc., supplied by Vendor.
11	a. Cable trays, accessories & cable trays supporting system b. 100/ 50 mm cable trays/ Conduits/ Galvanised steel cable troughs for local cabling	BHEL Vendor	BHEL Vendor	Local cabling i.e., branching from nearby main route cable tray (BHEL scope) to equipment (vendor's supply) shall be through 100/ 50 mm. cable trays/ conduits/ Galvanised steel cable troughs.
12	Conduit and conduit accessories for cabling of equipment supplied by vendor	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537.
13	Cable glands, lugs and cable tag for equipment supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type Aluminium lugs for Aluminium power cables and heavy duty tinned copper lugs for copper power cables 3. Solder less crimping type heavy duty copper lugs for control and instrumentation cables.
	Lighting & Earthing			
14	Lighting	BHEL	BHEL	
15	Equipment grounding & lightning protection	BHEL	BHEL	There shall be provision for connecting earthing cable/ flat on equipment supplied by vendor.
16	Below grade grounding	BHEL	BHEL	
	Drawing/ Document			
17	For Control & Instrument Cables a. Cable schedules b. Cable interconnection/ Loop diagram	Vendor Vendor	- -	Cable listing for Control and Instrumentation Cable (excluding power cables) in enclosed excel format shall be submitted by vendor during detailed engineering stage.

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18	Electrical cable tray layout drawing	Vendor	-	For ensuring proper cabling, vendor shall furnish cable tray layout drawings (both in print & AUTOCAD form) of complete plant indicating location and identification of all equipment that require cabling. Cabling arrangement (cable trays, ducts, conduits etc.) shall be decided during Engineering stage.
19	Electrical Equipment GA drawing	Vendor	-	For necessary interface review. Electrical equipment layout & cable tray layout drawing shall be subjected to BHEL/ customer approval without any commercial implications to BHEL.
20	Any other equipment/ material/ service required for completeness of system but not specified above (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	

NOTES:

1. Make of all electrical equipment/ items supplied shall be reputed make & shall be subject to approval of BHEL/ customer after award of contract.
2. All QAPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
3. In case the requirement of Junction Box arises on account of Power Cable size mismatch due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.
4. Vendor shall indicate location of Electronic Earth pit (if required) in their Civil assignment drawing.

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SECTION: F

Customer Specific Technical Requirement

**SECTION - II****A.C. & D.C. MOTORS****1.00.00 SCOPE**

- 1.01.00 This specification covers the general requirements of the electric motors for plant auxiliary equipment except for special application like crane, lift, submersible pump etc., motors for which are covered in individual equipment specifications.
- 1.02.00 Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification.
- 1.03.00 In case of any discrepancy, the driven equipment specification shall govern.

2.00.00 STANDARDS

- 2.01.00 All motors shall conform to the latest applicable IS, IEC and CBIP Standards/Publications except when otherwise stated herein or in the driven equipment specification.
- 2.02.00 Equipment and materials conforming to any other standard, which ensures equal or better quality may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

3.00.00 SERVICE CONDITIONS

- 3.01.00 The motors will be installed in hot, humid and tropical atmosphere, highly polluted area.
- 3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the annexure of this specification.
- 3.03.00 For motor installed outdoor and exposed to direct sun rays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

4.00.00 TYPE AND RATING**4.01.00 A.C. Motors**

- 4.01.01 Motors shall be general purpose, constant speed, squirrel cage, three/single phase, induction type.
- 4.01.02 All motors shall be either totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or closed air circuit air cooled (CACA) or closed air water cooled (CACW) type. Temperature rise shall be limited to 70 deg C by resistance method.
- 4.01.03 All motors shall be rated for continuous duty. They shall also be suitable for long period of inactivity.





- 4.01.04 All LT motor shall conform to minimum efficiency performance standards (MEPS) of **IE2 mentioned in IS: 12615**. All HT motors shall have efficiency and power factor higher than 90% and 0.83 respectively.
- 4.01.05 The motor name-plate rating at 50°C shall have at least 15% margin for LT system and 10% margin for HT system, over the input power requirement of the driven equipment at rated duty point and also covering the maximum load demand of the driven equipment under entire operating range, including voltage and frequency variations, unless stated otherwise in driven equipment specification or in general electrical specification.
- 4.01.06 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service. The direction of rotation of motor and its cooling fan should be properly matched with the driven equipment.
- 4.02.00 AC motor for VFD application (If applicable)
- 4.02.01 Inverter duty motors are designed according to the requirements of IEC/TS-60034 part17 & part 25 or NEMA MG-1, Part-30, Part 31 and have performance characteristics match with the driven equipment and variable speed requirement.
- 4.02.02 Induction motors to be operated in adjustable-speed drive applications should be de-rated as per NEMA/IEC standard due to the reduction in cooling resulting from any reduction in operating speed and the effect of additional losses introduced by harmonics generated by the control.
- 4.02.03 Inverter duty motors shall have VPI/improved insulation systems that do not degrade readily due to transient voltage spikes and have an adequate thermal margin.
- 4.02.04 Inverter duty motors shall be self ventilated without any auxiliary blower. Force ventilation shall be subject to purchaser approval.
- 4.02.05 Inverter motor shall be suitable for scalar (open loop) control, without any speed feedback signal, where fast response is not required. Vector (closed loop) control will be used with encoder if specified.
- 4.02.06 The breakdown torque at any frequency within the defined frequency range shall be not less than 150% of the rated torque at that frequency when rated voltage for that frequency is applied.
- 4.02.07 The motor should be capable of producing a breakaway torque of at least 140% of rated torque requiring not more than 150% rated current when the voltage boost is adjusted to develop rated flux in the motor and when the inverter is able to produce the required minimum fundamental frequencies
- 4.02.08 The motor shall be provided with insulated bearing on one side.
- 4.02.09 Normally the maximum safe speed shall be as per IEC/NEMA, however it should be coordinated with VSD requirement.



4.02.10 In case of a conflict, the requirement mentioned under clause no. 4.02.00 for motors for VFD application shall supersede the corresponding requirement for standard motors.

4.03.00 **D. C. Motors**

4.03.01 D.C. motor provided for emergency service shall be shunt wound type. It can also be of compound-wound type with the series field shorted.

4.03.02 Motor shall be sized for operation with fixed resistance starter for maximum reliability. Starter panel complete with all accessories shall be included in the scope of supply.

5.00.00 **PERFORMANCE**

5.01.00 **Running Requirements**

5.01.01 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given in the annexure.

5.01.02 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals.

5.02.00 **Starting Requirements**

5.02.01 Motor shall be designed for direct on line starting at full voltage. Starting current at rated voltage for LT motors shall be 6 times of full load current plus IS tolerance. For 3.3KV and 11KV motor except BFP, starting current shall be maximum 6 times of full load current inclusive IS tolerance. For Boiler feed pump motor, starting current shall be limited to 4.5times of full load current plus IS tolerance.

For D.C. Motors the starting current shall be limited to 2 times full load current.

5.02.02 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.

5.02.03 Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals without exceeding acceptable winding temperature.

5.02.04 Motor shall be capable of three equally spread starts per hour, two starts in quick succession from cold condition and one restart from hot condition.

5.02.05 Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with non-energized shaft rotating at 125% rated speed in reverse direction.

5.03.00 **Stress During Bus Transfer**

5.03.01 The motor may be subjected to sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.

5.03.02 The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics.





5.04.00 Locked Rotor Withstand Time

5.04.01 For motors with starting time upto 20 secs, starting time at minimum permissible voltage should be less than the locked rotor withstand time under hot condition at highest voltage limit by at least 2.5 secs.

For motors with starting time more than 20 secs. and upto 45 secs, starting time at minimum permissible voltage should be less than the locked rotor withstand time under hot condition at highest voltage limit by at least 5 secs.

For motors with starting time more than 45 secs, starting time at minimum permissible voltage should be less than the locked rotor withstand time under hot condition at highest voltage limit by at least 10% of the starting time

5.04.02 To prevent unwanted tripping of a high inertia load at start-up, there may be need to shunt out the motor's overload trip device. Speed switches mounted on the motor shaft may be provided in such case. Heating experienced during start-up must still be considered when sizing the motor.

5.04.03 Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.

5.05.00 Torque Requirements

5.05.01 Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.

5.05.02 Pull out torque at rated voltage shall not be less than 205% of full load torque.

6.00.00 SPECIFIC REQUIREMENTS

6.01.00 Enclosure

6.01.01 Enclosures for the motor and the cable box shall conform to the degree of protection IP-55 unless otherwise specified.

6.01.02 Motors like circulating water pumps of large output ratings, located inside a building and not directly exposed to coal dust or fly ash, could have screen protected drip proof enclosure conforming to IP-23.

6.01.03 Motor located in hazardous area shall have flameproof enclosure conforming to IS: 2148 /Equiv. as detailed below:

- a) Fuel Oil area : Group IIB
- b) Hydrogen generation plant area : Group IIC (or Group-I, Div-II as per NEC or Class-1, Gr-B, Div-II as per NEMA/IEC60034)

Separate Canopy shall be provided for LT motors located in outdoor or semi-outdoor area.

**6.02.00 Cooling**

6.02.01 The motor shall be self ventilated type, either totally enclosed fan cooled (TEFC) or closed air circuit air cooled (CACA).

6.02.02 For large capacity motors, totally enclosed tube ventilated (TETV) may be considered for acceptance. In case of motors rated 3000kW and above, closed air circuit water cooled (CACW) motors may be offered for consideration before proceeding with design and manufacturing.

DELETED

6.04.00 Tropical Protection

6.04.01 All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

6.04.02 All fittings and hardware shall be corrosion resistant.

6.05.00 Bearings

6.05.01 Motor rated above 1000kW shall have insulated bearings to prevent flow of shaft currents.

6.05.02 Vertical shaft motors shall be provided with thrust and guide bearings.

6.06.00 Noise & Vibration

6.06.01 Noise level shall not exceed 85 db (A) except for BFP motor for which the maximum limit shall be 90 db (A).

6.06.02 Peak amplitude of vibration shall be limited within the values prescribed in IS:12075 / IEC 60034-14.

6.07.00 Motor Terminal Box

6.07.01 Motor terminal box shall be detachable type, made of cast iron or pressed steel and located in accordance with Indian Standards clearing the motor base- plate/ foundation.

6.07.02 Terminal box shall be capable of being turned 360° in steps of 90°, unless otherwise approved.

6.07.03 Terminal box for all LT motors shall be diagonally split type and shall have the same degree of protection as motor.



- 6.07.04 The terminal box shall have sufficient space inside for termination /connection of suitable sized HT cables. Where the specified main cable size demands, adopter/extension box of suitable size shall be provided as a part integral to the motor, for easy termination of the cable.
- 6.07.05 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.
- 6.07.06 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.
- 6.07.07 The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.
- 6.07.08 For HT motor, the terminal box shall be phase segregated type. The neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type) with shorting links for star connection.
- 6.07.09 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match Owner's cable. All threads shall be ISO metric thread only.
- 6.07.10 The gland plate for single core cable shall be non-magnetic type.

6.08.00 **Grounding**

- 6.08.01 The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.
- 6.08.02 The grounding connection shall be suitable for accommodation of ground conductors as follows:

Motor above 90 kW	50 x 6 mm GI Flat
Motor above 30 kW upto 90 kW	35 x 6 mm GI Flat
Motor above 5 kW upto 30 kW	25 x 3 mm GI Flat
Motor upto 5 kW	8 SWG GI Wire

The above sizes shall be superseded by different sizes if so indicated in the relevant clause of the General Electrical Specification.

- 6.08.03 The cable terminal box shall have a separate grounding pad.

6.09.00 **Rating Plate**

In addition to the minimum information required by IS, the following information shall be shown on motor rating plate :

- Temperature rise in °C under rated condition and method of measurement.
- Degree of protection.
- Bearing identification no. and recommended lubricant.
- Location of insulated bearings.

**7.00.00 ACCESSORIES****7.01.00 General**

Accessories shall be furnished, as listed below, or if otherwise required by driven equipment specification or application.

7.02.00 Space Heater

7.02.01 Motor of rating 30 kW and above shall be provided with space heaters, suitably located for easy removal or replacement.

7.02.02 The space heater shall be rated 240 V, 1 phase 50 Hz and sized to maintain the motor internal temperature above dew point when the motor is idle.

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**7.06.00 Accessory Terminal Box**

7.06.01 All accessory equipment such as space heater, temperature detector, current transformers etc., shall be wired to and terminated in terminal boxes, separate from motor (power) terminal box.

7.06.02 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit owner's cable connections.

7.07.00 Drain Plug

Motor shall have drain plugs so located that they will drain the water, resulting from the condensation or other causes from all pockets of the motor casing.

7.08.00 Lifting Provisions

Motor weighing 25 kg. or more shall be provided with eye bolt or other adequate provision of lifting.

7.09.00 Dowel Pins

The motor shall be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment.

7.10.00 Painting

Motor including fan shall be painted with corrosion proof paints. The paint shade shall be as specified in the Annexure.

8.00.00 TESTS

8.01.00 Upon completion, each HT & LT motor shall be subject to routine tests as per Schedule-C of Section -I. In addition, any special test called for in the driven equipment specification shall be performed.

8.02.00 Unless and otherwise stated, Six (6) copies of routine test certificates shall be submitted for approval prior to the despatch of the motors from works.

8.03.00 The following type test reports shall be submitted for each type and rating of HT motor:

- a) Degree of protection test for the enclosure followed by IR, HV and no load run test.
- b) Fault level withstand test for each type of terminal box.
- c) Lightning impulse withstand test on the sample coil as per IEC 60034, part-15.
- d) Surge withstand test on inter-turn insulation as per clause no. 5.1.2 of IEC 60034, part-15.

8.03.04 The following type tests shall be performed on a representative sample of 11000V and 3300V motor of each type & rating, even if type test certificates of these tests are submitted by the Bidder for Purchaser's approval:



- a. Measurement of stator resistance (and rotor resistance on slip ring motors).
- b. No load test at rated voltage to determine voltage, current, power input and speeds.
- c. Locked rotor reading of voltage, current, power input and values of torque of motor.
- d. Full load test to determine efficiency, power factor and slip.
- e. Temperature rise test. During heat run test, bearing temperature, Winding temperature, core temperature, coolant flow and its temperature shall be recorded. In case temperature rise test is carried at any load other than rated load, specific approval for test procedure and method has to be obtained.
- f. Momentary overload test.
- g. Test for noise level of motor.

9.00.00 SPARE

Recommended spares for three (3) years operation shall be quoted along with the bid clearly identifying the part numbers with recommended quantities.

10.00.00 DRAWINGS, DATA & MANUALS

Drawings, data & manuals for the motors shall be submitted as indicated below :

10.01.00 Along with the bid

- a) List of the motors
- b) Individual motor data sheet as per Annexures
- c) Scheme & write up on forced lubrication system, if any.
- d) Type test report

10.02.00 After Award of Contract for Information (I)/ Approval (A)

- a) Dimensional General Arrangement drawing (I)
- b) Foundation Plan & Loading (I)
- c) Cable end box details.(I)
- d) Space requirement for rotor removal (I)
- e) Thermal withstands curves hot & cold (I)
- f) Starting and speed torque characteristics at 80%, 100% & 110% voltage (A)
- g) Complete motor data sheet (A)
- h) Erection & Maintenance Manual (I)



ANNEXURE-A

DESIGN DATA

1.0 AUXILIARY POWER SUPPLY

DELETED

L.T. Supply 415V, 3 ϕ , 3W, 50 Hz Motors above 200W
Effectively earthed upto 160 kW

Fault level 50 KA symm.
for 1 seconds.

DELETED

2.0 RANGE OF VARIATION

A.C. Supply

Voltage : $\pm 10\%$ Frequency : $\pm 5\%$

Combined Volt & frequency : 10% (absolute sum)

D.C. Supply

Voltage : 190 to 240 Volt

3.0 Paint Shade : RAL 7032





SECTION - VIII

LOCAL CONTROL BOARDS/PANELS, LOCAL ISOLATING SWITCH UNITS AND LOCAL PUSH BUTTON STATIONS

1.00.00 SCOPE OF SUPPLY

1.01.00 The following equipment shall be furnished with all accessories:

- a) Complete set of Local Control Boards/Panels, an indicative list of which is given in Annexure-D
- b) Local Push Button Stations: As required
- c) Local Isolating Switch Units: As required

1.02.00 Furnishing, Mounting, and wiring of all equipments, devices and accessories.

1.03.00 Floor Channel sill, vibration damping pad, and kick plates for all floor-mounted control boards/panels, complete with holding down bolts and nuts.

1.04.00 Mounting hardware for all control boards/panels, Local Push Button Stations, and Local Isolating Switch Units.

1.05.00 Mandatory Spares

2.00.00 CODES AND STANDARDS

2.01.00 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC except where modified and/or supplemented by this specification.

2.02.00 Equipment and material conforming to any other standards, which ensure equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

2.03.00 The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

3.00.00 DESIGN CRITERIA

3.01.00 Local Push Button (L.P.B.) stations shall be used for controlling drives from local.

3.02.00 Local Isolating Switch (L.I.S) Units shall be used for local isolation of power supply to various machines in the Workshop Building.

3.03.00 All equipment except L.I.S. Units and L.P.B stations, shall be located in a clean but hot, humid, and tropical atmosphere. The L.I.S. Units and L.P.B. stations





shall be generally installed in a hot, humid, and tropical atmosphere, heavily polluted at places with fly ash and/or coal dust, and shall be suitable for outdoor service with degree of protection specified elsewhere in this specification.

- 3.04.00 All Control Boards/Panels, L.I.S. Units, and L.P.B. stations shall be liberally sized so as to provide spacious layout of equipment and devices with sufficient working space in between.
- 3.05.00 Adequate space/terminals shall be kept in the boards/panels for installing additional equipment in future.
- 3.06.00 For continuous operation at specified ratings, temperature rise of the various components/equipment shall be limited to the permissible values stipulated in the relevant standards and/or this specification.
- 3.07.00 All equipment/components thereof shall be capable of withstanding the mechanical forces and thermal stresses of the system short circuit current without any damage or deterioration of material.
- 3.08.00 Design, material selection, and workmanship shall be such as to present a neat appearance outside and inside with no welds, rivets, screws, or bolt heads apparent from the exterior surface of the boards/panels. All instrument cut-outs, mounting studs, and support brackets shall be accurately located.
- 3.09.00 **DB/Local Starter Panel for Dust Suppression, Dust Extraction, Sump Pump, Coal Sampler, Bunker Level and other Panels**

The Local Starter Panel shall be fixed type with compartmentalized execution. One (1) no. 415 V $\pm$ 10% 3 phase 3 wire 50 Hz +3 to -5% power supply feeder shall be provided for each panel. Power shall be received through an incoming MCCB having R/Y/B indication lamps, voltmeter with selector switch, and ammeter with selector switch. Individual motor feeder shall have their switch fuse, power contactor; overload relay-cum-single phasing preventor (hand reset type), stop/ start push button, auto/manual selector switch, Red/Green/Trip indication lamp, auxiliary relays, timers, etc. The stop push button shall be lockable type. Necessary interlock, annunciation, 415/240 V Transformers for control supply, space heating as applicable to meet system requirement shall also be provided and in no case derive any power supply from its main feeder. Separate feeders shall also be provided for brakes and rail clamp as applicable. Facility shall be provided for resetting the motor overload relay from outside without opening the panel door. Panel door shall be interlocked with the incoming MCCB such that the door cannot be opened when MCCB is ON.

The details indicated above for DB/Local Starter Panel is applicable for motors rated upto 90 KW. For motors rated above 100 KW, the details indicated in the respective 415V PMCC specification (Refer section-VI) and associated single line diagram shall govern.

Interlock, control, indication, annunciation etc. shall be achieved by relay logic with the exception of Paddle Feeder. For paddle feeder the logic shall be based





on PLC control and provision for remote operation from CHP control room shall be provided. .

Isolation of individual circuit in the DB/Local Starter Panel shall be provided through individual MCB/Fuse.

Control features as described under relevant mechanical section shall be considered for interlocking and preparation of control schematic.

Thermostatically controlled space heater shall be provided.

Necessary door interlock defeat feature shall also be provided for testing purpose. Wherever necessary, the panels shall be designed for outdoor and of weather proof/rain protection type. Ratings of components shall conform to the rating indicated in the enclosed module selection chart.

Paddle Feeder Local Panel (If applicable)

- a) Following indications shall be provided in local panel, for each drive :
 - i) Paddle feeder travel drive
 - ii) Paddle wheel ON/OFF
 - iii) Brake release
 - iv) Hydraulic power pack indication
 - v) Cable reeling drum on
- b) Annunciation windows shall be provided for all drive trip indications and all other major fault.
- c) Local & Remote metering shall be provided for current indication for drive rated 30 KW and above and also paddle wheel coal feeding rate .
- d) PLC based logic shall be provided for Paddle feeder and shall be interfaced with local panel for control, indication and annunciation.
- h) Separate cable reeling drum shall be provided for power & control cable. Combined trailing cable shall have 19C X 2.5 mm² (cu) control cable and 8 pair 1.5 mm² (cu) screened cable for signal and communication.

Travelling Tripper MCC Cum Control Panel

In addition to indication to be provided for drives, following indications shall also be provided in local panel:

- i) Brakes applied
- ii) Rail clamps applied
- iii) Flap Gate position
- iv) Travel driver over speed





- v) Traveling tripper – Forward/Reverse
- vi) Cable Reeling Drum on

Traveling tripper position on bunker shall be provided in the PLC.

Control features as described under relevant mechanical portion shall be considered for interlocking and preparation of control schematic.

Cable reeling drum shall be provided for power & control cable. Apart from meeting the requirements in respect of control, indication & annunciation and telecommunication following spare cores shall be provided :

- i) 4 pair cores (Shielded) for communication
- ii) 4 core for control.

Sump Pump Control Panel

Sump Pump Control Panel shall be provided with level controller, necessary contacts to start pumps in auto mode when level reaches high. Further, very high level shall cause hooter to blare for a predetermined period of time. In manual mode it shall be possible to start individual pump. However, in manual mode and auto mode of operation, pump shall be tripped when level in the sump pit reaches low. Working and standby logic also to be incorporated as per requirement.

In addition to other indicating lamps level high indication lamp shall also be provided in local panel.

Control Panel for Drives of ETP

Control panel for each drive shall be provided near the drive. The panel shall be fabricated from cold rolled MS sheets of minimum 2mm thickness for load bearing members, 1.6mm for non-load bearing members and 3mm for gland plates. Panel shall be suitable for outdoor installation with IPW-55 or better.

The panel shall house the starter for the drive motors. Motor starter feeder shall be chosen to provide Type-2 co-ordination. Power supply for motor space heater shall also be derived from this panel.

Control panel shall have all necessary standard features viz.

- Motor ON/OFF push buttons
- Process interlocking provisions
- Auto/Manual selection position
- Motor ON/OFF indication

Miscellaneous Control Panels

Miscellaneous control panel i.e. dust suppression panel, ventilation panel, etc. shall have individual starter feeder for individual drive. Other features as specified above shall also be provided. Equipment such as Vibrating feeders,





Magnetic separators, Metal detectors, Dust suppression, Ventilation, Dust extraction, Coal Sampler, Bunker Level, Hoists etc. shall have individual starter-cum-control panels to suit individual requirements. The panels shall include all necessary feeders, start stop PB, indicating lamp, annunciation system, 415/240V control transformers for control supply and space heating as applicable to meet system requirement. For Magnetic Separators, separate panels shall be provided. One panel shall accommodate transformer & rectifier and the other panel shall accommodate incomer and other controlling items.

The requirement of 4-20 mA signals for Belt Weigher and bunker level indicator have been provided in the relevant Specification.

4.00.00 **SPECIFIC REQUIREMENTS**

4.01.00 **Construction**

4.01.01 Local Control Boards/Panels

- a) Local Control Boards may consist of a number of vertical panels mounted side-by-side, in which case, they shall be bolted together to form a compact unit. Where two panels meet, the joints shall be smooth, close-fitting, and unobtrusive.
- b) The control boards/panels/stations shall be totally enclosed type, conforming to degree of protection IP-54 or better.
- c) Generally, the local control boards/panels shall be free-standing, floor-mounted, dead-front assemblies. In some cases, however, wall-mounted type control boards/panels may also be accepted.
- d) Floor-mounted control boards/panels shall be assembled on channel/angle base plates with anti-vibration mountings and stainless steel kick-plates.
- e) Control boards/panels shall be of folded sheet steel construction, minimum 2 mm. thick, and free from all surface defects.

The boards/panels shall have sufficient structural reinforcement to ensure a plane surface, to limit vibration, and to provide rigidity during shipment and installation.

- f) All floor-mounted panels shall have rear door.
- g) Doors shall have concealed type hinges and padlocking arrangement. Doors shall be grounded by flexible copper braid.
- h) All doors and removable covers shall be provided with neoprene rubber gaskets all round and latches sufficiently strong to hold them in alignment when closed.
- i) Working height of the panels shall be limited between 550 mm and 1800 mm above floor level.



**4.01.02 Local Push Button Stations**

- a) L.P.B. Stations shall be furnished in sheet steel enclosure of dust and vermin-proof, weather-proof, gasketed construction, suitable for outdoor use without canopy, and conforming to degree of protection IP-55 or better.
- b) L.P.B. Stations shall be suitable for column/structure/wall mounting and shall be complete with push-buttons, terminal blocks, anodised aluminum inscription plate, two (2) nos. earthing terminals, removable gland plate along with crimp type tinned copper lugs and compression type glands for cable/conduit entry from top and bottom. The earthing terminals shall be suitable for connection to one (1) no. 8 SWG G.I. wire.
- c) L.P.B. Stations shall be of the following basic type and equipped with:
 - Type-A : One(1) START push-button and one(1) STOP push-button.
 - Type-B : One(1) OPEN push-button, one(1) CLOSE push-button, and one(1) STOP push-button.
 - Type-C : Flame proof type as per IS-2148. one (1) START push-button and one(1) STOP push-button.
 - Type-D : One(1) STOP Lock-out switch.Any other type of L.P.B. Station, if required, shall be subject to approval of the Purchaser.
- d) OPEN, CLOSE, and START push-buttons shall be spring return to normal type. STOP push-buttons shall have mushroom head actuator with press-to-latch and key-to-release feature.
- e) OPEN/START push buttons shall be GREEN, STOP push buttons shall be RED, and CLOSE buttons may be YELLOW.
- f) All push-buttons shall have a minimum of two (2) Normally-Open and two (2) Normally-Closed electrically separate contacts, rated minimum 10 A at operating voltage.
- g) Wiring shall be done by 1/C - 2.5 sq.mm. 1100V grade, PVC/XLPE insulated, stranded copper conductor, cable. Each wire shall be identified at both ends by ferrules with wire designation.
- h) Terminals shall have provision for connecting at least two (2) nos. 2.5 sq.mm. copper cable and shall be rated for carrying continuously minimum 10 A at 240V A.C. and 2 A at 220V D.C.



**4.01.03****Local Isolating Switch Units**

- a) L.I.S. Units shall be furnished in sheet steel enclosure of dust and vermin-proof, weather-proof, gasketed construction, suitable for outdoor use without canopy, and conforming to degree of protection IP-55 or better.
- b) L.I.S. Units shall be suitable for column/structure/wall mounting and shall be complete with load-break switch, terminal blocks, anodized aluminum inscription plate, two (2) nos. earthing pads, removable gland plate along with crimp type tinned copper lugs and compression type glands for cable/conduit entry from top and bottom. The earthing pads shall be suitable for connection to 25 x 3 mm G.S. flat
- c) Load-break switches shall be four-pole, air break, heavy-duty type. Duty class of load-break switches shall be AC-23 for motor feeders. Motor feeder switches shall be capable of safely breaking the locked rotor current of the associated motor circuit.
- d) Terminals shall be clip-on type, 10 sq.mm. minimum.

4.02.00**Equipment Mounting****4.02.01**

All equipment shall be so mounted that removal and replacement may be accomplished individually without interruption of services to others. No equipment shall be mounted on panel door.

4.02.02

All equipment mounted inside the panels shall be so located that their terminals and adjustments are readily accessible for inspection or maintenance.

4.02.03

For Local Control Boards/Panels control components such as push buttons, indicating lamps, selector switches, indicating meters etc. shall be flush mounted on the front face of the board/panel while switch fuses, supervision relays (AC/DC) etc. shall be mounted inside.

4.03.00**Name Plate****4.03.01**

Nameplates shall be furnished for each panel and for each instrument or device mounted on the panel. Each LPB Station shall also be provided with a nameplate.

4.03.02

The material of the nameplate shall be lamicaid or approved equal, 3 mm thick, with white letters on black background.

4.03.03

The nameplates shall be held by self tapping screws. The size of nameplate shall be approx. 20 mm x 75 mm for equipment and 40 mm x 150 mm for the panels. The size of the nameplate shall suit the overall dimensions of LPB station/L.I.S Unit.

4.03.04

Nameplates for panels shall be provided both on the front and on the rear and shall be according to final device/designation list.





- 4.03.05 Control and meter selection switches shall have integral nameplates. Nameplates for all other devices shall be located below the respective devices.
- 4.03.06 Instruments and devices mounted on the face of the panels shall also be identified on the rear with the instrument or device number. The number may be painted on or adjacent to the instrument or device case.
- 4.04.00 Mimic Diagram
- 4.04.01 Mimic diagram of electrical connections shall be furnished on the front face of all electrical control panels.
- 4.04.02 Mimic buses shall be at least 3 mm thick and 10 mm in width, made of suitably treated metal strips or approved equivalent and colour coded to denote different voltages.
- 4.04.03 The mimic representation, colour and size of diagram are subject to the approval of the Purchaser.
- 4.05.00 Illumination, Space Heating and Receptacles
- 4.05.01 Each panel shall be provided with interior fluorescent tube with door switch, space heater with thermostat and 5A, 3-pin receptacle with plug. Third pin of the socket shall be effectively grounded through the metallic structure.
- 4.05.02 Tube, heater and receptacle circuits shall be suitable for available A.C. supply and furnished with individual ON-OFF switch.
- 4.05.03 The lamp shall be located at the ceiling and guarded with protective cage. Space heater shall be located near the floor so as not to pose any hazard to service personnel.
- 4.06.00 AC/DC Power Supply
- 4.06.01 Necessary A.C. and D.C. supplies as required for control and service shall be arranged by the contractor. Single feeder shall be arranged for A.C supply and duplicate feeders shall be arranged for D.C supply.
- 4.06.02 Isolating switch fuse units shall be provided for the incoming AC/DC power supplies and bus wires shall be run for power distribution to different panels. D.C. supply isolating switches shall be double pole, double throw with off and A.C. supply isolating switches shall be 4-pole, double throw type.
- 4.06.03 Fuse and link shall be provided for individual circuits for protection and also for isolation from bus wire without disturbing other circuits.
- 4.06.04 The fuse requirements in each panel shall be grouped in easily accessible fuse blocks or distribution panel. The grouping shall be done in a neat and orderly fashion.
- 4.06.05 Alarm relays with reverse flag shall be provided to annunciate failure of main incoming A.C. and D.C. power supplies and annunciation D.C. supply in each





panel. Lamp indications shall be provided individually for main D.C. supply-1 fail, main D.C. supply-2 fail, and panel annunciation D.C. supply fail. A common A.C. electric bell shall be provided to give an audible alarm in case of failure of D.C. supply-1/D.C. supply-2/annunciation D.C. supply in any panel. A common push-button shall also be provided for cancellation of lamp indications and audible alarm.

- 4.06.06 Separate circuits shall be provided for (a) indication and alarm (b) tripping, and (c) control.
- 4.06.07 For lighting, auxiliary supply and space heating A.C. supply shall be used. D.C. supply shall be used for providing control supply to annunciator.
- 4.06.08 Bus wires of adequate capacity shall be provided to distribute the incoming supplies to different cubicles of a VDB. Isolating switch fuse units shall be provided at each cubicle for A.C/D.C supplies.
- 4.07.00 Wiring
 - 4.07.01 The panels shall be fully wired up at the factory to ensure proper functioning of control, protection and metering schemes.
 - 4.07.02 All spare contacts of relays and switches shall be wired up to terminal blocks.
 - 4.07.03 Wiring shall be done with flexible, heat resistant, 1100V grade, PVC insulated, switchboard wires with stranded copper conductor, 2.5 Sq.mm for current, control circuits and voltage circuits.
 - 4.07.04 Each wire shall be ferruled by plastic tube with indelible ink print at both end having terminal Block No., terminal numbers, destination number as per approved wiring drawing.
 - 4.07.05 All wire termination shall be made with insulated sleeve solderless crimping type tinned copper lugs. Wires shall not be tapped or spliced between terminals.
 - 4.07.06 Wiring shall be neatly bunched in groups by non-metallic cleats or bands. Each group shall be adequately supported along its run to prevent sagging or strain on the termination.
 - 4.07.07 Colour codes shall be used for wiring as per latest revision of IS: 375.
- 4.08.00 Terminal Block
 - 4.08.01 Multi-way terminal blocks complete with necessary binding screws and washers for wire connections and marking strip for circuit identification shall be furnished for terminating the panel wiring and outgoing cables. Terminals shall be box-clamp type, 10 sq.mm. minimum. Terminals for C.T. secondary leads shall have provision of shorting and grounding.
 - 4.08.02 Not more than two wires shall be connected to one terminal. If necessary, a number of terminals shall be jumpered together to provide wiring points.





- 4.08.03 Each terminal shall be identified with designation as per approved schematic. At least 20% of the total number of active terminals shall be furnished as spare in each panel.
- 4.08.04 The wiring and terminals shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.
- 4.08.05 The terminal blocks shall be located to allow easy access and also to suit floor openings for cable entry.
- 4.08.06 The terminal blocks within the panels shall be mounted on vertical support brackets. The support brackets shall be tack welded to the interior sheet steel mounting plates of the cabinet. Support brackets shall not be welded directly to the walls of the enclosure. The terminal blocks shall be attached to the support brackets with round head machine screws.
- 4.08.07 Terminal blocks shall generally be mounted vertically with adequate spacing (not less than 100 mm) between adjacent rows.
- 4.08.08 The bottom of the terminal block shall be at least 200 mm above the incoming cable gland plate.
- 4.09.00 Cable Entry
- 4.09.01 The Control Boards/Panels shall have provisions of cable entry from the bottom. Bottom plate shall be provided to make entry dust-tight. L.P.B. stations and Local Isolating Switch Units shall have provision for cable/conduit entry from both top and bottom. Suitable cable gland-plates shall be provided.
- 4.10.00 Grounding
- 4.10.01 50 x 6 mm TINNED COPPER ground bus shall be provided in each control panel extending along the entire length of the assembly.
- 4.10.02 The ground bus shall have two-bolt drilling with GI bolts and nuts at each end and shall be suitable for connection to 50 x 6 mm G.S. flat.
- 4.10.03 The ground bus shall be bolted to the panel structures and shall effectively ground the entire assembly. The cases of meters, relays and switching devices shall be grounded through the steel structure.
- 4.10.04 Whenever a circuit is grounded, a single wire from the circuit shall be run independently to the ground bus and connected to it.
- 4.11.00 Painting
- 4.11.01 Panels and Push-button Stations shall be finished with two coats of synthetic enamel paint white inside and gray (shade 631 of IS-5) outside. Panels and push-button stations shall be stoved after each spraying of finish paint. Painting process shall be of powder coating.





- 4.11.02 Caution Notice plate shall be affixed at the back of each vertical panel.
- 4.12.00 Switches
- 4.12.01 Switches shall be dust protected, heavy duty, switchboard type, complete with escutcheon plate. Contacts shall be silver surfaced and rated minimum 10A at operating voltage.
- 4.12.02 415V Breaker control switches shall be 3-position (TRIP/NORMAL/-CLOSE), 120°, spring return to neutral with lost motion device, non-lockable, sequence device, pistol grip handle, RED/AMBER/GREEN (circuit breaker CLOSED/TRIPPED-OR-TRIP CIRCUIT UNHEALTHY/OPEN) indicating lamps shall be provided with each breaker control switch.
- 4.12.03 Contact details and type of handle required for other types of switches are given below:

Sl. No.	Application	Switch description
a)	Synchronizing Selector switch	180°, 4-position (INCOMER-1/BUS-SECTION/INCOMER-2/OFF), stayput type, pistol grip handle. OR 120°, 3-position (INCOMER/TIE/OFF) stayput type, pistol grip handle.
b)	Trip Selector Switch	120°, 3-position (INCOMER-1/BUS-SECTION OR TIE/INCOMER-2), stayput type, pistol grip handle.
c)	Meter Selector Switch	4-position (OFF/R/Y/B for ammeter selector switch and OFF/R/Y/YB/RB for voltmeter selector switch), maintained contact, stay-put type, knob handle. Ammeter selector switches shall have make-before-break contacts.
d)	Auto-Manual Selector switch	120°, 2-position (AUTO/MANUAL), stayput type, non-lockable, spade handle.
e)	On-off Switch/Local-Remote Selector Switch	90°, 2-position (ON/OFF OR LOCAL/REMOTE), stayput type, non-lockable, spade handle.

- 4.12.04 Any other type of switch, if required, shall be subjected to approval of purchaser.





- 4.12.05 Tenderer shall decide the number of switch contacts taking into account the scheme requirements and spares.
- 4.13.00 Fuses
- 4.13.01 Fuses shall be HRC, preferably link type, with a minimum interrupting capacity equal to the system short circuit current.
- 4.13.02 Fuses shall be furnished complete with fuse boxes and fittings of such design as to permit easy and safe replacement of fuse element. Visible indication shall be provided on blowing of the fuse.
- 4.13.03 Motor fuse characteristics and ratings shall be chosen to ride over motor starting period without blowing. The fuse on incoming feeder, wherever provided, shall be chosen to provide discrimination with motor/feeder fuses.
- 4.14.00 Contactors
- 4.14.01 Contactors shall be three pole, air break type, with non-bouncing silver/silver alloy contacts. Contactor duty shall be class III - category AC3 for unidirectional drives and AC4 for bi-directional and inching drives/class I - category DC2.
- 4.14.02 Each contactor shall be provided with minimum two (2) N/O and two (2) N/C auxiliary contacts rated 10 A at operating voltage. The exact requirement of contacts shall be decided by the Tenderers taking into account the scheme requirements and spares.
- 4.14.03 Contactor starters shall comply with the requirements of IS-8544 (Part - 1) in respect of co-ordination of the characteristics of contactor, overload relay, and fuse. The type of co-ordination shall be Type-C as per IS-8544.
- 4.15.00 Thermal Overload
- 4.15.01 Thermal overload relays shall be three elements, positive acting, ambient temperature compensated with adjustable settings.
- 4.15.02 Single phasing preventor shall be provided as an inbuilt feature of the thermal overload relay.
- 4.15.03 Overload relays shall be manual reset type with 1 NO and 1 NC contacts. Resetting of relays shall be possible with compartment door closed. Colour of resetting button shall be BLACK.
- 4.15.04 Relays for fan motors having long starting time shall be saturable core C.T. operated.
- 4.16.00 Current Transformers
- 4.16.01 Current Transformers shall be cast resin type. All secondary connections shall be brought out to terminal blocks where wye or delta connection will be made.





- 4.16.02 Accuracy class of the current transformers shall be:
- a) Class PS for differential
 - b) Class 5P20 for other relaying
 - c) Class 0.5, ISF<5 for metering.
- 4.16.03 Drives requiring current monitoring shall be provided with current transducers with calibration for full-scale reading. The output shall be 4-20 mA D.C; 4-18mA of which shall correspond to the normal range and 18-20 mA shall correspond to the suppressed range.
- 4.17.00 Voltage Transformers
- 4.17.01 Voltage Transformers shall be cast-resin type and shall have an accuracy class of 0.5.
- 4.17.02 High voltage windings of voltage transformer shall be protected by current limiting fuses.
- 4.17.03 Low voltage fuses, sized to prevent overload, shall be provided in all ungrounded secondary leads. Fuses shall be suitably located to permit easy replacement while the board/panel is energised.
- 4.18.00 Push Button
- 4.18.01 All push buttons shall be oil tight, heavy duty, push to actuate type, with coloured button and inscription plate marked with its function. The colour of "ON" and "OFF" push buttons shall be RED and GREEN respectively. RESET push buttons shall be coloured black.
- 4.18.02 Each push button shall have minimum 2 NO. + 2 NO. contacts, rated 10A at 240V AC and 2A at 220V DC.
- 4.18.03 Push buttons shall be shrouded type except for emergency trip button, which shall be mushroom type for easy identification.
- 4.19.00 Lamps
- 4.19.01 Lamps shall be LED type.
- 4.19.02 LED lamp shall be made in accordance with InP Technology (Aluminium Indium Gallium Phosphide Technology). The body shall be made of Poly Carbonate Unbreakable Lens. LED shall be protected by inbuilt fuse with surge suppressor or leakage voltage glow protection. LED circuit shall be PCB mounted. Intensity shall be greater than 200 mcd. All Push Button lamp shall be as per LED indicating lamp.



**4.20.00 Operating Range**

All instruments shall be generally suitable for operation on 1A or 5A C.T. secondary circuit and/or 110V V.T. secondary circuit.

4.21.00 Meters

4.21.01 All indicating instruments shall be switchboard type, back connected, suitable for flush mounting, 96 x 96 mm with 240 Deg. scale, antiglare glass and accuracy class of $\pm 2\%$ of the full scale. The dials shall be made of such material as to ensure freedom from warping, fading, and discolouring during the lifetime of the instruments.

4.21.02 All indicating instruments shall be enclosed in dust-tight cases suitable for tropical use.

4.21.03 Meters shall have provision for zero-adjustment from front of the panel.

4.21.04 Meters shall be compensated for temperature errors and factory calibrated to read the primary quantities directly without using a multiplying factor.

4.21.05 D.C. ammeters, wherever required, shall be provided with external shunt if the current exceeds 5A. The rated voltage drop for the shunts shall be 75mV.

4.22.00 Annunciator System

4.22.01 Each control panel shall be provided with an annunciator window board. The annunciator boards shall be back-connected and suitable for semi-flush mounting.

4.22.02 The annunciator system shall be solid state type with optical isolation for input signals. The functional requirements shall be as per Annexure-C.

4.22.03 Each annunciator group shall be independent, complete with its own power supply, acknowledge-reset-test buttons and other necessary accessories. Hooter for audible alarm shall be common for each control panel assembly.

4.22.04 Each annunciator group shall be provided with a common alarm relay for group alarm annunciation in remote control room. The common alarm relay will operate on actuation of any alarm point of the group.

4.22.05 The annunciator shall be non-integral type with hardware box mounted separately for easy access and maintenance.

4.22.06 Audible alarms with different tones shall be used for trip, non-trip and ring back functions.

4.22.07 The window size shall be such as to accommodate minimum three (3) lines of twelve (12) characters each. Each character shall be minimum 4.75 mm high.

4.22.08 The annunciator system shall be suitable for operation from both NO and NC type initiating contacts.





- 4.22.09 At least 10% spare channels and window facia shall be provided in each annunciator group.
- 4.23.00 Relays
- 4.23.01 Auxiliary relays shall be furnished in fixed, dust-tight, casings and mounted inside the panel.
- 4.23.02 The relays shall have adequate numbers of contacts to suit scheme requirements. Besides, each relay shall have spare contacts for future use.
- 4.23.03 Contacts shall be silver-surfaced, bounce-free, and capable of repeated operation without deterioration.
- 4.24.00 Auxiliary Devices
- 4.24.01 The Contractor shall furnish, install, and wire-up all auxiliary devices such as timing / switching / lockout / auxiliary relays/auxiliary contactors, etc. as required for the proper functioning of the approved schemes.
- 4.24.02 The Contractor shall number the various types of relays and contactors as per the numbers appearing in the approved Schematic/Wiring appearing in the approved Schematic/Wiring diagrams.
- 5.00.00 **TESTS**
- 5.01.00 All Control Boards/Panels, L.I.S. Units and L.P.B. Stations shall be completely assembled, wired, adjusted and tested at the factory prior to shipment to ensure accuracy of wiring, correctness of control scheme and proper functioning of all components.
- 5.02.00 Routine Tests
- 5.02.01 The tests shall include wiring continuity tests, high voltage tests, insulation measurement test both before and after high voltage test, and functional tests to ensure accuracy of wiring operation of the control/ protection/metering schemes and individual equipment. Detailed test report including procedure and drawing shall be furnished.
- 5.02.02 All switches, meters, relays and other devices shall be tested and calibrated in accordance with relevant IS standards.
- 5.03.00 Type test certificate on any equipment, if so desired by the Purchaser shall be furnished. Otherwise the equipment shall have to be type tested, free of charge, to prove the design.
- 6.00.00 **DRAWINGS, DATA & MANUALS**
- 6.01.00 To be submitted with the Bid





- 6.01.01 General Arrangement drawings and cross-section of each equipment showing constructional features, cable entry points etc.
- 6.01.02 Typical foundation plan.
- 6.01.03 Bill of Materials.
- 6.01.04 Technical leaflet and Catalogues of:
- a) Local Control Boards and Local Starter-cum-Control panels
 - b) Local Isolating switch units
 - c) Local Push Button Stations
 - d) Switches and Lamps
 - e) Meters, relays, push buttons
 - f) Switch fuse units
 - g) Annunciator System
 - h) Auxiliary Devices
 - i) Terminal Blocks/glands.
 - j) Temperature Scanner
- 6.02.00 To be submitted after award of Contract
- 6.02.01 Dimensional general arrangement of all Local Control Boards, Local Starter-cum-control panels, Local Push Button Stations, and Local Isolating switch units showing equipment disposition and identification along with space requirements and cable entry points.
- 6.02.02 Foundation plan and loading diagram, clearly showing panel fixing arrangement, floor opening for cable entry etc.
- 6.02.03 Cross section with parts list.
- 6.02.04 Schedule of materials and label inscriptions.
- 6.02.05 Detailed Control Schematics clearly showing terminal and wire numbering.
- 6.02.06 Wiring diagram showing all equipment and devices in their relative physical positions and all wiring upto the terminal blocks.

Equipment/Device and terminals shall be identified with designations/numbers as per approved schematic and connection diagrams.





- 6.02.07 Data Sheets and Instruction Manual for each piece of equipment.
- 6.02.08 Any other relevant drawing or data necessary for satisfactory installation operation and maintenance or as required by purchaser.
- 6.03.00 Tenderers may note that the drawings, data and manuals listed are minimum requirements only. The Bidder shall ensure that all other necessary write-ups, curves and information required to fully describe the equipment offered are submitted with his bid.



ANNEXURE-A

RATINGS & REQUIREMENTS

1.0 LOCAL CONTROL BOARD

1.1 General

Type	:	Fixed type
Service	:	Indoor/Outdoor
Enclosure	:	IP-54/ IP-65 (Weather Proof)

1.2 System

Voltage	:	415 Volt $\pm$ 10%
Phase	:	3
Frequency	:	50 Hz +3 to- 5%
System	:	Solidly grounded

1.3 Rated Current at 50°C

Bus bar	:	To be decided by the Bidders
Switches	:	To be decided by the Bidders

1.4 Short Circuit Rating

Interrupting	:	50 KA
Short time for 3 Second	:	50 KA

1.5 Insulation Level : 2.5 KV for 1 min.





WBPDCL

**EPC Bid Document
Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase - III**

SECTION-X

ERECTION AND COMMISSIONING



Development Consultants Pvt. Ltd.

**Volume : II-E
Section : X
Erection and Commissioning**

**CONTENT**

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SECTION-X

ERECTION AND COMMISSIONING

1.00.00 ERECTION TESTING & PRE-COMMISSIONING PRACTICES - GENERAL

1.00.01 This part of the specification is intended to provide a general guideline for the procedures to be followed for the erection, testing and commissioning of various Control & Instrumentation Systems, field instrumentation, final control elements and accessories.

1.00.02 Omission of any specific reference to any method, parts, accessories or material required for proper and efficient execution of the work shall not in any way relieve the Contractor from his responsibilities of providing such facilities and performing the successful erection, testing and commissioning.

1.01.00 Equipment, Materials & Services to be provided by Contractor

1.01.01 Contractor shall follow the stipulations of the contract enumerated elsewhere in the specification regarding Equipment, Materials & Services to be provided under this specification and shall include but not limited to the following:

- a) Shop testing and Factory Acceptance Test.
- b) Pre-calibration of instruments at site and maintaining record of the same.
- c) Pre-assembly at site, as required.
- d) Erection of items.
- e) Cleaning / flushing (as required), pre-commissioning checking to ensure correctness of erection.
- f) In-situ calibration, testing, loop checking etc. of instruments and accessories, as required and maintaining record of the same.
- g) Cleaning up of instruments, accessories and worksite during and after erection.
- h) Powering on and Commissioning of all the instruments and equipment and systems.

1.02.00 Site Acceptance Test

1.02.01 General

- a) The work under Control & Instrumentation shall include activities like placement of equipment on foundation/ support, leveling and alignment, grouting on foundation, other miscellaneous civil work such as dressing / chipping of foundation / surfaces and also assembly and





pre-assembly, minor rectification, welding, cutting, site adjustments and all other incidental activities, as applicable.

- b) Contractor shall arrange all testing, erection and commissioning tools and tackle like hydraulic jacks, precision levels including micro level, dial and other gauges, surface plates, straight edges, vacuum cleaners, blowers, pumps and other equipment / implements necessary for hydro testing, compressed air testing, calibration and all other necessary tests as may be required for timely and efficient execution of the Contract.
- c) Bidder shall furnish a detailed erection micro-plan consistent with the overall project schedule and keeping in view the various site facilities and constraints encountered during various phases of work.

2.00.00**SPECIFIC ERECTION PRACTICES AND GUIDELINES**

The specification provides the general guidelines to be followed for the warehousing, handling, testing, erection, pre commissioning checks and commissioning of various types of instruments and accessories.

- a) The guidelines provided shall not be deemed as an effort to describe the entire work involved or to identify the steps and sequence to be adhered to in the erection of specific work items.
- b) The basic intent is to establish a sound engineering practice to be adopted throughout.
- c) Equipment manufacturers' recommendation, where available, shall prevail over the guidelines furnished in this section and in case of any contradiction between the stipulations.
- d) For special instruments viz. analyzers etc., the specification furnished are of general nature only and manufacturer's recommendation shall be strictly followed as guideline for erection and commissioning.
- e) The specification shall not be treated as comprehensive. Any activity, not specifically mentioned but felt essential or advisable from good engineering consideration shall be performed.

2.01.00**Field Instruments**

Guidelines provided herein shall be adhered to while erecting an instrument or accessory in the plant beyond control room areas.

- a) Care should be taken to avoid damage to the instruments during handling and transportation. Special care shall be taken while handling breakable, spillable, fragile and delicate items.
- b) Before erection, all instruments shall be subjected to calibration and other functional checks at Contractor's site laboratory. The instruments shall be uncrated and unpacked with utmost care and as



per instructions furnished on the respective packages, using appropriate tools and implements.

- c) All instruments, jigs, tools and tackle for the purpose of performing the tests shall be arranged by Contractor.
- d) All instruments shall be tagged with engraved aluminum / stainless steel tag plates and shall be secured to the instrument with metallic wire fasteners, during the test.
- e) For instruments found acceptable and conforming to the declared performance parameters of the manufacturer, the test report shall be prepared.
- f) Minor repairs and adjustments of the instruments shall be performed by Contractor. Once the defective instrument has been successfully repaired, it shall again be subjected to calibration and functional checks, as indicated above.
- g) A record of such repairs and adjustments shall be systematically maintained by Contractor.
- h) For instruments where the extent of damage is such that the same cannot be repaired at site, a failure report shall be generated by Contractor, enumerating the nature of fault/ damage. Cases where the damages are only superficial and which does not affect the appearance and performance of the instrument/s, the decision as to whether such instruments are fit for erection shall solely lie with Owner.
- i) In no case, erection work shall be taken-up in areas where heavy equipment movement is foreseen, major welding activity is under progress, heavy structural items are being erected or any other major activity is being carried out or is anticipated, which may cause damage to the erected instrument or its support.
- j) If any erected instrument or its accessories are found to be vulnerable to damage or to be fouling/interfering with progress of other activities in the area, same shall be dismantled/removed. During re-erection of such instruments, all the necessary steps as indicated in the specification for the erection of the instrument shall be carried out afresh.
- k) After erection, the instruments shall be covered with transparent polyethylene sheets to protect from unauthorized handling.
- l) Colored PVC adhesive tapes shall be put on the polyethylene cover to indicate various stages of activities. Red tape shall indicate erection under progress. Yellow tape shall indicate completeness of erection. Blue tape shall imply approval of erection and Green tape shall signify the commissioning of the instrument. Adhesive paper tapes shall be fixed on the respective tapes to inscribe the dates of completion of activities.



- m) Location of field instruments shall be consistent with tapping points on pipes and equipment.
- n) No field mounted instrument shall be installed in such a manner that it depends on rigidity of the impulse piping or the electrical connection to it for support.
- o) Handrails shall not be used for mounting or supporting instruments.
- p) The place where the instrument is to be installed must be easily accessible from nearest floor / platform level and there must have enough clear space to allow maintenance work and lay-down.
- q) The installed position must be such as not to cause any inconvenience to repair, removal, observation, inspection and maintenance of the installed equipment and other items nearby.
- r) The nearby high temperature equipment or process piping shall not give rise to any injurious effect to instruments.
- s) There will be no safety valve or effluent drain point which may cause injurious effect near the instrument. In general, no instrument shall be erected in areas prone to vibration.
- t) Instruments which are outside the building or shed and are not located within transmitter rack shall be provided with protective cover or canopy to provide effective protection against dust, rain, sun etc. The cover shall be provided immediately after mounting the instrument.
- u) All clamps, supports, stands etc. required for installation and erection of instruments and their accessories, shall be painted.
- v) No field mounted instruments shall be installed without simultaneously taking up impulse line work connected with the instrument.
- w) Proper precaution is to be to protect his installations, instruments, accessories, devices etc. by isolation/removal from possible damages during flashing, pressure testing of main pipe lines, air headers, vessels, equipments etc.
- x) Wherever practicable the height of the instrument from its working floor/ platform shall be between 1000-1400 mm. The illumination at the locations where instruments are located shall be adequate so that the scales can be read unassisted.
- y) Sub-trays, where required, shall be erected for proper routing of the cables and tubes and no cable shall be laid unsupported.
- z) The indicating meters shall be oriented properly so that the scale can be read unassisted and unobstructed from the approach floor / platform.

**2.01.01 Pressure / Differential Pressure (D.P) Transmitters / Level Transmitters**

Pressure and DP transmitters shall in general be on transmitter rack/enclosure mounted or shall be mounted locally on fabricated structures. Displacer type level transmitters shall, however, be mounted directly on the vessel / stand pipe attached to the vessel.

- a) All manifolds, cocks and valves shall be pressure tested at rated hydraulic test pressure. All air line and draft / vacuum service cocks and valves shall be leak tested.
- b) Manifolds / valves shall be mounted on / connected to transmitter at Contractor's workshop / site and the assembly shall be leak tested after completion of the plumbing. The leak test shall be performed with compressed air and soap solution at pressure not exceeding the maximum overload pressure of the transmitter.
- c) All tests on the transmitters shall be performed after mounting / connecting of the manifold / valve assembly.
- d) For transmitters located in transmitter racks, the erection activities shall normally include mounting of the transmitter with its manifold/valve assembly on appropriate support structures in the rack with proper fasteners, viz. U-clamps, bolts etc., proper leveling of the transmitter, all pipe connections from process to the transmitter, piping from transmitter to drain valve / vent valve, supporting/ clamping of the valve, pipe connections from transmitter / valve to drain pot/drain header/ nearest system drain, cabling from transmitter to the rack / external junction box using flexible conduits, termination of the cable with appropriate lugs, sleeves and markers; mounting and connecting all settling chambers / damper pots / siphons etc., as applicable.
- e) For transmitters mounted on stanchions, brackets etc., such supporting structures shall be designed properly to support all transmitter accessories.
- f) For displacer type level transmitters, the blanks provided on the vessel / stand pipe shall be removed and the transmitter shall be mounted with proper gaskets, bolts and nuts. All nut and bolt heads shall be properly greased before tightening.
- g) For external cage type level transmitters, additional supports to the transmitters in the form of bracings / pedestals, if felt necessary, shall be fabricated and erected. While supporting/mounting such structures due consideration shall be given to the movement/expansion of the main equipment.
- h) For transmitters mounted on local structures, cabling shall be done up to the nearest junction box through suitable flexible / rigid conduits.



- i) Attention shall be paid to allow free space for the removal of transmitter cover.
- j) During installation of level instruments on vessels, if the nozzles on vessels are found to be out of alignment, necessary modification or addition of spool pieces as required, for proper installation, shall be carried out.

2.01.02 Temperature Instruments / Thermowells

- a) Welded thermowells shall be welded on pipes / vessels / equipment by certified welders only and all post-weld tests shall be performed as per main pipeline specification.
- b) All thermowells shall be thoroughly cleaned with air jet and wire brush before insertion of temperature gauges / element.
- c) The dial of temperature gauges and switches shall be oriented properly so that the scale can be read / set point can be adjusted unassisted from the approach floor/ platform.
- d) Capillary type instruments shall be mounted on appropriate support structure with clamps, bolts etc.
- e) Contractor shall fabricate structures for routing, supporting and protecting the capillary tubes. Capillaries shall be clamped at intervals not more than 1 meter. Capillaries shall not run unsupported.
- f) The cable take-off from temperature switches/elements shall be with flexible conduits up to the nearest sub-tray / junction box. Where appreciable movement of the pipelines are expected, adequate loop lengths shall be kept in the flexible conduits to allow the movement of the elements / switches without any strain.
- g) In the phase between erection and cabling work all cable entry points shall be kept plugged with PVC caps.
- h) Both the elements of duplex type elements shall be terminated at the junction box.
- i) All compensating cables shall be terminated with proper polarity.
- j) All cables shall cross ferruled at both the junction box and element head end.
- k) In case of thermowells with long immersion length and temperature elements having long and rigid extension neck, as in case of air or flue path measurements, mechanical supports shall be provided to avoid excessive suspension weight on the boss.

2.01.03 Pressure Gauges / Switches, Differential Pressure Gauges / Switches



Pressure gauges / switches and differential pressure gauges / switches shall either be directly mounted on the process pipeline or shall be mounted on local brackets, gauge boards or racks depending on accessibility and maintainability. Guidelines provided in clause 2.01.01 (a), (b), (c) & (d) above shall be generally followed for pressure and differential gauges and switches as well.

2.01.04 Stand Alone Field Mounted Electronic Controllers

Installation, supporting, cabling, calibrating, and commissioning of field mounted stand-alone electronic controllers (wherever used), fabrication of necessary supporting structures, pedestals, etc. shall be deemed as a part of the erection activity.

- a) Contractor shall fabricate protective enclosure of canopy wherever deemed required.
- b) The structure fabricated for installing the controller must have provision for mounting the associated accessories.
- c) All pneumatic tubing from the related I/P converter to the final control element shall be done in accordance with the specification laid down elsewhere in this specification.

2.01.05 Level Gauges / Switches

Level Gauges and Switches shall either be directly mounted on the vessel or on standpipe.

- a) Float and switching mechanism shall be installed only after welding and installing the cage in position.
- b) Contractor shall verify the following well in advance:
 - i) Necessary access platforms, ladders are provided.
 - ii) The center line of the tap-off valves are in plumb.
- c) Necessary support structures, if required for installation of external cages/gauges shall be fabricated.
- d) The erection activity of Level Gauges / Switches shall normally include mounting of the instrument, to vessel/stand pipe with necessary pipes, nipples, drain / vent valve, connection of drain to nearest system drain, cabling up to external junction box using flexible conduit, termination of cable with proper sleeves, conductor marker/ferrules and lugs etc.
- e) Necessary sub-trays, wherever required, shall be erected for proper routing of cable.
- f) The indicating side of gauge glasses shall be so oriented that it can be read unassisted and unobstructed from the approach floor / platform.



- g) Illumination in the areas where level gauges are mounted shall be adequate for the level to be visible without the help of flash light. Areas where this requirement can not be met, gauge glasses shall be provided with internal illumination.

2.02.00 Analyzers

Analyzers shall include flue gas analyzers, boiler emission monitoring system and the steam and water analysis system with all accessories, associated pipings / tubings and drain / purge line work/sampling system and necessary cabling.

- a) All necessary measures and precautions to be exercised for field mounted instruments shall be adhered to for field mounted analyzers, as well.
- b) Attention shall be paid to the accessibility of probe locations and withdrawal area for the probes. If Probe locations are found inaccessible, Contractor shall arrange for the construction of necessary access platforms. Also if any restriction is noted to the smooth withdrawal of the probes due to some interfering structures / railings etc., necessary modification work shall be performed by Contractor.
- c) Protective covers / canopies shall be fabricated and installed to protect the probe head/converter cabinet/calibration kit.

2.02.01 Flue Gas Oxygen Analyzers

- a) Suitable adapter plates with necessary openings on the duct or furnace wall properly stiffened and blanked with suitable blank flanges, shall be used for mounting Zirconia probe type Oxygen analyzers.
- b) Work shall include the erection of sub- trays or conduits for the cabling between probe head to the converter cabinet and the tubings for reference air and test gas, from calibration kit to the probe.
- c) While installing the converter cabinet, care shall be taken to locate the same within the specified distance from the probe.
- d) Activities shall also include the necessary sub-header work to extend reference air supply line from the nearest instrument air header to the reference air set, piping/tubing work between reference air purge meter to the reference air set and the probe, piping/tubing work between auto calibration kit to the probe and the necessary piping / tubing between the reference gas cylinders to the probe.
- e) All earthing continuity tests, insulation tests etc. shall be done as per manufacturer's recommendation.

**2.02.02 Emission Monitoring System**

Contractor's scope of work shall include complete transportation, lifting, mounting, calibrating, testing and commissioning of stack emission monitoring system consisting of stack gas monitoring system (SO_x, NO_x, CO, CO₂, moisture). Contractor's scope of work shall also include drawing of instrument air line up to platforms and subsequent distribution at Consumer points, if applicable. Necessary tubing, sub-tray work, cabling up to junction box on stack platform, conduiting etc. shall also be deemed to be a part of installation activity.

- a) Contractor's scope of work shall also include to arrange :
 - i) Inserts and cutouts on stack or duct wall with studs blanked-off temporarily by plates.
 - ii) Main cable tray/ladder up to the platform level.
 - iii) Instrument air take-off point near the analyzer location, if applicable.
- b) Adapter plate should be removed before installation and then bolted to the insert available on the stack or duct wall.
- c) The SO_x / NO_x/ CO / CO₂, moisture monitoring systems shall be mounted in the stack together with cubicle for housing the analyzers and all accessories like gas coolers, diaphragm pumps, test gas cylinders etc.
- d) Contractor's scope shall include; rigging, installation by bolting, necessary air piping up to the cubicle, cabling up to local junction box, testing, calibrating and commissioning of the system.
- e) The necessary precautions for probe mounting as detailed in the installation procedure of Oxygen analyzers shall be taken.
- f) Cabling from probe head to analyzer cubicle, analyzer cubicle to local junction box including laying of cable subtrays, conduits as required shall be in Contractor's scope of work.
- g) SO_x / NO_x/ CO / CO₂, moisture monitoring will consist of transmitter and receiver units and electronic signal conditioning unit with necessary air purge units.

Contractor's scope of work shall include mounting of the transmitter and receiver units on the ducts / inserts.

- h) Before mounting the trans-receiver units, the alignment of ports must be checked optically for straightness.
- i) Contractor's scope of work shall also include cabling from trans-receiver units to local junction box or electrical unit; providing air purge connection up to trans-receiver units and routing of air lines up to the required point with valves, air filter regulators, pneumatic lines.





- j) Field mounted electronic unit (if any) shall be installed on site fabricated stands/stanchions/enclosures.

2.02.03 Steam and Water Analysis System (SWAS)

- a) The scope of work shall include installation of all panels and the skid mounted equipment; connecting all incoming sample lines/cooling water lines to the sample conditioning panel bulkhead, laying of instrument air lines and cooling water lines up to and inside SWAS room; connecting of all drain headers up to the nearest system drain, installation of the chilled water compressor system with associated cooling water connection and chilled water connection to the bath, insulation of chilled water lines; laying of all special/prefab cables, mounting of all loose supply instruments/equipment in position.
- b) Contractor shall take utmost care in handling the pre-tubed and pre-wired panel sections during transportation and installation.
- c) The general guidelines for installation of SWAS panels shall be as per panel erection specification.
- d) Contractor shall be responsible for meticulous cleanliness of the SWAS room during and after installation work.

2.03.00 Local Panels, Racks, Cubicles, Gauge Boards Enclosures and Structures

Local racks, panels, gauge boards, cubicles shall be installed at specified locations. Work shall also include fabrication and installation of gauge boards, stands, mounting brackets and frames, drain headers etc. with associated painting and civil work.

- a) Contractor shall erect panels / cubicles / enclosures etc. only after ensuring availability of work front.
- b) The panels shall be issued from warehouse or storage yard on the same day when the actual erection is performed.
- c) Panel, once uncrated, must be installed on the same day.
- d) Panels supplied in packed condition, will be properly slinged for lifting. When lifting unpacked panels eye-bolts shall be used. Unpacking should be done at store or installation site only.
- e) During slinging or lifting of the panel, care shall be taken not to damage the structure or any instrument/equipment mounted on the panel.
- f) Panels shall be slowly lowered on its foundations and shall not be subjected on unnecessary jerk or bounce.
- g) Prior to the installation of panels the foundation shall be inspected for presence of foreign matters and existence of possible defects or damage. Positions, shape and dimensions of the foundation shall be





verified against corresponding drawing. Pockets for grouting shall normally be on the concrete base. Contractor shall arrange anchor bolts or grouting spikes and grout the same in the pocket.

- h) Accurate center lines and auxiliary lines shall be marked-off with due consideration of proper alignment and level. Base channel of panel shall be dismantled from the panel and shall be positioned and set by grouted anchor bolts. Before fixing the bolts, the panels must be properly aligned and plumbed. Only brass shims may be used for leveling of the panels. Leveling of panel should be done by the help of spirit level or similar device.
- i) Contractor shall arrange to provide suitable protective coverings for the panels since unpacking and after erection to avoid any damage due to movement of men and materials in the vicinity.
- j) Retouching work of painted surface of panels shall be carried out wherever required.
- k) During installation of panels and panel instruments the panels must be kept in perfectly clean condition.
- l) All panels shall be suitably earthed as per guidelines furnished in the specification.
- m) Only construction power shall be utilized during erection of panels. Under no circumstances power lines shall be tapped-off from the panels.

2.03.01 Junction Boxes and Pull Boxes

Contractor's scope of erection of junction boxes shall include mounting of junction boxes in appropriate locations indicated in the drawings, fabrication of necessary supports, pedestals, brackets, frameworks etc., for erection and final painting of the structures and the junction boxes.

- a) Junction boxes and pull boxes shall be provided for multi-pair / multi-core cables and compensating cables.
- b) Junction boxes shall be provided either with un-drilled removable gland plates or with knock-outs. Before installation gland plates shall be drilled/knock-outs shall be removed based on the cable schedule.
- c) The junction boxes shall be fixed to the nearest available structures as far as possible. In certain cases, special pedestals may have to be fabricated and grouted/bolted to nearest available structure.
- d) Before installation, junction boxes may have to be assembled by fixing terminal blocks, mounting rail etc. Any other connected job shall be a part of the junction box installation.



- e) Unused knock-outs in the junction boxes shall be left plugged to prevent dust and moisture entry.
- f) All necessary nuts, bolts, screws, foundation bolts etc. for mounting the junction boxes and their supporting structure shall be supplied by Contractor.
- g) Identification tags for the cables shall be provided both inside and outside the junction boxes close to the glanding point.
- h) Junction box mounting shall include the fabrication of steel supporting structures as well as other connected jobs.
- i) Contractor shall arrange to repaint junction box if the paint is damaged due to improper handling. Wherever required, Contractor shall arrange to perform retouching of paint on the junction boxes. Proper identification numbers shall be labeled on the junction boxes for ease of identification.
- j) After erection, junction boxes shall be covered with polyethylene sheets.
- k) Ideally the height of junction boxes shall be 1000-1400 mm from the approach floor level.

2.03.02 Transmitter Racks

- a) The location of transmitter racks shall normally be pre-assigned. However, depending on site conditions, some may have to be relocated at site.
- b) Guidelines provided for erection of panels shall apply for erection of transmitter racks, as well.
- c) Impulse lines shall normally terminate at a bulk head union at the top or back side of the closed type racks. In cases when bulk heads are not available, entry holes shall be drilled (not gas cut) and properly sealed after installation.
- d) Contractor shall avoid hot bending of impulse pipes inside the enclosures. All bending and forming activity should be performed outside before fixing in position.
- e) Contractor shall suitably support the drain/vent valves, manifolds etc. with the necessary clamps, bolts, washers etc.
- f) Contractor's scope of work shall also include terminating all rack mounted transmitters with electrical wires/cables in flexible conduits up to the terminal blocks with necessary cable and conduit supports, clamps, glands, sleeves, conductor markers/ferrules, lugs etc.



- g) Cabling from transmitter rack up to local junction box through flexible conduits, supporting and fixing of conduits at both ends, glanding of cables, ferruling and terminating are in Contractor's Scope of Work.

2.03.03**Stanchions, Site Structures and Mounting Frames**

Contractor's scope of work shall include fabrication and installation of mounting frames, pedestals, canopies, protective enclosures and local gauge boards for mounting local instruments, analyzer and junction boxes. Contractor's scope shall also include mounting of the instruments in these local stanchions/ pedestals/gauge/boards with all necessary mounting fixtures; piping, painting cabling up to local junction box and any other associated civil work like chipping, grouting etc.

- a) All steel items shall be de-scaled and degreased by suitable solvent cleaning.
- b) All structures shall be welded throughout.
- c) All faces supporting instruments shall be constructed with MS sheets of thickness not less than 3 mm.
- d) The support structure shall be designed to support all accessories related to the instruments; neatly and rigidly.
- e) While fabricating the structures, attention shall be paid to accessibility and maintainability of all equipment and accessories.
- f) All floor/platform mounted structures shall be self-supporting and free standing type. These should not depend on supports derived from nearby columns/structures/pipelines etc. for their rigidity and mounting.
- g) Adequate stiffness shall be provided on flat faces to avoid waviness of the surfaces. Necessary instrument cutouts are to be formed and all edges shall be rounded to avoid any sharp projection. Gas cutting of sheet metals are not permissible.
- h) All welds should be ground to smoothness; corners should be rounded and weld splatters should be cleaned.
- i) After welding, the structure surfaces shall be smoothed with emery paper and painted with two coats of red oxide primer.
- j) Before installation, accurate center lines and other auxiliary lines are to be marked for proper leveling and alignment.
- k) Necessary grouting pockets are to be chipped and anchor bolts/studs shall be fixed on floor, column or wall.
- l) Necessary precaution should be taken during locating site mounted structures so as not to interfere with erection activity in the area or



block passage for movement of personnel/equipment during normal operation and maintenance.

- m) Contractor shall arrange to provide suitable protective coverings for site fabricated structures to avoid damage due to movement of men and materials with vicinity.
- n) After erection, all site fabricated structures shall be painted with two coats of finishing paints of 2.0 mil/coat DFT. Sags, cracks, blisters, tear drops, fat edges of paint shall render the structures unacceptable.
- o) All instruments shall be mounted as per the recommendation of the manufacturer. Associated impulse and drain pipe work and supporting of accessories; cabling up to local junction box shall be Contractor's responsibility.
- p) Structures supporting indicating instruments shall be so oriented that the dials are visible unassisted from the nearest approach floor/platform. Ideally the height of instruments shall be 1000-1400 mm from the approach floor level.
- q) Contractor shall carry out retouching of painted surface of the structures wherever required, after installation.
- r) Contractor shall fabricate 3 mm MS/Aluminum canopies for shielding of instrument from direct exposure to sun & rain.

2.04.00 Cabling and Interconnection

Cabling and interconnection activity shall include cabling work between local switches, resistance temperature detectors, transmitters, converters, limit switches, smart positioners, torque switches, solenoid valves etc. up to local junction boxes; thermocouples up to local thermostatic junction boxes, temperature transmitters or control room panels from local junction boxes / local panels / transmitter racks / instruments to termination cabinets / panels / electronic cabinets in control room / control equipment room ; command and feedback signals from MCC / Switch Gear room to termination cabinets / panels / electronic cabinets in control room / control equipment room; inter-cabling between various cabinets in control room / control equipment room ;earthing of all panels / racks / cabinets / junction boxes etc, up to ground lug / riser with appropriate cable; special cabling between sensing devices to converter cabinets and cabling work of prefabricated and hiway cables. Cabling work shall normally imply pulling, laying, marking, splicing, glanding, dressing, ferruling, crimping and termination of cables at both ends with associated conduit and sub-tray work; followed by testing of cables.

- a) Single and multi pair/core cable shall be laid on trays or in conduits. Cable shall be neatly laid with proper dressing and adequately fixed.
- b) Cable shall enter in the enclosures through cable glands.
- c) All the cable runs shall be properly identified by easily readable printed permanent tag plate fastened to the cable with steel wires,





provided at both field ends and panel ends and at a maximum of 20 meter intervals in straight length. Tags shall be provided in all bends and both sides of the barrier walls as well as at both terminal ends.

- d) In the cable spreader room, cables shall be clamped rigidly below the panel entry. If required, vertical cable tray shall be provided in case where the horizontal cable tray is more than 1 Meter below the respective Panel bottom.
- e) Cables laid near the main Steam Piping and other high temperature steam pipings shall be protected through proper insulation arrangements against damage due to continuous exposure to high temperature.
- f) Bend trays with suitable roller arrangements shall be used for cross over of cables from one section to other in perpendicular direction.
- g) Spare cable runs shall be kept coiled inside the enclosures with the ends suitably protected and cables properly identified.
- h) In case of single piece straight multipair/core cable run, no joint in the cable shall be provided in between.
- i) All Control and Instrumentation Cables shall be laid maximum upto 2 layers for horizontal cable trays and in single layer for vertical trays.
- j) Cable glands and other openings in the junction boxes shall be properly sealed by means of sealing compound to make them thoroughly dust and moisture proof.
- k) The cables laid, shall not be subjected to excessive tension so as to cause damage to the conductors.
- l) At bends where excessive spatial stress may concentrate or where danger exists of damaging the insulation, extreme care shall be taken while laying the cables, to avoid any possible damage.
- m) All cable shall be tested for continuity and insulation before and after installation as per the latest Indian Electricity Rules. Test for continuity shall be done by a circuit tester. Insulation resistance test shall be done with a 500V megger. The measured insulation resistance shall be more than 50 meg. Ohms between conductors and one conductor to ground.
- n) All cable shall run through conduits up to local junction box / nearest sub-tray.
- o) All cable shields shall be individually terminated and jumpered together at the terminal blocks. Earthing of the shields shall, however, be performed at the control panel end.
- p) All cable shall be laid only along the route specified in the cable schedule.



- q) If at any time during progress of work, trays are found inadequate to accommodate the assigned cable, Contractor shall discontinue laying of the cable until the problem is rectified.
- r) Cable conducting AC and DC signals shall be segregated. Compensating cables shall not be mixed with cables carrying milliampere signals. The signal cables and power cables shall not be in the same conduit, tray or junction box. In general, a minimum clearance of 1500 mm shall be maintained between noise generating equipment like large motors, generators, transformers etc. and signal/control cables. The minimum distances to be maintained between the instrumentation signal cables and any AC power cables running in parallel are as follows :

Maximum Circuit Voltage	Separation (mm)
240 V AC	250
415 V AC	300
3.3 KV / 11 KV	600 / 900

- s) All cable shall be carefully laid or pulled in trays so that neither cable nor the trays are damaged. Cable shall be cut sufficiently long to conform to the contour of the trays, especially for vertical inside bends. All excessive slack shall be removed from the cable so that the cables lie parallel to the sides of the trays.
- t) The cable shall be tied to the trays with G.I./Aluminum or self-locking cable grip strip at not more than 2 meter intervals for horizontal runs and at not more than 1 meter intervals for vertical runs. All cable shall be strapped individually.
- u) Pulling of cable shall be done with manila rope or nylon rope.
- v) Only the type of lubricants recommended by cable manufacturer shall be used.
- w) Before pulling cable from the drum, the drum shall be visually inspected for protruding nails, fastenings or other objects which may damage the cable. Such articles shall be removed before pulling of the cable. Continuity and I.R. test shall also be performed.
- x) Contractor shall perform a thorough visual inspection for flows, breaks, cracks and abrasions in the cable sheath during pulling.
- y) Cable damaged in any way during installation shall be replaced.
- z) The pulling tension of any cable shall not exceed the maximum tension recommended by the cable manufacturer.
- aa) To avoid insulation damage from excessive sidewall pressure at bends in conduit runs, the pulling tension in Kilograms shall not exceed 1.5 times the radius of bend in centimeters.



- bb) For cable without metallic shielding or armor and cable with metallic tape shielding, the cable bend radius shall be in accordance with the requirements of IPCEA standards. For cable with metallic wire shielding or metallic armor the bend radius shall not be less than 8 times the overall diameter of the cable.
- cc) All spare conductors of a multipair/core cable shall be left at their maximum lengths for possible future replacements of any other conductors in the cable. Each spare conductor shall be identified and neatly coiled separately and then taped to the conductors being used.
- dd) All exposed conductor surfaces shall be taped with all-weather vinyl plastic electrical tape.

2.04.01 Instrumentation Twisted Pair Cables

Cabling in this category shall include cabling between local switches, resistance temperature detectors, transmitters, local converter, smart positioner, limit/torque switches, solenoid valves etc. up to local junction box by means of single or multipair armoured / unarmored cables up to local junction boxes and from local junction boxes to panels/cabinets in Control Room/Control Equipment Room etc. and interconnection between various panels/cabinets .

- a) Contractor's scope of work shall include conduit and sub-tray work from all field instruments to junction boxes, pulling, laying, glanding, dressing, sleeving ferruling, crimping and termination at both ends.
- b) Contractor should take special care regarding wastage of cables while splicing.

2.04.02 Compensating Cables

Compensating cables shall be single or multiple pair cables for connecting thermocouple head to thermostatic or ordinary field junction box or control panel in control room or field mounted converter.

- a) In general, thermocouple will be duplex type and both the elements shall be terminated in local junction box.
- b) Contractor shall also lay multipair compensating cables from local junction boxes to control panel/cabinets in central control room / control equipment room
- c) All compensating cables except multipair type shall be drawn through conduit. Lubricants like French chalk, soap stone etc., shall be used liberally so as to facilitate pulling the wires in the conduit, but in no case shall it be greased or coated with oil or any substance injurious to the insulation of the cables.
- d) Compensating cables shall be directly connected from thermocouple head/junction box to the Input modules of DCS/ instruments.



- e) While connections for thermocouple, due care shall be taken to connect compensating cable with proper polarity to T/C and Input modules of DCS/ instruments.
- f) Sufficient length of multipair cable will be left extra in the form of loop at either end.
- g) Multipair compensating cables shall be laid on the main rack sufficiently away from the power cables as specified in the table of this section so as to eliminate the stray current effect in the temperature measurement.

2.04.03 Prefabricated Cables

Cabling work shall include laying and terminating prefabricated cables between different panels.

- a) All necessary special glands, grommets of nylon or rubber etc. shall be supplied and erected.
- b) Prefab cables shall run through cable spreader room on trays. Vertical riser trays, to support the vertical run of cables from the main trays in cable spreader room to the panel glanding areas shall be supplied and erected.
- c) All the cable runs shall be properly identified by engraved aluminum tag plates fastened to the cable at not more than 10 meter intervals by steel wires.
- d) Cables laid shall not be subjected to excessive tension so as to cause damage to the conductors or plugs.
- e) In cases where the connecting heads/plugs may be supplied loose, Contractor, after laying the cable, shall solder cable cores and screen ends to connector pins/ plug-in crimped ends of the cable to the connector plug socket/crimp-in special connectors for coupling the cable to the plug socket/wire wrap the ends to connector pins, as the case may be. Contractor shall ensure properness of end connection before embarking upon the termination.
- f) All necessary modifications, rework, splitting etc. of the gland plates to accommodate prefab cables, their glands/ grommets shall be performed.
- g) Prefab cables shall be routed through special glands/ grommets as recommended by the manufacturer.

2.04.04 Special Cables

The category of special cables shall include the cabling work related to the data highways, flue gas and water analysis system, vibration monitoring system etc. where proprietary cables are supplied as part of instrument & for



the transmission of low level voltage signals or other signals susceptible to noise interference.

- a) Special cables shall not be laid through trays carrying signals having voltage level of more than 60 volts AC/DC. As far as practicable special cables shall be laid through conduits.
- b) Minimum separation to be maintained between special cables and other cables shall be as indicated in the specification, unless specified otherwise by the supplier of the cable/ instrument.
- c) All necessary connectors, lugs, sleeves, conductor markers/ferrules etc. for termination of special cables shall be supplied by Contractor .
- d) Special cables shall not run unsupported for more than 1 meter.
- e) Special cables shall run un-spliced for each individual run. Junctions, loops, bends and long vertical falls shall be avoided to the extent possible.
- f) Tools recommended by the cable/instrument supplier shall only be used for splicing, connecting and terminating special cables.
- g) Where teeing, tapping, looping or branching are required for special or co-axial cables; only the equipment, tools and tackle recommended by the manufacturer shall be used.

2.04.05 Conduits

Flexible and rigid conduits shall be used for connecting instruments to the junction boxes or nearest trays/sub-trays. The activities shall include threading, plumbing, routing, supporting, connecting to cabinets; cleaning, sealing grounding painting and other related activities, as required.

- a) Where threads are required to be formed they shall be cut and cleaned before conduit reaming.
- b) Ends of all conduits shall be reamed to remove all burrs and rough edges.
- c) Cutting oil shall be used for threading operation and the dies shall be kept sharp.
- d) Rigid conduits shall be installed in exposed runs either parallel or perpendicular to dominating surface, with right angle turns made of symmetrical bends only.
- e) Conduit shall not be installed on the outside face of exposed columns but shall be routed on the web or on the inside of the flange of column.
- f) Metal conduits shall be joined by threaded conduit couplings.



- g) A run of conduit shall not contain more than the equivalent of four quarter bends including those immediately at the outlets or fittings of cabinets.
- h) Precautions shall be taken to prevent accumulation of water, dirt, concrete, foreign material etc. in the conduit.
- i) Bending radius of the rigid conduits shall not be less than six times the internal diameter of the conduits.
- j) Rigid conduits shall be regularly clamped at intervals of not more than 600 mm.
- k) Flexible conduits shall be installed in conduit runs across expansion joints.
- l) All screwed joints shall be properly sealed with sealing compound to make them thoroughly water proof.
- m) Loop shall be provided in the flexible conduit while joining with rigid conduit, enclosure or detector. Flexible conduit shall not be kept under tension.
- n) Flexible conduits shall essentially be used for connecting instruments or equipment subjected to vibration, expansion or thermal movement. In all such cases adequate loop lengths shall be provided to allow free movement at the connected points.
- o) Not more than 40% of conduit area shall be taken up by cables.

2.04.06**Sub-trays/Supports**

Erection of sub-trays / supports shall include sub-tray sections up to the main trays. In areas where main trays are not available, tray sections shall be laid up to the master junction boxes/local panels/cable spreader areas. Contractor's scope of work shall include laying and supporting of trays, fabrication of trays wherever required, painting of trays and supports and associated minor civil work wherever required.

- a) Normally slotted G.I. trays or aluminum trays shall be used.
- b) Trays shall be used to run pneumatic tubes and electrical cables and shall be mounted on steel structures and along the pipe racks wherever convenient. Special stands/supports have to be fabricated wherever required.
- c) The erection of trays shall include fabrication, welding and installation of racks including supports from structurals and installation of various sizes of tray in position. Trays shall be screwed or bolted to the supports.
- d) The supports shall be welded to the main structures, grouted in the walls/roof or welded to the plate inserts. Welding of supports to main





equipment/piping shall never be allowed. Welding or gas cutting of trays shall not be allowed.

- e) The scope of work shall also include the supply, fabrication and fixing of supports, bends, offsets, corners, tees, crossings etc. as per requirement.
- f) Civil / masonry works like grouting, providing inserts, chipping the concrete, bricks etc. for providing supports etc. shall be included.
- g) Contractor shall arrange to provide hangers, jigs, inserts and other fixtures on walls, ceilings, structures and permanent scaffolding etc., for fixing racks. Fabrication and fixing of necessary jigs, hangers, inserts and other fixtures, as required, shall be considered a part of erection of structural steel work.
- h) The trays shall be properly finished and laid to give neat appearance.
- i) Cable trays shall be fixed on angle iron supporting racks fabricated at site.
- j) All supports, clamps and other fixtures shall be painted.
- k) All trays carrying SS tubes shall, in general, be vertical type.
- l) Industry areas, Contractor shall provide covers for trays. In such cases, Contractor shall procure, fabricate and strap the covers with G.I. strips, nuts and bolts.
- m) If any erected tray or its supporting structures are found to be vulnerable to damage or to be fouling/interfering with progress of other activities in the area, the same shall be dismantled and re-erected.
- n) The selection, whether to use rigid conduit or sub-tray shall be judiciously decided.

2.04.07 Earthing

Contractor's scope of work shall include the earthing of all instruments/equipment, enclosures and other metallic parts and objects. Necessary wires, lugs, sleeves, markers/ferrules etc. shall be supplied. In addition to the general guidelines given below, Contractor shall remain responsible to follow the instrument/equipment manufacturer's grounding recommendation.

- a) Screens of all screened cables between field instruments to local junction box shall be terminated to individual terminal blocks. The other end of the screen shall be left disconnected and taped with adhesive vinyl tape. All screen terminal blocks at JB end shall be shorted with shorting links. The screen of multipair cables to cabinets shall be connected to the screen terminal block in JB and the other end to be grounded at panel end only.



- b) Compensating cable screens shall be terminated at independent terminal blocks in control panel end only. This terminal block shall, however, be wired up to insulated screen bus bar integral to the panel.
- c) All junction boxes, stands, stanchions, local panels, cubicles etc., must be connected to the nearest riser of electrical earth mat by SWG 10 MS galvanized steel wire.
- d) All control panels, desks, consoles, cubicles, cabinets etc. must be physically earthed with the electrical ground mat inside the control room area.
- e) All electrical ground terminals of local instruments shall be individually terminated up to local junction box by one core of the signal cable and these terminal blocks shall be shorted by links. The common earth point then may be led to local earth point by SWG 10 galvanized steel wire.
- f) All local panel and central panel instruments shall be grounded to the common ground bus available inside the panel. Normally the grounding wires will be available as wired-up inside the panels. Wherever grounding wires are not available inside the panel, the same shall be provided by Contractor.
- g) For terminating grounding wires only ring-tongue type lugs shall be used.

Regarding the earthing requirement of power supplies and electronic equipment, manufacturer's recommendation shall be strictly adhered to. The earthing cables shall be carefully sized not to exceed the specified earth impedance. Separate salt pit earth and earth risers shall be created as required.

2.05.00 Piping and Tubing

Instrument piping and tubing work shall include the impulse piping work between take-off valves on pipe lines or equipment/take-off nozzles (for air and flue gas connections) and the instrument; the drain pipings to the nearby drain point; sample pipings from take-off valves to coolers and coolers to analyzer system either in SWAS panel or in the field with associated cooling water pipings and drain pipings; instrument air sub-header and main header (wherever required) installation and testing and tubings between air header/sub-header to different instruments/consumers.

2.05.01 Impulse Piping / Tubing and Accessories

- a) This section enumerates the basic guidelines for erection of primary impulse pipings, all associated fittings on primary impulse pipings, pipings for all instrument drain and vent lines with all associated valves and fittings, impulse line support and routing with accessories, all impulse line accessories viz condensing pots, temperature equalizing columns, seal chambers, settling columns, drain headers



etc. connections between instruments and valves/manifolds and their testing.

- b) For impulse piping/tubing routing Contractor shall develop a field routing sketch.
- c) The pipes shall be cut with a hacksaw or high speed cutting emery wheel; squarely and all burrs shall be removed. Roller type tube cutters shall not be used.
- d) Cold bending of the pipes shall be performed with the use of a proper pipe bender with radius of bends greater than five times the outside diameter of the pipe/tube. Allowable deformation shall be within 4%.
- e) Impulse piping shall always be installed with a slope greater than 10% in proper direction for draining and shall never be installed in level horizontally.
- f) Piping shall run with the minimum of changes in direction consistent with good practice and neat appearance.
- g) The bends/offsets must be smooth and regular. Bending shall not exceed 90 Deg. in any case. Necessary couplings, unions, fittings etc. shall be provided on impulse lines to facilitate removal and maintenance of instruments conveniently.
- h) No pipe shall be left with strain on it.
- i) Drain lines shall terminate at approved drains only.
- j) The total length of impulse piping/tubing between tapping point and instrument shall, in general, be within 10 meters.
- k) Pipes/tubes and accessories shall be adequately supported and fixed. Distance between the supports shall not exceed 1.5 meters in any case. Process piping shall not be used for supporting instrument piping. If additional structures and scaffoldings etc. are required for proper supporting of instrument pipes or accessories the same shall be arranged.
- l) Contractor shall follow the welding specifications of the main piping for the instrument piping, as well, wherever applicable. While welding, full care shall be taken to provide sufficient grounding so as not to damage any part of the instrument by arc current.
- m) Welding of steam piping and high pressure piping shall be carried out by duly certified welders only.
- n) Pipes installed but not connected, shall have ends closed with caps or plugs to prevent the entry of foreign material. All reasonable precautions shall be taken to prevent the entry of foreign materials in pipelines before and during erection. All drain points, after installation shall be sealed with caps/plugs.



- o) All pipes shall be thoroughly cleaned to remove all foreign materials, scales, oil, grease etc., before installation. This shall invariably be done after disconnecting the instruments. After testing of steel impulse piping, the same shall be painted.
- p) The color coding to be followed for impulse pipes shall be as follows :
- | | | |
|----------------------------|---|-------------------------|
| Steam (Main and Auxiliary) | : | Red (IS-5 : 537) |
| Condensate | : | Azure Blue (IS-5 : 104) |
| Feed Water | : | Sea Green (IS-5 : 247) |
| Air | : | Sky Blue (IS-5 : 101) |
| Flue Gas | : | Yellow (IS-5 : 356) |
| Fuel Oil | : | Brown (IS-5 : 439) |
| Hot Reheat/Cold Reheat | : | Orange (IS-5 : 591) |
- q) All instrument impulse pipe fittings and accessories which shall include but not limited to brackets, supports, clamps, angle irons/flats shall also be painted as per the color code above.
- r) SS pipes, tubes and fittings need not be painted. Similarly G.I. pipes and fittings need not be painted.
- s) All clamps shall be first painted properly and then fitted.
- t) All surfaces to be painted and also impulse pipe shall first be cleaned by wire brushing and then with emery cloth to remove all rust/dust/grease etc. After proper cleaning two coats of red-oxide zinc chromate primer (conforming to IS-2074)/followed by two coats of at a D.F.T. of 1 mil shall be applied.
- u) For differential pressure instruments, wherever applicable, both the seal pots/condensate pots shall be brought to the same level.
- v) Thread lubricants shall be dry film type. Any of the following compounds shall be used as pipe thread sealer :
- i] Permatex
 - ii] Molycote
 - iii] Neolube
 - iv] Teflon tapes shall not be used as pipe thread sealer.
- w) The preferred path for all instrument piping shall be along concrete walls, ceilings and building steel. Instrument piping may be routed through open areas, if necessary, provided that the lines are adequately supported and protected from damage. Instrument piping and piping supports shall not be supported from electrical raceways or electrical raceway supports, or process piping.



Piping/Tubing shall not be routed :

- i] Across equipment removal areas.
 - ii] Below monorails or cranes.
 - iii] Above or below removable gratings.
 - iv] Above, below, or across cable trays.
- x) All instrument piping shall be installed to permit thermal expansion without placing excessive stress on the piping and without affecting the gradient of slope described above. Long continuous straight runs of piping shall be avoided. Where required, expansion loops shall be provided to take care of thermal expansion/contraction.
- y) For differential pressure instrument both impulse lines shall run in parallel and shall be as close as possible.
- z) All impulse pipes shall be subjected to hydraulic test/ leakage test at site after erection.
- aa) When carrying out hydraulic test, hydraulic pressure of 1.5 times the maximum working pressure shall generally be applied but care shall be taken that the pressure more than the pressure rating of the instrument is not applied. In order to prevent the instruments from being subjected to excessive testing pressure for long durations inlet valves of instruments shall be kept closed. In case of differential pressure instruments equalizing valve shall be kept open.
- bb) Before using pipes, fittings, isolation valves and manifolds etc. for impulse line work, the same shall be thoroughly tested. Contractor shall not use any defective or untested material for impulse line work.
- cc) After hydraulic testing of impulse lines, the same shall be completely drained out and service quality air shall be blown through the pipes to dry the pipes completely.
- dd) The instrument take-off piping up to the first isolation valve shall be laid and tested. However, in certain non-IBR pressure piping cases, Contractor may be required to lay the piping right from the tapping point on main piping / equipment. Any defect noticed in the piping shall be rectified.
- ee) For furnace non pressure parts, root valves shall not be available at the take-off points. Instead, the take-off nozzle shall be sealed with threaded plug. Contractor's scope of work shall include, removal of the plug, threading of the impulse pipe to match the take-off with suitable adapters, if necessary. A vertical rise of not less than 300 mm shall be allowed from the take-off point to act as a settling column.
- ff) All bends on boiler air and flue gas path shall be performed with screwed tees/crosses with free ends plugged.



Contractor's scope of work shall include the erection of air purging system for the impulse tubes with all necessary valves and fittings, wherever required.

2.05.02 Sample Pipings and Accessories

2.05.02.1 Contractor's scope of erection of sample and associated piping shall include the take-off valves on pipes/vessels to the primary sample coolers; from primary coolers to the sample bulk head of SWAS panel or between the sample take-off valves to the locally mounted analyzers; erection of cooling water piping from nearby cooling water header take-off valves to primary coolers/ SWAS system drains with the supply and erection of all necessary mounting plates, fittings, connectors, flanges, adapters, cooling water sub-headers, drain headers and other accessories.

2.05.02.2 Clauses (b), (c), (d), (f), (g), (h), (k), (l), (m), (n), (o), (r), (s), (v), (w), (aa) regarding the erection of impulse pipes and tubes of clause no. 2.05.01 shall apply for sample tubes as well.

- a) Sample piping shall always be installed with a slope of greater than 10% in proper draining and shall never be installed in level horizontally.
- b) All welding on stainless steel lines shall be TIG welding only.
- c) All sample piping shall be installed to permit thermal expansion without placing excessive stress on the piping and without affecting the gradient of slope described above. Long continuous straight runs of piping shall be avoided. Where required, expansion loops shall be provided to break up the continuity.
- d) All sample pipes shall be subjected to hydraulic test/leakage test at site after erection.
- e) Before using pipes, fittings, isolation valves etc. for sample line work the same shall be thoroughly tested. Contractor shall not use any defective or untested material for sample line work.
- f) After hydraulic testing of sample lines, the same shall be completely drained out and service quality air shall be blown through the pipes to dry the pipes completely.
- g) All necessary sample, cooling water and condensate drain pipings shall be envisaged upon Contractor.
- h) Contractor shall fabricate drain headers wherever necessary and shall route drain lines properly up to the approved drains.
- i) All cooling water and drain lines and headers shall be painted Azure blue (IS-5 : 247)

**2.05.03 Instrument Air Distribution Piping**

Erection of instrument air distribution piping include connection from nearest main air header take-off valves to the vicinity of air consumers viz. control valves, pneumatic controllers, I.P. converters, impulse line purge connections, power cylinders, purge rotameters etc. Sub-headers shall be formed with GI pipes.

- a) Supply and installation of all intermediate pipe fittings, isolation valves etc. including supply and installation of necessary clamps and supports will be considered as in integral part of instrument air piping work.
- b) For instrument air sub-header work, carbon steel hot-dipped, inside and outside galvanized pipes shall be used. Only fittings of carbon steel galvanized threaded type shall be used for GI application.
- c) Outlets of air headers shall be provided with 1/2" isolation valves, for upto 7 consumers. Contractor shall install air sub-headers up to vicinity of the consumer and thereafter 6 mm O.D. tube shall be laid.
- d) All headers and sub-headers shall be thoroughly cleaned before installation by means of compressed air.
- e) All headers and sub-headers, shall be supported properly. The distance between any two supports shall not exceed one meter unless otherwise required to suit site condition.
- f) Air supply piping shall be installed always with a slope of not less than 1/100 in suitable direction to prevent accumulation of condensed water within the pipe.
- g) All joints in the instrument air header shall be screwed on all screwed joints in air header, of size 1/2" and below, Teflon sealing tape and for other sizes, good quality sealing compound shall be used in proper quantity to ensure leak-proofness.
- h) Gas cutting and gas or arc welding on all GI pipes shall not be allowed.
- i) After completion of air supply piping and prior to connection to the instruments, the piping shall be blown with oil free and dry compressed air at 5 to 7 Kg./Sq. cm to clean out any dust or foreign matter.
- j) After applying the air pressure, all connections shall be checked for possible leaks with soap solution and all leaks shall be rectified.



- k) All instrument air tubes shall be disconnected from instruments, tube ends shall be blocked, air at pressure equal to 1.5 times the working pressure shall be applied and the tubes shall be isolated from the source of pressure. The pressure shall not fall by more than 0.1 Kg./Sq. cm in ten minutes.
- l) Air to be used for testing shall be oil free dry clean air.

2.05.04 Stainless steel Tubings and Fittings

Contractor's scope shall include stainless steel pneumatic tubing for the signal and supply air control valves, servo drives, impulse line purge connections, solenoid valves, local controllers, I/P converters etc. with all necessary fittings and air filter regulators, wherever required.

- a) The tubes shall be thoroughly cleaned and flushed with air before installation and defective tubes detected during checking, if any, shall be removed.
- b) Single tube runs shall be joined together by means of straight connector (double compression fitting) at every joint of the tube or shall be telescopically brazed & sleeved.
- c) The individual single run pneumatic signal tubing shall be run and connected from the field mounted instruments to locally mounted controllers/indicators mostly on tray work or on angles.
- d) Tubes shall be run with the minimum number of changes in direction consistent with good practice and neat appearances.
- e) Tube runs shall be properly dressed, neatly laid and adequately clamped / supported on angles/trays. Distance between any two supports shall not exceed one meter in any case.
- f) Tubes installed but not connected shall have ends suitably closed to prevent the entry of foreign materials.
- g) Tube runs shall be provided with suitable identification tags indicating the run number for easy correlation and identification of connections. Identification ferrules at both ends shall be provided.
- h) Fittings shall be of brass flareless, of double compression type, and in accordance with ASTM or similar standard specifications. All compression fittings shall be provided by Contractor.
- i) When tightening up the nuts of the compression type fittings, spanner of suitable size shall be used. To avoid any deformation to the compression ring, adjustable wrench shall never be used.



- j) The bending radius for single tubes shall be more than five times the outside diameter of the tubes. The tubes shall be bent with proper benders and care shall be taken not to cause an flattening of the bend.
- k) The tubes shall be properly dressed on the trays to remove bends, dents etc. Tubes shall not be directly hit by steel hammers.
- l) Aluminum clamps or self-locking straps shall be used for clamping the tubes on trays/angles and same shall be supplied by Contractor at his own cost.
- m) When connecting tubings on servo-drives / valves mounted on structures having thermal movement, sufficient expansion loops shall be formed at the ends to allow for equipment movement without developing any stress on the end fittings.
- n) All tubing shall be checked for proper connections and pressure tested by Contractor in the following manner :
 - i] All tubes connected to field instruments and control valves shall be disconnected at the consumer end.
 - ii] From end fittings, dry dust free air at 5-7 Kg/sq. cm shall be blown into tubings which have been disconnected. In this way continuity of tubing shall be confirmed and at the same time any dust or foreign matters shall be blown out from the tubes. At this stage connections to the field instruments and control valves to be made and with 1.5 Kg/sq. cm air pressure leak test shall be done. Soap solution shall be applied to all joints including junction boxes to check leaks. If any leak is found, nuts of compression fittings shall be tightened and soap solution check shall be repeated. If the leak can not still be remedied, ring of the fittings shall be replaced and the soap solution test be repeated till the leak is stopped.
 - iii] Final testing shall be done by Contractor in the following manner :
 - The tubes shall be blanked off from one end and pressurized from the other end pneumatically to 1.5 Kg/sq. cm using bubble bottle.
 - The bubble rate after pressurizing shall be less than one bubble per ten minutes.

2.06.00 Control Valves and Accessories

Contractor's scope of work shall include erection of control valves along with all related accessories like air filter regulator, smart positioners, limit switches, mechanical indicators, solenoid valves, airlock relays, volume boosters etc. Contractor's scope of work shall also include all related interconnecting tubing work for the above accessories and terminating all electrical connections up to local junction box. Any supporting structures, pedestals etc. required to make the installation complete shall be considered part of erection activity.



Contractor's scope of work also include testing and commissioning of all pneumatic control valves.

- a) The general conditions laid down for erection of field instruments shall also be valid for control valves (wherever applicable).
- b) Slight reorientation of flanges, if necessary, shall be considered a part of erection activity.
- c) Before installation, Contractor shall verify the adequacy and check the make/model etc. of each item with respect to the data sheet and hook-up diagrams.
- d) Control valve should be identified with regard to their tag number, control action, Cv value, flow direction etc. as inscribed on the tag plate vis-a-vis the data sheet.
- e) The orientation and position of the control valve shall be such that difficulties shall not arise while removing, repairing or servicing the valve after installation.
- f) Contractor shall install valves only after ensuring proper flow direction.
- g) The preferred position of a control valve is diaphragm up.
- h) Air supply line shall be drawn from nearest air header by means of a G.I. sub-header to the vicinity of the installation.
- i) Tubing work shall generally comprise of tubing between air supply to filter regulator from nearest G.I. sub-header, to smart positioner/ solenoid valve and actuator..
- j) Contractor's scope of cabling pertaining to control valve erection shall include cabling from solenoid valves, limit switches and electronic position transmitter up to local junction box, if not prewired.
- k) Contractor shall include gaskets, nuts, bolts, site fabricated clamps and other erection items required to complete the installation.
- l) All air pipings/tubings shall be blown clean with compressed air at 3.5 Kg/sq. cm and complete lines along with fittings must be tested for leakage with soap bubbles.
- m) After installation, the control valves shall be greased at greasing nipples wherever applicable.
- n) After completing the installation satisfactorily in all respect, Contractor shall perform the following tests.
 - i] Linearity of stem movement shall be checked at four points (inputs 25%, 50%, 75%, 100% of spring range) while rising and while falling.
 - ii] Hysteresis shall be checked.



- iii] Response time shall be noted.
- iv] Operation of airlock relay shall be checked.
- v] Operation of stay put conditions (under electrical signal failure shall be checked).
- o) After testing, the valve shall be boxed up with blind gaskets at both ends to prevent entry of foreign materials and clogging of plug and seat.

During steam blowing/acid cleaning it may be necessary to remove the valve as a whole or in part breaking a part of top-work and reconnect the spool piece. The removal, reinstallation, dismantling and reconnection of tubing and cabling shall be Contractor's scope of work.

2.07.00 Flow Elements

2.07.01 Orifice Plates

For orifice plates with flange taps Contractor's scope shall include fixing of nipple and first take-off valve, fixing and supporting condensation pot (wherever applicable) and insertion of orifice plate with suitable gaskets, nuts and bolts. For orifice plates with D, D/2 tapping, pipe welded stubs shall be available.

The general guidelines for installation of orifice plates are given below.

- a) The length of the take-off nipples shall be sufficient so that the first take-off valve protrudes beyond the thermal insulation.
- b) The take-off nipples shall be screwed/welded according to the design requirement.
- c) The hand wheel of the take-off valves shall be so oriented that they can be operated conveniently from approach platform, ladder etc.
- d) For steam services, condensation pots shall be connected to the tapping point before or after first take-off valves. Utmost care shall be taken to ensure that both the condensation pots are at the same level. All necessary bracing, saddle etc. shall be fabricated and used to support the condensation pots with the main pipe.
- e) Orifice plates shall be inserted with proper orientation with respect to fluid flow in line.
- f) Orifice plate should only be inserted in position for checking the alignment. Thereafter, it will be withdrawn and preserved till pre-commissioning activities are over.
- g) Contractor shall supply suitable gaskets while fixing the orifice plates in position.



- h) The orifice bar handle, shall be so oriented that the imprints are readable unassisted from the access floor of platform.
- i) Contractor shall ensure proper orientation of drain or vent holes.

2.07.02 Flow Nozzles

Flow Nozzles shall normally be shop assembled in branch pipe and welded in position with main pipe. The flow nozzles shall generally have D - D/2 tappings and shall be shop assembled with take-off nipples and root valves. Contractor's scope of work shall include connecting the condensation pots (for steam services) before installation of the differential pressure instrument.

2.08.00 Control Room Control Panels/Desks, Consoles & Cubicles/Cabinets

This section provides guidelines for the erection of desks, panels, consoles, cabinets etc, in the Control Room, Control equipment room, Local Control Room and other such locations.

Clauses (c), (d), (e), (i), (j), (k), (f), (g), (h), (i), (m) for the installation of Local Panels shall apply.

- a) After Inter-sectional bolting with necessary nuts and bolts, inter-sectional wiring shall be terminated at both ends
- b) Contractor shall arrange anchor bolts or grouting spikes and grout the same in the pocket. Any civil job concerned with the proper installation of the panel shall be considered as part of the panel installation work.
- c) After installation, the main incoming fuse of each panel section shall be removed and preserved till commissioning.
- d) For panels, desks, consoles etc. supplied without instruments and accessories mounted on them, Contractor shall mount and terminate all instruments & desk accessories as per drawing. Contractor shall also dress & bunch the cables properly after termination is over.
- e) If Solid state panels/desks/consoles/cubicles are supplied without the electronic PCB's plug-in modules etc. mounted on them, Contractor's responsibility shall include inserting these in position as per drawings. This activity shall be carried out only after complete installation of the panel/cubicles.
- f) After installation the following tests shall be carried out.
 - i] Visual inspection for proper alignment and inter-sectional crevices.
 - ii] Meggering shall be done between terminal blocks and ground before terminating the panel instruments.
 - iii] Visual inspection of surface finish for scratches & blemishes.
 - iv] Tightness of nuts and bolts to be physically checked.



- v] Dressing and bunching to internal wires after termination to panel instruments.

2.08.01 Unit Control Room / Computer Room Panels/Desks and Consoles/ Local Control Panels/consoles and Desks

Contractor's scope of work shall include the installation of Operator's Terminals, Engineering Terminals, Performance Calculation Terminals and other terminals, consoles and some other peripheral devices in the Unit Control Room / Computer Room/ Local Control room wherever applicable. Associated activities shall include laying, glanding and terminating prefabricated cables, related structural work and other completing activities viz. modification of internal wirings, mounting and termination of instruments/equipment supplied loose etc.

- a) Erection of panels and desks in Control room area shall involve precise alignment and matching of surfaces. Contractor shall perform all related activities to achieve an aesthetic completion of the job. All necessary realignment, foundation work, packing and filling shall be done to compensate for shifting, waviness, misalignment etc.
- b) When bolting the panel sections, care shall be taken not to leave excessive strain on any of the surfaces. All necessary packing and filling materials shall be provided.
- c) Instruments and accessories supplied loose for mounting on panels shall be installed only after installation of the panels.
- d) Tools and tackle recommended by the desk/panel/console manufacturer shall only be used.
- e) No element shall be forced or hammered into its slot.
- f) If matching prefab connectors are available in pig-tail form the properness of connection shall be checked by Contractor before plugging-in. Contractor shall be fully responsible for improper connection of the connectors.
- g) Contractor's activities shall also include splitting of gland plates, if required, to admit plug-in connector, mounting of special cable clamps on the gland plates and dressing, routing and clamping of the prefabs within the panel/desk/ console.

2.08.02 Control Equipment Room Panels / Cubicles

Contractor's scope of work shall include installation of Control equipment room (CER) panels, cubicles and consoles and peripherals like console, printers etc., laying and interconnection of prefab cables, conduits and trays as required. Floor cutouts shall be provided for cable entry.

- a) Contractor shall generally follow the guidelines for installation as laid down in previous sections.



- b) Some of the panel sections may arrive in connected and pre-wired conditions. Contractor may have to disconnect these sections for transportation, rigging and installation. Reassembly of such sections shall be Contractor's responsibility.
- c) The panels/cubicles in CER are generally blind type. However, if some of the items are supplied loose, Contractor shall also mount the same in position.
- d) Height of all the CER panels shall range between 1.8 to 2.5 meters.

2.08.03**Steam & Water Analysis System Panels**

The steam and water analysis system with all associated accessories shall be located in the SWAS room.

- a) Some of the primary coolers may be located at site and shall serve as grab sample coolers during commissioning.
- b) Reagents required for commissioning shall be supplied.
- c) Contractor's scope of calibration and functional checking shall include the adjustments for the primary coolers, calibration of the analyzer-converter units and other associated activities.
- d) Analyzers shall be tested separately, as per manufacturer's recommendation with the help of standard solutions.
- e) It is recommended that the standard solutions be fed to the analyzer through a sample patch board by-passing all sample-line accessories.
- f) Measuring cells and other wetted parts which comes into the contact with standard solutions shall be thoroughly rinsed before commissioning.
- g) In view of large drift of most of the analyzers and limited life of the reagents, it is recommended that calibration and functional checking activity for the analyzers be performed immediately prior to commissioning.
- h) Contractor's scope of work shall also include laying and connecting of all drain headers (sample drain, cooling water drain, grab sample basin drain etc.) up to nearest system drain.
- i) After installation of pre-tubed panels Contractor shall check all connectors, pipe/tube fittings and anchoring of panel mounted equipments.
- j) All tubing and bulk head connectors inside the panel shall be blown clean with air at 3.5 Kg./Sq. cm.
- k) Any tubing work inside the panel shall be done, if necessary.



- l) Laying of air sub-header, if required, from nearest take-off point in main header up to SWAS room shall be as a part of Contractor's responsibility.
- m) Contractor shall also be responsible for mounting all loose supply instrument/equipment in the SWAS panels. Instruments in the panel shall be mounted & terminated in accordance to the guidelines as specified elsewhere in this specifications.

2.08.04 LVS, LCD Monitors, CCTV, Master Clock etc.

- a) All items must be unpacked at installation site only.
- b) Contractor shall follow the general guidelines for installation of the blind panels as spelt out in previous sections.
- c) All unarmoured prefab cables shall run through flexible/rigid conduits and all conduiting and tray laying shall be considered to be a part of Contractor's scope of work.
- d) Installation of Close Circuit TV Camera System at different locations of the Plant are in Contractor's scope. This also includes supply of all installation hardware as required to complete the installation.
- e) Installation and commissioning of LVS & LCD Monitors in the control room is under Contractor's scope of work. This includes supply laying and termination of all interconnecting cables to complete the installation.
- f) Interconnection with Plant Master Clock and its Display devices (i.e. slave clocks) at different locations are under Contractor's scope of work. This includes supply of all mounting hardware and accessories, laying and termination of all interconnecting cables and other accessories to make the installation complete.

2.09.00 Panel Mounted Instruments (For Local Panel, wherever applicable)

- a) Before erection all instruments & accessories shall be subjected to visual and calibration checks and other functional checks as per manufacturer's standard at site laboratory.
- b) All instruments, jigs, tools and tackle for the purpose of performing the tests shall be provided by Contractor.
- c) Minor repairs, adjustments of the instruments & accessories shall be performed. Once the instrument has been successfully repaired it shall be subjected to test, afresh.
- d) A record of such repairs and adjustments shall be systematically maintained.
- e) For instruments & accessories where the extent of damage is such that the same can not be repaired at site the same shall be brought to



the notice of Owner by Contractor as early as possible for appropriate action.

- f) Cases where the damages are only superficial viz. cover warping or paints peeling etc., the decision whether such instruments are fit for erection shall solely lie with Owner.
- g) If any erected instrument or its accessories are found to be vulnerable to damage or to be fouling/interfering with progress of other activities in the area, same shall be dismantled/removed.
- h) During re-erection of such instruments, all the necessary steps as indicated in this specification for the erection of the instrument shall be carried out afresh.
- i) Contractor shall take utmost care during removal/dismantling as not to damage the instrument, its accessories, support or any other equipment in the vicinity.
- j) Completion of erection of any panel mounted instrument or accessory shall be signified by its mounting, fixing, termination, power connection, earthing, touch-up painting, tagging of the instrument and mounting of its title plate.
- k) On completion of erection, a certificate signifying Owner's approval to erection, in an agreed proforma, shall be obtained from Owner after joint inspection of the erected instrument by Owner and Contractor.
- l) After obtaining the completion certificate, all power line fuses of instruments shall be removed by Contractor and shall be kept in his custody only to be reinserted when directed by Owner.

2.09.01 Panel Mounted Indicators

- a) Instruments shall be carefully unpacked so that no damage occurs to the instruments during unpacking.
- b) Clamps, clips or saddles if provided to lock the servo mechanism during shipment shall be removed carefully to free the movements.
- c) Mechanical checking for freedom of movement of the instruments within its mounting bin and locking in position shall be performed where applicable.
- d) Instruments shall be calibrated for indication accuracy at least at five points in the scale. Repeatability and hysteresis of indication and signaling contacts shall also be checked by adjusting the set points at four points of the scale.
- e) After calibration, the multiplication factor, tag number, service inscriptions shall be properly affixed on instruments in cases where such inscriptions are not already present or factory inscriptions need to be changed.





- f) The panel cut-outs shall be checked for properness of dimension, smoothness of edges etc. and necessary minor modification work on the panel, if required shall be performed by Contractor.
- g) The mounting bin, where applicable, shall be installed, leveled and plumbed at location first, without the instrument and shall be terminated with proper lugs only.
 - a. Instruments mounted in bins shall have flexible connector connected both at bin and instrument end. The instrument shall be powered from Contractor's test power pack through panel terminal block and the span and zero of the instruments shall be rechecked and adjusted if necessary.

2.09.02 Special Instruments

- a) For installation of any instrument/equipment which does not fall into the categories whose detail erection procedure have been spelt out above, specifically shall be considered as special instrument. Contractor's scope of work shall include installation, calibration, testing and commissioning of all such instruments/equipment. Instruments like conductivity type separator level indicators and other Packaged devices, are example of such instruments.
- b) Integral annunciation system, if any, shall be tested by simulation in situ. If these are supplied as loose items, then the same shall be mounted on the panel concerned.

2.09.03 Electrical Transducers

- a) This category of instruments shall include AC/DC current transducers, voltage transducers, MVAR transducers, MW transducers, Frequency transducers, PF transducers, etc. Contractor's scope of work shall include mounting and terminating these instruments in position on transducer panel located in CER as per approved drawings.
- b) Contractor shall test and calibrate the instruments. The special testing equipments, if required, shall be provided by Contractor.

2.09.04 Desk / Panel Accessories

A few control and instrumentation items of various packaged equipment are to be installed, as per approved mounting drawings supplied by the equipment supplier. Following is the procedure to be adapted for erection of the same :

- a) Contractor's scope of erection shall include mounting, connecting and terminating the desk accessories along with their respective tag plates, as applicable, on the Panel / desks.
- b) All loose supply items shall be carefully unpacked to avoid damage to the surface, connectors, contacts or lenses.





- c) The panel cut-outs shall be checked for properness of dimension, smoothness of edges etc. and necessary minor modification work on the panel, if required, shall be performed.
- d) Manufacturer's recommended tools and tackle shall only be used.
- e) Prefab cables may be kept coiled and supported in the panel in the form of pig-tails. Such strapping shall be removed carefully before plugging-in the connector plugs.
- f) All connectors shall be properly identified before coupling. Plugs shall be properly oriented before connection. Contractor may be required to connect additional isolating diodes within the connectors if envisaged by Owner.

2.09.05 Annunciation System (For Local Panel based systems)

- a) Minor modifications in the desk/panels, if required, shall be carried.
- b) Contractor shall check the fascia inscriptions and their positions with respect to drawings and carry out any rearrangement or reallocation of existing fascia inscriptions.
- c) Annunciation push buttons (Accept/Test/Reset) and hooters shall be mounted in position and wired up to fascia terminal block or logic cabinet, as required.
- d) The testing of annunciation system shall comprise of -
 - System test for sequence
 - Point wise status acceptance test (initiation test)
 - I.R. check at logic cabinet and fascia w.r.t ground
 - Operation of push buttons and hooters.

3.00.00 CONSUMABLE, TOOLS AND TACKLE, CALIBRATION AND TEST, INSTRUMENTS AND ERECTION MATERIALS

The purpose of this section is to outline, in general, the minimum necessary equipment / tools & tackle and consumable that may be required for erection work. The list hereunder is only meant to be a guideline and Contractor shall be responsible to arrange for supply any other equipments/ tools & tackle or consumable that may be required for satisfactory completion of the job.

- a) Erection consumables shall include but not be limited to the following :
 - i) Polythene sheets for covering field instruments and panels.
 - ii) Grease of approved quality.
 - iii) Colored adhesive PVC tapes.



- iv) Gaskets and washers of various size and types as required.
 - v) Paints of approved quality and shade.
 - vi) Brass shims/foils for levelling of panels
 - vii) Welding electrodes, Oxygen, Acetylene and Argon Cylinders.
 - viii) Dry seal type thread sealant.
 - ix) Insulated PVC/Vinyl adhesive tapes, sleeves etc.,
 - x) Cable markers and clamps (G.I. or Aluminum)
 - xi) Hacksaw
 - xii) Cleaning solvent, petrol, rustolene, kerosene etc.
 - xiii) Gland sealing compound
 - xiv) 2 mm thick Aluminum Sheets
 - xv) Twisted galvanized steel wire
 - xvi) Cutting oil
 - xvii) Teflon tape
 - xviii) Liquid soap, Jute
 - xix) Solder and flux
 - xx) Nuts, bolts, screws and gaskets as required
 - xxi) Perforated G.I./aluminum tray (if required)
- b) Necessary tools & tackle/equipment that may be required for erection/ installation/testing shall be provided.

The items listed below are indicative in nature and any other tools & tackle/equipment that may be required shall be arranged by Contractor.

- i) Hydraulic Test Jack (0-400 Kg/Sq. mm) [2 sets at least]
- ii) Continuity Tester and 500V Megger
- iii) Engraving machine
- iv) Sheet punching machine
- v) Hand drill with bits of various sizes



- vi) Welding kit (2 sets at least).
 - vii) Thread cutter (with different sizes of die)
 - viii) Test pressure gauges for hydraulic testing
 - ix) Wire wrapping tool and soldering iron
 - x) Materials for scaffolding
 - xi) Materials for rigging
 - xii) Sets of wrenches, spanners, Allen keys, screw drivers and other tools for wiring and impulse piping work.
 - xiii) Crimping tool, splicing tool
 - xiv) Pipe bending jig
 - xv) High speed cutting emery wheel
 - xvi) Sheet bending machine
 - xvii) Multimeter
 - xviii) Air compressor and spray painting gun
 - xix) Air filter regulators
 - xx) Slide caliper/screw gauge
 - xxi) Tube cutter
 - xxii) Tube bender
 - xxiii) Hacksaw
- c) Necessary tools & tackle, jig, instruments/equipments that may be required for loop checking, calibrating and commissioning of all supervisory and modulating control loops, binary system, annunciation system and calibration/checking of all field instruments, receiver instruments etc. as detailed in this specification shall be arranged.
- The items listed below are indicative in nature. Any other items that may be required shall also be arranged by Contractor at his own cost
- i) Precision calibration standard mercury manometers of accuracy $\pm 0.02\%$ of full scale.
 - ii) Portable pneumatic calibrators of accuracy $\pm 0.1\%$ of full scale.
 - iii) Sub-standard test gauges of accuracy $\pm 0.1\%$ of full scale.



- iv) Dead weight testers of accuracy $\pm 0.05\%$ of measured pressure.
- v) Hydraulic gauge testers of accuracy of ± 0.1 of measured pressure.
- vi) D.C. potentiometers of accuracy $\pm 0.1\%$
- vii) Wheatstone bridge of accuracy $\pm 0.1\%$
- viii) Decade Resistance Boxes of accuracy $\pm 0.1\%$.
- ix) Multimeters of accuracy $\pm 2\%$
- x) Temperature Bath
- xi) Line testers
- xii) Telephone sets with battery
- xiii) Oscilloscope (Dual trace, 75 Hz)
- xiv) Signal generator
- xv) mV generator
- xvi) Bench top power supply (0-30 VDC, 10A) - 4 nos. at least
- xvii) Special testing/calibration kit for electronic panel mounted receiver instruments e.g. indicators, recorders etc.
- xviii) Metal film resistor (100 Ohms, 250 Ohms, 62.5 Ohms of 0.1% tolerance).
- xix) Rules generator, logic probes and other digital test instruments
- xx) Stop watch
- xxi) Variac (0-260 VAC continuous output)
- xxii) Solder suckers and IC extractors.
- xxiii) Multifunction calibrators.
- xxiv) RTD / Thermocouple Calibrator.
- xxv) Electronic transmitter Calibrator.
- xxvi) Continuity Tester.
- xxvii) Electronic Meggar.

- d) This section grossly summarizes the different items to be supplied by Contractor for completion of activities specified. The detailed job-wise requirement shall be guided by final engineering drawings and various clauses of the technical specification :
 - i) Conductor markers/Ferrules, lugs, connectors as required for cabling and terminations.
 - ii) Glands and grommets for cable entry.
 - iii) Straps, nylon rope fasteners for cable support and dressing.
 - iv) Bends, tees, unions, crosses, plugs, caps and other fittings for impulse and drain pipe work.



- v) Compression fittings, adapters ferrules etc. for SS tubing.
- vi) G.I. tees, unions, elbows, reducer, screwed brass needle valves.
- vii) Perforated G.I./Aluminum subtrays (50, 100, 150 mm) for cabling and tubing work.
- viii) 1/2 & 3/4" rigid and flexible conduit fittings
- ix) Terminal blocks (1.5 Sq.mm).

Contractor shall include all structural steel items.

4.00.00 INSTRUMENT CALIBRATION / CHECKING AT SITE PRIOR TO ERECTION

The general guidelines for calibration and functional checking of instruments and accessories are as given below :

- a) For calibration and functional checking of different types of instruments, check lists shall be prepared. The results and observations of checks and tests shall be recorded in appropriate forms.
- b) Qualified and experienced engineers, supervisors and skilled technicians shall be deployed for calibration and functional checking of instruments.
- c) Only precision testing instruments of certified accuracy specially made for testing particular make/type of instruments shall be used for calibration and functional checking of instruments.
- d) Physical checking of the instruments shall be carried out to find out any possible damage to the instruments.
- e) Instruments requiring calibration shall be calibrated, in general, throughout the instrument range at five check points viz. 0%, 25%, 50%, 75% & 100% of span, both upscale run and downscale run. The error between theoretical and calibration figures thus obtained at each check point shall not exceed the instrument manufacturer's stated figures. If the error exceeds the limits specified by the manufacturer, the instruments shall be adjusted to achieve calibration accuracy within the specified limits.
- f) Regarding the calibration and functional checking of special instruments, the instruction of the manufacturer shall be followed.

4.01.00 Pressure / DP Gauges

4.01.01 Calibration for pressure / DP gauges shall be carried out with dead weight testers / hydraulic testers / vacuum pumps against manometers / precision manometers/sub-standard gauges of certified accuracy.

4.01.02 Test results shall be presented to indicate accuracy, hysteresis and linearity.





- 4.01.03 Gauges shall be subjected to over-range test as per manufacturer's recommendation. Gauges shall be recalibrated after over-range test.
- 4.01.04 Gauges for compressed air service shall be tested with air compressor and sub-standard gauges.
- 4.01.05 Low pressure/dp gauges shall be tested with compressed air test jigs and sub-standard gauges.
- 4.02.00 Pressure / DP Switches
- 4.02.01 Pressure / DP switches shall be tested for adjustability and repeatability of set point by means of dead weight tester / hydraulic testers / vacuum pumps against manometers/precision manometers / sub-standard gauges of certified accuracy.
- 4.02.02 Exact operating point of the switches shall be identified by means of a multimeter or any appropriate instrument.
- 4.02.03 For switches having adjustable differential, the differential shall be maintained fixed during the test.
- 4.02.04 Test results shall be presented to indicate linearity and differential.
- 4.02.05 Switches shall be subjected to over-range and contact rating test. Switches shall be recalibrated after over-range test.
- 4.02.06 Switches for compressed air service shall be tested with air compressor test jigs and sub-standard gauges. Low pressure/dp gauges shall be tested with compressed air and sub-standard gauges.
- 4.02.07 The switches shall be set at the desired set point after calibration. Where set points are not available at the time of erection, the same shall be set in site, after erection, by means of compressed air/hydraulic hand jack and sub-standard gauges through the instrument drain connection after closing the instrument root valve.
- 4.03.00 Temperature Gauges
- 4.03.01 Temperature gauges shall be calibrated in controlled temperature oven with the help of standard laboratory thermometer of certified accuracy in addition to check ambient temperature reading.
- 4.03.02 Zeroing of the gauges shall be done separately by means of ice bath.
- 4.03.03 Test results shall be presented to indicate accuracy, hysteresis and linearity.
- 4.04.00 Temperature Switch (if applicable)
- 4.04.01 Temperature switches shall be calibrated in controlled temperature oven with the help of standard laboratory thermometer of certified accuracy in addition to check ambient temperature reading.



- 4.04.02 Switches shall be set at known set point after testing for repeatability and hysteresis as mentioned above. Differential, if adjustable, shall be kept fixed.
- 4.04.03 Set point and differential shall be adjusted as per Engineering data.
- 4.04.04 Temperature switches shall be set prior to installations. However, in situ setting may be necessary during commissioning by comparison with other gauges on the line.
- 4.05.00 Temperature Elements
- 4.05.01 Temperature elements shall be tested for continuity from their terminals at element head.
- 4.05.02 Temperature elements shall be ungrounded and duplex type. Both the elements shall be checked for continuity.
- 4.05.03 I.R. shall be measured between individual elements and between element and thermowell.
- 4.05.04 In general, thermocouples and RTDs will be factory tested. However, in case of any malfunction while loop testing, an element may have to be tested for linearity and accuracy at Contractor's shop.
- 4.05.05 Thermocouple & RTD will be tested in temperature controlled bath at several temperature (depending on the type of T/C or RTD) points with digital millivoltmeter / Thermocouple or RTD calibrator. The results thus obtained must be compared with standard table as per ASME / DIN.
- 4.06.00 Electronic Pressure and Differential Pressure Transmitter
- 4.06.01 Calibration of electronic transmitters will be carried out with dead weight tester or hydraulic tester with sub-standard gauges or multifunction calibrator. The output (4-20 mA) shall be checked with standard DMM at five different points throughout the specified range including zero and span with rising and falling input. Power supply to the transmitter receiver 2-wire loop should be given from 24V DC source in the Analog Input Card and the series load should be around 500 Ohms.
- 4.06.02 Following performance data should be calculated from observed input-output data and should be presented in agreed proforma.
- a) Accuracy
 - b) Hysteresis
 - c) Dead band
 - d) Repeatability
 - e) Linearity
- 4.06.03 Transmitter shall always be calibrated in vertical position rigidly fixed to a suitable jig.



- 4.06.04 It may be necessary to recalibrate the zero while commissioning by equalizing the ports of dp transmitters or opening input port of pressure transmitters to atmosphere.
- 4.06.05 Electrical tests shall include supply voltage sensitivity, short circuit proofness and maximum loading in sample cases.
- 4.07.00 Stand Alone Electronic Controllers (wherever applicable)
- 4.07.01 Stand alone electronic controllers shall be checked at Contractor's shop with input signal from milliampere source, temperature controlled bath etc., depending on the type of input.
- The output signals of the controllers (4 – 20 mA DC) shall be read against a calibrated milliammeter installed in the two wire loop.
- 4.07.02 During shop testing the settings of P.I. & D action shall be as follows :
- a) P.B. = 100%
 - b) TR = Maximum
 - c) TD = Minimum
- Minimum five points shall be taken upscale and downscale and input-output curves shall be plotted to read the following performance data.
- a) Linearity
 - b) Response / Sensitivity
 - c) Indication accuracy of measured variable
 - d) Repeatability
- During the above tests the set point shall be adjusted at 50- 60% of the range.
- 4.07.03 On-line tuning of controllers shall be Contractor's responsibility. In general, accepted methods like Ziegler-Nicol's technique may be used. However, detailed procedure may be decided at later stage.
- 4.08.00 Level Switch (if applicable)
- 4.08.01 Level switch shall be functionally checked by operating the float mechanically and hydraulically and testing the make and break of the switches with ohmmeter or continuity tester.
- 4.08.02 Contractor shall also be responsible for checking the current rating of the contacts.
- 4.09.00 Current to Pneumatic Converters (if applicable)



- 4.09.01 Contractor shall shop test I/P converters with input of 4-20 mA DC from standard current source. The output (0.2 to 1 Kg/Sq. cm) shall be read against substandard gauges and input- output relation shall be presented.
- 4.09.02 Air supply to the I/P Converter should be given through air filter regulator.
- 4.10.00 Receiver Instruments (wherever applicable)
- 4.10.01 Receiver instruments, in general, shall cover all panel mounted instruments like digital panel meters etc.
- 4.10.02 Contractor's responsibility shall include calibrating all receiver instruments with specified inputs like mA, pulse etc.

Indicators

- a) Input shall be provided from constant current source/ voltage generator depending upon the specified input.
 - b) Input shall be given for 0%, 25%, 50%, 75% and 100% of the span and the readings shall be taken for both rising and falling input.
 - c) Indicators will generally be scaled in Engineering Units.
 - d) Zero and span shall be readjusted, if necessary, after mounting in position during loop checking and commissioning.
 - e) Tag No., service, range and multiplication factor shall be neatly typed/engraved and pasted to the body/casing of the instrument.
- 4.11.00 Control Valves
- 4.11.01 Valves shall be lubricated (if required), stroked and checked for hysteresis. Alignment of valve positioners shall be checked. Connection and operation of solenoid valves and air lock relays (if provided) shall also be checked.
- 4.11.02 Action of actuator shall be checked by applying spring range pressure through air filter regulator / multifunction calibrator and observing the stem travel against a scale.
- 4.11.03 Smart positioner shall be tuned to achieve proper valve response.. Necessary adjustment of zero and span shall be done by the Contractor for accurate valve positioning and feedback .
- 4.11.04 Contractor shall also check the function and adjustability limit switches.
- 4.12.00 Flue Gas Oxygen Analyzers
- 4.12.01 Zirconium probe type oxygen analyzers shall be calibrated in situ with the aid of two-point automatic calibration kit and reference gas cylinders.
- 4.12.02 Test procedure available in the manufacturer's catalogue shall be followed.



- 4.12.03 Prior to calibration all air and gas lines shall be tested for leakage and air tightness and all electrical connections are to be checked for correctness.
- 4.12.04 Reference gases shall approximately have 0.4 and 8 percent Oxygen.
- 4.12.05 Sample and air flow regulators shall be preset to recommended settings prior to the test.
- 4.12.06 Probes shall be purged for at least 30 seconds with instrument quality air between introduction of successive test gases.
- 4.12.07 The action of the temperature controller shall be checked prior to the test.
- 4.13.00 Special Instruments
- 4.13.01 The category of special instruments shall include flue gas CO, Sox, NOx , CO, CO2, moisture analyzers, opacity monitors, etc.
- 4.13.02 The test procedure for such instruments shall be guided by the recommendation of the respective manufacturers.
- 4.14.00 Annunciation System
- 4.14.01 The annunciation system shall be functionally checked only after complete installation.
- 4.14.02 Following mandatory requirement must be met before applying power to the annunciation system :
- a) IR test between input power terminal blocks (P/N) after disconnecting the input side.
- b) Loose ends of wires/cables must be tied with insulated vinyl tape.
- 4.14.03 After applying power to the system the following tests shall be carried out sequentially :
- a) Checking of power-up and power failure reset conditions.
- b) Sequence testing by operating "System test P.B.".
- c) Sequence testing by operating "System test P.B.".
- d) Initiation test shall be carried out for all input points by simulating "abnormal" condition .

5.00.00 EXAMINATIONS AFTER INSTALLATION

- 5.00.01 On completion of erection of the equipment and before start-up, each item of the equipment shall be thoroughly cleaned and inspected by Contractor for correctness and completeness of installation and acceptability for start-up, leading to initial pre-commissioning tests at Site. The list of pre-



commissioning tests to be performed shall be as mutually agreed and included in Contractor's quality assurance program.

5.00.02 Contractor's commissioning / start-up engineers shall be responsible for carrying out all the pre-commissioning tests. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the complete equipment shall be placed on Initial Operation during which period the complete equipment shall be operated integral with sub-systems and supporting equipments.

5.00.03 All insulated conductors furnished and installed shall be electrically tested after installation.

5.00.04 All circuits shall be tested complete except for connections at equipment end.

5.01.00 Continuity, Identification and Short Circuit Tests

All insulated conductors shall be tested for continuity and conductor identification. In addition, all insulated conductors of multi-conductor cable shall be tested for short circuit. Short circuit tests shall include all tests necessary to confirm that no conductor of a multi-conductor cable is short circuited to another conductor in that cable.

5.02.00 Insulation Tests

All insulated conductors shall be tested with a 500 volt megger or an equivalent testing device. Insulation resistance measurements shall be made between each conductor and ground and between each conductor and all other conductors of the same circuit. Minimum acceptance resistance values shall be 10,000,000 ohms.

5.03.00 Testing

5.03.01 Tests shall be performed as many times as necessary to assure proper quality of materials and workmanship. If any tests reveal unsatisfactory materials or workmanship, such materials or installation shall be repaired or replaced.

5.03.02 All hydrostatic and pneumatic testing shall conform to ANSI B 31.1 - Code for Pressure Piping, Paragraph 137.

5.04.00 Hydrostatic Testing

5.04.01 All instrument piping which connects to process piping shall be hydrostatically tested. The specified test pressure shall be applied to the instrument piping upon completion of erection.

5.04.02 Before the leak tests are performed all instrument piping welds and screwed connections shall be inspected and all air expelled from the piping being hydrostatically tested. Welds shall be visually inspected for defects and screwed connections shall be inspected for tightness.



5.04.03 Leak tests shall be performed using cold water to pressurize the systems. The adverse effects upon test results caused by air pockets shall be avoided by expelling all of the air from the system during filling.

Tests shall be made by one of the two following methods :

- a) Isolate the instrument piping from the instrument and the process piping by disconnecting the flexible connection from the instrument and closing the root valve(s). Fill and pressurize the instrument piping through the flexible connection.
- b) Coordinate testing of instrument piping with the testing of associated process piping. Isolate the instrument by closing the shut off valve and disconnecting the flexible connection from the instrument. Test the instrument piping by opening root valve(s) and visually inspecting the instrument piping for leaks. Special precautions shall be exercised by Contractor to avoid damage to instruments and conflict with others performing the process piping hydrostatic tests.

5.05.00 Air Testing

5.05.01 All control air headers, branches and short tubing drops and all pneumatic signal tubing shall be air tested as specified herein. Additionally, all boiler draft and all vacuum instrument piping shall be air tested as specified herein.

5.05.02 All control air headers and instrument supply take-offs shall be blown out with clean dry air using full receiver air pressure. Larger headers shall be blown first, using full size valves. Smaller headers and take-offs shall be blown last. All supply headers shall be blown before any instrument connected to the header system is turned on. Instrument air headers and branch lines shall be tested by the pressure decay method.

5.05.03 Flexible hoses and short signal tubing runs between adjacent components shall be tested at normal operating pressure by visually inspecting for leaks using a commercial leak detection fluid. Long signal tubing runs shall be tested by charging each tube with air at 2 Kg/Sq. cm through a bubbler sight glass. Tubing shall be isolated from associated instruments with all open ends plugged.

5.05.04 Boiler draft and all vacuum instrument piping shall be tested by the same method as long signal tubing runs above except that the boiler draft tap root valve shall be closed in each case and the instrument piping shall be charged from the flexible connection at the instrument. Close shutoff valves to any permanently installed purge meters. Special considerations shall be given to multiple instruments sharing the same process connection or signal source. The Pressures applied shall not in any case exceed the allowable pressure rating of any connected devices which cannot be isolated.

**6.00.00 PROTECTION DURING MANUFACTURE, TRANSPORTATION AND STORAGE BEFORE ERECTION**

This section provides special precautions, protection & care to be taken for delicate electronic items and supplements the general guidelines provided in the specification.

6.01.00 Protection

- a) All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or non-metallic protecting device. Ends of valves and conduit shall be sealed with suitable devices to protect them from damage. The parts which are likely to get rusted due to exposure to weather, should be properly treated and protected in a suitable manner.
- b) All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. The surfaces that are to be finish painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer.
- c) Special high temperature primer shall be used on surfaces exposed to temperature higher than 95°C.

6.01.01 Protective Guards

Suitable guards shall be provided for protection of personnel and delicate instrument. All such guards shall be designed for easy installation and removal for maintenance.

6.02.00 Storing

6.02.01 Stored equipment and materials shall be adequately supported and protected to prevent damage.

6.02.02 Stored equipment and materials shall not be allowed to contact the ground in ware houses that do not have dry concrete or suspended floors, material and equipment shall be stored on platforms or shoring.

6.02.03 Strip heaters and similar heating devices shall be energized immediately upon placement of the equipment in storage.

6.02.04 Mechanical dehydrators provided in control panels shall be maintained in operation from the date of receipt of equipment.

6.03.00 Defects

6.03.01 All defects in erection shall be corrected. The dismantling and reassembly to remove defective parts, replace parts, or make adjustments shall be included as a part of the work.





6.03.02 The removal of control and instrument equipment in order to allow bench calibration, if required, and the reinstallation of said equipment after calibration shall also be included as a part of the work under these specifications.

7.00.00 QUALITY ASSURANCE SERVICES

This section outlines, in general terms, the inspection, testing and QA/QC procedures to be adhered to with suitable check-points for Owner's intervention for Control & Instrumentation items. The general conditions outlined elsewhere in the specification over and above. The special requirements furnished below.

7.01.00 Quality Assurance Program

7.01.01 To ensure that the equipment and services of Control & Instrumentation items under the scope of this Contract, whether manufactured or assembled within Contractor's works or at his Sub-contractor's premises or at the site or at any other place of work, are in accordance with the specification, Contractor shall adapt suitable quality assurance program to ensure proper quality and workmanship at all points. A quality assurance program of Contractor for Control & Instrumentation items shall generally cover the following :

- a) Organization structure for the management and implementation of proposed quality assurance program.
- b) Documentation control system.
- c) Qualification and experience data of his key personnel.
- d) The procedure for Purchase of materials, parts, components and selection of Sub-contractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of materials purchased etc.
- e) System for shop manufacturing and site erection controls including process controls and fabrication and assembly controls.
- f) Control of non-conforming items and system for corrective actions.
- g) Inspection and test procedure both for manufacture and field activities.
- h) Control of calibration and testing of control, measuring and testing instruments/systems.
- i) System for indication and appraisal of inspection status.
- j) System for quality audits.
- k) System for handling, storage and delivery.
- l) Item/System-wise QA/QC and inspection flow charts clearly identifying the check-points of three types





- Where in-house checks will be performed
 - Where in-house test reports will be submitted for Owner's approval
 - Where Owner's inspection is necessary
- m) System for authorizing release of manufactured product.
- n) System for maintenance of records, and
- o) A quality plan detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component furnished.

7.02.00 Quality Assurance Documentation

7.02.01 Contractor shall be required to submit the following Quality Assurance Documents well ahead of dispatch of the equipment :

- a) All non-destructive calibration, testing , examination procedures and repair procedure actually used during fabrication.
- b) The inspection plan with verification, inspection plan check points, verification sketches (if used) and methods used to verify that the inspection were performed satisfactorily.
- c) Factory test results for testing required as per applicable codes and standards.

7.02.02 Owner shall have access to the works of Contractor and Sub-contractor at all times for the purpose of carrying out system audits, conducting quality surveillance, witnessing of tests and inspections etc.

7.02.03 Owner or his authorized representative may periodically check the work and Contractor's method of operation to assure that quality control practices are being followed. At the time of Owner's visit, all quality documentation pertaining to test, qualifications, inspections etc., shall, upon request, be made readily available.

7.02.04 All reports of tests and inspections as per Quality Control Practices and Quality Plans shall be made available to Owner on demand.

7.02.05 Contractor shall prepare quality plan in two sections, one for quality control at shop and the other for quality control at site.

7.02.06 Testing/inspection procedures as detailed herein gives a basic program to be followed and is in no way comprehensive or complete. Any other inspection stages not mentioned in these clauses but required as per Contractor's quality assurance program shall included. Any tests necessary from operation, safety and reliability point of view shall also be included.

7.02.07 These procedures shall include all checks/tests conducted at site for preservation, pre-assembly, alignment, positioning of equipment, foundation





preparation, grouting, welding/bolting, heat treatment, non-destructive examination, hydraulic test, performance tests, etc.

7.03.00 Shop Test

7.03.01 Shop tests shall include all tests to be carried out at Contractor's works, at works of his sub-contractor and at works where material used for production of the equipment is manufactured.

7.03.02 Individual components, instruments and devices furnished in accordance with specification shall be shop tested by manufacturer prior to shipment. The tests and test certificates shall be in accordance with the agreed QA program.

7.03.03 Such tests shall include electrical, mechanical, performance and hydraulic tests in accordance with relevant standards called for in the specifications to ensure that the plant being supplied fulfills the requirement of the specifications. Equipment not covered by any approved standards shall be tested in accordance with Contractor's quality control program.

7.03.04 All material shall be of tested quality, supported with duly correlated test certificates and wherever called upon by the Indian Boilers Regulations or by the design code, the test pieces shall be prepared and tested as per such regulation/code.

7.04.00 Site Test

7.04.01 Site tests shall include but not be limited to calibration, pre-commissioning trials, start-up trials, trial operation and performance guarantee test.

7.04.02 Contractor shall provide all required test equipment and simulation devices of reputed make, of required accuracy class and recently calibrated by some appropriate authority.

8.00.00 INSPECTION AND TESTING

8.00.01 General Requirements

- a) Equipment furnished under this specification shall be subject to test by quality assurance personnel of Contractor and Owner during manufacture, erection and on completion at specific agreed hold points.
- b) Contractor shall conduct all necessary shop and site tests and maintain proper records to fully meet the following requirements.
- c) Demonstrate to Owner's satisfaction that each equipment/sub-system fully meet all functional, parametric and other requirement of this specification and Owner's approved drawings/documents under all operating regimes.
- d) All applicable requirements of latest revised edition of I.S.A. Recommended practice MC-55.1 - 1982/ANSI MC 8.1-1975 regarding hardware testing of Digital process computers shall be fully met.





- e) All applicable tests shall be performed in accordance with the latest revisions of pertinent codes of ANSI, ISA and other applicable codes and standards. For equipment not covered by these codes, Bidder shall apply his standard shop and site testing procedures subject to Owner's approval.
- f) Contractor shall prepare detailed shop and site "Draft Quality Assurance Program" to fully meet the requirements of this specification. The document shall cover the following :
 - Quality assurance and testing procedures from component inspection stage up to final acceptance test at site.
 - Formats for recording calibration/test results.
 - Formats for test reports.
 - Specifications of test equipment proposed to be used for shop and site tests.
- g) The above "**Draft Quality Assurance Program**" shall be reviewed by Owner. The "**Quality Assurance Program**" as approved by Owner shall be used for conducting all shop and site tests.
- h) Additionally all standard quality assurance procedures of Contractor shall also be followed to ensure proper quality of equipment and compliance with specification requirements.

8.00.02 Shop Tests

- a) Contractor shall maintain proper records duly signed by authorized quality assurance personnel regarding all stage inspections, tests on individual equipment/sub-system/systems which are conducted by Contractor as per his standard procedure as well as those conducted to meet the requirements of his specification and Owner's approved "Quality Assurance Program". These records shall be made available to Owner during Acceptance Test.
- b) Contractor shall provide a complete factory test report of the system hardware and software.

8.01.00 Functional And Pre Acceptance Test

The authorized quality assurance personnel of Contractor shall conduct all tests as per the requirements of approved quality assurance program and fully satisfy compliance with specification requirements by all equipment / sub-systems and the system as a whole before sending notification for Acceptance test to Owner. Contractor shall maintain accurate records for all pre-acceptance test which shall be properly documented and duly certified documents shall be furnished to Owner at least one month prior to Factory Acceptance Test.

**8.01.01 Input-output wiring check (for system cabinets, relay cabinets etc.)**

- a) Contractor shall conduct a point by point wiring continuity check to every input and output and verify that the wiring connections agree with documentation. The test shall be performed by connecting a controlled signal to each input point in sequence. One point at a time, the wiring of all outputs shall be checked.
- b) Upon completion of point wiring checkout, Contractor shall conduct a system operational test employing static signals over the range of input signal. Appropriate static signals simulating each input shall be applied, scanned, processed, printed etc. as directed by the program. Signal strength shall be varied in order to check alarm functions and output fidelity. Simulation shall include testing of all specified system functions and operation. All calculations and conversions shall be verified against pre-calculated results.
- c) Calibration of outputs shall be individually tested for the quality and range over the period of not less than ten days (i.e. 240 hours) after completion of debugging, in order to confirm system stability and accuracy and to detect faulty programming, operation and components.

8.01.02 Special Tests for Solid State Equipment

All solid state equipment shall be subjected to Burn-in and Elevated temperature test and surge protection test :

- a) Surge protection test shall be conducted on all fully equipped system panels as per IEC information 255-4 Class-II. The equipment shall be designed to successfully withstand, without damage to component and/or wiring.
- b) Burn-in & Elevated Temperature Test

All solid state equipment shall be tested for a minimum of 168 hours continuously under power and simulated load prior to shipment.
- c) Acceptance Criteria for Burn-in and Elevated Temperature Test :
 - i) Functional test to be performed before and after Burn-in + ET Test.
 - ii) At no point of time the average temperature rise inside the cabinet shall be 10°C more than the ambient temperature.

8.01.03 Test for Closed Loop Control System

- a) Closed loop control system furnished as per this specification shall be subject to shop and site tests as per the requirements of this specification, applicable codes and Owner approved Quality





Assurance Program so as to demonstrate to Owner, that the equipment furnished by Contractor meets the intent and requirements of this specification. These tests shall include but not be limited to the tests indicated in the subsequent clauses.

- b) All control systems shall be factory tested for circuit continuity and direction of the response. The components to be tested shall include all controllers, stations, other system modules, alarm contacts and multi-conductor inter-connecting cables. The tests shall be performed with all of the system components connected to form a complete system with the exception of field instrument. The tests shall include a means of confirming the mathematical design response of the control system by simulating changes in system inputs. The tests shall be a qualitative functional test of each component of the control system which simulates dynamic inputs and monitors system outputs.
- c) Control loops shall be factory tested using closed loop mathematical simulating techniques. Control loops typically to be tested by the closed loop methods are :
 - i) Master coordinated control
 - ii) Firing rate control (fuel and air flow control).
 - iii) Furnace draft control
 - iv) Drum level control
- d) The input simulation equipment shall be designed to produce effects from control system outputs based on mathematical model of the predicted performance and process dynamics of the main unit equipment. The control constants of various control loop components shall be adjusted to produce a stable and optimum simulation equipment.
- e) Simulation data, including factory adjustment of control system constants and simulation equations shall be tabulated and shall be made available by Contractor for Owner's use during field check and start-up.
- f) Bidder shall state in his proposal, the availability of equipment for a simulated type test for automatic control loop specified herein, with a detailed description of testing methods utilized.
- g) Bidder shall furnish details of test procedures and copies of test results conducted for a similar fossil fired unit.

8.01.04 Tests for Field Instruments and Devices

The shop test for all field instruments, control actuators and devices shall include electrical, mechanical, performance and hydraulic tests in accordance with relevant IS, IBR or any other relevant approved standard or any other tests called for by Owner approved Quality Assurance Program.



**8.01.05****Notification for Acceptance Test at Shop**

- a) Owner, his duly authorized representative and/or an outside inspection agency acting on behalf of Owner shall have access at all reasonable times to inspect and examine the material and workmanship of the works during its manufacture of erection and if part of the works is being manufactured or assembled on other premises or works.
- b) Contractor shall give Owner/Inspector written notice of any material being ready for testing.
- c) Owner or Inspector shall within fifteen (15) days from the date of inspections, as notified by Contractor give notice in writing to Contractor of any objection to any drawings and if any equipment and proposed workmanship which in his opinion is not in accordance with the Contract. Contractor's shall give due consideration to such objections and shall either make the modifications that may be necessary to meet the said objection or shall inform in writing to Owner/Inspector giving reasons therein, that no modifications are necessary to comply with the Contract.
- d) The completion of these tests or the issue of the certificate shall not bind Owner to accept the equipment should it, on further tests after erection, be found not to comply with the Contract.
- e) The inspection by Owner and issue of inspection certificate thereon shall in no way limit the liabilities and responsibilities of Contractor in respect of the agreed quality assurance program forming a part of the Contract.
- f) Contractor shall furnish copies of the following as implemented documents as prior to Acceptance Tests, failing which, Owner may withhold program for Acceptance Tests :
 - i) System configuration drawings
 - ii) Copies of all as-built drawings
 - iii) Final approved copies of all drawings/documents.
 - iv) All off-line diagnostic program listings
 - v) Off-line diagnostic manuals
 - vi) Dump of individual and complete data base
 - vii) Detailed main and bulk memory maps
 - viii) Final Design Specification Volumes
 - ix) Test data to verify all calculations
 - x) All console operation manuals



- xi) Procedures of generating graphic displays, data base, logs, structuring/tuning of controllers etc.
- xii) Test procedures, copies of approved data sheets and relevant pages of approved QAP for field instruments & control actuators.
- xiii) All test reports for all types of tests carried out by Contractor.

8.01.06 Acceptance Test

8.01.06.1 The Acceptance Test shall include all reasonable exercises which the combination of equipment and software can be expected to perform. The test shall include but not be limited to, the following :

- a) Demonstration of the proper function of all hardware.
- b) Demonstration of required spare system capacity and all other parametric requirements of this specification.
- c) Demonstration of all man/machine functions.
- d) Demonstration of the proper functioning of all software.
- e) Demonstration of all diagnostic features.
- f) Point by point exercising of each input and output.
- g) Thorough exercising of each device, including the processor/ CPUs, Peripherals etc.

8.01.06.2 The Acceptance Tests shall also include the following Tests :

- a) Simulation of Inputs - to verify conversion accuracies, scan rates, operator functions, corrections of calculations.
- b) Operational Tests - to verify that the system performs all required functions and meets the specification requirements with respect to "free" processor time, spare memory requirements, loop response time and other parametric requirements.
- c) Diagnostics Test - to test working and bulk memory locations, instruction complements, functioning of outputs and peripheral devices, functioning of system check modules, etc.
- d) Power-consumption test - to verify KW consumption.
- e) Power failure test - to observe the consequences of a total power failure.
- f) Accuracy and Repeatability Test - accuracy and repeatability for analog inputs shall be demonstrated by statistical analysis using the point values read every scan cycle for a consecutive 8 hours period for a total of 10 percent of all analog inputs. The specified noise rejection capabilities shall be demonstrated using the same test and





analysis, by the application of at least 135V RMS common mode and 25V RMS differential mode to the same inputs. The noise rejection test shall be a second 8 hours test. Inputs to be used will be randomly selected by Owner prior to the test.

- g) Functions - All system functions shall be tested to demonstrate that they are in accordance with the specification.
- h) Format - All printouts and CRT display formats shall be checked to demonstrate that they are in accordance with the specification.
- i) Calculations - All calculations shall be tested to demonstrate that they are in accordance with the specification and I/O schedule. Contractor shall prepare all test cases for calculations (three for each calculation at low, mid and upper ranges of inputs) and submit them for Owner's review in accordance with contract schedule. Test cases shall include performance calculations, flow and level calculations.
- j) Demonstration of the manual and auto switch over from main to standby Bus/Controllers.

8.01.06.3 The following minimum criteria shall be followed during all tests :

- a) System shall meet all parametric and functional requirements of contract specification.
- b) The DCS shall be able to perform all specified functions without any interruption and/or degradation.
- c) Any allowable operator inputs through keyboards shall not result in system crash or hanging.
- d) Except for bulk memory failure, the disconnection / failure of any peripheral device while system is operating shall not lead to system crash.
- e) Disconnection/Failure of any offsite DPU shall not result in loss of any control function.
- f) Pulling out or insertion of any I/O module from its slot, shall not result in any system/sub-system failure.

8.01.06.4 The results of all Acceptance Tests shall be properly documented by Contractor and submitted to Owner.

8.01.06.5 Upon successful completion of Acceptance Test, Owner will provide Bidder with a written authorization for shipment of the system equipment to the project site.

8.02.00 On Site Tests

- a) On-site test shall include all tests to be carried out by Contractor at site upon receipt of equipment. These shall include but not be limited





to inspection of equipment, preliminary on-site checks and tests, pre-commissioning trials, start-up tests, trial operation, performance and guarantee test, availability test etc. as per the requirements of clause 4.00.00 and other applicable clauses of this specification.

- b) Contractor shall perform the site tests in accordance with the requirements of these specifications and Owner's approved **"Quality Assurance Program"**.
- c) Contractor shall maintain all test records in Owner's approved formats. These shall be countersigned by the authorized quality assurance personnel of Contractor supervising these works.

8.02.01 Preliminary On-Site Inspection And Tests

After field installation and before equipment energization and connection of field inputs, Contractor shall inspect all equipment and shall check wiring and cable to assure correctness of connections and power equipment installation. After these checks, Contractor's representative shall power the system and perform standard diagnostic tests on all system modules and equipment to assure that the system is working. The field inputs and outputs will then be connected by Contractor.

8.02.02 Start-up

- a) On completion of erection of the equipment and before start-up, each item of the equipment shall be thoroughly cleaned and inspected for correctness and completeness of the installation and acceptability for start-up, leading to initial pre-commissioning tests at site. The list of pre-commissioning tests to be performed shall be as Owner's approved "Quality Assurance Program".
- b) On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the complete equipment shall be operated integrally with sub-systems and supporting equipment as a complete system.

8.02.03 Distributed Control System (Site Testing)

Site testing of DCS being largely system-specific, only general guidelines have been provided in this section to ascertain the end-behavior of the system offered. However, detail site test procedure shall be mutually decided between Owner and Contractor during detail engineering stage and shall be followed at site.

- a) The front end or the I/O sub-system calibration and functional check procedure shall be as per the recommendation of the system manufacturer.
- b) Cards shall be inspected visually and subjected to standard pre-commissioning checks in standard test jigs before insertion in sub-racks.



- c) Cards requiring recalibration at site shall be calibrated before insertion.
- d) Contractor's activities may include minor hardware and software modification work at site.
- e) Contractor scope of work regarding the commissioning of modulating control sub-system shall include presetting of values of loop constants in respective cards, setting of alarms, timers, visual checking, mechanical and electrical testing and functional checking of all closed loop modulating controls associated with DCS. All tests shall be carried out after isolating field inputs/outputs from the system.
- f) Tests on the control system shall broadly consist of the following :
- i) Check of Equipment
- Cable termination of the cubicles will be checked.
- Locks, door function, lamps etc. shall be visually checked.
- ii) Functional Test
- Functionally test the system according to control diagram, wiring diagram and functional diagram. In case of any non-conformity, do some minor rectifications. All loops prior to functional test shall be ensured to be in manual position.
- Function test will be performed for each individual control loop successively, related or cascaded control loops must also be tested together. All normal as well as disturbance functions of the control loop and the cubicle shall have to be tested.
- iii) Testing of closed loop modulating control functions :
- Closed loop modulating control functions shall be tested with simulated input signals. Contractor shall check at least the following function :
- Inputs and outputs shall be checked for polarity
 - MVS and 1/2 selection circuits shall be checked
 - Controller cards shall be adjusted to initial setting
 - Alarm limit shall be set to process requirement
 - A/M bumpless transfers/tracking
 - Transparent fall backs and retransfer
 - Release function
 - Loading of output of signal distributors



- Memory retention time on power failure.
- g) Contractor's responsibility shall also include testing of the following performance criterion of CLCS together with control peripherals :
- i) Keyboard operation of closed loop controls
 - ii) Mimic diagram and graphic displays
 - iii) Logs
 - iv) Current and Historical trend displays of parameter associated to CLCS
 - v) Alarm displays in VDU
 - vi) Printer activation test
 - vii) Keyboard latency, control latency
 - viii) A/M transfer from keyboard
- h) In addition, to the above functional tests, Contractor shall also check the function of the Engineer's console with respect to loop configurability, graphic & log generation, power failure rebooting, trend generation etc at software level and all hardwire interface requirement with other systems.
- i) The tests on binary and sequential control sub-system shall be similar to modulating control sub-systems. The functional tests shall be performed at drive level as well as in group level.
- j) Complete off-line simulation testing of the binary control sub-system shall be carried.
- k) Prior to simulation test, Contractor should ensure that all the interposing relays are in position.
- l) Contractor shall also check the reporting function system to the Information System over the system bus.
- m) Setting of all timers as per process requirement shall also be done by Contractor during start-up.

8.03.00 Loop Checking and Pre-Commissioning

- a) After successful completion of erection and in situ calibration of field and control room instruments and equipment and on completion of associated cabling and tubing activity, Contractor shall undertake progressive loop checking of supervisory/binary and modulating loop controls to ensure all elements in measurement, protection and control loops to function in desired fashion.
- b) In the category of instrument loop checking Contractor's activities shall include broadly the following :-



- i) Loop checking for supervisory instruments.
- ii) Loop checking for modulating control sub-system
- iii) Loop checking for binary & sequential sub-system

All loop checking shall be properly recorded and shall be submitted to Owner after completion of loop checking section wise/equipment wise.

8.03.01 Supervisory Loops

- a) Supervisory loops shall imply measurement loops having monitoring functions only and shall include the bulk data acquisition system.
- b) All loops shall be checked for electrical continuity and air leakage prior to loop checking.
- c) All associated groundings shall be checked before the electrical power system is energized.
- d) Spare cores of field cables can be used for communication during commissioning.
- e) If discontinuity is noted in any field cabling, Contractor shall identify the run of cable/junction at which the discontinuity has developed.
- f) Cable identification markers shall be checked at all points of the loop.
- g) Termination of all associated cable screens shall be checked for properness.
- h) All instrument fuses and power line fuses which were removed after erection shall be reinserted.
- i) If any failure of any component of the loop occurs during loop checking and commissioning the same shall be replaced by drawing from commissioning spare and reerected.
- j) All outgoing cables from temperature elements shall be disconnected at the junction head during loop checking. Proper simulated signals shall be inputted from field through the field cables to simulate temperature.
- k) Similarly, for field transmitters, field cables shall be disconnected from transmitter terminal box and simulated 4-20 mA current signal shall be injected to the loop from field through a constant current signal generator.
- l) In case of inputs connected to bulk data acquisition system the input interface card shall be progressively adjusted to obtain proper display at the console.



- m) Simulated signals shall be inputted for at least five points at equal intervals (including span and zero) of the span, both upscale and downscale.
- n) All accessories related to the measurement loops shall be adjusted/checked as a part of loop checking and commissioning.
- o) For analytical system viz. SWAS system, the loop checking shall include the adjustment of sample flow rate through the primary coolers, adjustment of pressure breakdown valves, isothermal bath temperature control systems.
- p) Reagents and cation exchange filters, having limited operating life, shall be regenerated by wash out or acid treatment if required, before commissioning. All reagents having limited self life shall be checked for expiry and recharging with reagent shall be performed before commissioning.

8.03.02 Modulating Control Loops

- a) Loop checking will be carried out with all the devices hooked up as per drawings. The intent of loop checking is to establish that all wiring and tubing are as intended and all components are in functional condition. Final tuning of control loops will however be done only during commissioning / pre-commissioning stage depending upon complexity of the loops and as per manufacturer's recommendation.
- b) Before a particular modulating control loop is selected for loop checking, Contractor shall carry out the following checks :
 - i) Final control element (control valve/damper etc.) shall be checked for proper tagging, stroke and sealing, friction free movement of stem and positioner setting.
 - ii) Air supply to smart positioners, actuator shall be ensured at proper values.
 - iii) Contractor shall ensure that all primary sensors are properly installed, calibrated and are functioning properly.
 - iv) All scales and charts for indicators/recorders are installed properly.
 - v) Check proper hook-up between operator interface station (A/M station) and control cabinets
 - vi) All control loops must be selected in MANUAL MODE while checking.
 - vii) Controllers constants are adjusted to nominal values as below :

PARAMETER CONTROLLED	P.B.		
Flow	150	0.1	0
Pressure (Water)	50	0	0
Pressure (Steam)	100	0	0





Differential Pressure (Water)	50	0.1	0
Differential Pressure (Steam)	100	0.1	0
Temperature	100	0.3	0.5
Level	100	0	0

Final values of the above constants will however be adjusted during tuning of the controller on-line.

- viii) Power supply to smart positioners of final control elements shall be ensured.
- c) All input process signals shall be given from the field terminals in terms of current/voltage or resistance. The input signals should be variable over the total span.

8.03.03 Binary and Sequential Loops

- a) Binary and Sequential controls shall imply those loops associated with interlock and protection system, drives controlled from DCS, manual controls of drives not associated with DCS, input and output signal loops from protection system to field, MCC/SWGR etc., input signal loops to annunciation system and their fan out loops to DCS.
- b) All loops shall be checked for electrical continuity and air leakage prior to loop checking.
- c) All associated groundings shall be checked before energizing the loop component.
- d) Suitability of power at final control element (air or electrical) shall be checked.
- e) All process switches, limit switches etc. shall be mechanically activated from the field and shall be checked at the receiving end. After testing for proper operation of the switches, these will be hooked up to the receiving system as applicable.

Loops will be tested as follows :

- i) One functional loop will be energized at a time.
- ii) Binary inputs shall be simulated from the field end by actuating the initiating devices mechanically whenever possible after setting the design set values.
- iii) The logical output from the binary system shall be checked at the receiving end like MCC, SWGR, DC starter panel, lamps, annunciation, DCS etc.
- iv) All timers will be set at optimum values.



- f) Testing the loops associated with annunciation system shall be performed with the total system energized. The initiating devices shall be actuated mechanically or electrically.
- g) First-up alarm groups shall also be tested as per sequence by generating fault from initiator end.
- h) Accept/Reset Operation shall be checked.
- i) Manual control loops shall be checked as follows :

Manual controls loops will generally consist of operation interface station (P.B/Lamp) and drive interface cards.
- i) Contractor shall loop check between operator interface on desk/panel and MCC/SWGR/DC starter panel/solenoid valve, etc. as the case may be.
- ii) While loop checking MCC/SWGR etc. at the receiving end shall be de-linked.
- iii) Open/Close, Start/Stop push button shall be activated and simulated check-back signals shall be given from the receiving end.
- iv) Action of open/close and start/stop lamps shall be observed.
- v) In case of throttling devices, simulated current/voltage inputs shall be given to the associated portion indicator from the actuator, by operating hand wheel of the valve/damper

8.04.00 Commissioning

During plant / equipment / section trial run, start up, running etc. Contractor shall put the associated instruments, loops, controls etc. in service in respective sections/areas for smooth commissioning. The instruments/equipment are to be put in operation/service as per sound engineering practice & manufacturer's recommendations. Any instrument problem/trouble that may arise during commissioning and afterwards is to be attended and solved promptly by Contractor.

8.04.01 Trial Operation

- a) The plant shall then be on Trial Operation during which period all necessary adjustments shall be made by Contractor while operating, over the full load range enabling the system to be made ready for Performance and Guarantee Tests.
- b) The duration of Trial Operation of the complete equipment shall be 14 days out of which at least 72 hours shall be continuous operation on full load, or any other duration as may be agreed to, between Owner and Contractor. The trial operation shall be considered successful, provided that each item of equipment/ sub-system/software supplied and erected by Contractor and the system as a whole can operate continuously at the specified operating characteristics for the period of trial operation.





- c) For the period of trial operation, the time of operation with load shall be counted. Minor interruptions not exceeding 4 hours at a time caused during the continuous operation shall not affect the total duration of trial operation. However, if in the opinion of Owner, the interruption is longer, the Trial Operation shall be prolonged for the period equivalent to the duration of interruption.
- d) Trial Operation Report comprising of observation and recording of various parameters to be measured in respect to the above described Trial Operation shall be prepared by Contractor. This report, besides recording the details of the various observations during trial run, shall also include the dates of start and finish of the Trial Operation and shall be signed by the representatives of both the parties. The report shall record all the details of interruptions, adjustments made and any minor repairs done during Trial Operation. Based on the observations, necessary modifications/repairs to the system shall be carried out by Contractor to the full satisfaction of Owner to enable the latter to accord permission to carry out Performance and Guarantee Tests on the System.
- e) During the preliminary on site inspection and test, start up and Trial Operation the system shall be completely tested in the presence of Owner's representative to fully satisfy Owner that each equipment/sub-system/ software module individually and the system as a whole fully meets the functional, parametric and other requirements of this specification. All diagnostic and software debug tests performed at the factory shall also be performed in the field. These tests shall include a full demonstration of all operating software program operating in the real time environment. Contractor shall be responsible for documentation of all test results, records of defects observed and adjustments / modifications made during these tests. Contractor shall furnish certified copies of the site tests carried out prior to date of commencement of Performance and Guarantee Test.

8.04.02 Performance and Guarantee Test

- a) Performance and Guarantee Test shall be conducted by Owner after the following requirements are met.
 - i) Preliminary on site inspection, start up test and trial operation tests are successfully completed.
 - ii) Certified copies of the results of all site tests are furnished by Contractor.
 - iii) All deficiencies noticed during shop tests and site-tests including trial operation are satisfactorily resolved.
 - iv) System documentation check is successfully completed.
- b) Performance and Guarantee Test shall cover all test covered under Acceptance Test using actual plant inputs and outputs. Additionally, Owner may perform any other test which in his opinion is required for



satisfying himself regarding full compliance of equipment with the intent and requirements of this specification.

- c) The guaranteed performance figures of all equipment as well as functional and parametric requirements of this specification shall be provided / demonstrated during these Performance and Guarantee Tests.
- d) Should the results of these tests show any decrease from guaranteed value or non fulfillment of specification requirements, Contractor shall provide all necessary enhancements / replacements / modifications / additions in hardware, software, system configuration and other technical features as required to enable the system and parts thereof to meet the guarantees and specification requirements. In such cases the Performance and Guarantee Test shall be repeated for retest.

8.04.03 Availability Guarantee and Stability Test Run

- a) Contractor shall guarantee 99.7 percent system availability for a period of 180 days. An Availability Guarantee Test shall be conducted to assure this level of availability. If the accrued down time exceeds 0.3 percent of 180 days, during availability test run, a new 180 days test run shall start at the time when the system becomes available again. Loss of availability shall be defined as the loss of the system's guaranteed accuracy and repeatability or of any system function; except, however, that the loss of a function for not more than five percent of the I/O points shall not be considered loss of availability. Loss of a function for not more than five percent of the points shall be treated as partial unavailability and the corresponding outage time shall be weighted with respect to function and the percentage of the points for which the function is unavailable. Loss of each function shall have one weighing factor and unavailability of each equipment, peripheral device or process I/O card etc. shall have another weighing factor. The guaranteed accuracy and repeatability and system parametric requirements specified elsewhere shall be maintained for the entire 180 days run without any manual recalibration or any other changes made to the system.
- b) Downtime shall start upon loss of a system function and shall end upon full restoration of the affected system function. A minimum of one hour's down time shall be charged for each loss of availability in determining system availability.
- c) If availability is lost due to Owner's error, down time will not be charged to Contractor.

8.04.04 Availability Test Dates

The availability test shall commence at a date which will occur between the commissioning date and 5 months following commissioning.





Contractor will be notified of the test starting date at the time of Performance and Guarantee Test. Any subsequent changes in the starting date shall require the mutual consent of both Contractor and Owner.

8.04.05 Test Duration and Definition

- a) The availability test duration shall be 180 days of accumulated test duration time. Such duration time shall be continuous from the start of test, except as defined hereinafter.
- b) The availability shall be expressed by a percentage which shall be calculated as

$$\frac{100 \times [\text{Test Duration Time} - \text{Accumulated System Outage Time}]}{\text{Test Duration Time}}$$

- c) The accumulated system outage time shall be a total of time in which all systems and system functions are not available. A weighing factor shall be used to determine the amount of outage time assessed due to partial failures. System outage time shall be calculated as :

$$(\text{Outage time}) \times (\text{Weighing factors})$$

- d) System outage time shall be accumulated over the test duration and shall be the accumulated system outage time.

8.04.06 Outage Time and Weighting Factors

- a) Contractor shall submit a list of weightage factors for all system elements / components required for conducting the availability test. A list shall be submitted along with the bid documents. The finalization of the same shall be subject to Owner's approval.
- b) Outage time will be assessed for the length of time in which all or any part of any of the functions are either continuously available or not available when requested by operator action. The outage time shall be weighed by each functions associated weighing factor.
- c) Weighing factors for system elements shall be defined and mutually agreed upon before award of Contract.

8.04.07 Conditions

- a) Downtime shall start at the time of notification exclusive of actual travel time required by Contractor but not in excess of 8 hours.
- b) Contractor shall state in his proposal the unit price and quantity of each spare part which will be required at site during the availability test run to maintain the guaranteed availability figure.
- c) If the spare parts which are necessary for repair are not available with Owner at his site stock, the outage time necessary for obtaining the parts by Contractor shall not be counted if the spare part is on





Contractor's recommended list and within the quantities indicated for each type of spares.

- d) If Contractor had not listed the spare parts or in case the requirement exceeds the quantity indicated as per point (b) above the time required to obtain the part by Contractor shall be multiplied by a weighing factor of 0.05 and counted as accumulated outage time.
- e) Spare parts which are used by Contractor and not promptly replaced by Contractor, shall accumulate outage time at the rate of time required to obtain the spare parts multiplied by a weighing factor of 0.05 if the part is on a subsequent outage.
- f) Contractor shall be responsible for replacing any of Owner's spare parts which are used in the availability run.
- g) Failure of peripheral output devices shall be counted as outage time if failure of the device affects any or part of any function as per clause.
- h) Any degradation of function shall accrue to outage time regardless of system configuration.
- i) During a period of system outage, Owner shall use operable functions of the system provided that such use does not interfere with maintenance of the inoperable functions or hardware as determined by Contractor.
- j) Should Contractor determine that partial use of the system by Owner will interfere with Contractor's maintenance procedures, system outage time shall accumulate with a weighing factor of 1.0 since no functions are available to Owner. This shall include off-line servicing.
- k) Outage time for each function shall stop at the time Contractor returns each of the functions as listed in clause on "outage time and weighing factors" to full service and relinquishes full use of the system to Owner.

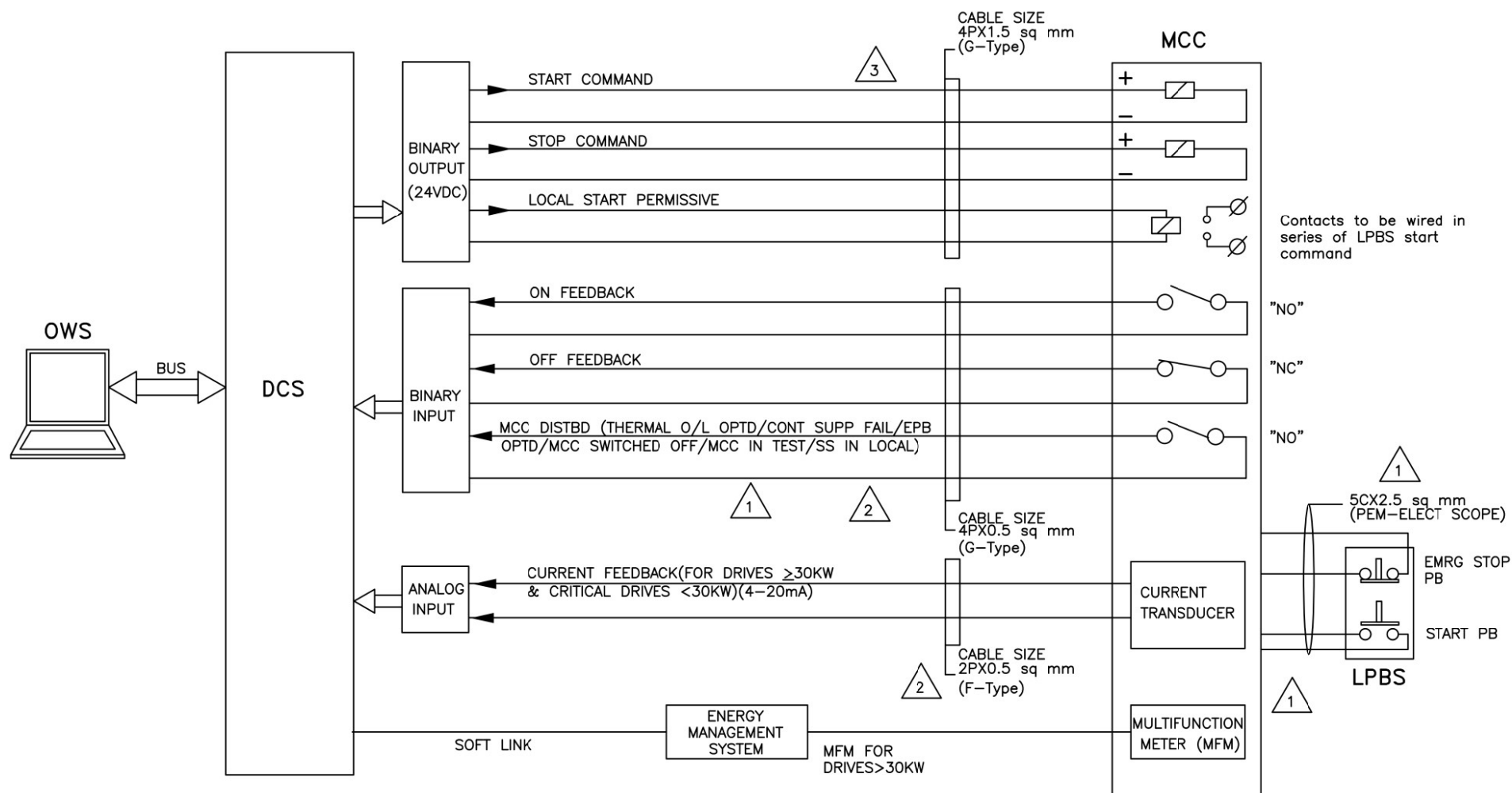
8.04.08 Criteria for Handing-over of Control & Instrumentation System

- a) Contractor shall apply in writing to Owner for handing over of the complete Control & Instrumentation System after successful demonstration of tests as specified up to "Availability Guarantee Test".
- b) Owner shall take over charge of the C&I system subject to fulfillment of the conditions enumerated hereunder :
 - i) All site check-list prepared by Owner are fruitfully attended by Contractor and certified by Owner.
 - ii) All Operation/Instruction manuals are updated to incorporate changes made up to Availability Test Run.
 - iii) All drawings/sketches are submitted as per Contract, on as-built basis.





- iv) All Close loop controls, Binary & Sequential controls should be working on auto and all interlocks are demonstrated to be functional.
- v) All equipments and system supplied by Bidder are in working condition.
- vi) All short supply items, as per Contract, are refurbished by Contractor.
- vii) The above conditions are in addition to fulfillment of any/all other contractual obligations of Contractor towards Owner. Partial handing-over of systems/equipments shall not be permissible, except if desired so by Owner in special cases.

DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE (CONTACTOR OPERATED) 1

NOTES:

REDUNDANCY IN OUTPUT SHALL BE PROVIDED FOR ALL CRITICAL LT DRIVES 2



PROJECT: 1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)

TITLE DDCMIS INTERFACE FOR UNIDIRECTIONAL LT DRIVE (CONTACTOR OPERATED)

DRG.NO. PE-DM-445-145-1002

DATE 20.04.2021

REV.NO. 04

SHT

[illegible]

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

1. For the purpose of clarity, it may please be noted that the information given in regard to the cables to be routed through WinPath as per the system elaborated below is called "Cable List", while the term "Cable Schedule" applies to the cable list with routing information added after routing has been carried out.
2. The cable list shall be entered as an MS Excel file in the format as per enclosed template EXT_CAB_SCH_FORMAT.XLS. No blank lines, special characters, header, footer, lines, etc. shall be introduced in the file. No changes shall be made in the title line (first line) of the template.
3. The field properties shall be as under:
 - a. UNITCABLENO: A/N, up to sixteen (16) characters; each cable shall have its own unique, unduplicated cable number. In case this rule is violated, the cable cannot be taken up for routing.
 - b. FROM: A/N, up to sixty (60) characters; the "From" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - c. TO: A/N, up to sixty (60) characters; the "To" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - d. PURPOSE: A/N, up to sixty (60) characters; the purpose (i.e. power cable/ indication/ measurement, etc.) to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - e. REMARKS: A/N, up to forty (40) characters; Any information pertinent to routing to be specified here (e.g., cable number of the cable redundant to the cable number being entered). Information in excess of 40 characters will be truncated after 40 characters.
 - f. CABLESIZE: A/N, 7 characters exactly as per the codes indicated below shall be specified here. The program cannot route cables described in any other way/ format.
 - g. PATHCABLENO: Field reserved for utilization by the program. User shall not enter any information here.
4. One list shall be prepared for each system/ equipment (i.e., separate and unique cable lists shall be prepared for each system).
5. The cables shall be described as per the scheme listed below:

A	NN	A	NNN
Cable	No. of cores	Cable code	Cable size
Voltage	(e.g. 01,03,3H, 07)	(See C below)	(e.g. 035,185,2.5, 0.5)
Code (see B below)			

(A) SYSTEM VOLTAGE CODES:

(ac) A = 11KV, B = 6.6KV, C = 3.3KV, D = 415V, E = 240V, F = 110V
 (dc) G = 220V, H = 110V, J = 48V, K = +24V, L = -24V

(B) CABLE VOLTAGE CODES:

A = 11KV (Power cables)

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

B = 6.6KV (Power cables)
C = 3.3KV (Power cables)
D = 1.1KV (LV & DC system power & control cables)
E = 0.6KV (0.5 sq. mm. Control cables)

(C) CABLE CODES

PVC Copper

A = Armoured FRLS	B = Armoured Non-FRLS
C = unarmoured FRLS	D = Unarmoured Non-FRLS

PVC Aluminium

E = Armoured FRLS	F = Armoured Non-FRLS
G = unarmoured FRLS	H = Unarmoured Non-FRLS

XLPE Copper

J = Armoured FRLS	K = Armoured Non-FRLS
L = unarmoured FRLS	M = Unarmoured Non-FRLS

XLPE Aluminium

N = Armoured FRLS	P = Armoured Non-FRLS
Q = unarmoured FRLS	R = Unarmoured Non-FRLS

S = FIRE SURVIVAL CABLES
T = TOUGH RUBBER SHEATH
U = OVERALL SCREENED
V = PAIRED OVERALL SCREENED
W = PAIRED INDIVIDUAL SCREENED
Y = COMPENSATING CABLES
I = PRE-FABRICATED CABLES
Z = JELLY FILLED CABLES

	TITLE MOTOR DATA SHEET - C	SPECIFICATION NO.
		VOLUME II B
		SECTION D
		REV NO. 00 DATE 08/09/2010
		SHEET 1 OF 7

LT MOTORS**A. GENERAL**

1. Manufacturer & Country of origin.
(Shall be as per approved QA make)
2. Equipment driven by motor
3. Motor type
4. Quantity

B. DESIGN AND PERFORMANCE DATA

1. Frame size
2. Type of duty
3. Type of enclosure /Method of cooling/Degree of protection
4. Applicable standard to which motor generally conforms
5. Efficiency class as per IS 12615
6. (a) Whether motor is flame proof Yes/No
(b) If yes, the gas group to which it conforms as per IS:2148
7. Type of mounting
8. Direction of rotation as viewed from DE END__
9. Standard continuous rating at 40 deg.C. ambient temp. as per Indian Standard (KW)
10. Derated rating for specified normal condition i.e. 50 deg. C ambient temperature (KW)
11. Maximum continuous load demand of driven equipment in KW
12. Rated Voltage (volts)
13. Permissible variation of :

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- a. Voltage (Volts)
 - b. Frequency (Hz)
 - c. Combined voltage and frequency
14. Rated speed at rated voltage and frequency(RPM)
15. At rated Voltage and frequency:
 - a. Full load current
 - b. No load current
16. Power Factor at
 - a. 100% load
 - b. NO load
 - c. Starting.
17. Efficiency at rated voltage and frequency,
 - a. 100% load
 - b. 75% load
 - c. 50% load
18. Starting current (amps) at
 - a. 100 % voltage
 - b. 85% voltage
 - c. 80% voltage
19. Minimum permissible starting Voltage (Volts)
20. Starting time with minimum permissible voltage
 - a. Without driven equipment coupled
 - b. With driven equipment coupled

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21. Safe stall time with 100% and 110% of rated voltage
 - a. From hot condition
 - b. From cold condition
22. Torques :
 - a. Starting torque at min. permissible voltage(kg-mtr.)
 - b. Pull up torque at rated voltage.
 - c. Pull out torque
 - d. Min accelerating torque (kg.m) available
 - e. Rated torque (kg.m)
23. Stator winding resistance per phase (ohms at 20 Deg.C.)
24. GD^2 value of motors
25. No of permissible successive starts when motor is in hot condition
26. Locked Rotor KVA Input
27. Locked Rotor KVA/KW
28. Vibration limit :Velocity (mm/s)
29. Noise level limit (dBA)

C. CONSTRUCTIONAL FEATURES

1. Stator winding insulation
 - a. Class & Type
 - b. Winding Insulation Process
 - c. Tropicalised (Yes/No)

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- d. Temperature rise over specified maximum ambient temperature of 50 deg C
 - e. Method of temperature measurement
 - f. Stator winding connection
2. Main Terminal Box
 - a. Type
 - b. Location (viewed from NDE side)
 - c. Entry of cables(bottom/side)
 - d. Recommended cable size (To be matched with cable size envisaged by owner)
 - e. Fault level (MVA), Fault level duration (sec)
 - f. Cable glands & lugs details (shall be suitable for power cable)
3. Type of DE/NDE Bearing
4. Motor Paint shade
5. Weight of
 - a. Motor stator (KG)
 - b. Motor Rotor (KG)
 - c. Total weight (KG)

D. List of accessories.

1. Space Heaters (Applicable for 30 KW & above motor)
(Nos./Power in watts/supply voltage)
2. Terminal Box for Space Heater (Yes/No)
3. Speed switch (Yes/No)
No of contacts and contact ratings of speed switch

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4. Insulation of bearing (Yes/No)

5. Noise reducer(Yes/No)

6. Grounding pads

i) No and size on motor body

ii) Nos on terminal Box

7. Vibration pads

i) Nos and size

ii) Location

8. Any other fitments

E. List of curves.

1. Torque speed characteristic of the motor

2. Thermal withstand characteristic

3. Starting. current Vs. Time

4. Starting. current Vs speed

5. P.F. and Effi. Vs Load

F. Additional Data to be filled for each rating of DC Motor

1. Rated armature voltage (Volt)

2. Rated field excitation (Amp)

3. Permissible % variation in voltage

4. Minimum Permissible Starting voltage (volt)

5. At rated voltage

i) Full load Armature current.(Amp)

ii) Full load Field current (Amp)

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- iii) No load Armature current (Amp)
6. Full load Field current (Amp)
7. No load Armature current (Amp)
8. Minimum permissible field current(Amp) to avoid overspeeding at
 - i) Maximum permissible voltage
 - ii) Rated voltage
 - iii) Minimum Permissible Voltage
9. Resistance (indicative Values) in ohm
 - i) Armature winding (Arm + IP + Series) at 25 deg.C
 - ii) Field Winding at 25 deg. C
10. Inductance (indicative values)
 - i) Armature winding
 - ii) Field winding
11. Value of trimmer resistance (ohm) to be connected in series with the shunt field to obtain rated speed at
 - i) 220 V DC
 - ii) 250 V DC
 - iii) 187 V DC
12. Value of the external resistance (ohm) required to be connected in series with armature during starting only
13. Technical data sheet for external resistance box
14. GA drawing of motor
15. Starting time calculation

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16. Starter resistance design calculation
17. Electrical connection diagram of motor

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1. Bidder shall follow the attached approved Sub-Vendor list. The Sub Vendor list provided is compiled list of all BHEL units and sufficient Sub-Vendors have been already approved by WBPDCCL. No additional Vendors will be entertained for the equipment already available in the Sub-Vendor list.
2. Incase any equipment is not specified in the list, Bidder shall submit the credentials of the Sub Vendors during contract stage for Approval.
3. Credentials shall consist of the following as minimum
 - a. List of references for similar application
 - b. Minimum 2nos. of Purchase Orders of similar references
 - c. Minimum 2nos. of Performance certificates/ Inspection clearance reports
 - d. Sub Vendor Catalogues
4. Finalized list of Sub Vendors shall be submitted to WBPDCCL for intimation/ approval/ clearance.



The West Bengal Power Development Corporation Limited

(A Government of West Bengal Enterprise)

Corporate Identity No.: U40104WB1985SGC039154

Registered & Corporate Office: Bidyut Unnyan Bhavan,

Plot - 3/C, LA - Block, Salt Lake City, Sector - III, Kolkata - 700 098

Phone: 033-2335-0445/2335-0571/2339-3100

Fax: 033-2339-3286/2335-0516

website: www.wbpdcl.co.in E-mail: wbpdcl@wbpdcl.co.in

Ref. No. WBPDC/Corp./SGMP03/AV/8/047

Date: 16.06.2020

To,
Shri A.K. Singhal, GM
PS- MKTG. BHEL House,
Siri Fort, New Delhi 110 049

Sub : Vendor List of Sagardighi Thermal Power Extension Project Unit No.5 (1X660MW)

Ref : E-mail from BHEL PS-MKTG dtd. 29th August, 2019

Dear Sir,

Please find the reviewed Vendor List for the captioned Project.

BHEL may note that some Vendors have been identified under 'DR' category for which BHEL is requested to provide detail credentials of the Vendor in line with the tender requirements for Approval consideration from WBPDC.

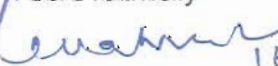
The entire Vendor List is divided under the following sub heads-

- a) Mechanical Aux.Packages :
- b) Mechanical Equipment List :
- c) FGD Plant Equipment List :
- d) CHP Equipment List :
- e) AHP Equipment List :
- f) Electrical Equipment List :
- g) C&I Equipment List :
- h) FPA Equipment List :
- i) HVAC System :
- j) PSER Erection Vendors :

This is for your information and further necessary action from your end.

Thanking you,

Yours faithfully,


Kalyanbrata Chakrabarty
GM (Projects)

Bandel Thermal Power Station GM-26846369,DGM(O) 26846447, DGM(M) 26846403, Senior Manager(P&A)-26845086 Senior Manager-26845083 Guest House-26845201 Fax : 2684 6151	Santalidih Thermal Power Station GM-260227 Senior Manager(P&A)260226 Senior Manager(F&A)260341 Electrical Control Room-260228 Guest House260342/260203 Fax:260217 STD Code-3251	Kolaghat Thermal Power Station Ph: GM 231110,DGM(O)231254 DGM(M)231261 DGM(U)231255 DGM(Accts.)231290 STD Code-03228 E mail: ktpsdccl@cal.vsnl.net.in	Bakreswar Thermal Power Project GM- 220201DGM(Const.)-220210 Senior Manager(P&A)/(F&A)-220202 Guest House(Abdarpur)225475,225346 PBX:220694, Fax-220214 Email: bktpp@cal2.vsnl.net.in STD Code:03462

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

SL. NO.	Item Description	Vendor Name	Remarks
1	OXYGEN DOSING SYSTEM	ENPRO INDUSTRIES PVT.LTD. MARKAL KHED,PUNE	Approved
		POWER PIPING COMPANY ,Mandaiyur	DR
		PSI ENGINEERING SYSTEMS (P) LTD., Chennai	Approved
		Positive Metering Pumps (I) Pvt. Ltd.,Nasik	DR
		V.K PUMP INDUSTRIES PVT LTD, Nasik	Approved
2	CHEMICAL DOSING SYSTEM	ENPRO INDUSTRIES PVT.LTD., MARKAL KHED,PUNE	Approved
		PSI ENGINEERING SYSTEMS (P) LTD., Chennai	Approved
		SWELORE ENGG. PVT. LTD, AHMEDABAD	Approved
		TECHNO CONSULTANTS , GHATKOPAR (W) MUMBAI	Approved
		MILTON ROY INDIA (P) LTD.	Approved
		V.K PUMP INDUSTRIES PVT LTD, Nasik	Approved
3	CONDENSATE POLISHING UNIT	BGR ENERGY SYSTEMS LIMITED.,	Approved
		DRIPLEX WATER ENGINEERING INTERNATIONAL PRIVATE LIMITED, Hardwar	Approved
		ION EXCHANGE (INDIA) LTD	Approved
		THERMAX LTD. PUNE	Approved
		VA TECH WABAG LTD	Approved
4	MILL REJECT SYSTEM (PNEUMATIC TYPE)	MECAWEBER BEEKAY PVT LTD., GREATER NOIDA	Approved
		UNITED CONVEYOR CORPORATION (INDIA) PVT.LTD.,KOLKATA	Approved
5	COLTCS	GEA BGR ENERGY SYSTEM INDIA LTD., Noida	Approved
		TAPROGGE GmbH, Noida	Approved
		TECHNOS, FRANCE	Approved
		EIMCO WATER TECHNOLOGIES ,LLC, USA	Approved
		KLUMPF & KOLLER GmbH	Approved
		FILTRATION ENGINEERS LTD.	Approved
6	CW TREATMENT PLANT (Items to be procured from the approved Vendor List)	MULTITEX FILTRATION ENGINEERS LIMITED,	Approved
		CLEAR WATER LTD.	Approved
		THERMAX LTD.	Approved
		DRIPLEX WATER ENGG. LTD.	Approved
		CHEMBOND ASHLAND WATER TECHNOLOGIES LTD.,MUMBAI	Approved
7	CHLORINATION PLANT (Items to be procured from the approved Vendor List)	VA TEC WABAG LTD	Approved
		PERFECT CHLORO SYSTEMS	Approved
		METITO POLLUTION CONTROL INDIA LTD	Approved



**SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)**

Sl. No.	Item Description	Vendor Name	Remarks
1	VIBRATION ISOLATION	GERB	Approved
2.	STEEL GATE / GLOBE / NR VALVES 'BHEL' Make Valves are approved for only for 1500 CLASS or below.	WEIR B.D.K VALVES INDIA PVT. LTD. KIRLOSKAR BROTHERS LTD. LEADER VALVES LTD. KSB VALVES FOURESS ENGG.INDIA LTD. VAG VALVES AUDCO INDIA DEWARANCE Hawa Valves (India) Pvt. Ltd. HAWA ENGINEERS LTD. INTERVALVE POONAWALLA LTD. MICON VALVES (INDIA) PVT. LTD.	Approved Approved Approved Approved Approved DR Approved DR Approved Approved Approved DR
3.	BALL VALVES	FLOW CHEM INDUSTRIES FISHER SANMAR LIMITED KIRLOSKAR BROS. LTD. LEADER VALVES LTD. KSB VALVES WEIR B.D.K VALVES INDIA PVT. LTD. VAG VALVES A.V. VALVES LTD Hawa Valves (India) Pvt. Ltd. INTERVALVE POONAWALLA LTD.	Approved Approved Approved Approved Approved Approved Approved Approved Approved Approved
4.	CAST IRON GATE /GLOBE/ NR/V SAFETY RELIEF VALVES	H.SARKER & COMPANY G.M.DALUI & SONS PVT.LTD. KIRLOSKAR BROS. LTD. LEADER VALVES LTD. VENUS PUMP & ENGG. WORKS	Approved Approved Approved Approved Approved
5.	SAFETY RELIEF VALVE (TUBE SIDE AND SHELL SIDE)	BHEL-HPBP TRICHY	Approved for Class 1500 or below
6.	Safety Valve, Safety relief Valve & ERV 'BHEL' Make Valves are approved for only for 1500 CLASS or below.	SEMPELL GmbH./Germany DRESSER CONSOLIDATED./USA DRESSER CONSOLIDATED./United Kingdom TYCO VALVES & CONTROLS./USA MEIWA CORPORATION./Japan BOPP&REUTHER,SICHERHEITS-UND/Germany REINEKE MESS-UND REGELTECHNIL GMBH/Germany VALVTECHNOLOGIES./USA BOPP&REUTHER,SICHERHEITS-UND/Germany VALVTECHNOLOGIES./USA	Approved Approved Approved Approved Approved Approved Approved Approved Approved Approved
7	GUN METAL VALVES	A.V.VALVES LTD, LEADER VALVES LTD., VALTECH INDUSTRIES	Approved Approved Approved

**SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)**

Sl. No.	Item Description	Vendor Name	Remarks
8	BUTTER FLY VALVES (STEAM SERVICE)	FOURESS ENGG.INDIA LTD.	Approved
		INSTRUMENTATION LTD.	Approved
		BDK PROCESS CONTL. HUBLI	Approved
9.	BUTTER FLY VALVES (WATER SERVICE)	WEIR B.D.K VALVES INDIA PVT. LTD.	Approved
		FOURESS ENGG.INDIA LTD.	Approved
		INSTRUMENTATION LTD.	Approved
		LARSEN & TOUBRO LTD.	Approved
		KIRLOSKAR BROS. LTD.	Approved
		TYCO VALVES & CONTROLS INDIA PVT.LTD.	Approved
10.	SPRING LOADED BYPASS VALVES/ PLUG VALVES/ ANGLE DRAIN VALVES	WEIR VALVES & CONTROLS M.E.	Approved
		WEIR B.D.K VALVES INDIA PVT. LTD.	Approved
		FISHER SANMAR LIMITED	Approved
		LARSEN & TOUBRO LTD	Approved
		LEADER VALVES LTD.	Approved
		REINEKE MEB-UND REGELTECHNIK GMBH	Approved
		SEMPELL AG, GERMANY	Approved
		VELAN INC.,CANADA	Approved
11.	AIR RELEASE VALVES	H.SARKER & COMPANY	Approved
		LEADER VALVES LTD.	Approved
		VENUS PUMP & ENGG. WORKS	Approved
		G.M.DALUI & SONS PVT.LTD.	Approved
		A.V VALVES LTD	Approved
12.	DUAL PLATE CHECK VALVES	VENUS PUMP & ENGG. WORKS	Approved
		FLUIDLINEVALVES COMPANY PRIVATE LTD.	Approved
13.	FLOAT VALVES	H.SARKER & COMPANY	Approved
		G.M.DALUI & SONS PVT.LTD.	Approved
		LEADER VALVES LTD.	Approved
14	CONDENSATE PUMP-LP	SAM TURBO INDUSTRY PVT LIMITED	Approved
		SULZER PUMPS INDIA PVT LTD	Approved
		KIRLOSKAR BROTHERS LTD	Approved
		CLYDE PUMPS INDIA PVT LTD,	Approved
15.	FUEL OIL PUMPS (POSITIVE DISPLACEMENT PUMPS)	TUSHACO PUMPS PVT. LTD.,	Approved
		ALEKTON ENGG.INDUSTRIES PVT.LTD.	Approved
		U.T.PUMPS & SYSTEMS (P) LTD.	DF
		ALLWEILER INDIA PVT.LTD.,	Approved
16.	PGB SPECIAL OIL-ISO VG 320	INDIAN OIL CORPN.LTD.,	Approved
		HINDUSTAN PETROLEUM CORPN. LTD.	Approved
		CASTROL INDIA LIMITED	Approved
		EXXONMOBIL LUBRICANTS PVT LTD	Approved
		SHELL INDIA MARKETS PRIVATE LIMITED	Approved
17.	JACKING OIL PUMPS WITH MOTOR (SCREW TYPE) FOR MAIN TURBINE	TUSHACO PUMPS LIMITED	Approved
		ALLWEILER AG ,GERMANY	Approved

**SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)**

Sl. No.	Item Description	Vendor Name	Remarks
19.	AUX. OIL PUMP (AOP) & EMERGENCY OIL PUMP WITH MOTOR (EOP) FOR MAIN TURBINE	KSB PUMPS LIMITED	Approved
		MATHER & PLATT PUMPS	Approved
		KBL	Approved
20.	VACUUM PUMPS	EDWARDS LIMITED, UK	Approved
		NI-TECH INC. USA	DF
		NASH ELOM INDUSTRIES, GERMANY	Approved
21	LUB OIL TRANSFER PUMPS	MATZ PUMPS PVT.LTD.	DF
		TUSHACO PUMPS PVT.LT	Approved
		IDEX INDIA PVT LTD	DF
		DELTA P D PUMPS PVT LTD	Approved
		ALLWEILER INDIA PRIVATE LIMITED	Approved
22	CONCRETE VOLUTE PUMP	KIRLOSKAR BROS. LTD.	Approved
		CLYDE UNION PUMPS	Approved
		FLOWERVE CORPORATION	Approved
		BHEL HYD BASED ON MHI COLLABORATION	DR
23.	MISC.PUMPS (VERTICAL)	KIRLOSKAR BROS. LTD.	Approved
		KSB PUMPS LTD.	Approved
		SULZER PUMPS INDIA LTD.	Approved
		WEIR,UK	Approved
		WPIL LIMITED	Approved
		FLOWMORE	Approved
		BHARAT PUMPS & COMPRESSORS LTD	Approved
		WILO MATHER & PLATT PUMPS PVT. LTD.	Approved
24.	BOILER WATER RECIRCULATION PUMP	TORISHIMA PUMP MFG CO.LTD, Japan	Approved
		KSB AKTIENGESellschaft, Germany	DR
25.	PUMPS (HORIZONTAL) Type-I (FLOW<300 CMH)	KIRLOSKAR BROS. LTD.	Approved
		MATHER & PLATT PUMPS LTD.	Approved
		KSB PUMPS LTD.	Approved
		SULZER PUMPS INDIA LTD.	Approved
		WEIR,UK	Approved
		WPIL LIMITED	Approved
26.	PUMPS (HORIZONTAL) Type- II (FLOW>300 CMH)	FLOWMORE LTD.	Approved
		WPIL LIMITED	Approved
27.	SUMP PUMPS / SUBMERSIBLE PUMPS/ SLUDGE PUMP	KISHOR PUMPS PVT.LTD	Approved
		KIRLOSKAR BROS. LTD.	Approved
		KSB PUMPS LTD.	Approved
		FLOWMORE LTD.	Approved
		JASCO PUMP PVT. LTD.	Approved
		SAM TURBO	Approved
28.	OIL MODULE AND ACCESSORIES	HYDAC (INDIA) PVT. LTD.	Approved
		ALLWEILER INDIA PRIVATE	Approved
		AEL APPARATEBAU GMBH LEISNIG	Approved
		VDL DELMAS GMBH	Approved

Sagardighi Thermal Power Project (EOP)
Mech. Equipment

**SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)**

Sl. No.	Item Description	Vendor Name	Remarks
		FLENCO FLUID SYSTEM S.R.L (FOR KELAG AG	Approved Approved
29.	LUBE OIL PUMPS (CENTRIFUGAL)FOR TDBFP	KSB PUMPS LTD. KIRLOSKAR EBARA, KIRLOSKARWADI SULZER, MUMBAI. FLOWSERVE SANMAR LTD.,	Approved Approved Approved Approved
30.	LUBE OIL PUMPS (SCREW TYPE) FOR TDBFP	ALLWEILER, GERMANY IMO PUMP, USA TUSHACO, DAMAN LEISTRITZ (EMPIRE), GERMANY	Approved Approved Approved Approved
31.	JACKING OIL PUMP TDBFP	HAGULLAND DENSION TUSHACO PUMPS PVT. LTD., DELTA P D PUMPS PVT LTD	Approved Approved Approved
32.	EHA FOR TURBINE VALVES	BOSCH REXROTH AG HORST THIELE MASCHINENBAU HYDRAULISCHE GERATE GMBH, GERMANY	Approved Approved
33.	HPSU FOR TURBINE VALVES	HYDAC (INDIA) PVT LTD REINEKE MESS-UND REGELTECHNIK GMBH BOSCH REXROTH (INDIA) PRIVATE LIMITED; HYDAC SYSTEM GMBH KEICHER ENGINEERING AG	Approved Approved Approved Approved Approved
34.	OIL ACCUMALATOR	BOLENZ & SCHAFER MASCHINENFABRIK, Germany HYDAC INDIA PVT LTD, Navi Mumbai PARKER HANNIFIN CORPORATION, USA	Approved Approved Approved
35.	VACUUM BREAKER VALVE ASSY	MULLER CO-AX AG INSTRUMENTATION LIMITED CRANE PROCESS FLOW	Approved Approved DF
36.	SCANNER AIR FAN	C.DOCTOR & CO.PVT.LTD. PATELS AIRFLOW LTD. AIR CONTROL & CHEMICAL ENGG. CO.LTD.	Approved Approved Approved
37.	OIL PURIFICATION UNIT (OIL CENTRIFUGE)/PORTABLE OIL PURIFIERS	ALFA LAVAL LIMITED, INDIA SERVIZE INDUSTRIAL, ITALY ALFA-LAVALSEPARATION AB - SWEDEN	Approved DF Approved
38.	ELECTRICAL HOIST	REVA INDUSTRIES LTD CONSOLIDATED HOIST PVT LTD TUOBRO FURGUSON(INDIA)PVT.LTD HERCULES HOISTS LTD. UNIVERSAL HOIST - O- FABRIK BRADY & MORRIS ENGINEERING CO. LTD. TRACTEL TIRFOR INDIA PVT. LTD.	Approved Approved Approved Approved Approved Approved Approved
		UNIVERSAL HOIS -O-FABRIK HERCULES HOISTS LTD. TUOBRO FURGUSON(INDIA)PVT.LTD	Approved Approved Approved

Sagardighi Thermal Extension Unit 5 (PROJ)

Mech. Equip. 433

**SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)**

Sl. No.	Item Description	Vendor Name	Remarks
39	CHAIN PULLEY BLOCK	BRADY & MORRIS ENGINEERING CO. LTD.	Approved
		TRACTEL TIRFOR INDIA PVT. LTD.	Approved
		UNIVERSAL HOIS -O-FABRIK	Approved
		HERCULES HOISTS LTD.	Approved
		TUOBRO FURGUSON(INDIA)PVT.LTD	Approved
40	DOUBLE GIRDER EOT CRANES UPTO 50T	UNIQUE INDUSTRIAL HANDLERS PVT.LTD	Approved
		MUKAND LIMITED,	Approved
		REVA INDUSTRIES LTD.	Approved
		HEAVY ENGG. CORPORATION LTD.	Approved
		UNIVERSAL HOIST-O-FABRIK,	Approved
		CONSOLIDATED HOISTS PVT LIMITED	Approved
41	D/G EOT CRANES UP TO 100T	FURNACE & FONDRIE EQUIPMENT CO.	Approved
		FURNACE & FONDRIE EQUIPMENT CO.	Approved
		Grip Engineers Pvt. Ltd.,	Approved
		HEAVY ENGG. CORPORATION LTD.	Approved
		MUKAND LIMITED	Approved
		REVA INDUSTRIES LTD.	Approved
		TUOBRO FURGUSON (INDIA) PVT LTD	Approved
42	D/G EOT CRANES ABOVE 100T	UNIQUE INDUSTRIAL HANDLERS PVT LTD.	Approved
		FURNACE & FONDRIE EQUIPMENT CO.	Approved
		HEAVY ENGG. CORPORATION LTD.	Approved
		MUKAND LIMITED	Approved
		REVA INDUSTRIES LTD.	Approved
43	Single Girder EOT / HOT Misc. Cranes	UNIQUE INDUSTRIAL HANDLERS PVT LTD.	Approved
		BRADY & MORRIS ENGINEERING CO. LTD.	Approved
		CONSOLIDATED HOISTS PVT LTD	Approved
		REVA INDUSTRIES LTD.	Approved
		TRACTEL TIRFOR INDIA PVT. LTD.	Approved
44	MILL HANDLING EQUIPMENT	Universal Hoist-O-Fabrik	Approved
		GRIP ENGINEERS PVT LTD, HYDERABAD	Approved
		LIFTING EQUIPMENT & ACCESSORIES, NEWDELHI	Approved
		REVA INDUSTRIES LIMITED, FARIDABAD	Approved
		CONSOLIDATED HOIST, PUNE	Approved
		EDDYCRANES ENGINEERS PVT, MUMBAI	Approved
		CENTURY CRANE ENGINEERS (P) LTD.	Approved
45	FURNACE MAINTENANCE PLATFORM	UNIVERSAL HOIST-O- FABRIK, MUMBAI	Approved
		N.V.SKY CLIMBER EUROPE S.A	Approved
		N.V.SKY MAN INTERNATIONAL S.A.	Approved
46	QUICK ERECT SCAFFOLD	ALTREX B.V, Netherlands	DR
		INSTANT UPRIGHT LIMITED, DUBLIN	Approved
47	ELEVATOR-PASSENGER CUM GOODS	KONE ELEVATOR INDIA LTD.	Approved
		OTIS ELEVATOR	Approved

**SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)**

Sl. No.	Item Description	Vendor Name	Remarks
48.	CASTABLE REFRACTORY	BASKAR REFRACTORIES AND S.W PIPES(P)LTD	Approved
		THE ACE REFRACTORIES LTD.	Approved
		DALMIA REFRACTORIES	Approved
		SOUVENIOR CERAMICS	Approved
		MAHAKOSHAL REFRACTORIES PVT. LTD.	DF
		CASTWEL INDUSTRIES	DF
49.	POURABLE INSULATION	BASKAR REFRACTORIES & STONEWARE PIPES(P)LTD	Approved
		THE ACE REFRACTORIES LTD.	Approved
		DALMIA REFRACTORIES	Approved
		INDUSTRIAL ASSOCIATES,	Approved
		CASTWEL INDUSTRIES	DF
50.	FIRE BRICKS	BASKAR REFRACTORIES AND STONEWARE PIPES (P) LTD	Approved
		DALMIA REFRACTORIES	Approved
51.	WOOL MATTRESS	ROCKWOOL INDUSTRIES LTD	Approved
		MINWOOL ROCK FIBRES LTD	Approved
		LAPINUS ROCKWOOL PVT. LTD	Approved
		ROCKWOOL INDIA LTD.	Approved
		LLOYD INSULATION (I) LTD.	Approved
		LLOYD ROCKFIBRES LTD.	Approved
		DHANBAD ROCKWOOL INSULATION PVT LTD	Approved
		GOENKA ROCKWOOL (INDIA) PVT LTD.,	Approved
		JAMSHEDPUR MINERAL WOOL MFG.CO.	Approved
52	MINERAL WOOL MATTRESS	JAMSHEDPUR MINERAL WOOL MFG.CO.	Approved
		ROCKWOOL (INDIA) PVT LTD.	Approved
		ROCKWOOL INDUSTRIES	Approved
		DHANBAD ROCKWOOL INSULATION PVT LTD	Approved
		GOENKA ROCKWOOL (INDIA) PVT LTD.,	Approved
53.	THERMAL INSULATION OF STEAM TURBINE/THERMAL INSULATION OF TURBINE INTEGRAL PIPING/THERMAL INSULATION- ROCKWOOL MATTRESSES/ PIPE SECTIONS	LLOYD INSULATIONS	Approved
		ROCKWOOL	Approved
		HEINRICH TAPP GMBH	Approved
		EUGEN ARNOLD GMBH	Approved
		Dhanbad Rockwool Insulation (P) Ltd.	Approved
		GOENKA ROCKWOOL (INDIA) PVT.LTD.	Approved
54.	THERMAL INSULATION - ANCILLARY MATERIAL	LLOYD INSULATIONS (INDIA) LIMITED	Approved
		ALLIED INSULATIONS (INDIA), GHAZIABAD	Approved
		ENERGY SAVING & ALLIED PRODUCTS	Approved
55.	INSULATION:BED MATERIALS	BHASKAR REFRACTORIES&SW PIPES P LTD, Faridabad	Approved
		SOUVENIOR CERAMICS, Faridabad	Approved
		ALWAR REFRACTORIES PVT LTD, Jaipur	Approved
		CHAMPION CERAMICS PVT LTD, Champa	DR

**SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)**

Sl. No.	Item Description	Vendor Name	Remarks
56.	INSULATION:CALCIUM SILICA	HYDERABAD INDUSTRIES LTD., Faridabad NEWKEM PRODUCTS CORPORATION, Mumbai	DR DR
57.	INSULATION:CERAMIC WOOL	LLOYD INSULATIONS (INDIA) LIMITED, Chennai	Approved
58.	INSULATION:WOVEN WIRE CLO	BANARASWALA METAL CRAFTS PVT.,COIMBATORE BOKARIA WIRENETTING INDUSTRIES,CHENNAI JEETMULL JAICHANDLALL (MADRAS),CHENNAI KIRAN WIRE NETTING CO.,CHENNAI QUALITY WIRE PRODUCTS,NAVI MUMBAI	Approved Approved Approved Approved Approved
59	STEAM TRAPS	SPIRAX MARSHALL PVT.LTD. PENNANT ENGINEERING PVT.LTD. ESCO STEAMCON PVT. LTD. FORBES MARSHALL PVT. LTD.	Approved Approved Approved Approved
60	AIR TRAPS	PENNANT ENGINEERING PVT.LTD. SPIRAX MARSHALL PVT.LTD. ESCO STEAMCON PVT. LTD. FORBES MARSHALL PVT. LTD.	Approved Approved Approved Approved
61	GRAVIMETRIC FEEDER	STOCK INDIA	Approved
62	COMPRESSED AIR SYSTEM	ATLAS COPCO (INDIA) LTD.	Approved
63	SELF CLEANING STRAINERS	FILTRATION ENGINEERS (I) PVT. LTD. GEA BGR ENERGY SYSTEM INDIA LTD. MULTITEX FILTRATION ENGINEERS LIMITED	Approved Approved Approved
64	DEBRIS FILTER	GEA BGR ENERGY SYSTEM INDIA LTD. MULTITEX FILTRATION ENGINEERS LIMITED TAPROGGE GmbH	Approved Approved Approved
65	ALUMINIUM SHEETS/ COILS/CLADDING	BHARAT ALUMINIUM CO.LTD. INDIAN ALUMINIUM CO.LTD. HINDALCO INDUSTRIES LTD. NATIONAL ALUMINIUM COMPANY LTD. JINDAL ALUMINIUM LIMITED	Approved Approved Approved Approved Approved
66	CORRUGATED AL SHEET	HINDALCO INDUSTRIES LTD.,Chennai JINDAL ALUMINIUM LIMITED, Bangalore MPIL STEEL STRUCTURES LTD.,Thane	Approved Approved Approved
67	HOC TYPE GAS DRIER	DELAIR INDIA PVT. LTD. ATLAS COPCO (INDIA) LTD.	Approved Approved
68	REFRIGERATION TYPE GAS DRIER	DELAIR INDIA PVT. LTD. SUMMIT SAVRO JINDAL ELECTRONICS PVT. LTD. SPAN MANUFACTURING CO. PVT. MELLCON ENGINEERS PVT. LTD.	Approved Approved Approved Approved DR Approved

Sagardighi Extn. Unit 5 (PROJ)

Mech. Equip. 483

**SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)**

Sl. No.	Item Description	Vendor Name	Remarks
69	MISC. TANKS (SHOP)	GENERAL MECHANICAL WORKS	Approved
		UNITECH MACHINES LTD.	Approved
		TECHNO ELECTRIC & ENGG. CO. LTD.	Approved
		THERMOPADS PVT LIMITED	Approved
		VIJAY TANKS & VESSELS LTD	Approved
		THERMOSYSTEMS PVT. LTD.	Approved
70	MISC. TANKS(SITE FABRICATED)	TECHNO ELECTRIC and ENGG. CO. LTD.	Approved
		THERMOSYSTEMS PVT. LTD. HYDERABAD	Approved
		UNITECH MACHINES LTD.	Approved
71.	FLAME ARRESTOR (MISCELLANEOUS TANKS)	PROCESS INSTRUMENTS	Approved
		ASIAN INDUSTRIAL VALVES	Approved
		ACCOUSTICS INDIA PVT. LTD.	Approved
		MULTITEX FILTERS PVT. LTD.	Approved
72	M.E. BELLOWS	FLUIDINE ENGRS.INDIA PVT.LTD	Approved
		EXPANSION JOINT SYSTEMS INC. USA	Approved
		MUNRO & MILLER FITTINGS LTD., U.K	Approved
		SENIOR FLEXONICS, U.K.	Approved
		SUR INDUSTRIES PVT.LTD.,KOLKATA	Approved
		CORBIS	Approved
		FLEXATHERM EXPANLOW PVT LTD	Approved
		MB METALLIC BELLOWS PVT. LTD.	Approved
		FLEXICAN BELLOWS & HOSES (P) LTD	Approved
73	EXPANSION BELLOWS-NON METALLIC	LONE STAR INDUSTRIES	Approved
		EAGLE BURGMANN K.E. PVT.LTD, Chennai	Approved
		AIROCHEM ENGINEERING COMPANY, Kolhapur	Approved
		PATELS AIRFLOW LIMITED,Ahmedabad	Approved
74	HEAT EXCHANGERS (PLATE TYPE)	MECHWELL INDUSTRIES LTD, Mumbai	Approved
		ALFA LAVAL (INDIA) LTD.	Approved
		GEA ECOFLEX INDIA PVT LTD	Approved
		TRANSTER INDIA PRIVATE LIMITED	Approved
		L&T	Approved
75	JOURNAL BEARING BFP & BP/THRUST CUM JOURNAL BEARING FOR CEP/THRUST BEARING (BFP & BP)	IDMC LIMITED	Approved
		COLHERENE, UK	Approved
		WAUKESHA BEARINGS (GLACIER), UK	Approved
		KINGSBURY, USA	Approved
76	THRUST BEARING FOR CWP	MITCHELL, UK	Approved
		MICHELL BEARINGS,	Approved
		OSBORNE ENGINEERING LIMITED	DR
		OSAKA ASAHI METAL MFG. CO. LTD.	DR
77.	HYDRAULIC COUPLING	MICHELL BEARINGS (INDIA) LLP	Approved
		VOITH TURBO PVT LTD	Approved
		VOITH TURBO PVT. LTD. - HYDERABAD, INDIA	Approved
78.	DISCONNECTING COUPLING FOR TDBFP	VOITH TURBO GMBH & CO. KG. - GERMANY	Approved
		ZURN INC, USA	Approved

**SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)**

Sl. No.	Item Description	Vendor Name	Remarks
79.	SUCTION STRAINERS (BFP, BP & CEP)	OTOKLIN MULTITEX GUJARATH OTOFILT FILTRATION ENGINEERS INDIA PVT LTD JAY-EESH ENGINEERING COMPANY	Approved Approved Approved Approved Approved
80.	MECHANICAL SEAL (BFP/BP & CEP)	BURGMANN, GERMANY. EAGLE POONAWALA LTD.PUNE FLOWSERVE SANMAR, CHENNAI	Approved Approved Approved
81.	CONNECTING COUPLING FOR CEP, DRIP PUMP, CWP, BFP & BP	FLEXIBOX LTD., UK TURBOFLEX, UK BIBBY TURBOFLEX (FORMERLY EUROFLEX), UK EUROFLEX TRANSMISSION LTD., HYDERABAD. CUBIC TRANSMISSION PVT. LTD. JOHN CRANE SEALING SYSTEMS, UK	Approved Approved Approved Approved DR Approved
82	CONNECTING COUPLING (MEMBRANE TYPE/GEAR TYPE) FOR TDBFP	EUROFLEX TRANSMISSION, HYDERABAD. RENK AG,GERMANY JOHN CRANE, UK KOPFLEX, USA BIBBY TURBOFLEX (FORMERLY EUROFLEX), UK AMERIDRIVES (ZURN), USA LUFKIN, USA/FRANCE BHS, GERMANY FLENDER GRAFFENSTADEN, FRANCE RENK AKTIENGESELLSCHAFT -	Approved Approved Approved Approved Approved Approved Approved Approved Approved Approved
83	GEAR BOX FOR TDBFP	WALCHAND NAGAR, PUNE RENK AG,GERMANY LUFKIN, USA/FRANCE FLENDER GRAFFENSTADEN, FRANCE BHS, GERMANY VOITH TURBO BHS - GETRIEBE GMBH, RENK AKTIENGESELLSCHAFT - TRIVENI ENGG & IND LTD	Approved Approved Approved Approved Approved Approved Approved Approved
84.	BARE RUBBER BELLOWS	CORI ENGINEERS PVT. LTD CHENNAI. SRM ESOFLEX PVT. LTD. KOLKATTA CORBIS	Approved Approved Approved
85.	SPRING SUPPORTS / HANGERS	SARATHI ENGG. ENTERPRISES PVT. LTD. HYDERABAD PIPING & ENERGY PRODUCTS (P) LTD. NEW DELHI SHAPE BAHADARABAD DARSHANI-INDIA PAL ENGINEERING YAMUNANAGAR	Approved Approved Approved Approved Approved Approved
86	SELF LUBRICATING BEARING	TEN MAT LTD UK (FEROFORM T 814 TUBES)	Approved Approved

**SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)**

Sl. No.	Item Description	Vendor Name	Remarks
86	TUBES FOR BF VALVES	THORDON	Approved
		THORPLAS TUBES, CANADA	Approved
87	KNIFE GATE VALVES	VAAS	Approved
		TYCO, USA	Approved
		VELAN, UK/USA	Approved
		INDURE PVT. LTD.	Approved
		ORBINOX INDIA (P) LTD.	Approved
		JASH ENGINEERING LIMITED	Approved
		GALAXY CONTROLS PVT LTD.,	Approved
88	MS AND GI PIPES	SAIL	Approved
		JINDAL	Approved
		INDUS TUBES	Approved
		SURYA ROSHNI	Approved
		TATA	Approved
89	STAINLESS STEEL PIPES	RATNAMANI METAL & TUBES	Approved
90	VACUUM PUMP / MECHANICAL EXHAUSTER (LIQUID RING TYPE)	VACUNAIR	Approved
		GARDNER DENVER, KOREA	Approved
		EDWARDS LIMITED, UK	Approved
91	STRAINER	STRAINWELL INDIA	Approved
		ACME FLUID SYSTEMS	Approved
		SRK STRAINERS & VALVES INDIA	Approved
		FILTRATION ENGINEERS INDIA PVT LTD	Approved
		GUJARAT OTOFILT,	Approved
92	CONICAL STRAINERS	FILTRATION ENGINEERS (I) PVT. LTD.	Approved
		GUJARAT OTOFILT	Approved
		JAY-EESH ENGINEERING COMPANY	Approved
		MULTITEX FILTRATION ENGINEERS LIMITED	Approved
		OTOKLIN GLOBAL BUSINESS LIMITED	Approved
93	CONDENSER TUBES	RATNAMANI METALS & TUBES LTD	Approved
		REMI EDELSTAHL TUBULARS LTD	Approved
		RATNADEEP METAL & TUBES LTD.	Approved
94	GRINDING ROLLS	AIA Engineering Ltd., Ahmedabad	Approved
		Magotteaux Industries Pvt. Ltd., Rajkot	Approved
95	BULL RING SEGMENTS	AIA Engineering Ltd., Ahmedabad	Approved
		Magotteaux Industries Pvt. Ltd., Rajkot	Approved
96	PGB SPECIAL OIL-ISO VG 320	INDIAN OIL CORPN. LTD.,	Approved
		HINDUSTAN PETROLEUM CORPN. LTD.	Approved
		CASTROL INDIA LIMITED	Approved
		EXXONMOBIL LUBRICANTS PVT LTD	Approved
		SHELL INDIA MARKETS PRIVATE LIMITED	Approved

Sagardighi Extn. Unit 5 (PROJ)
Mech. Equipments

**SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)**

Sl. No.	Item Description	Vendor Name	Remarks
97	CANISTER DRAINAGE PUMP SUBMERSIBLE/ BOOSTER PUMPS OF CVP	KIRLOSKAR BROTHERS LTD	Approved
		KSB PUMPS LIMITED,	Approved
		SULZER PUMPS INDIA LIMITED	Approved
		CLYDE PUMPS LTD.	Approved
98	SPIRAL WOUND GASKETS	CHAMPION SEALS (INDIA) PVT LTD.,	Approved
		STARFLEX SEALING (I) PVT .LTD	DR
		DYNAMIC GASKETS PVT LTD	DR
		SPIRASEAL GASKETS PVT LTD	DR
		GOODRICH GASKET PRIVATE LIMITED,	DR
99	PTFE SHEETS	As per BHEL Approved Sources	
100	AVERAGING PITOT TUBE	TECHNOMATIC	Approved
		EMERSON PROCESS MANAGEMENT (I) PVT	Approved
		MINCO (INDIA) PVT. LTD.	DR
		SWITZER PROCESS INSTRUMENTS	Approved
101	SEALING COMPOUND	As per BHEL Approved Sources	
102	H2, N2 & CO2 CYLINDERS (EMPTY)	BHARAT PUMPS AND COMPRESSORS	Approved
		SARJU IMPEX LTD	Approved
		EVEREST KANTO CYLINDER LIMITED	Approved
		RAMA CYLINDERS PVT LTD.	DR
103	STROBOSCOPE	ZENTRONIC SYSTEMS	Approved
		BEM-MESSTECHNIK GMBH	Approved
		IAG AUTOMATION PVT LTD	Approved
104	AIR CYLINDER	EASTERN PNEUMATICS PRIVATE LTD., Kolkata	Approved
		INSTRUMENTATION LTD.,Kerala	Approved
		KELTRON CONTROLS,Aroor	Approved
		NUCON PNEUMATICS PVT.LTD. Medak	Approved
		VELJAN HYDRAIR LIMITED, Hyderabad	Approved
		DUNCAN ENGINEERING LIMITED, Pune	Approved
		NEWTON PNEUMATICS, Chennai	Approved
105	SLIDING BEARING	Avi Oilless die Components India Pvt. Ltd, Pune	DR
		NEXGEN FLUOROPOLYMERS PVT.LTD, Alwar	DR
106	BLOWERS	ACME AIR EQUIPMENTS CO PVT LTD,Ahmedabad	Approved
		AERZEN MACHINES INDIA PVT.LTD., Vadodara	Approved
		RKR,GEBLASE UND VERDICHTER GMBH, Germany	Approved
		SWAM PNEUMATICS PVT LTD.	Approved
107	DIRECT WATER LEVEL GUAGE	CLARK RELIANCE CORPN, USA	Approved
		IGEMA GmbH, Munster Germany	Approved
		NISAN SCIENTIFIC PROCESS,Mumbai	Approved

Sagardighi Extension Unit#5 (PROJ3)

Mech. Equip. List

**SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)**

Sl. No.	Item Description	Vendor Name	Remarks
		PENTAIR VALVES & CONTROLS INDIA, Baroda	Approved
108	HEA IGNITOR ASSY	UNISON INDUSTRIES, USA	Approved
		IGNITION SYSTEM Inc., USA	Approved
		DURAG, Germany	Approved
		FIVES COMBUSTION SYSTEMS PVT. LTD	Approved
		TESI SPA, Italy	Approved
		TURBINE TECHNICS, INC., Florida USA	Approved
109	HP FILL & PURGE FILT	PALL INDIA PVT LTD, Mumbai	Approved
		VENS HYDROLUFT (P) LTD, Chennai	Approved
110	VARIABLE ORIFICE	BMW STEELS LTD., UTTAR PRADESH	DF
		ELECTRO PORCELAIN DIVN., BANGALORE	DF
		PROMECON GmbH., GERMANY	Approved
111	Lub oil system for FANS (ID, FD & PA)	PSI ENGINEERING Systems pvt ltd	Approved
		SOUTHERN LUBRICATION PVT LTD	Approved
		YUKEN INDIA LTD	Approved
112	STEAM COIL AIR PRE HEATR	C DOCTOR INDIA PVT LTD	Approved
		PATEL AIR TEMP(INDIA) LTD	Approved
		BARODA EQUIPMENT &VESSEL PVT LTD	Approved
		NU WAY HEATTRANSFER PVT LTD	Approved
		CHINTAMANI THERMAL TECHNOLOGIES PVT LTD	Approved
		PAR ENERGY INFRA PVT.LTD	Approved
113	AIR RECEIVER	VEE SONS ENERGY SYSTEM PVT LTD	Approved
		PATEL AIR TEMP(INDIA) LTD	Approved
		C DOCTOR INDIA PVT LTD	Approved
		AIRCON HANDLING SYSTEMS PVT LTD	Approved
		BARODA EQUIPMENT &VESSELS PVT LTD	Approved

**SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)**

SL. NO.	Item Description	Vendor Name	Remarks
1	Slurry Recirculation pumps	BHEL, Hyderabad	DR
		Duchting Pumpen, Germany	Approved
		KSB, Germany	Approved
		KSB India	DR
		Weir Minerals, Australia	Approved
		Weir Minerals, India	DR
		Andritz China	
		Andritz India	DR
		Xiangyang WuerWu China	
2	Oxidation Blowers	BHEL, Hyderabad	DR
		ITO, Japan	Approved
		GEMSL, UK	Approved
		Aerzen, Germany	Approved
		Aerzen, India	Approved
		Howden, India	Approved
		Boldrocchi, India	Approved
		Siemens, Italy/Germany	Approved
		Boldrocchi, Italy	Approved
3	Slurry pumps	Duchting Pumpen, Germany	Approved
		Weir Minerals, Australia	Approved
		Weir Minerals, India	DR
		Andritz China	
		Andritz India	DR
		Metso Minerals USA	Approved
		Metso Minerals India	DR
		KSB Germany	Approved
		KSB India	DR
		Krebs USA	Approved
		Krebs India	DR
		Xiangyang WuerWu China	
4	Agitators	Ekato, Germany	Approved
		Ekato, India	DR
		STC, Germany	Approved
		REMI-STC, India	DR
		Nippon Gears, Japan	Approved
		SPX, USA	Approved
		SPX, India	DR
		Chemineer, China	

Vendor List

SL. NO.	Item Description	Vendor Name	Remarks
		Zhejiang Great wall mixers china	
		Mixing Solutions, USA	Approved
		Mixing Solutions, India	DR
		Milton Roy Mixing, France	Approved
		Milton Roy Mixing, India	Approved
		Tschamber, Germany	Approved
5	Mist Eliminator	REA Plastik Tech GmbH, Berlin Germany	Approved
6	Wet Ball Mills	Christian Pfeiffer, Germany	Approved
7	Vacuum Belt Filter and Hydrocyclone	Xuhe, Japan	Approved
8	Rubber lining	Steuler-KCH GmbH	Approved
		Rubber Source Inc.	Approved
		Blair Rubber Company	Approved
9	Rubber lining Applicator	Labrex, Puducherry	Approved
10	Alloy C276/Alloy 59 liner	ATI, Relentless Innovation	Approved

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

SL. NO.	Item Description	Vendor Name	Remarks
1	PIPES & CONDUITS/ACCESSORIES	As per BHEL approved source.	
2	EM BRAKES	SIEGERLAND-BREWSEN, GERMANY	Approved
		STROM KRAFT CONTROLS, MUMBAI	Approved
		BCH Electric Limited	Approved
		SIEMENS India Ltd.	Approved
	Caliper Brakes,EHT Gear Boxes,Industrial Valves,	KATEEL Engineering Industry Pltd	DR
3	SOLENOID VALVES	ASCO, Chennai	Approved
4	AIR CONDITIONING SYSTEMS	shall be as per approved sources listed in Package items in Main Plant Package area.	
5	VENTILATION SYSTEM	shall be as per approved sources listed in Package items in Main Plant Package area.	
6	VALVES	shall be as per approved sources listed in Mechanical Equipment in Main Plant Package area.	
7	DUST EXTRACTION SYSTEM	C.Doctor & Company Privae Ltd.,	Approved
		DUSTVEN Pvt .Ltd., Bangalore	Approved
		THERMEX	Approved
		Batilboi Environmental Engg Ltd.,	Approved
		TPS,DELHI	Approved
		F. Harley	Approved
		SPRAYING SYSTEMS INDIA PVT. LTD	Approved
8	DUST SUPPRESSION SYSTEM	SPRAYING SYSTEMS INDIA PVT. LTD	Approved
		KAVERI ULTRA POLYMER LTD.	Approved
		F. HARLEY & COMPANY. PVT. LTD.	Approved
		TPS INFRASTRUCTURE LTD.	Approved
9	E O T CRANE / MANUAL HOIST	shall be as per approved sources listed in Mechanical Equipment in Main Plant Package area.	
10	PUMPS & ACCESSORIES	shall be as per approved sources listed in Mechanical Equipment in Main Plant Package area.	
		PHOENIX CONVEYOR BELT INDIA PVT LTD	Approved
		SEMPERTRANS INDIA PRIVATE LIMITED	Approved
		HILTON-FORECH	Approved

Sagardighi Extn. U#5 (PROJ3)

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

11	CONVEYOR BELT	MRF	Approved
		YOKOHAMA	Approved
		FORECH INDIA LTD, KOLKATA	Approved
		HINDUSTAN RUBBERS, SILVASA	Approved
		NORTHLAND RUBBER MILLS, NEW	Approved
		ORIENTAL RUBBER INDUSTRIES PVT LTD.	DR
		JONSON RUBBER INDUSTRIES	Approved
		EUREKA COVEYOR BELTINGS PVT LTD.	Approved
		FLEXER RUBBER PVT LTD	Approved
12	BELT VULCANIZER	SHAW ALMEX	Approved
		S. V. DATTAR	Approved
		NILOS	Approved
13	STRUCTURAL STEEL	Follow Civil Structural Vendor Approval List.	
14	COAL SAMPLING UNIT	ADVANCED SYSTEMS SAMPLING PVT LTD	Approved
		THERMO RAMSAY, AUSTRALIA	Approved
		ERIEZ MAGNETICS EUROPE LTD., CAERPHILLY	Approved
		EASTMAN CRUSHER Co. (P) Ltd.	Approved
15	BELT WEIGHER SCALES	THERMO RAMSAY, AUSTRALIA	Approved
		AVERY INDIA LTD., NEW DELHI	Approved
		TRANSWEIGH	Approved
		SCHENCK PROCESS INDIA LIMITED	Approved
16	FLAP GATES	PRECISION PROCESSING EQUIPMENT CO.	Approved
		DA ENGG.	Approved
		MERIT CHENNI	Approved
		MMHE	Approved
		MSE	Approved
		HINDUSTAN M/C TOOLS CORPORATION, KOLKATA	Approved
		CONTINENTAL PROFILES LTD., FARIDABAD	Approved
17	Flow elements, Condensate pots, Manifolds etc for process instrumentation	shall be as per approved sources listed in C&I in Main Plant Package area.	
18	GRATINGS	PATNY SYSTEMS, HYDERABAD	Approved
		PINAX STEEL INDUSTRIES PVT LTD	Approved
		INDIANA GRATINGS PVT. LTD. Sagardighi Extn. Unit (Phase III)	Approved

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

		CAUVERY ENGINEERING WORKS	Approved
19	GEAR BOXES	R&D MULTIPLES (METAL CAST) PVT. LTD.	Approved
		ESSENTIAL POWER TRANSMISSION PVT.LTD	Approved
		FLENDER	Approved
		NEW ALLENBURY	Approved
		KATEEL Engineering Industry Pltd	DR
		PREMIUM TRANSMISSION LIMITED	Approved
		SHANTHI GEARS LIMITED	Approved
20	ERW PIPES	STEEL AUTHORITY OF INDIA LTD.	Approved
		WELSPUN GUJARAT STAHL ROHERN LTD	Approved
		TUBES INDIA	Approved
		JCO GAS PIPE LIMITED	Approved
		RATNAMANI METALS & TUBES LTD	Approved
		MAHARASHTRA SEAMLESS LIMITED	Approved
		JINDAL PIPES LIMITED	Approved
21	COMPRESSORS	ATLAS COPCO (INDIA) LIMITED	Approved
		ELGI EQUIPMENTS LTD	Approved
		INGERSOLL- RAND (INDIA) LIMITED	Approved
22	Bull Dozer	BHARAT EARTH MOVERS LIMITED	Approved
23	Twin Wagon Trippler	THYSSENKRUPP INDUSTRIES INDIA PV	Approved
24	Feeders (Apron ; Grizzly; Vibrating; Paddle)	FL Smidth	
		Metso Minerals(I) Pvt.Ltd.	Approved
		LARSEN & TOUBRO LTD, ECC DIVN	Approved
		ELECON ENGINEERING COMPANY LTD	Approved
		TRF LTD., JAMSHEDPUR	Approved
		THYSSENKRUPP INDUSTRIES INDIA PVT	Approved
25	Crusher	LARSEN & TOUBRO LTD	Approved
		TRF LIMITED	Approved
		ELECON ENGINEERING COMPANY LTD	Approved
		THYSSENKRUPP INDUSTRIES INDIA PV	Approved
		SANDVIK ASIA PRIVATE LIMITED	DR
		MCNALLY SAYAJI ENGINEERING LIMITED	Approved
		Amps Engineering & Equipments Pvt Ltd	DR
		Devas Engineering Systems	DR
		GOLDEN ENGINEERING INDUSTRIES	DR
		INDIANA CONVEYORS PVT LTD	DR
		VISHWA INDUSTRIAL COMPANY LTD.,	DR
		NEW ERA CONVEYORS PVT LTD.,	DR

Sagardighi Extn. U#5 (PROJ)

CHP-Mech. Package 160 of 433

SAGARDIGHI THERMAL Power EXTENSION PROJECT

PHASE-III, UNIT#5 (1 x660 MW)

26	Idlers	TURBO ENGINEERS (CBE),	DR
		ROLLWELL CONVEYOR COMPONENTS PVT LTD	DR
		ELECON ENGINEERING CO. LTD.	Approved
		ARUDRA	Approved
		TRF LIMITED	Approved
		MCNALLY BHARAT, ENGG. CO. LTD.	Approved
		TEGA	Approved
		BENGAL TOOLS.	Approved
		ARYAN CLEAN COAL TECHNOLOGIES PVT LTD.,	DR
		Bevcon Wayors Pvt Ltd	DR
27	Pulleys	I & B ENGINEERS PVT LTD	DR
		TECHNO IMPEX	DR
		INDIANA CONVEYORS PVT LTD	DR
		AMPS ENGINEERING & EQUIPMENTS PVT LTD	DR
		Devas Engineering Systems	DR
		VISHWA INDUSTRIAL COMPANY LTD.,	DR
		NEW ERA CONVEYORS PVT LTD.,	DR
		TURBO ENGINEERS (CBE),	DR
		BENGAL TOOLS	Approved
		MCNALLY BHARAT ENGG. CO. LTD.	Approved
		ELECON	Approved
		ARUDRA	Approved
		ROLLWELL CONVEYOR COMPONENTS PVT LTD	DR
		ARYAN CLEAN COAL TECHNOLOGIES PVT LTD.,	DR
28	Internal / External Scrapers & Skirt Board Sealing System	As per BHEL approved source.	
29	Roller SCREENS	POSCO PLANT ENGINEERING CO., LTD.,	DR
		ELECON	Approved
		msel	Approved
		Thyssen	Approved
		Electro Zavod (India) Pvt Ltd.	DR
30	RPG GATES	BENGAL TOOL	Approved
		MSEL	Approved
		DA ENGG.	Approved
		HMTC ENGINEERING CO (KOLKATA) PVT LTD	Approved

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

31	HVAC System	shall be as per approved sources listed in Package items in Main Plant Package area.	
32	REDUCTION GEAR BOX	PREMIUM ENERGY TRANSMISSION	Approved
		FLENDER LIMITED	Approved
		ELECON ENGINEERING CO. LTD.	Approved
33	FLUID COUPLING	VOITH	Approved
		PREMIUM ENERGY TRANSMISSION	Approved
		FLUIDOMAT	Approved
34	FLEXIBLE GEAR COUPLING	GMB MFG. (P) LTD., KOLKATA	Approved
		HI-CLIFF	Approved
		FENNER	Approved
		LOVEJOY	Approved
		WELLMAN	Approved
		CONCORD	Approved
		ELECON ENGINEERING COMPANY LIMITED	Approved

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

SL. NO.	Item Description	Vendor Name	Remarks
1	Ash Slurry Pumps	SAM TURBO INDUSTRY PRIVATE LTD	Approved
		WIER MINERALS (India) Pvt. Ltd	Approved
		INDURE PVT. LTD.	Approved
		METSO MINERALS (INDIA) PVT LTD.,	Approved
2	Water Pumps & Accessories	KIRLOSKAR BROTHERS LIMITED	Approved
		Flowmore Limited, Gurgaon	Approved
		BEACON WEIR LTD, CHENNAI	Approved
		Kishor Pumps Pvt. Ltd., Chennai	Approved
		Maxflow pumps india Pvt Ltd.	Approved
		Wilo Mather and Platt Pumps Pvt Ltd	Approved
3	ERW Pipes	STEEL AUTHORITY OF INDIA LTD.	Approved
		WELSPUN GUJARAT STAHL ROHERN LTD	Approved
		TATA	Approved
		JCO GAS PIPE LIMITED	Approved
		TUBES INDIA	Approved
		RATNAMANI METALS & TUBES LTD	Approved
		MAHARASHTRA SEAMLESS LIMITED	Approved
		JINDAL PIPES LIMITED	Approved
4	Compressors	ATLAS COPCO (INDIA) LIMITED	Approved
		ELGI EQUIPMENTS LTD	Approved
		INGERSOLL- RAND (INDIA) LIMITED	Approved
5	FLUIDIZING AIR HEATER	ESCORTS	Approved
		SPHEREHOT	Approved
		RAYCOLD	Approved
		INDURE PVT. LTD.	Approved
6	Cast Basalt Lined bends/ fittings/ pipes	TURBO ENGINEERS (CBE)	Approved
		INDURE PVT. LTD.	Approved
		DEMECH	Approved
		ENVIRO ABRASION	Approved
		Densen Technologies, Thane	Approved
		Deccan Mechanical and Chemical Industries Pvt. Ltd.,	Approved
7	ALLOY C.I. FITTINGS & LINERS	MENON METALLIKS	Approved
		CRAWLEY & RAY	Approved
		SAM CASTINGS	Approved
		CRESENT	Approved

Vendor List

8	E O T CRANE / MANUAL / Electric HOIST	shall be as per approved sources listed in Mechanical Equipment in Main Plant Package area.	
9	Gear Box	R&D MULTIPLES (METAL CAST) PVT. LTD.	Approved
		ESSENTIAL POWER TRANSMISSION PVT.LTD	DR
		KATEEL Engineering Industry Pltd	DR
		PREMIUM TRANSMISSION LIMITED	Approved
		New Allenburry	Approved
10	Couplings	ESCO COUPLINGS & TRANSMISSIONS PVT LTD	Approved
		PREMIUM TRANSMISSION LIMITED	Approved
		ELECON ENGINEERING COMPANY LIMITED	Approved
11	Air conditioning	shall be as per approved sources listed in Package items in Main Plant Package area.	
12	Ventilation System	shall be as per approved sources listed in Package items in Main Plant Package area.	
13	Valves/Gate	shall be as per approved sources listed in Mechanical Equipment in Main Plant Package area.	
14	TWIN LOBE TYPE ROTARY FLUDIZING AIR BLOWER	SWAM PNEUMATICS	Approved
		KAY INTERNATIONAL	Approved
		EVEREST	Approved

SAGARDIGHI THERMAL Power EXTENSION PROJECT PHASE-III, UNIT#5 (1 x660 MW)			
SL. NO.	Item Description	Vendor Name	Remarks
1	Electrical Valve Actuators	AUMA (I) LTD., BANGALORE	Approved
		AUMA, GERMANY	Approved
		LIMITORQUE (I) LTD, FARIDABAD	Approved
		LIMITORQUE, US	Approved
		ROTORK CONTROLS (I) LTD, CHENNAI & BANGALORE	Approved
		ROTORK, UK	Approved
		NIPPON GEAR CO., JAPAN	DR
2	OIL FILLED TRANSFORMER (More than 10 MVA)	BHEL	Approved
		GE	Approved
		AREVA T & D INDIA LIMITED	Approved
		FUJI	Approved
		ABB	Approved
		ALSTOM	Approved
3	OIL FILLED SERVICE TRANSFORMER (Applicable only for less than 10 MVA)	KIRLOSKAR ELECTRIC CO.LTD. Mysore	Approved
		BHEL	Approved
		SCHNEIDER ELECTRIC INFRASTRUCTURE LIMITED	DR
		TOSHIBA TRANSMISSION & DISTRIBUTION SYSTEMS(i) PVT.LTD.,MEDAKH	DR
		CROMPTON GREAVES LTD.	Approved
		AREVA T & D INDIA LIMITED ,	Approved
		MARSONS LIMITED	Approved
		VOLTAMP TRANSFORMERS LTD.	Approved
4	SEGREGATED PHASE BUSDUCTS	BHEL	Approved
		L&T	Approved
		SIEMENS	Approved
		ALSTOM LTD.	Approved
		BEST & CROMPTON	Approved
5	ISOLATED PHASE BUSDUCT	BHEL	Approved
		SIMELECTRO, FRANCE	Approved
6	HT MOTORS (above 500 kW)	ABB	Approved
		BHEL	Approved
		SIEMENS	Approved
7	HT MOTORS (upto 500 kW)	ABB	Approved
		BHEL	Approved
		SIEMENS	Approved
		CROMPTON GREAVES	Approved

Vendor List

8	ELECTRIC LT MOTOR (ABOVE 90 KW)	CG POWER AND INDUSTRIAL SOLUTIONS LIMITED	Approved
		MARATHON ELECTRIC MOTORS INDIA LIMITED	Approved
		ABB	Approved
		SIEMENS	Approved
9	ELECTRIC LT MOTOR (UPTO 90 KW)	CG POWER AND INDUSTRIAL SOLUTIONS LIMITED	Approved
		MARATHON ELECTRIC MOTORS INDIA LIMITED	Approved
		ABB	Approved
		SIEMENS	Approved
		KIRLOSKAR	Approved
		BHARAT BIJLEE	Approved
10	HT SWITCHGEAR (11KV, 3.3 KV)	AREVA LTD.	Approved
		BHEL	Approved
		Schneider	Approved
		SIEMENS LTD	Approved
11	LT Switch Gear Panel [PMCC, PCC & MCC]	Siemens India Ltd	Approved
		GE India Industrial pvt ltd	Approved
		Schneider Electric India pvt ltd	Approved
		ABB	Approved
		AREVA LTD.	Approved
		LARSEN & TOUBRO LTD.	Approved
12	TRANSFORMER (DRY TYPE)	VOLTAMP	Approved
		AREVA	Approved
		CGL	Approved
		BHEL	Approved
13	NON SEGREGATED PHASE BUS DUCTS	KGS Engineering Limited	Approved
		L&T	Approved
		SIEMENS	Approved
		ALSTOM LTD.	Approved
		BEST & CROMPTON	Approved
14	ACDB, DCDB, , MLDB, ELDB, PDB, WELDING DB, VENTILATION DB	Siemens India Ltd	Approved
		GE India Industrial pvt ltd	Approved
		Unilec Engineers Ltd	Approved
		Schneider Electric India pvt ltd	Approved
		ABB	Approved
		AREVA LTD.	Approved
15	LOCAL STARTER PANEL, LOCAL CONTROL PANEL, LIGHTING PANEL	L & T	Approved
		Schneider	Approved
		L & T	Approved
		Siemens	Approved
		UNILEC ENGINEERS LTD.	Approved
		AREVA LTD.	Approved
		PYROTECH	Approved
16	Vacuum Interrupter, 3.6kV40kA	Bharat Electronics Ltd.	Approved
17	Vacuum Interrupter, 12kV50kA	Eaton Incorporation	Approved

Vendor List

18	Air Circuit Breaker (ACB)	ABB	Approved
		Schneider	Approved
		L & T	Approved
		Siemens (3WL model only)	Approved
		AREVA LTD.	Approved
		GE-POWER	Approved
19	Molded case circuit breakers (MCCB)/Motor Protection Circuit Breaker (MPCB)/ Power Contactor/Aux. Contactor/ Thermal Overload Relay (OLR)/SFU	ABB	Approved
		Schneider	Approved
		L & T	Approved
		Siemens	Approved
		GE-POWER	Approved
20	Miniature Circuit Breaker (MCB)	ABB	Approved
		Schneider	Approved
		L & T	Approved
		Siemens	Approved
		GE-POWER	Approved
		LEGRAND	Approved
21	Electronic Motor Protection Relay (EMPR)	ABB	Approved
		Schneider	Approved
		Siemens	Approved
		GE-POWER	Approved
22	Current transformer / Voltage Transformers (VT/PT)/ Control Transformers(CST) upto 1.1KV	Automatic Electric	Approved
		Prayog Electricals	Approved
		Precise Electricals	Approved
		Kappa Electricals	Approved
		Pragati Electricals	Approved
		Indcoil	Approved
23	Interposing Relays	Jyoti	Approved
		OEN	Approved
		PLA	Approved
		Schneider	Approved
		GUARDIAN	Approved
		OMRON	Approved
24	Numerical Relay	Asea Brown Boveri Ltd., Vadodara	Approved
		Asea Brown Boveri Limited, Bangalore	Approved
		GE (Alstom)	Approved for MICOM Series
		Siemens Ltd.	Approved for SIPROTEC Series
		Schneider Electric Infrastructure limited	Approved for MICOM Series

Vendor List

25	Static / Electromechanical / Auxiliary / Tripping Relays	Asea Brown Boveri Ltd., Vadodara	Approved
		Asea Brown Boveri Limited, Bangalore	Approved
		Schneider Electric Infrastructure limited	Approved
		GE T & D India Limited	Approved
		Siemens Ltd.	Approved
		Alstom, Chennai	Approved
26	Energy Meters	SCHNEIDER CONZERVE	Approved
		Secure Meters (SEMS)	Approved
27	Multifunction Meter	Secure Meters (SEMS)	Approved
		SIEMENS Ltd.	Approved
		Schneider	Approved
28	Alarm Annunciators	MINILEC India Pvt Ltd.	Approved
		Accord Electro-Technics Pvt. Ltd.	Approved
		Alan Instrumentation Pvt. Ltd.	Approved
		JVS Electronics Pvt. Ltd.	Approved
		PROCON Instrumentation (P) Ltd.	Approved
		VESTAL Electronics	Approved
29	Timer/ TIME DELAY RELAY	ABB	Approved
		Schneider	Approved
		L & T	Approved
		Siemens	Approved
		GE-POWER	Approved
30	Digital Indicating meters	Automatic Electric Limited (AEL)	Approved
		RISHABH Instruments Pvt Ltd.	Approved
		L&T	Approved
		MECO Instrument Pvt. Ltd.	Approved
		MASIBUS AUTOMATION & INSTRUMENTATIO, GANDHI NAGAR	Approved
		Secure	Approved
		Schneider/conzerv	Approved
31	Analog Indicating meters	Automatic Electric Limited (AEL)	Approved
		MECO Instrument Pvt. Ltd.	Approved
		RISHABH Instruments Pvt Ltd.	Approved
		ABB	Approved
		GOSSEN	Approved
		YOKOGAWA	Approved
		PYROTECH Electronics Pvt. Ltd.	Approved
		SELEC Controls Pvt. Ltd.	Approved
32	Transducers	Camille Bauer, Germany	Approved
		Automatic Electric Limited (AEL)	Approved
		ELSTER Metering Pvt Ltd, Mumbai	Approved
		Siemens	Approved
		MASIBUS Automation and Instruments (P) Ltd.	Approved
		Southern Transducers Pvt. Ltd.	Approved
33	Control / Selector Switches	KAYCEE Industries Ltd., Mumbai	Approved
		L & T (Salzer)	Approved
		Reliable Electronic Components Pvt. Ltd (RECOM)	Approved
		SETON Electrical Products	Approved
		SWITRON Devices	Approved

Vendor List

34	Discrepancy switch	Asea Brown Boveri Limited(ABB)	Approved
		Control Dynamics	Approved

Vendor List

35	FUSE Base with holder	ABB	Approved
		Schneider	Approved
		L & T	Approved
		Siemens	Approved
		GE-POWER	Approved
36	FUSES (Power/Control)	GE-Power	Approved
		Siemens	Approved
		L & T	Approved
		Schneider	Approved
		COPPER BUSSMANN	Approved
		ABB	Approved
37	Indicating Lamp	Siemens	Approved
		Vaishno	Approved
		L & T (ESBEE)	Approved
		Schneider	Approved
		ABB	Approved
		SECO	Approved
38	Push Button	TEKNIK	Approved
		Siemens	Approved
		Vaishno	Approved
		L & T (ESBEE)	Approved
		TEKNIK	Approved
		Schneider	Approved
39	Disturbance Recorders / Event Logger	ABB	Approved
		Alstom T&D India Ltd, Chennai	Approved
		Ametek Power Instruments, USA	Approved
		QUALITROL HATHWAY, UK	Approved
40	Time Synchronizer	SERTEL, Chennai	Approved
		ARBITER, USA	Approved
		SEL, USA	Approved
		MASIBUS Automation and Instruments (P) Ltd.	Approved
41	(Indoor) CT / PT up to 11 kV, CBCT,Aux. CT / PT (ICT)	Prayog Electricals (P) Ltd.	Approved
		Pragati Electricals Pvt. Ltd.	Approved
		Silkaans Elect. Mfg. Co. Pvt. Ltd.	Approved
42	Surge Suppressor/Arrestor (Less than 15KV)	Raychem	Approved
		CGL	Approved
		Elpro	Approved
		Obdum Electrical Industries (P) Ltd.	Approved
43	Bus Transfer Scheme Panel(Numerical)	Aartech Solonics Ltd.	Approved
		Asea Brown Boveri Ltd.	Approved
44	Data Concentrator	ABB	Approved
		Schneider	Approved
		SIEMENS	Approved
		GE(ALSTOM)	Approved

Vendor List

45	Ethernet Switches	RUGGEDCOM	Approved
		NETGEAR	Approved
		HIRSCHMANN	Approved
		MOXA	Approved
		CISCO	Approved
46	Terminals Block	Phoenix	Approved
		Connect well	Approved
		Elemex	Approved
		Wago	Approved
47	Cable Glands	HEX	Approved
		Commet	Approved
		DOWELLS	Approved
		Jainson	Approved
		3D	Approved
		Sunil & Co.	Approved
48	Cable Lugs	HEX	Approved
		Commet	Approved
		DOWELLS	Approved
		Jainson	Approved
		3D	Approved
		Sunil & Co.	Approved
49	Local Motor Starter	L & T	Approved
		Schneider	Approved
		ABB	Approved
		BCH	Approved
50	LPBS (NON-FLAME PROOF)	L&T	Approved
		SCHNEIDER	Approved
		Tecknic Controls	Approved
		SIEMENS	Approved
51	LPBS (FLAME PROOF)	BALLIGA	Approved
		EX-PROTECTA	Approved
52	Industrial Switch & Socket / Receptacles	Schneider	Approved
		Anchor	Approved
		Bajaj	Approved
		Phillips	Approved
		crompton Greaves	Approved
		BEST & CROMPTON ENGG. LIMITED	Approved
		AIMERA INDUSTRIES & ENGG. WORKS	Approved
		BCH Electric	Approved
53	ISOLATING SWITCH	SALZER, L&T	Approved
		SIEMENS	Approved
		ALSTOM LTD.	Approved
		GE - POWER	Approved
		SCHNEIDER	Approved
		ABB	Approved
		KAYCEE	Approved

Vendor List

54	SYNCHROSCOPE	AUTOMATIC ELECTRIC	Approved
		GEC - ALSTHOM	Approved
55	EARTH LEAKAGE CB	SCHNEIDER	Approved
		L&T	Approved
		SIEMENS	Approved
		ABB	Approved
56	EARTH LEAKAGE RELAY [ELR] ALONGWITH CBCT	AREVA	Approved
		PRO'KDEVICES	Approved
57	EARTH LEAKAGE RELAY [ELR] ALONGWITH CBCT	AREVA	Approved
		PRO'KDEVICES	Approved
58	PANEL SPACE HEATER	C&S ELECTRIC	Approved
		SPACEAGE	Approved
59	Neutral Grounding Transformer	Pragati Electricals Pvt. Ltd., Thane	Approved
		Prayog Electricals Pvt. Ltd., Pune	Approved
60	Lightning Arrester for Busduct	Elpro International Ltd., Pune	Approved
		Oblum Electronics, Hyderabad	Approved
61	Surge Capacitor	ABB Ltd., Bangalore	Approved
		Madhav Capacitor Pvt. Ltd., Pune	Approved
62	NEUTRAL GROUNDING RESISTOR	LACHHMAN ELECTRONICS, NEW DELHI	Approved
		RSI SWITCHGEAR PVT. LTD., Bhiwadi Extn, INDIA	Approved
		RESITECH ELECTRICALS PVT.LTD. KOLKATA	Approved
		S.R.NARKHEDE ENGG.PVT.LTD. PUNE	Approved
63	TREFOIL CLAMPS	AJMERA INDUSTRIAL & ENGINEERING WORKS, MUMBAI	Approved
		ELECTROMAC INDUSTRIES, MUMBAI	Approved
		MOULDED FIBREGLASS PRODUCTS, KOLKATA	Approved
		SUMIP COMPOSITES PVT.LTD. Ahmedabad	Approved
64	CABLE TRAYS & ACC	INDUSTRIAL PERFORATION (I) PVT.LTD.	Approved
		PREMIER POWER PRODUCTS (CAL) PVT. LTD., Howrah	Approved
		PATNY SYSTEMS (P) LTD	Approved
		PARMAR METALS PVT.LTD.	Approved
		UNITECH FABRICATORS and ENGINEERS PVT LTD	Approved
		RATAN PROJECTS & ENGINEERING CO. PVT.LTD., Howrah	Approved
		RABI ENGINEERING WORKS PVT. LTD., Kolkata	Approved

Vendor List

65	CABLE TRAY SUPPORT SYSTEM- WELDED(GALV)	INDUSTRIAL PERFORATION (I) PVT.LTD., Kolkata	Approved
		PREMIER POWER PRODUCTS (CAL) PVT. LTD., Howrah	Approved
		UNITECH FABRICATORS and ENGINEERS PVT LTD	Approved
		PATNY SYSTEMS (P) LTD	Approved
		RATAN PROJECTS & ENGINEERING CO. PVT.LTD., Howrah	Approved
		RABI ENGINEERING KOLKATA	Approved
		HOWRAH	Approved
66	ABOVE GROUND EARTHING MATERIALS	INDUSTRIAL PERFORATION (I) PVT.LTD., Kolkata	Approved
		PREMIER POWER PRODUCTS (CAL) PVT. LTD., Howrah	Approved
		PATNY SYSTEMS (P) LTD, HYDERABAD	Approved
		UNITECH FABRICATORS and ENGINEERS PVT LTD	Approved
		RATAN PROJECTS & ENGINEERING CO. PVT.LTD., Howrah	Approved
		RABI ENGINEERING WORKS PVT. LTD.	Approved
67	CABLE TERM.& JOINT KITS	3M Electro and Communication India P.Ltd	Approved
		RAYCHEM RPG PRIVATE LIMITED	Approved
68	FIRE SEALING SYSTEM	3M INDIA LIMITED, Bangalore	Approved
		HILTI India Pvt. Ltd., New Delhi	Approved
		LLOYD INSULATIONS (INDIA) LIMITED, Chennai	Approved
		MULTI KILFIRE PVT LTD, VADODARA	Approved
		VIJAY SYSTEMS ENGINEERS PVT.LTD., MUMBAI	Approved
69	ELECTRICAL - HEAT TRACING	THERMOPADS PVT.LTD.,	Approved
		XICON INTERNATIONAL LTD.	Approved
		THERMON INDIA PVT. LTD.	Approved
		RAYCHEM RPG LIMITED	Approved
70	HT XLPE CABLES	CABLE CORPORATION OF INDIA LTD.	Approved
		UNIVERSAL CABLES LTD.	Approved
		KEC INTERNATIONAL LIMITED	Approved
		RAVIN CABLES LIMITED	Approved
		KEI INDUSTRIES LTD., ALWAR	Approved
		POLYCAB WIRES PVT. LTD. Daman	Approved
		UNIVERSAL CABLES LTD., SATNA	Approved
71	LT XLPE POWER CABLE	GEMSCAB INDUSTRIES LTD.	Approved
		SUYOG ELECTRICALS LTD.	Approved
		RAVIN CABLES LIMITED	Approved
		CORDS CABLE INDUSTRIES LTD., BHIWADI DIST.	Approved
		CMF LTD.	Approved
		CRYSTAL CABLE INDUSTRIES LTD., HOWRAH	Approved
		KEI INDUSTRIES LTD., ALWAR	Approved
		KEC INTERNATIONAL LIMITED, Silvassa	Approved

Vendor List

	POLYCAB WIRES PVT. LTD., Daman	Approved



Vendor List

72	LT PVC CONTROL CABLE	Advance Cable Technologies (P) Ltd., Bengaluru	Approved
		CORDS CABLE INDUSTRIES LTD., BHIWADI DIST.	Approved
		CMI LTD.	Approved
		CRYSTAL CABLE INDUSTRIES LTD., HOWRAH	Approved
		KEI INDUSTRIES LTD., ALWAR	Approved
		KEC INTERNATIONAL LIMITED, Silvassa	Approved
		POLYCAB WIRES PVT. LTD., Daman	Approved
		RAVIN CABLES LIMITED	Approved
		UNIVERSAL CABLES LTD., SATNA	Approved
73	SCREENED CONTROL CABLES	CORDS CABLE INDUSTRIES LTD., BHIWADI DIST.	Approved
		DELTON CABLES LTD. FARIDABAD	Approved
		KEI INDUSTRIES LTD., ALWAR	Approved
		POLYCAB WIRES PVT. LTD., Daman	Approved
		THERMO CABLES LTD. HYDERABAD	Approved
74	LT XLPE FIRE SURVIVAL CABLES	KEI INDUSTRIES LTD., ALWAR	Approved
		POLYCAB WIRES PVT. LTD., Daman	Approved
75	DC LEAD ACID BATTERIES	EXIDE INDUSTRIES LTD, KOLKATA	Approved
		HOPPECKE BATTERIEN GMBH & CO.KG,	Approved
76	DC Ni-Cd BATTERIES	HBL Power Systems Ltd Hyderabad	Approved
77	DC BATTERY CHARGER	CHHABI ELECTRICALS PVT.LTD.(.)	Approved for Capacity < 100 AH
		AMAR RAJA POWER SYSTEMS, TIRUPATHI	Approved for Capacity < 100 AH
		Chloride Power Systems & Solutions Ltd., Kolkata	Approved
		HBL POWER SYSTEMS LTD ,	Approved
		STATCON ENERGIAA PRIVATE LIMITED,Hapur	Approved
78	MS ROD FOR BELOW GROUND EARTHING	RASHTRIYA ISPAT NIGAM LIMITED	Approved
		STEEL AUTHORITY OF INDIA LTD.	Approved
79	STATION LIGHTING SYSTEM	BAJAJ ELECTRICALS LTD., PUNE	Approved
		CROMPTON GREAVES LTD.	Approved
		PHILIPS INDIA LTD.	Approved
80	LIGHTING TRANSFORMERS	SUDHIR TRANSFORMERS LIMITED	Approved
		INDCOIL TRANSFORMERS PVT LTD	Approved
81	LIGHTING MAST	BAJAJ ELECTRICALS LIMITED	Approved
		CROMPTON GREAVES CONSUMER ELECTRICALS LIMITED	Approved

Vendor List

82	LIGHTING POLE	BOMBAY TUBE & POLES CO..	Approved
		BAJAJ ELECTRICALS LTD.	Approved
83	LIGHTING WIRE	CORDS CABLE INDUSTRIES LTD	Approved
		DELTON CABLES LTD.	Approved
		KEC	Approved
		KEI INDUSTRIES LTD.	Approved
		NICCO CORPORATION LTD.	Approved
		POLYCAB WIRES PVT.LTD	Approved
		TORRENT CABLES LTD.	Approved
		UNIVERSAL CABLES D.	Approved
		Finolex	Approved
		CMI Energy India Pvt. Ltd.	Approved
		Elkay Telelinks Ltd.	Approved
		Havells India Ltd	Approved
		Paramount Communications Ltd.	Approved
		Ravin Cables Ltd	Approved
		Special Cables Pvt. Ltd.	Approved
		Anchor	Approved
		CABLE CORPORATION OF INDIA	Approved
		RR Kabel Limited	Approved
		Thermo Cables Limited	Approved
84	HVR Transformer and EC Panel	ADOR POWERTRON LTD.,	DR
		BHARAT HEAVY ELECTRICALS LIMITED	Approved
		KRAFT POWERCON INDIA PRIVATE LTD	DR
85	Rubber Bellow for Bus Duct	Cori Engineers Pvt. Ltd., Chennai	Approved
		Resistoflex Pvt. Ltd., Noida	Approved
		United Rubber Industries, Mumbai	Approved
86	Epoxy Insulator for Bus Duct Package	A-Bond Strands Pvt. Ltd., Chennai	Approved
		Baroda Bushing & insulator, Vadodara	Approved
		Baroda Mould & Dies, Vadodara	Approved
		Ganpati Fibertech India (P) Ltd.	Approved
87	Epoxy Seal Off Bushing for Bus Duct Package	A-Bond Strands Pvt. Ltd., Chennai	Approved
		Baroda Bushing & insulator, Vadodara	Approved
		Baroda Mould & Dies, Vadodara	Approved
88	Current Transformer for Bus Duct Package	Instrans Engg & Mfg, Bangalore	Approved
		Pragati Electricals Pvt. Ltd., Thane	Approved
		Prayog Electricals Pvt. Ltd., Pune	Approved
		Silkaans Electrical Mfg. Co. Pvt. Ltd., Bangalore	Approved
89	Voltage/ Potential Transformer for Bus Duct Package	Instrans Engg & Mfg, Bangalore	Approved
		Pragati Electricals Pvt. Ltd., Thane	Approved
		Prayog Electricals Pvt. Ltd., Pune	Approved
		Silkaans Electrical Mfg. Co. Pvt. Ltd., Bangalore	Approved

Vendor List

90	Hot Air Blowing Equipment for Bus Duct	Elmech Pneumatic Industries	Approved
		Melcon Engg, New Delhi	Approved
		Powergear Ltd	Approved
91	Air Pressurization Equipment for Bus Duct Package	Elmech Pneumatic Industries, New Delhi	Approved
		Mellcon Engineers Pvt. Ltd., New Delhi	Approved
		Powergear Ltd	Approved
92	LAVT & NG Cubicle Assembly for Bus Duct Package	BHEL-RUDRAPUR	Approved
		Pyrotech Electronics Pvt. Ltd., Udaipur	Approved
		RSI Switchgear Pvt. Ltd., Gurgaon	Approved
		Busbar Systems India Ltd.	Approved
		Powergear Ltd.	Approved

Vendor List

93	Copper Strip Flexible/Copper Braided Flexible for Bus Duct Package	B.B. Electro Technique, Mumbai/Thane	Approved
		Shree Cable & Conductors Pvt. Ltd., Bhopal	Approved
94	DG SET ENGINE	CUMMINS	Approved
		MITSHUBISHI	DR
		CATERPILLAR	Approved
95	ALTERNATOR	NIDEC-LEROY SOMER	Approved
		CATERPILLAR	Approved
		KIRLOSKAR ELECTRIC	Approved
		CUMMINS GEN TECH.(STAMFORD)	Approved
96	DG SET ASSEMBLERS	JAKSON LTD.	Approved
		POWERICA LTD.	Approved
97	DG SET BATTERY BANK	EXIDE	Approved
		HBL	Approved
		CUMMINS	Approved
98	DG SET CONTROL PANELS / AUX.DIST. BOARD	JAKSON LTD	Approved
		PYROTECH	Approved
99	ALUMINUM TUBE	Hindalco Industries Limited	Approved
		Jindal Aluminium Ltd Bangalore Karnataka	Approved
		Balco	Approved
		Alom Extrusions Ltd.	Approved
100	CLAMPS & CONNECTORS	Electromech & Transtech Private Limited Kolkata West Bengal	Approved
		Klemmen Engineering Corporation Chennai Tamil Nadu	Approved
		Peevee Engineering Enterprises Bangalore Karnataka	Approved
		Utsav Electro-Mech Pvt Ltd Vadodara Gujarat	Approved

Vendor List

101	SWITCHYARD CONTROL PANELS	ABB India Limited	Approved
		GE T&D India Limited Noida Uttar Pradesh	Approved
		Schneider Electric Infrastructure Limited Noida Uttar Pradesh	Approved
		Siemens Ltd	Approved
102	SPACER COUPLING (REGIFLEX TYPE)	SIEMENS LTD	Approved
		ESCO COUPLING NV	Approved
		KTR Couplings (India) pvt.ltd	Approved
		UNIQUE TRANSMISSION INDIA P LTD.	Approved
		ESCO COUPLING & TRANSMISSION PVT LTD.	Approved
		Cubic Transmission pvt ltd unit-II	Approved
		RATHI TURBOFLEX PVT LTD	Approved
		Dipl.ing.Herwarth Reich GMBH	Approved
		Reich India Ltd	Approved
KTR KUPPLUNGSTECHNIK Gmbh	Approved		
103	BAY CONTROL UNIT	ALSTOM	Approved
		SIEMENS	Approved
		ABB	Approved
104	FRP JUNCTION BOXES/ JUNCTION BOXES(POWER/CONTROL), LIGHTING JB	Jakson Engineers Limited	Approved
		Jasper Engineers Private Limited	Approved
		Mika Engineers	Approved
		Popular Switchgears Pvt Ltd	Approved
		Pyrotech Electronics Pvt Ltd	Approved
		RSI Switchgear Private Limited	Approved
		Sarvana Switchgears	Approved
Unilec Engineers Ltd	Approved		
105	MARSHALLING KIOSK	Mika Engineers Thane Maharashtra [MSE: MICRO]	Approved
		Popular Switchgears Pvt Ltd Nashik Maharashtra	Approved
		Pyrotech Electronics Pvt Ltd Udaipur Rajasthan	Approved
		RSI Switchgear Private Limited Bhiwadi Rajasthan	Approved
		RST Electricals Pvt. Ltd. Sahibabad Uttar Pradesh	Approved
		Sarvana Switchgears Bangalore Karnataka	Approved
		Unilec Engineers Ltd Gurgaon Haryana	Approved
106	PIPE STRUCTURE	Advance Steel Tubes Ltd. Ghaziabad Uttar Pradesh	Approved
		Associated Power Structures Pvt. Ltd. Vadodara Gujarat upto 400 kV System	Approved
		Goodluck India Limited Sikandrabad Uttar Pradesh	Approved
		Vijay Transmission Pvt. Ltd Raipur Chhattisgarh	Approved
		New Modern Technomech Pvt Ltd	Approved
		Rs Infraprojects Pvt. Ltd. Noida Uttar Pradesh	Approved
		UTKARSH TUBES & PIPES LIMITED Kolkata	Approved
		DEEPAK FASTNERS LTD	Approved

Vendor List

107	STRUCTURE HARDWARE	NAVEEN METAL INDUSTRIES, KOLKATA	Approved
		NEW INDIA ENGINEERING CORPORATION	Approved
		TECHMAN (INDIA)	Approved
108	SHIELD WIRE	Bharat Wire Ropes Ltd	Approved
109	STRING INSULATOR HARDWARE	Asbesco (India) Pvt. Ltd.	Approved
		Electromech & Transtech Private Limited	Approved
		EMC	Approved
		ITPPL	Approved
		TYCO	Approved
		Tag Corporation, Chennai	Approved
		IAC	Approved

Vendor List

110	400 kV SF6 BREAKERS	ABB	Approved
		CGL	Approved
		SIEMENS	Approved
		GE T&D India Limited	Approved
111	400 kV SWITCHYARD CURRENT TRANSFORMER	ABB	Approved
		CGL	Approved
		GE T&D India Limited	Approved
		BHEL	Approved
		SIEMENS	Approved
112	400 kV SWITCHYARD PT/POTENTIAL TRANSFORMER/VOLTAGE TRANSFORMER	ABB	Approved
		CGL	Approved
		SIEMENS	Approved
		ALSTOM	Approved
		BHEL	Approved
113	400 kV ISOLATOR	SIEMENS	Approved
		ABB	Approved
		GE T&D India Limited	DR
114	400 kV EARTH SWITCH	SIEMENS	Approved
		ABB	Approved
115	400 kV LATTICE STRUCTURE	GOOD LUCK STEEL TUBES LTD., BULANDSHAHAH (UP)	Approved
		UTKARSH TUBES AND PIPES LIMITED, KOLKATA, WEST BENGAL	Approved
		Richardson & Cruddas (1972) Ltd, NAGPUR	Approved
116	ACSR CONDUCTOR	HINDUSTAN VIDYUT PRODUCTS LTD., HARYANA	Approved
		GUPTA POWER INFRASTRUCTURE LTD., BHUBANESWAR	Approved
		HIREN ALUMINIUM Ltd., SILVASSA DADRA & NAGAR HAVELI	Approved
117	RAIL POLE	SAIL	Approved
		RINL	Approved
		TATA	Approved
118	CABLE for ROLLED -E-CHAIN BAY CONTROL UNIT	IGUS	Approved
		ALSTOM	DR
		SIEMENS	DR
		ABB	DR

Vendor List

119	Control and Relay Panel / SAS	ABB India Limited	Approved
		GE T&D India Limited	Approved
		Siemens Ltd	Approved
120	400KV LIGHTNING ARRESTOR	Crompton Greaves Ltd	Approved
		Elpro International Ltd	Approved
		Oblum Electrical Industries Pvt Ltd	Approved
121	400 kV DISC INSULATOR/ LONG ROD INSULATOR (120KN)/ BUS POST INSULATOR(For Switchyard)	BHEL	Approved
		NGK BIRLA, JAYASHREE	Approved
		W.S. INDUSTRIES LTD,CHENNAI	Approved
		INDIAN POTTERIES	Approved
		Saravana Global Energy Limited	Approved
		Aditya Birla Insulators (A unit of Aditya Birla Nuvo Ltd.)	Approved
		Modern Insulators Ltd.	Approved
ESP/HVR (Jhansi Works)			
122	CRGO Steel-ESP/HVR TRANSFORMERS UPTO 95 KVP, 1400 mAmps	Bralco Resources,Canada (Mill-A K Steel, USA)	Approved
		Nippon Steel Corporation , Japan	Approved
		Kawasaki Steel , Japan	Approved
		TKES , Germany	Approved
		POSCO, Korea	Approved
		Viz Stal, Russsia	Approved
123	PICC (PAPER INSULATED COPPER CONDUCTOR)Conductor-ESP/HVR TRF	Shree Cabies & Conductor, Bhopal	Approved
		BCPL , Raisen / Mandideep	Approved
		Shakti Insulated Wires, Ankleshwar / Mumbai	Approved
		Delta Trans Conductors Pvt. Ltd. Mumbai	Approved
		KSH International,I Mumbai	Approved
		Signet Conductors, Rewa	Approved
		NKM Sales, Mandideep	Approved
		Electromech, Rewa	Approved
		Chandra Metals, Allahabad	Approved
		Malwa Strips, Dewas	Approved
		Precision Wires India Ltd,	Approved
		Mimani Indore.	Approved
		RIMA TRANSFORMER	Approved
124	Press Board	Senapathy Whitley, Bangalore	Approved
		Raman Boards, Mysore	Approved
		H Weidman / Weidman Systems, Switzerland	Approved

Vendor List

125	Transformer Oil (Mineral Oil)-ESP/HVR TRF	Apar Industries, Mumbai	Approved
		Savita Oil Tech. Ltd. Mumbai	Approved
		Raj Petro Specialties Mumbai	Approved
		COLOMBIA PETRO CHEM, INDIA	Approved
		Savita Chemicals India Pvt. Silvassa	Approved
126	Transformer Oil (Silicon Oil)	GE Momentive Silicon, USA	Approved
		DOW Corning, USA	Approved
		Shin-ETSU, Singapore	Approved
127	Synthetic Rubber Bonded Cork Sheet	James Walker, UK	Approved
		NU Cork Product, Gurgaon	Approved
		Gujrat Cork And Rubber, Valsad	Approved
		Indian Cork Industries	Approved
128	OTI	Perfect Control, Chennai	Approved
		Precimeasure, Bangalore	Approved
129	Buchholz Relay	ATVUS Industries, Kolkata	Approved
		Press-N-Forge, Mumbai	Approved
		A.J Service, Mumbai	Approved
130	MOG	Sukrut Udyog, Pune	Approved
		ATVUS Industries, Kolkata	Approved
		Yogya Enterprises, Jhansi	Approved
		Press-N-Forge, Mumbai	Approved
Power Transformers Oil Filled(JHANSI WORKS)			
131	CRGO STEEL (Supplier)	AK STEEL, Netherlands/ USA	Approved
		NIPPON STEEL, JAPAN	Approved
		VIZSTAL, RUSSIA (Only M4 grade)	Approved
		POSCO, KOREA	Approved
132	PAPER INSULATED COPPER CONDUCTOR (PICC)	SHREE CABLES & CONDUCTORS BHOPAL	Approved
		KSH INTERNATIONAL CHAKAN,PUNE	Approved
		RIMA TRANSFORMER & CONDUCTORS BANGALORE	Approved
		BCPL, MANDIDEEP	Approved
		PRECISION WIRES INDIA LTD, SILVASSA.	Approved
		SHAKTI INSULATED WIRES PVT LTD, ANKLESHWAR	Approved
		CHANDRA METALS LTD. TELIARGANJ	Approved
		DELTA TRANS CONDUCTORS(P)LTD. MUMBAI	Approved

Vendor List

133	CONTINUOUSLY TRANSPOSED CONDUCTOR	ASTA INDIA PVT LTD	Approved
		KSH INTERNATIONAL PVT LTD	Approved
		PRECISION WEIR INDIA LTD	Approved
		SAMDONG	Approved
134	PRECOMPRESSED PRESSED BOARDS	ABB INDIA LIMITED, MYSORE	Approved
		ABB AB, SWEDEN.	Approved
		SENAPATHY WHITELEY PVT.LTD. BANGALORE	Approved
135	INSULATING OIL	Apar Industries, Mumbai	Approved
		Savita Oil Tech. Ltd. Mumbai	Approved
		Raj Petro Specialties Mumbai	Approved
		BPCL	Approved
136	BUCCHOLZ RELAY	P&B WEIR ELECTRICAL-UNIT 10, U.K	Approved
		PRESS-N-FORGE, MUMBAI	Approved
		A.J .SERVICES (PRAYOG), MUMBAI	Approved
		SUKRUT ELECTRIC CO.PVT.LTD. PUNE	Approved
		VIAT INSTRUMENTS PVT. LTD. KOLKAT/AHMEDABAD	Approved
137	PRESSURE RELIEF VALVE	MESSKO GMBH GERMANY	Approved
		QUALITROL COMPANY LLC USA	Approved
		RAJSHI ENGINEERS JHANSI	Approved
		Atvus, Kolkata	Approved
		SUKRUT UDYOG PUNE	Approved
138	AIR CELL	PRONAL ASIA MANUFACTURING MALAYSIA	Approved
		UNIRUB TECHNO INDIA PVT. LTD. PUNE	Approved
139	MOLG	QUALITROL COMPANY LLC, USA	Approved
		MESSKO GMBH GERMANY	Approved
		Atvus, Kolkata	Approved
		PRESS-N-FORGE, MUMBAI	Approved
		YOGYA ENTERPRISES, JHANSI	Approved
		SUKRUT UDYOG PUNE	Approved
140	OTI / WTI/ RTD	PRECIMEASURE CONTROLS (PVT.) LTD., BANGALORE	Approved
		PERFECT CONTROL, CHENNAI	Approved
141	OFI/WFI	SUKRUT UDYOG	Approved
		VIAT INSTRUMENTS PVT LTD	Approved

Vendor List

142	CONDENSER BUSHING-OIP	BHEL	Approved
		CGL	Approved
		GE T&D	Approved
143	ON LOAD TAP CHANGER	M/S BHEL BHOPAL	Approved
144	RADIATORS	TTP TECHNOLOGIES PVT LTD	Approved
		CTR MANUFACTURING INDUSTRIES LTD	Approved
		GURURAJ RADIATORS PVT LTD	Approved
		HI-TECH RADIATORS PVT LTD	Approved
		P.E. ENGINEERS PVT LTD	Approved
		TRANSPARES LIMITED	Approved
		BHEL, BHOPAL	Approved
145	~~N2 FIRE PROTECTION SYSTEM~~	As per Approved Vendors of Fire Detection system Package for the Main Plant.	
146	BUSHING-RIP	NANJING, CHINA	DR
		HSP, GERMANY	DR
		TRENCH, CHINA	DR
		ABB, SWITZERLAND	DR
		MOSER GLAZER, SWITZERLAND	DR
		YASH HIGH VOLTAGE INSULATORS (up to 145 kV), VADODARA	DR
Dry Type Transformers(JHANSI WORKS)			
147	CRGO STEEL (Supplier)	Mill-A K Steel, USA/ Netherlands	Approved
		Metal One Corp.(Mill-Nippon Steel, Japan)	Approved
		TKES , Germany	Approved
		Novex Trading, Switzerland { Mills - Viz Stahl	Approved
		POSCO IPPC, Pune (Mill-Posco, Korea)	Approved
148	COPPER CONDUCTOR	Mimani Wires, Indore	Approved
		Malwa Strips, Dewas	Approved
		Copral Insulated, Hosur	Approved
		BCPL, Raisen/ Mandideep	Approved
		M P Cupro metals, Bhopal	Approved
		SCR Wires, Tunkur	Approved
		Chandra Metals, Allahabad	Approved
		Pearl, Bangalore	Approved
		COSMOS Conductors, Tunkur	Approved
		Vimlesh Industries, Sonipat	Approved
		Permaili Wallace Ltd. Bhopal	Approved
		Mica Ply, Bhopal	Approved

Vendor List

149	Fiber Glass Sheet	Glass Fiber Ltd. Mumbai	Approved
		Surendra Engg. Bhopal	Approved
		Texplas, Haridwar	Approved

Vendor List

150	Epoxy Insulators	Baroda Mould and Die, Vadodara	Approved
		Baroda Bushing, Baroda	Approved
		India Insulator, Miraj	Approved
		Epothane Civelec, Ghaziabad	Approved
		Quality Engg. & In sulation products, Bhopal	Approved
		A-Bond Strands PVI. Ltd, Chennai	Approved
151	Epoxy Casting Materials	Huntsmann Chennai	Approved
		Atul Ltd, Val sad	Approved
152	Sheet Metal Enclosure	Electro Auto Bhopal	Approved
		Shrao Engg. Bhopal	Approved
		Bansal Fabwel, Jhansi	Approved
		Anupam Industries, Jhansi	Approved
		R Industries, Bhopal	Approved
		Bharat Fabricators, Bhopal	Approved
		Mahadev Ind, Bhopal	Approved
153	Temperature Scanner	Pecon, Ahemdabad	Approved
		Precimeasure, Bangalore	Approved
Power Transformer (Bhopal Works)			
154	PRECOMPRESSED PRESSED BOARDS	ABB INDIA LIMITED, MYSORE	Approved
		ABB AB, SWEDEN.	Approved
		KOKUSAI PULP AND PAPER CO. LTD. JAPAN	Approved
		KREMPEL GMBH GERMANY	Approved
		OJI F-TEX CO. LTD. JAPAN	Approved
		SENAPATHY WHITELEY PVT.LTD. BANGALORE	Approved
		WEIDMANN ELEC. TECHNOLOGY A.G. SWITZERLAND	Approved
		ENPAY ENDUSTRIYEL PAZARLAMA VE YATIRIM A.S. TURKIYE	Approved

Vendor List

155	TRANSFORMER TANK	BHARAT HEAVY ELECTRICALS LTD BHOPAL	Approved
		BHOPAL ENGINEERING GOVINDPURA BHOPAL	Approved
		DUNHIL PRODUCTS GOVINDPURA BHOPAL	Approved
		ELECTRO AUTO INDUSTRIES GOVINDPURA BHOPAL	Approved
		E.M. ELECTRO MECHANICALS PVT.LTD GOVINDPURA BHOPAL	Approved
		GTV ENGINEERING LTD. GOVINDPURA BHOPAL	Approved
		MECH & FAB INDUSTRIES GOVINDPURA BHOPAL	Approved
		SIGMA HEAVY ENGG. INDUSTRIES GOVINDPURA BHOPAL	Approved
		SATYAM (FAB) INDUSTRIES PVT. LTD., BHOPAL	Approved
		SHRAO ENGG.WORKS GOVINDPURA BHOPAL	Approved
156	STEEL PLATE	STEEL AUTHORITY OF INDIA LTD	Approved
		ISCO	Approved
		JINL	Approved
		TISCO	Approved
157	CRGO STEEL (Supplier)	AK STEEL INTERNATIONAL B.V., USA (Regd. office at Netherlands)	Approved
		IFE SHOJI TRADE CORPORATION, JAPAN (Auth. Agent POSCO PUNE)	Approved
		NIPPON STEEL, JAPAN (Auth. Trader METAL ONE JAPAN)	Approved
		VIZSTAL, RUSSIA (Auth. Trader NOVEX TRADING	Approved
		POSCO KOREA (Auth. Agent POSCO-PUNE)	Approved
158	INSULATING OIL	APAR INDUSTRIES LTD., CHEMBUR, MUMBAI	Approved
		RAJ PETRO SPECIALITIES PVT LTD MUMBAI	Approved
		SAVITA OIL TECHNOLOGIES LTD. MUMBAI	Approved
159	PAPER INSULATED COPPER CONDUCTOR (PICC)	SHREE CABLES & CONDUCTORS BHOPAL	Approved
		KSH INTERNATIONAL CHAKAM, PUNE	Approved
		PRIMA TRANSFORMER & CONDUCTORS BANGALORE	Approved
		BCPL, MANDIDEEP	Approved
		BHANDARY POWER LINE, MANIPAL	Approved
		PRECISION WIRES INDIA LTD, SILVASSA	Approved
		SHAKTI INSULATED WIRES PVT LTD, ANKLESHWAR	Approved
		CHANDRA METALS LTD. TELIARGANJ	Approved
		M.P.CUPRO METALS PVT.LTD.BHOPAL	Approved
		DELTA TRANS CONDUCTORS(P)LTD. MUMBAI	Approved

Vendor List

160	CONTINUOUSLY TRANSPOSED COPPER CONDUCTOR (CTC)	KSH INTERNATIONAL CHAKAN,PUNE	Approved
		PRECISION WIRES INDIA LTD, SILVASSA.	Approved
		SAMDONG KOREA	Approved
		ASTA, INDIA VADODARA	Approved
161	UNIMPREGNATED DENSIFIED WOOD	PERMALI WALLACE PVT. LTD. GOVINDPURA, BHOPAL	Approved
		SURENDRA COMPOSITES PVT LTD RAISEN	Approved
162	ON LOAD TAP CHANGER/ OFF CIRCUIT TAP CHANGER	BHEL BHOPAL	Approved
		ABB AB COMPONENTS SWEDEN	Approved
		MASCHINENFABRIK REINHAUSEN GERMANY	Approved
163	OIL CONDENSOR BUSHING	BHEL BHOPAL	Approved
		GE T&D INDIA LIMITED, HOSUR	Approved
		GRID SOLUTIONS, A GE AND ALSTOM JOINT VENTURE, ITALY	Approved
		ABB AB COMPONENTS, SWEDEN	Approved
		CG POWER & INDUSTRIAL SOLUTIONS LTD, NASHIK	Approved
164	BUCHLOZ RELAY	P&B WEIR ELECTRICAL-UNIT 10, U.K	Approved
		SUKRUT ELECTRIC CO.PVT.LTD. PUNE	Approved
		VIAT INSTRUMENTS PVT. LTD. KOLKATA	Approved
		VIAT INSTRUMENTS PRIVATE LIMITED UNIT- II SANAND	Approved
165	OTI / WTI/ RTD	PRECIMEASURE CONTROLS (PVT.) LTD., BANGALORE	Approved
		PERFECT CONTROL, CHENNAI	Approved
166	PRESSURE RELIEF VALVE	MESSKO GMBH GERMANY	Approved
		QUALITROL COMPANY LLC USA	Approved
		RAJSHI ENGINEERS JHANSI	Approved
		SUKRUT UDYOG PUNE	Approved
167	AIR CELL	PRONAL ASIA MANUFACTURING MALAYSIA	Approved
		UNIRUB TECHNO INDIA PVT. LTD. PUNE	Approved
168	MOLG	QUALITROL COMPANY LLC, USA	Approved
		MESSKO GMBH GERMANY	Approved
		SUKRUT UDYOG PUNE	Approved
169	OIL FLOW INDICATOR	SUKRUT UDYOG, PUNE	Approved
		VIAT INSTRUMENTS PRIVATE LIMITED UNIT- II AHMEDABAD	Approved

Vendor List

170	OIL PUMP	FLOW OIL PUMPS PVT. LTD. BANGALORE	DR
		NXL FLOW INSTRUMENTS BANGALORE	DR
		SPP PUMPS LIMITED ENGLAND	DR
171	COOLING FAN & MOTOR ASSLY	EPC ELECTRICAL PVT.LTD. KOLKATA	Approved
		MARATHON ELECTRIC MOTORS(INDIA)LTD KOLKATA	Approved
172	RADIATOR	BHEL BHOPAL	Approved
		CTR MANUFACTURING INDUSTRIES LTD. PUNE	Approved
		TTP TECHNOLOGIES PVT. LTD. BANGALORE	Approved
173	MARSHALLING BOX / CONTROL CABINET/RTCC	ASHOKA ELECTRONICS, BHOPAL	Approved
		ENTERPRISING ENGINEERS,BHOPAL	Approved
		PURNIMA ELECTRICAL INDUSTRIES , BHOPAL	Approved
		PYROTECH ELECTRONICS PVT. LTD. (UNIT-IV), UDAIPUR	Approved
		R.S.I.SWITCH GEAR PVT LTD. BHIWADI	Approved
174	TERMINAL CONNECTOR	KLEMMEN ENGINEERING CORPN., CHENNAI	Approved
		PEE VEE ENGG.ENTERPRISES, BANGALORE	Approved
175	GAS COLLECTING DEVICE	SUKRUT UDYOG, PUNE	Approved
		YOGYA ENTERPRISES, JHANSI	Approved
176	N2 BASED FIRE PROTECTION SYSTEM	CTR MANUFACTURING INDUSTRIES LTD. NAGPUR	DR
		EASUN-MR TAP CHANGERS (P) LTD, CHENNAI	DR
		SERGI TRANSFORMER EXPLOSION PREVENTION, GURGAON (HARYANA)	DR
		VENDERE SALES SERVICES (I) PVT. LTD. AURANGABAD	DR
		GK POWER TRANSMISSION COMPANY PVT. LTD., NAGPUR	DR
177	FIBRE OPTIC HOT SPOT TEMP MONITORING SYSTEM	LUXTRON CORPORATION DBA LUMASENSE TECHNOLOGIES, USA	DR
		MACHTECH ENGINEERING SOULUTIONS LLP, VASAI	DR
		PRECIMEASURE CONTROLS (PVT.) LTD, BANGALORE	DR
		QUALITROL COMPANY LLC, USA	DR

Vendor List

178	ONLINE DGA	A.EBERLE GMBH AND CO. KG GERMANY	DR
		MTE METER TEST EQUIPMENT AG SWITZERLAND (Installation & Commissioning of DGA by MTE-INDIA, New Delhi)	DR
		MORGAN SCHAFFER INC CANADA (M/S Doble)	DR
		GE KELMAN (Auth. Agent PCI PRECISION CASTING LIMITED DELHI)	DR
		QUALITROL COMPANY LLC USA	DR
		CHROMATOGRAPHY & INSTRUMENTS COMPANY, VADODARA	DR
179	INSULATOR	M/S BHEL ELECTRO-PORCELAIN DIVN. BANGALORE	Approved
		M/S CJI PORCELAIN PVT. LTD. KHURJA	DR
		M/S KHYATI CERAMICS. KALOL	DR
HT MOTOR COMPONENTS (Bhopal Works)			
180	CACA COOLER.	FITWELL CORPORATION	Approved
		KARNATAKA ENGINEERING ENTERPRISES	Approved
		LAXMI ENGG. IND.	Approved
		MEHTA INDUSTRIES	Approved
181	CACW COOLER	FITWELL CORPORATION	Approved
		KARNATAKA ENGINEERING ENTERPRISES	Approved
		LAXMI ENGG. IND.	Approved
		MEHTA INDUSTRIES	Approved
182	ANTIFRICTION BEARING	SKF	Approved
		FAG	Approved
183	COPPER SECTION/ ROUND/FLAT ROTOR BAR	BHANWARDEEP COPPER STRIPS(P)LTD	Approved
		COPPER STRIPS PVT LTD	Approved
		CHANDRA METALS LTD.	Approved
		MALWA STRIPS PVT.LTD.	Approved
		OMEGA ROLLING MILLS PVT LTD.	Approved
184	FORGED SHAFT	BHARAT FORGE LIMITED	Approved
		BAY-FORGE LTD.	Approved
		BHARAT HEAVY ELECTRICALS LTD	Approved
		GHAZIABAD ISPAT UDYOG LTD	Approved
		KISCO CASTINGS (INDIA) LTD.	Approved
		KISAAN STEELS PVT.LTD	Approved
		PUNJAB HAMMERS PVT.LTD.	Approved
		PAHLADRAI STEEL FORGING WORKS,	Approved
		STEEL AUTHORITY OF INDIA LIMITED	Approved
185	ENAMELLED MICA TAPED COPPER CONDUCTOR.	M.P.CUPRO METALS PVT.LTD.	Approved
		NKM CABLES & STRIPS(PVT)LTD.	Approved
		SHREE CABLES & CONDUCTORS (P) LTD	Approved
		VIMLESH INDUSTRIES(P)LTD.	Approved

Vendor List

The diagram shows a horizontal line representing a 1D chain. Along this line, there are several small circles representing particles and larger circles representing clusters. Some clusters are connected to each other, forming a chain of clusters. A specific cluster is highlighted with a label 'Cluster' and a particle is labeled 'Particle'. The diagram illustrates the interaction between a cluster and a single particle, with labels for 'Cluster' and 'Particle'.



Vendor List

186	MICA TAPED CONDUCTORS	BHANWARDEEP COPPER STRIPS(P)LTD	Approved
		BCPL CONDUCTORS PVT.LIMITED	Approved
		COSMOS CONDUCTORS PVT.LTD.	Approved
		COPRAL INSULATED CONDUCTORS PVT.,LTD.	Approved
		CHANDRA METALS LTD.	Approved
		MIMANI WIRES PVT LTD	Approved
		MALWA STRIPS PVT.LTD.	Approved
		M.P.CUPRO METALS PVT.LTD.	Approved
		NKM CABLES & STRIPS(PVT)LTD.	Approved
		SHREE CABLES & CONDUCTORS (P) LTD	Approved
		VIMLESH INDUSTRIES(P)LTD.	Approved
187	RTD/BTD	JINDAL ELECTRONICS PRIVATE LIMITED	Approved
		TECHNO INSTRUMENTS	Approved
Note:-			
1	SUB ITEMS (not covered specifically in the Vendor List) for Power Transformer, DTT and HVR Transformer from BHEL Units.		BHEL Approved sources
2	SUB ITEMS (not covered specifically in the Vendor List) for HT Motors to be supplied from IS Motors.		BHEL Approved sources
3	SUB ITEMS (not covered specifically in the Vendor List) FOR Busduct package, supplies from BHEL- Rudrapur Unit		BHEL Approved sources

**SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)**

SI No	Item	Vendor Name	Status
1	Severe Service Control Valve for BFP Re-Circulation / SH & RH Attenuation Control Valve	DRESSER VALVE INDIA PVT. LTD, Coimbatore	Approved
		CONTROL COMPONENTS INC.	Approved
		KSB MIL CONTROLS LIMITED	Approved but only for 9000 Series Valves
2	Oil Trip Valves (FUEL OIL SYSTEM)	INSTRUMENTATION LTD., KERALA	Approved
		KSB MIL CONTROLS LIMITED, THIRISSUR DIST	Approved
		Kuehne Armaturen GmbH, Germany	DR
		SAMSON CONTROLS PRIVATE LIMITED	Approved
		MASCOT VALVES PVT. LTD, AHMEDABAD	Approved
3	NORMAL SERVICE CONTROL VALVE	DRESSER VALVE INDIA PVT. LTD, Coimbatore	Approved
		EMERSON PROCESS MANAGEMENT CHENNAI LIMITED, Chennai	Approved
		INSTRUMENTATION LTD., PALAKKAD	Approved
		Koso India Private Limited, Nashik	Approved
		PARCOL S.P.A.	Approved
		SEMPELL GmbH.	Approved
		DAUME REGELARMATUREN GMBH	DR
		KSB MIL CONTROLS LTD. Thrissur	Approved
		Valvitalia S.P.A. , Italy	Approved
		WALDEMAR PRUSS ARMATURENFABRIK GMBH, Germany	Approved
4	Severe Service Control Valve for AUX PRDS	Control Component India Pvt. Ltd. Chittoor	Approved
		Daume Regelarmaturen GmbH, Isernhagen, Germany	Approved
		HOLTER REGELARMATUREN GmbH & CO., HOLTESTUKENBR OCK	Approved
		Koso India Private Limited, Nashik	Approved
		PARCOL S.p.A Canegrate MI, ITALY	Approved
5	VALVE:SOOT BLOWER PR	DRESSER VALVE INDIA PVT. LTD, Coimbatore	Approved
		CONTROL COMPONENTS INC.	Approved
		KSB MIL CONTROLS LIMITED	Approved
6	LP STARTUP CONTROL VALVES	CONTROL COMPONENT INDIA PVT LTD	Approved
		INSTRUMENTATION LTD.,	Approved
		EMERSON PROCESS MANAGEMENT CHENNAI	DR
		WELLAND & TUXHORN AG	Approved
		KOSO INDIA PRIVATE LIMITED.	Approved
		KSB MIL CONTROLS LIMITED	Approved

Vendor List

SI No	Item	Vendor Name	Status
7	HIGH PR. STARTUP SCV	CONTROL COMPONENT INDIA PVT LTD, Bangalore	Approved
		SEMPELL GmbH., Germany	Approved
		KOSO INDIA PRIVATE LIMITED., Nashik	Approved
		PARCOL S.P.A., Milan Italy	Approved
8	HPBP Control Valve	SULZER-CCI AG, SWITZERLAND	Approved
		CONTROL COMPONENT INDIA PVT LTD, Bangalore	Approved
9	LP BYPASS SYSTEM	SULZER-CCI AG, SWITZERLAND	Approved
		CONTROL COMPONENT INDIA PVT	Approved
		WELLAND & TUXHORN AG	Approved
		HOLTER REGELARMATUREN GMBH & CO.	DR
10	SEAL STEAM VALVE/ LEAK STEAM VALVE WITH PNEUMATIC ACTUATOR	SAMSON CONTROLS PVT. LTD.	Approved
		INSTRUMENTATION LIMITED	Approved
		KSB MIL CONTROLS LIMITED	Approved
		GE OIL & GAS INDIA PRIVATE LIM	Approved
		WELLAND & TUXHORN AG	Approved
		HOLTER REGELARMATUREN GMBH & CO.	Approved
11	Air Filter Regulator [Either from OEM/Authorised Source]	Parker Hannifin, Lebanon	Approved
		SHAVO NORGREN(INDIA)PVT LTD, BANGALORE	Approved
		JRU INSTRUMENTS (Formerly PLACKA)	Approved
12	HPT STEAM EVACUATION VALVE	GE OIL & GAS INDIA PRIVATE LTD	Approved
		HOLTER REGELARMATUREN GMBH & CO., GERMANY	Approved
		KSB MIL CONTROLS LIMITED, INDIA	Approved
		INSTRUMENTATION LIMITED	Approved
13	SOLENOID VALVE	ASCO (I) LTD.	Approved
		ROTEX AUTOMATION LTD.	Approved
		NUCON INDUSTRIES PVT LTD	Approved
		IMI NORGREN HERION PVT. LTD.	Approved
14	Bypass Rotameter	EUREKA INDLEQUIPMENT PVT., LTD., PUNE	Approved
		FLUIDYNE INSTRUMENTS PVT. LTD., CHEMBUR, MUMBAI	Approved
		PLACKA INSTRUMENTS INDIA PVT LTD, CHENNAI	Approved

Vendor List

Sl No	Item	Vendor Name	Status
		INSTRUMENTATION ENGINEERS PVT LTD, JEEDEMATLA, HYDERABAD	Approved
		TRANSDUCER & CONTROL PVT LTD, HYDERABAD	Approved
15	C&I Laboratory Furniture/ Computer Furniture	ADARSHA CONTROL SYSTEMS PVT. LTD., BANGALORE	Approved
		COSMOS MEDIA PRODUCTS PVT. LTD, GREATER NOIDA, UP	Approved
		FEATHERLITE OFFICE SYSTEMS PVT. LTD, BANGALORE	Approved
		GODREJ AND BOYCE MANUFACTURING CO., ROORKEY, UTTARAKAND.	Approved
		HARMONY SYSTEMS, GREATER NOIDA, UP	Approved
		OTS OFFICETECH SYSTEMS (P) LTD, BANGALORE	Approved
		PYROTECH WORKSPACE SOLUTIONS PVT. LTD, UDAIPUR	Approved
16	CBLM Sys (3D Type)	APM, Israel	Approved
		EIP TECHNOLOGIES PVT. LTD. NOIDA/ Process Management Mumbai	Approved
17	CBLM Sys (Ultrasonic Or RADAR Type) Panel	ENDRESS + HAUSER INDIA PVT. LTD. MUMBAI	Approved
		KISTLER MORSE AUTOMATION LTD., HYDERABAD	Approved
		KROHNE MARSHALL PVT LTD., PUNE	Approved
		VEGA INDIA LEVEL & PRESSURE MEASUREMENT PVT LTD., MUMBAI.	Approved
		EMERSON PROCESS MANAGEMENT, MUMBAI.	Approved
		SIEMENS LIMITED, BANGALORE	Approved
18	CBLM Sys (Strain Gauge Type) Sensor & Panel	KISTLER - MORSE AUTOMATION LTD., HYDERABAD	Approved
		VENTURE MEASUREMENT, US	Approved
		THERMO RAMSEY INC, CHICAGO, US	Approved
19	CO Analyser	CHEMTROLS INDUSTRIES LIMITED, POWAI, MUMBAI	Approved
		FORBES MARSHALL CODEL PVT. LTD., PUNE	Approved
		SICK INDIA PVT LTD, MUMBAI.	Approved
		MARVEL ENGG COMPANY, CHENNAI	Approved

Vendor List

SI No	Item	Vendor Name	Status
20	Compression Fittings	PARKER HANNIFIN INDIA PVT. LTD.,CHENGAL PATTU,TAMILANADU	Approved
		PRECISION ENGG INDUSTRIES, MUMBAI	Approved
		SWAGELOCK,USA	Approved
		TROUVAY & CAUVIN FRANCE	Approved
		HOKE	Approved
		METPRESS ENGINEERING WORKS, KOLKATA	DR
21	Condensate Pots	BALDOTA VALVE AND FITTING COMPANY PVT LTD,MUMBAI	Approved
		FLOWTECH, KOLKATA	Approved
		PRECISION ENGG INDUSTRIES, MUMBAI	Approved
		EXCEL HYDRO-PNEUMATICS PVT LTD,MUMBAI	DR
		PMT ENGINEERS,N.H.NO.-8, NARODA, AHMEDABAD	DR
		HP VALVES & FITTINGS (INDIA) PVT. L,MOGAPPAIR WEST, CHENNAI	DR
		ARCELLOR CONTROLS (INDIA), Ahmedabad	DR
22	Dust Density (Opacity) Monitor(Analyzer)	CODEL INTERNATIONAL LTD ,UK	Approved
		DURAG GMBH AND CO KG, HUMBURG,GERMANY	Approved
		LAND INSTRUMENTS INTERNATIONAL, ENGLAND (UK)	Approved
		SICK MAIHAK GMBH,GERMANY	Approved
23	Dust Density (Opacity) Monitor(panel)	CHEMTROLS INDUSTRIES LIMITED, POWAI,	Approved
		DURAG INDIA INSTRUMENTATION PVT LTD,BANGALORE	Approved
		SICK INDIA PVT LTD,MUMBAI.	Approved
		MARVEL ENGG COMPANY, CHENNAI	Approved
24	E/P Convertor(if required)	FAIRCHILD INDIA PRIVATE LIMITED, NOIDA	Approved
		WATSON SMITH LTD ,UK	Approved
25	Smart Positioner	EMERSON PROCESS MANAGEMENT	Approved
		SIMENS	Approved
		ABB	Approved
		ASTEC VALVE & FITTINGS PVT. LTD,MUMBAI	Approved
		AURA INC, NEW DELHI	Approved
		BALDOTA VALVE AND FITTINGS PVT LTD,MUMBAI	Approved
		EXCEL HYDRO-PNEUMATICS PVT LTD, MUMBAI	Approved
		FLOWTECH, KOLKATA	Approved

Vendor List

Sl No	Item	Vendor Name	Status
26	Erection Material	FLUID CONTROLS PVT. LTD,PUNE	Approved
		HP VALVES & FITTINGS (INDIA) PVT LTD, CHENNAI	Approved
		MET LOK HYDRO PENUMATICS PVT LTD,MUMBAI	Approved
		METPRESS ENGINEERING WORKS, KOLKATA	Approved
		PANAM ENGINEERS LTD,MUMBAI	Approved
		PMT ENGINEERS,AHMEDABAD	Approved
		PRECISION ENGG INDUSTRIES, MUMBAI	Approved
		V.K.INDUSTRIES, BANGALORE	Approved
		VIKAS INDUSTRIAL PRODUCTS, NOIDA	Approved
		PAUL INDUSTRIES,HOWRAH	Approved
		NAV DURGA FORGING AND FITTINGS,THANE,MAHARASTRA	Approved
		SANDEEP INDUSTRIES,JALANDHAR,PUNJAB	Approved
27	FGA Insitu (SOX/NOX/CO/CO2)(Analyzer)	CODEL INTERNATIONAL LTD ,UK	Approved
		SICK MAIHAK GMBH,GERMANY	Approved
		CODEL INTERNATIONAL LTD ,UK	Approved
		SICK MAIHAK GMBH,GERMANY	Approved
28	FGA Insitu (SOX/NOX/CO/CO2)(panel)	CHEMTROLS INDUSTRIES LIMITED, POWAI, MUMBAI	Approved
		FORBES MARSHALL CODEL PVT. LTD., PUNE	Approved
		SICK INDIA PVT LTD,MUMBAI.	Approved
		ICE (ASIA) PRIVATE LIMITED, MUMBAI	Approved
29	FGA Sys(SOX/NOX/CO)Samplg Type(Analyzer)	ABB INSTRUMENTATION LTD,GLOUCESTERSHIRE,UK	Approved
		EMERSON PROCESS MANAGEMENT INDIA PVT LTD, MUMBAI	Approved
		FUJI ELECTRIC SYSTEMS CO. , LTD,SHINAGAWA-KU, TOKYO	Approved
		SICK MAIHAK GMBH,GERMANY	Approved
		SIEMENS LIMITED, BANGALORE	Approved
		YOKOGAWA ELECTRIC CORPORATION,TOKYO,JAPAN	Approved
30	FGA Sys(SOX/NOX/CO)Sampling Type(panel)	ABB LTD, Bangalore	Approved
		ADAGE AUTOMATION PRIVATE LIMITED, KHAIRANE MIDC, NAVI MUMBAI	DR
		CHEMTROLS INDUSTRIES LIMITED, POWAI, MUMBAI	Approved
		EMERSON PROCESS MANAGEMENT INDIA PVT LTD, MUMBAI	Approved

Vendor List

Sl No	Item	Vendor Name	Status
		YOKOGAWA INDIA LIMITED, BANGALORE	Approved
31	H ₂ GAS ANALYSER CABINET	SIEMENS LTD.	Approved
		YOKOGAWA INDIA LIMITED	Approved
		ABB INDIA LTD	Approved
32	GI Pipes	BALDOTA VALVE AND FITTINGS PVT LTD,MUMBAI	Approved
		BHUWALKA PIPES LIMITED,BANGALORE.	Approved
		FLOWTECH, KOLKATA	Approved
		JINDAL INDUSTRIES LIMITED,NEW DELHI	Approved
		METPRESS ENGINEERING WORKS, KOLKATA	Approved
		NATHMAL DAGA & CO, BANGALORE	Approved
		PIPE CORPORATION PVT LTD, BANGALORE	Approved
		PRECISION ENGG INDUSTRIES,MUMBAI	Approved
		SURYA ROSHNI LTD,BAHADURGARH,HARYANA.	Approved
		V.K.INDUSTRIES, BANGALORE	Approved
		VIKAS INDUSTRIAL PRODUCTS, NOIDA	Approved
		SANDEEP INDUSTRIES,JALANDHAR,PUNJAB	Approved
		MKK METAL SECTIONS PVT LTD,VELLORE,TAMILANADU	Approved
		RIDDHI STEEL AND TUBE LIMITED,AHMEDABAD	Approved
		INDUS TUBES LTD,GHAZIABAD,UP	Approved
33	Impulse Pipes(Alloy steel)	BHARAT HEAVY ELECTRICALS LTD, TIRUCHIRAPALLI,TAMILANADU	Approved
		EVERGREEN SEAMLESS PIPES & TUBES PVT LTD,BANGALORE	DR
		GANPAT METALS PVT. LTD.,MUMBAI	DR
		JINDAL SAW LTD,CHENNAI	Approved
		RIDHI SIDDHI STEEL CORPORATION,MUMBAI	DR
		TROUVAY CAUVIN,GULF	Approved
		SUMITOMO CORPORATION,JAPAN.	Approved
		TPS TECHNITUBE ROHREN WERKE	Approved
		BHARAT HEAVY ELECTRICALS LTD, TIRUCHIRAPALLI,TAMILANADU.	Approved
		EVERGREEN SEAMLESS PIPES & TUBES PVT LTD,BANGALORE	DR
		GANPAT METALS PVT. LTD.,MUMBAI	DR
		HEAVY METAL AND TUBES LTD,AHMEDABAD/MUMBAI	DR

Vendor List

Sl No	Item	Vendor Name	Status
34	Impulse Pipes(Carbon Steel)	INDIAN SEAMLESS METAL TUBES LTD,PUNE.	Approved
		JINDAL SAW LTD,CHENNAI	Approved
		RIDHI SIDDHI STEEL CORPORATION,MUMBAI	DR
		TROUVAY CAUVIN,GULF	Approved
		SUMITOMO CORPORATION,JAPAN.	Approved
		SUMITOMO CORPORATION ASIA & OCEANIA PTE. LTD.,SINGAPORE	Approved
		TPS TECHNITUBE ROHREN WERKE GMBH,DAUN,GERMANY	Approved
35	Impulse Pipes(Stainless Steel)	RATNAMANI METALS & TUBES LTD, AHMEDABAD	Approved
		SUMITOMO CORPORATION,JAPAN.	Approved
		TPS TECHNITUBE ROHREN WERKE	Approved
		EVERGREEN SEAMLESS PIPES & TUBES PVT	DR
		GANPAT METALS PVT. LTD.,MUMBAI	DR
		RIDHI SIDDHI STEEL CORPORATION,MUMBAI	DR
		SUMITOMO CORPORATION,JAPAN.	Approved
36	Instrument Valve	TROUVAY CAUVIN,GULF	Approved
		BALDOTA VALVE AND FITTINGS PVT LTD,MUMBAI	Approved
		BHARAT HEAVY ELECTRICALS LTD, TIRUCHIRAPALLI,TAMILNADU.	Approved
		EXCEL HYDRO-PNEUMATICS PVT LTD, MUMBAI	Approved
		INSTRUMENTATION LIMITED, PALGHAT	Approved
		METPRESS ENGINEERING WORKS, KOLKATA	Approved
37	Lab Items Mechanical	PRECISION ENGG INDUSTRIES, MUMBAI	Approved
		FLUKE TECHNOLOGIES PVT. LTD., ANDHERI (EAST), MUMBAI	Approved
		GE OIL AND GAS INDIA PVT. LTD,PUNE.	Approved
		ISOTHERMAL TECHNOLOGY PVT. LTD., DELHI	Approved
		NAGMAN INSTMTS. & ELECTRONICS (P) L, CHENBARAMBARKAM,CHENNAI.	Approved
		WIKA INSTRUMENTS INDIA PVT. LTD., VILLAGE KESNAND, PUNE	Approved
		CHEMTROLS ENGG. (P) LTD.	Approved
		LEVCON INSTRUMENTS (P) LTD.	Approved
		S. B. ELECTRO-MECHANICALS PVT. LTD.	Approved
		V. AUTOMAT & INSTRUMENTS PVT. LTD.	Approved

Vendor List

Sl No	Item	Vendor Name	Status
38	LEVEL GAUGE	DK INSTRUMENTS	Approved
		SIGMA INSTRUMENTS COMPANY	Approved
		IGEMA GMBH	Approved
		ASIAN INDUSTRIAL VALVES AND	Approved
		CESARE BONETTI S.P.A	Approved
39	Level Switch Capacitance Type	LEVCON INSTRUMENTS PVT. LTD.	Approved
		ENDRESS & HAUSER	Approved
40	Level Switch Conductivity Type	EMERSON PROCESS MANAGEMENT(I)PVT. L, M.I.D.C.PAWANE,NAVI MUMBAI	Approved
		IGEMA GMBH,MUNSTER,GERMANY.	Approved
		LEVELSTATE SYSTEMS LTD,U.K	Approved
		SOLARTRON TRANSDUCER, U.K	Approved
41	Level Switch Float Type	CHEMTROLS INDUSTRIES LIMITED, POWAI, MUMBAI	Approved
		IGEMA GMBH,MUNSTER,GERMANY.	Approved
42	Level Switch Top mounted	CHEMTROLS INDUSTRIES LIMITED, POWAI, MUMBAI	Approved
		D.K.INSTRUMENTS PVT. LTD., DHAKURIA, KOLKATA	Approved
		LEVCON INSTRUMENTS Pvt LTD, KOLKATA	Approved
		PUNE TECHTROL PVT LTD,PUNE	Approved
		IGEMA GMBH,MUNSTER,GERMANY.	Approved
		SBEM PRIVATE LIMITED, PUNE	Approved
		SIGMA INSTRUMENTS COMPANY,BHANDUP(WEST),MAHARASTRA.	Approved
		V.AUTOMAT & INSTRUMENTS PVT. LTD., NEW DELHI	Approved
43	LIE/LIR	CHEMIN CONTROLS AND INSTRUMENTATION, PONDICHERRY	Approved
		PYROTECH ELECTRONICS (P) LTD.,UDAIPUR	Approved
44	LOCAL GAUGE BOARD (LGBs)	PANAM CONTROLS - HYDERABAD, INDIA	Approved
		NAGARJUNA FABRICATORS - HYDERABAD, INDIA	DR
		INSTRUMENTATION LTD. - KOTA, INDIA	Approved
		PYROTECH ELECTRONICS PVT.LTD. - UDAIPUR, INDIA	Approved
		PROCON INSTRUMENTATION PVT.LTD - CHENNAI, INDIA	Approved

Vendor List

Sl No	Item	Vendor Name	Status
45	Oxygen Analyser (LT)	EMERSON PROCESS MANAGEMENT INDIA PVT LTD, MUMBAI	Approved
		EMERSON PROCESS MANAGEMENT INDIA PVT LTD, MUMBAI	Approved
46	Oxygen Analyser (LT) Panel & Accessories	EMERSON PROCESS MANAGEMENT INDIA PVT	Approved
47	Pneumatic Actuator	EMERSON PROCESS MANAGEMENT CHENNAI, CHENNAI	Approved
		INSTRUMENTATION LIMITED, PALGHAT	Approved
		MIL CONTROLS LIMITED, ALWAYE, KERALA	Approved
48	SNUBBERS	LISEGA SE	Approved
		MAURER SOHNE GMBH & CO.KG	Approved
		JIANGSU ROAD DAMPING TECHNOLOGY CO.	Approved
		PIPE SUPPORT SYSTEMS GMBH INTL.	Approved
		QUIRI HYDROMECHANIQUE,	Approved
		SANWA TEKKI CORPORATION	Approved
49	Pressure & Differential Pressure Gauges	A.N.INSTRUMENTS PVT LTD, CHENNAI	Approved
		PRECISION MASS PRODUCTS PVT. LTD,GANDHI NAGAR,GUJARAT.	Approved
		BAUMER TECHNOLOGIES INDIA LTD,VAPI	Approved
		FORBES MARSHALL(HYD) LTD., HYDERABAD	Approved
		GAUGES BOURDON (INDIA) PVT. LTD, MUMBAI.	Approved
		GOA THERMOSTATIC INSTRUMENTS, GOA	Approved
		MANOMETER (INDIA) PVT. LTD.,, MUMBAI	Approved
50	Pressure & Differential Pressure Switch (Critical/Tripping applications of Boiler & Turbine)	DELTA CONTROLS LTD	Approved
		SOR INC.	Approved
		ASCROFT, USA	Approved
		DRESSER INDUSTRIES INC.	Approved
51	Pressure & Differential Pressure Switch (Non Critical applicaion)	PRECISION MASS PRODUCTS PVT. LTD,GANDHI NAGAR,GUJARAT.	Approved
		SWITZER PROCESS INSTRUMENTS PVT. LT, T Nagar, CHENNAI	Approved
		ASHCROFT INDIA	Approved
		TRAFAG CONTROLS INDIA PVT. LTD.,, IMT MANESAR, GURGAON	Approved
		CHIENTROLS SAMIL (INDIA) PVT. LTD., POWAI, MUMBAI	Approved
		INSTRUMENTATION ENGINEERS PVT LTD	Approved

Vendor List

SI No	Item	Vendor Name	Status
52	Sight Flow Indicator	SIGMA INSTRUMENTS CO.	Approved
		D.K.INSTRUMENTS PVT. LTD.	Approved
		LEVCON INSTRUMENTS Pvt LTD, KOLKATA	Approved
		V.AUTOMAT & INSTRUMENTS PVT LTD.	Approved
		FORBES MARSHALL LTD.	Approved
53	FLOW SWITCH	GENERAL INSTRUMENTS CONSORTIUM	Approved
		KROHNE MARSHALL	Approved
		SWITZER INSTRUMENT CO.	Approved
54	FLOW ELEMENTS (ORIFICE/NOZZLE)	MICRO PRECISION PRODUCTS	Approved
		M/S ESPL KOLKATA	Approved
		IL PALGHAT	Approved
55	IMPACT HEAD TYPE ELEMENT	DETREICH / EMERSON PROCESS	Approved
		MIDWEST	Approved
		STARMECH	Approved
		SWITZER INSTRUMENT CO.	Approved
		VERIS INC.	Approved
		EMERSON PROCESS MANAGEMENT (INDIA) PVT. LTD.	Approved
56	RRI FOR CVP	BRAUN GMBH INDUSTRIE - ELEKTRONIK	Approved
		SHINKAWA ELECTRIC CO LTD.,	Approved
		BENTLY NEVADA, LLC	Approved
57	Socket Weld Fittings	BALDOTA VALVE AND FITTINGS PVT LTD,MUMBAI	Approved
		METPRESS ENGINEERING WORKS, KOLKATA	Approved
		V.K.INDUSTRIES, BANGALORE	Approved
		MULTIMETAL INDUSTRIES,	DR
		COMFIT & VALVES PVT LTD.	DR
		DYNAFLUID VALVES AND FLOW	DR
		PRESHZINGER ENGINEERING CO PVT LTD.	DR
		FLUID CONTROLS PRIVATE LTD.,	DR
		VALTEX INDIA,	DR
		H.P.VALVES & FITTINGS INDIA PVT LTD	DR
58	Steam and Water analysis Sys(Analyzer)	VIKAS INDUSTRIAL PRODUCTS, NOIDA	Approved
		ABB INDUSTRIES ,SWITZERLAND.	Approved
		ABB INDUSTRIES ,SWITZERLAND.	Approved
		HACH LANGE S.A.R.L,VESENAZ,SWITZERLAND.	Approved
		METTLER-TOLEDO INDIA PVT. LTD., POWAI, MUMBAI	Approved
		EMERSON PROCESS MANAGEMENT,USA	Approved

Vendor List

Sl No	Item	Vendor Name	Status
		SWAN ANALYTISCHE INSTRUMENTE AG, SWITZERLAND.	Approved
		THERMO ORION INC., CHELMSFORD	Approved
59	Steam and Water analysis System(Panel)	ABB LIMITED, PEENYA INDL. AREA, BANGALORE.	Approved
		EMERSON PROCESS MANAGEMENT INDIA PVT LTD,MUMBAI.	Approved
		FORBES MARSHALL PVT LTD, PUNE	Approved
60	THERMOWELL	INDUSTRIAL INSTRUMENTATION	Approved
		GENERAL INSTRUMENTS CONSORTIUM	Approved
		MICRO PRECISION PRODUCTS (P) LTD.	Approved
		DETRIV INSTRUMENTATION &	Approved
		TEMPSSENS INSTRUMENTS (I) PVT.LTD.,	Approved
		GOA INSTRUMENT INDUSTRIES PVT LTD.	Approved
		BAUMER TECHNOLOGIES INDIA PVT.LTD,	Approved
61	Temperature Elements	DETRIV INSTRUMENTATION AND ELECTRONICS OKAZAKI MANUFACTURING COMPANY,JAPAN.	Approved
		PYRO ELECTRIC INSTRUMENTS GOA PVT.LTD,GOA.	Approved
		TECHNO INSTRUMENTS,GANDHINAGAR,GUJARAT.	Approved
		TEMPSSENS INSTRUMENTS (I) PVT LTD,UDAIPUR,RAJASTHAN	Approved
		BAUMER TECHNOLOGIES INDIA LTD,MUMBAI/VAPI	Approved
		WIKA INSTRUMENTS INDIA PVT. LTD,PUNE	Approved
62	Temperature Gauges	A.N.INSTRUMENTS PVT LTD, CHENNAI	Approved
		PRECISION MASS PRODUCTS PVT. LTD,GANDHI NAGAR(Earlier Aschcroft)	Approved
		BAUMER TECHNOLOGIES INDIA LTD,MUMBAI/VAPI	Approved
		FORBES MARSHALL(HYD) LTD., HYDERABAD	Approved
		GOA THERMOSTATIC INSTRUMENTS, GOA	Approved
		WIKA INSTRUMENTS INDIA PVT. LTD,PUNE	Approved
		BALDOTA VALVE AND FITTINGS PVT LTD,MUMBAI	Approved
		EXCEL HYDRO-PNEUMATICS PVT LTD, MUMBAI	Approved
		FLOWTECH, KOLKATA	Approved

Vendor List

SI No	Item	Vendor Name	Status
63	Valve Manifolds	Parker HANNIFIN INDIA PVT. LTD, LEBANON (M/s Super technical dealer for Parker)	Approved
		METPRESS ENGINEERING WORKS, KOLKATA	Approved
		MICRO PRECISION PRODUCTS PVT LTD, FARIDABAD	Approved
64	Vibration Monitoring System (Sensors, Monitors & Panel)	BENTLY NEVADA INC, MINDEN, U.S.A.	Approved
		MEGGITT SA, SWITZERLAND.	Approved
		SHINKAWA ELECTRIC CO., LTD, TOKYO, JAPAN	Approved
65	Mercury Analyzer	DURAG, BANGALORE (MAKE OF DURAG GERMANY)	Approved
		THERMO FISHER INDIA, MUMBAI (MAKE OF THERMO FISHER SCIENTIFIC CONTROL, USA)	Approved
		ANALYSER INSTRUMENTATION CO PVT LTD, KOTA, RAJASTHAN (MAKE OF PS ANALYTICAL, UK)	Approved
		SICK INDIA PVT LTD, MUMBAI (MAKE OF SICK GMBH, GERMANY)	Approved
66	24 V DC SMPS based Battery Charger	CHHABI ELECTRICALS PVT. LTD., JALGAON	Approved
		VERTIV ENERGY PVT LTD (FORMERLY EMERSON NETWORK POWER INDIA), Ambarnath	Approved
67	24 V DC thyristor based Battery Charger	CHHABI ELECTRICALS PVT. LTD., BANGALORE	Approved
		CHLORIDE POWER SYSTEMS & SOLUTIONS LTD, Kolkata	Approved
		STATCON POWER CONTROLS LTD., KULICHNAGAR, DHAULANA, HAPUR	Approved
68	Cable trays	shall be as per approved sources listed in Electrical Equipment list in Main Plant Package area.	
69	Electronic Transmitter - Pr. / Diff. Pr.	EMERSON PROCESS MANAGEMENT, Navi Mumbai	Approved
		FUJI ELECTRIC CO., LTD, OSAKI 1-CHOME, SHINAGAWA-KU, TOKYO	Approved
		HONEYWELL AUTOMATION INDIA LTD., PUNE	Approved
		YOKOGAWA ELECTRIC CORPORATION, TOKYO 180	Approved

Vendor List

Sl No	Item	Vendor Name	Status
		YOKOGAWA INDIA LIMITED,BANGALORE	Approved
70	Nickel-Cadmium Battery (Fiber type/Pocket type) for UPS and Charger	HBL POWER SYSTEMS LTD,Hyderabad	Approved
71	Flexible conduit (Lead Coated)	BANSAL LABORATORIES AND,GOVINDPURA INDL. AREA, BHOPAL	Approved
		PLICA INDIA PVT LTD,GHAZIABAD, U.P.	Approved
72	Flexible conduit (Zinc Coated)	BANSAL LABORATORIES AND,GOVINDPURA PLICA INDIA PVT LTD,GHAZIABAD, U.P.	Approved Approved
73	HART Communicator	ABB LIMITED,PEENYA INDL. AREA, BANGALORE.	Approved
		EMERSON PROCESS MANAGEMENT, Navi Mumbai	Approved
		HONEYWELL AUTOMATION INDIA LTD.,PUNE	Approved
		YOKOGAWA INDIA LIMITED,BANGALORE	Approved
74	Instrumentation & Control cables (PVC, FRLS Type)	ADVANCE CABLE TECHNOLOGIES (P) LTD.,GEDDALAHALLI,ASWATHNAGAR,BANGAL ORE	Approved
		DELTON CABLES LIMITED, FARIDABAD	Approved
		KEI INDUSTRIES LIMITED,BHIWADI	Approved
		LAPP INDIA PVT. LTD.,PHASE II, ANEKAL TALUK, BANGALORE	Approved
		POLYCAB WIRES PVT. LTD, DAMAN	Approved
		THERMO CABLES LIMITED, HYDERABAD	Approved
75	Junction Box (Explosion Flame Proof)	CHEMIN CONTROLS AND INSTRUMENTATION,PONDICHERRY	Approved
		ELECTRO MECHANICAL (INDIA),KOLKATA	Approved
		FLAMEPACK, Mumbai	Approved
		K.S.INSTRUMENTS PVT LTD,Yeshwantpur, Bangalore	Approved
		KHODAY CONTROL SYSTEMS PVT. LTD.,PEENYA INDUSTRIAL ESTATE, BANGALORE	Approved
		MANISHA COMPOSITEK PVT. LTD.,PUNE	Approved
		PRAMMEN INDUSTRIES,PUDUKKOTTAI	Approved
		PYROTECH ELECTRONICS (P) LTD.,UDAIPUR	Approved
76	Junction Box (FRP)	K.S.INSTRUMENTS PVT LTD,Bangalore	Approved
		CHEMIN CONTROLS AND INSTRUMENTATION,PONDICHERRY	Approved

Vendor List

SI No	Item	Vendor Name	Status
		MANISHA COMPOSITEK PVT. LTD.,PUNE	Approved
77	Junction Box (Metal)	CHEMIN CONTROLS AND INSTRUMENTATION,PONDICHERRY	Approved
		ELECTRO MECHANICAL (INDIA),KOLKATA	Approved
		K.S.INSTRUMENTS PVT LTD,BANGALORE	Approved
		KHODAY CONTROL SYSTEMS PVT. LTD, BANGALORE	Approved
		MANISHA COMPOSITEK PVT. LTD.,PUNE	Approved
		PRAMMEN INDUSTRIES,PUDUKKOTTAI	Approved
		PYROTECH ELECTRONICS (P) LTD.,UDAIPUR	Approved
78	Junction Boxes (Die cast aluminium)	PYROTECH ELECTRONICS (P) LTD.,UDAIPUR	Approved
		K.S.INSTRUMENTS PVT LTD,Yeshwantpur, Bangalore	Approved
		MANISHA COMPOSITEK PVT. LTD.,PUNE	Approved
79	Lead Acid - Plante Battery for UPS and Charger	shall be as per approved sources listed in Electrical Equipment list in Main Plant Package area.	
80	Lead Acid - Tubular Battery for UPS and Charger	shall be as per approved sources listed in Electrical Equipment list in Main Plant Package area.	
81	ULTRASONIC FLOW METERS	FLEXIM Flexible Industriemesstechnik GmbH	Approved
		NIVUS GMBH	Approved
82	Level Transmitter (RADAR type)	EMERSON PROCESS MANAGEMENT, Navi Mumbai	Approved
		ENDRESS + HAUSER (I) PVT. LTD.,L.B.S. Marg, Vikhroli (West), Mumbai	Approved
		MAGNETROL INTERNATIONAL NV,BELGIUM	Approved
		VEGA GRIESHABER K.G,SCHILTACH	Approved
83	Level Transmitter (Ultrasonic type)	SIEMENS,BANGALORE	Approved
		EMERSON PROCESS MANAGEMENT, Navi Mumbai	Approved
		ENDRESS + HAUSER (I) PVT. LTD.,L.B.S. Marg, Vikhroli (West), Mumbai	Approved
		ENDRESS+HAUSER GMBH+CO.KG,WEIL AM RHEIN	Approved

Vendor List

Sl No	Item	Vendor Name	Status
84	LT Power Cables (PVC / XLPE Insulation)	shall be as per approved sources listed in Electrical Equipment list in Main Plant Package area.	
85	Maintenance & Calibration Equipments (Electrical Package)	shall be as per approved sources listed in Electrical Equipment list in Main Plant Package area.	
86	Rigid Conduit	shall be as per approved sources listed in Electrical Equipment list in Main Plant Package area.	
87	RTD - TT Junction Box (FRP)	K.S.INSTRUMENTS PVT LTD, Yeshwantpur, Bangalore	Approved
		MANISHA COMPOSITEK PVT. LTD., PUNE	Approved
88	RTD - TT Junction Box (Metal)	CHEMIN CONTROLS AND INSTRUMENTATION, PONDICHERRY	Approved
		ELECTRO MECHANICAL (INDIA), KOLKATA	Approved
		K.S.INSTRUMENTS PVT LTD, Yeshwantpur, Bangalore	Approved
		KHODAY CONTROL SYSTEMS PVT. LTD., PEENYA INDUSTRIAL ESTATE, BANGALORE	Approved
		MANISHA COMPOSITEK PVT. LTD., PUNE	Approved
		PRAMMEN INDUSTRIES, PUDUKKOTTAI	Approved
		PYROTECH ELECTRONICS (P) LTD., UDAIPUR	Approved
89	Thermocouple extension cables (PVC, FRLS Type)	ADVANCE CABLE TECHNOLOGIES (P) LTD., GEDDALAHALLI, ASWATHNAGAR, BANGALORE	Approved
		DELTON CABLES LIMITED, FARIDABAD	Approved
		KEI INDUSTRIES LIMITED, BHIWADI	Approved
		POLYCAB WIRES PVT. LTD, DAMAN	Approved
		THERMO CABLES LIMITED HYDERABAD	Approved
89	UPS System with ACDB	VERTIV ENERGY PRIVATE LIMITED	Approved
		HITACHI HI-REL POWER ELECTRONICS, Gandhinagar	Approved
90	UPS System with ACDB ((3Ph I/p, 1Ph O/p) IGBT based Rectifier	VERTIV ENERGY PRIVATE LIMITED	Approved
		HITACHI HI-REL POWER ELECTRONICS, Gandhinagar	Approved

Vendor List

Sl No	Item	Vendor Name	Status
91	CCTV SYSTEM (IP BASED-OEM) WITH ACCESSORIES .	PELCO, USA	Approved
		BOSCH	Approved
		HONEYWELL, USA	Approved
92	CCTV SYSTEM (IP BASED) SYSTEM INTEGRATORS	HARITASA CHECKMATE ELECTRONICS, BANGALORE	Approved
		SCHNEIDER ELECTRIC, BANGALORE	Approved
		TYCO FIRE AND SECURITY, BANGALORE	Approved
		HONEYWELL AUTOMATION, BANGALORE	Approved
		Siemens, BANGALORE	Approved
		SCORE INFORMATION TECHNOLOGIES LTD, KOLKATA	Approved
		WIPRO INFOTECH, BANGALORE	Approved
93	Public Addressing System (IP BASED-OEM)	ECIL, HYDERABAD	Approved
		COMMEND, AUSTRIA	Approved
		INDUSTRONICS, GERMANY	Approved
		ARMTEL, RUSSIA	Approved
94	Public Addressing System (IP BASED) SYSTEM INTEGRATORS	ZENITEL, SWEDEN	Approved
		AISHAN TECHNOLOGIES INDIA PVT LTD, BANGALORE	Approved
		INDUSTRONIC & INDCOM ENGINEERS	Approved
95	Large Video Screen	BARCO ELECTRONICS , NOIDA	Approved
		PLANER-USA /PYROTECH-UDAIPUR	Approved
		CHRISTIE-USA	Approved
96	MODULAR DESK/CRT Desk	PYROTECH WORKSPACE SOLUTIONS PVT LTD , UDAIPUR	Approved
		CHEMIN CONTROLS AND INSTRUMENTATION , PONDICHERRY	Approved
		COSMOS MEDIA PRODUCTS PVT LTD , NOIDA	Approved
		HARMONY SYSTEMS , NEWDELHI	Approved
97	CONTROL PANEL/RACK	PYROTECH	Approved
		RITTAL	Approved
		BHEL	Approved
98	Dot matrix Printer	WIPRO	Approved
		EPSON	Approved
		TVS	Approved
		LEXMARK	Approved
99	WORKSTATIONS , SERVER, PC'S	DELL	Approved
		HP	Approved

Vendor List

SI No	Item	Vendor Name	Status
100	PRINTERS (Laser/Inkjet)	HP	Approved
101	TFT MONITOR	DELL HP	Approved Approved
102	MINI UPS FOR HMI	HITACHI HI-REL POWER ELECTRONICS, BANGALORE POWERTRONIX SYSTEMS LTD., BANGALORE. SCHNEIDER ELECTRIC, BANGALORE EMERSON NETWORK INDIA, BANGALORE EMERSON NETWORK, PUNE	Approved Approved Approved Approved Approved
103	GIU	DIGITAL INSTRUMENTS & CONTROL SYSTEMS SSM INFOTECH SOLUTIONS PVT LTD. SCHNEIDER ELECTRIC INDIA PVT LTD, BANGALORE ROCKWELL AUTOMATION INDIA PVT LTD. ADVANCE TECH CONTROLS PVT. LTD.	Approved Approved Approved Approved Approved
104	STATION LAN EQUIPMENT	BHEL Approved Makes	
105	OFC	AKASH SOLAR SYSTIMAX BIRLA ERICSSON, REWA MOLEX TYCO	Approved Approved Approved Approved Approved
106	Turbine Supervisory System	MEGGITT SA, SWITZERLAND. BENTLY NEVADA INC. (GE OIL & GAS), U.S.A. SHINKAWA ELECTRIC CO. LTD., JAPAN	Approved Approved Approved
107	FEP insulated cables	DELTON CABLES, NEW DELHI HABIA CABLES, SWEDEN/CHINA LAPP CABLES, GERMANY LEONI KERPEN, GERMANY THERMOELECTRIC, USA	Approved Approved Approved Approved Approved
108	PTFE insulated Cables	ADVANCE CABLES TECHNOLOGIES, BANGALORE DELTON CABLES, NEW DELHI THERMOCABLES LIMITED CORDS CABLE INDUSTRIES LIMITED., TEMPSENS INSTRUMENTS (I) PVT LTD, UDAIPUR UNIVERSAL CABLES LIMITED, SATNA	Approved Approved Approved Approved Approved Approved

Vendor List

Sl No	Item	Vendor Name	Status
109	CONVERTERS/ INVERTORS AC, DC DRIVES	ROCKWELL AUTOMATION INDIA PVT., LTD.,	Approved
		SIEMENS INDIA LTD.	Approved
		KIRLOSKAR ELECTRIC COMPANY LIMITED.,	Approved
		LARSEN & TOUBRO LIMITED	Approved
		HIREL ELECTRONICS, GANDHINAGAR	Approved
		ABB LIMITED	Approved
110	PULSE JET CONTROLLER	SWITCHING CIRCUIT	Approved
		ADVANCE CONCEPT	Approved
		VOLTCRAFT	Approved
		SQUARE M	Approved
		MICRO SYSTEM	Approved
111	PLC / SCADA	ROCKWELL AUTOMATION INDIA PVT., LTD.,	Approved
		GE INTELLIGENT PLATFORMS PVT LTD	Approved
		SIEMENS INDIA LTD.	Approved
		LARSEN & TOUBRO LIMITED	Approved
		ABB LIMITED	Approved
		SCHNEIDER ELECTRIC INDIA PVT.LTD.	Approved
112	LIMIT SWITCHES	KA SCHMERSAL, GERMANY	Approved
		JOHAN VOLLENBROICH, GERMANY	Approved
		IFM ELECTRONIC, GERMANY	Approved
		JAYASHREE ELECTRON PVT. LTD,	Approved
		SIEMENS INDIA LTD.	Approved
		BCH ELECTRIC LIMITED	Approved
		PEPPERL+FUCHS(INDIA) PVT LTD	Approved
		JAI BALAJI & CO., CHENNAI	Approved
		ELECTRO MECHANICAL INDIA, KOLKATA	Approved
		AG SYSTEMS, (AG ELECTRONICS)MUMBAI	Approved
		BETA SYSTEMS ENGINEERING	Approved
113	PULLCHORD SWITCHES/BELT SWAY SWITCHES (BELT MONITORING / CONVEYOR SAFETY SWITCHES , AC/DC TACHOGENERATORS , SERVOMOTORS, DIGITAL DRIVES AND SELSYN MOTORS)	JAYASHREE ELECTRODEVICES PVT. LTD.,	Approved
		BETA SYSTEMS ENGINEERING	Approved
		PROTOCONTROL INSTRUMENTS (I) PVT LTD	Approved
		KANT: RUBBER PVT. LTD	Approved
		MAHAVEER ENGINEERING	Approved
		SUMAN CONTROLS, BANGALORE	Approved
		JYOTHI RUBBER UDYOG, GHAZIABAD	Approved
		SLN ENTERPRISES, BANGALORE	Approved

Vendor List

SI No	Item	Vendor Name	Status
114	SAFETY ITEMS (RUBBER MATS,DANGER BOARDS ETC.)	PROGRESSIVE RUBBER WORKS	Approved
		VARDHAMAN HOSES PRIVATE LIMITED	Approved
		PREMIER POLYFILM LTD	Approved
		RMG POLY VINLY INDIA LTD	Approved
		KAN POWER RUBBER INDUSTRIES, BANGALORE	Approved
		ARADHANA AGENCY	Approved

**SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)**

SL. NO.	Item Description	Vendor Name	Remarks
1	FIRE PROTECTION, FIRE DETECTION AND ALARM SYSTEM PACKAGE	TECHNICO (INDIA) PVT. LTD.	Approved
		AGNICE FIRE PROTECTION PVT. LTD.	Approved
		HITEK ENGINEERING SERVICES	Approved
		STERLING AND WILSON PVT LTD	Approved
		MX SYSTEMS INTERNATIONAL PVT. LTD.	Approved
		UTC FIRE & SECURITY INDIA LIMITED.	Approved
		NITIN FIRE PROTECTION INDUSTRIES LI	Approved
		TYCO FIRE & SECURITY INDIA	Approved
		FIREPRO SYSTEMS PVT. LTD.	Approved
		CONSILIUM MIDDLE EAST (FZC)	Approved
		DE S TECHNICO PRIVATE LIMITED	Approved
		THERMOSYSTEMS PRIVATE LIMITED.	Approved
2	HYDRANT VALVES	SHAH BHOGILAL	Approved
		SUKAN	Approved
		NEWAGE	Approved
		VENUS	DR
		WINCO	DR
		ASCO STRUMECH PVT. LTD.	Approved
3	FIRE HOSES	NEWAGE	Approved
		CHATTARIA RUBBER	Approved
		Sukan Equipments Pvt Ltd	Approved
		SHAH BHOGILAL JETHALAL & BROTHERS	Approved
4	WATER MONITOR & WATER-CUM FOAM MONITORS	SHAH BHOGILAL	Approved
		HD FIRE	Approved
		NEW AGE	Approved
5	BRANCH PIPE, NOZZLES, COUPLINGS & FIRE BRIGDAE CONNECTIONS	SUKAN	Approved
		VENUS	Approved
		NEW AGE	Approved
		WINCO	DR
		ASCO STRUMECH PVT. LTD.	Approved
		SHAH BHOGILAL JETHALAL & BROTHERS	Approved
6	DELUGE VALVES	HD FIRE	Approved
		TYCO (GRINELL)	Approved
		KIDDE (I) LTD.	Approved
7	HVW/ MVW SPRAY NOZZLE	KIDDE (I) LTD.	Approved
		TYCO	Approved
		HD FIRE	Approved
		ASCO STRUMECH PVT. LTD.	Approved
		NEWAGE FIRE FIGHTING CO. LTD.	Approved
		SHAH BHOGILAL JETHALAL & BROTHERS	Approved

Vendor List

SL. NO.	Item Description	Vendor Name	Remarks
8	QUARTZOID BULB SPRINKLERS/DETECTORS	TYCO(GRINELL)	Approved
		HD FIRE	Approved
		NEWAGE INDUSTRIES	Approved
9	HYDRO PNEUMATIC TANK	ARC WELD ENGINEERS	Approved
10	MICROPROCESSOR BASED FIRE ALARM PANEL	SIMPLEX	DR
		SCHRACK	Approved
		DETECTOMAT	Approved
		GENT	DR
11	LHS CABLE (FO Type) LHS CABLE (Intelligent Addressable Thermal Sensor Based)	AP SENSING, Germany	Approved
		SENSA, UK	Approved
		Listec (Schrack)	Approved
12	FOAM PUMP	DEL PD PUMPS & GEARS	Approved
13	FOAM TANKS	ARC WELD ENGINEERS	Approved
		HD FIRE PROTECT PVT. LTD.	DR
14	ADDRESSABLE MULTISENSOR TYPE DETECTORS	SIMPLEX	DR
		SCHRACK	Approved
		DETECTOMAT	Approved
		GENT	DR
15	ADDRESSABLE PHOTO ELECTRIC TYPE DETECTORS	SIMPLEX	DR
		SCHRACK	Approved
		DETECTOMAT	Approved
		GENT	DR
16	ADDRESSABLE HEAT DETECTORS	SIMPLEX	DR
		SCHRACK	Approved
		DETECTOMAT	Approved
		GENT	DR
17	INFRA RED DETECTORS	PATOL	Approved
		SYSTEM SENSOR	Approved
18	COATING & WRAPPING MATERIAL/ TAPE (COAL TAR BASED)	IWL LTD.	Approved
		RUSTECH	Approved
19	INERT GAS SYSTEM	GINGEKERR	Approved
		ANSUL	Approved
		SRI	Approved
		SIEMENS	Approved
		UTC FIRE & SECURITY INDIA LIMITED. / (KIDDE)	Approved
20	BATTERY	EXIDE	Approved
		AMCO	Approved
		HOPPECKE BATTERIEN GMBH & CO KG	DR
		AMARA RAJA POWER SYSTEMS LTD	Approved

Sagardighi Extn. U#5 (PROJ3)

FP-5/1433

Vendor List

SL. NO.	Item Description	Vendor Name	Remarks
21	FIRE SURVIVAL CABLES	POLYCAB	Approved
		RRKABEL	Approved
		KEI	Approved
		DELTON	Approved
22	HOSE REEL	SIEMENS	DR
		WINCO	Approved
		NEWAGE FIRE FIGHTING CO. LTD.	Approved
		Sukan Equipments Pvt Ltd	Approved
23	FIRE EXTINGUISHER (BIS APPROVED SOURCES WITH VALID LICENSE)	NITIN FIRE PROTECTION INDUSTRIES LI	DR
		KANADIA FYR FYTER PVT. LTD.	Approved
		SAFEX FIRE SERVICES LTD.	Approved
		KIDDE	Approved
24	PROBE TYPE HEAT DETECTOR	TYCO	Approved
Additional Items			
25	LT MOTORS	As per Approved Electrical Vendor List	
26	H.T. MOTORS (SAFE/HAZARDOUS AREA)	SIEMENS LTD	Approved
		ABB INDIA LIMITED, HYD	Approved
		KIRLOSKAR ELECTRIC CO. LTD.	Approved
		CG POWER & INDUSTRIAL SOLUTIONS	Approved
		BHEL BHOPAL	Approved
27	CABLE TRAYS	As per Approved Electrical Vendor List	
28	LEVEL GUAGES (MAGNETIC TYPE)	As per Approved C&I Vendor List	
29	PRESSURE GAUGES	As per Approved C&I Vendor List	
30	SAFETY RELIEF VALVES	INSTRUMENTATION LTD	Approved
		FORBES MARSHALL LTD.,	Approved
		UNI KLINGER LTD.	DR
		ANDERSON GREENWOOD CROSBY	Approved
31	GASKETS	BHEL Approved Sources	
32	FLANGES	BHEL Approved Sources	
33	STRAINERS (Y-TYPE / T-TYPE /	As per Approved Mechanical Vendor List	
34	VALVES- GATE/GLOBE/REG.GLOBE/NON- RETURN; MAT: CS/AS/SS; PR.CL.#150,#300,#800	LEADER VALVES LIMITED	Approved
		INTERVALVE POONAWALLA LIMITED	Approved
		MICON VALVES (I) PVT. LTD.	Approved
		WEIR BDK VALVES	Approved
		FLOTEK INDUSTRIES	Approved
		L & T VALVES LIMITED	Approved
		FOURESS ENGINEERING (I)PVT.LTD	Approved
		Any other Vendors as per Approved Mechanical Vendor List	

Vendor List

SL. NO.	Item Description	Vendor Name	Re
35	BUTT WELDED PIPE FITTINGS	BHEL Approved Sources	
36	BOLTING MATERIAL	BHEL Approved Sources	
37	WELDED PIPES UP TO 14" (M.S & G.I)	BHEL Approved Sources	
38	FOAM POURER AND GENERATION EQUIPMENTS FOR FIRE PROTECTION SYSTEMS	SHAH BHOGILAL JETHALAL & BROTHERS	Approved
		NEWAGE FIRE FIGHTING CO. LTD.	Approved
		HD FIRE PROTECT PVT. LTD.	Approved
39	BALANCE PROPORTIONER FOR FIRE PROTECTION SYSTEMS	HD FIRE PROTECT PVT. LTD.	Approved
		SHAH BHOGILAL JETHALAL & BROTHERS	Approved
40	FIRE WATER PUMPS	WPIL LIMITED	Approved
		WILO MATHER AND PLATT PUMPS	Approved
		KIRLOSKAR BROTHERS LTD	Approved
41	HOSE CABINETS FOR FIRE PROTECTION SYSTEMS	SHAH BHOGILAL JETHALAL & BROTHERS	Approved
		NEWAGE FIRE FIGHTING CO. LTD.	Approved
		Sukan Equipments Pvt Ltd	Approved
		ASCO STRUMECH PVT. LTD.	Approved
42	AIR RELEASE VALVES FOR FIRE PROTECTION SYSTEMS	SHAH BHOGILAL JETHALAL & BROTHERS	Approved
		NEWAGE FIRE FIGHTING CO. LTD.	Approved
43	CAST IRON VALVES (GATE/SLUICE AND CHECK)	As per Approved Mechanical Vendor List	
44	SOCKET WELDED / SCREWED WELDED PIPE FITTINGS	BHEL Approved Sources	
45	SOLENOID VALVES	As per Approved C&I Vendor List	
46	PRESSURE AND DIFFERENTIAL	As per Approved C&I Vendor List	
47	N2 BASED FIRE PROTECTION SYSTEM	CTR MANUFACTURING INDUSTRIES LTD. NAGPUR	Approved
		EASUN-MR TAP CHANGERS (P) LTD, CHENNAI	DR
		SERGI TRANSFORMER EXPLOSION PREVENTION, GURGAON (HARYANA)	Approved

**SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)**

Sl. No.	Item Description		Remarks
1	AIRCONDITIONING SYSTEM	Blue Star Ltd.	Accepted
		ADVANCE VENTILATION PVT.LTD.	DR
		ROOTS COOLING SYSTEMS PVT. LTD.	DR
		STERLING AND WILSON PRIVATE LIMITED	Accepted
		VOLTAS LTD.	Accepted
2	VENTILATION SYSTEM	ADVANCE VENTILATION PVT.LTD.,Sonepat	DR
		C.DOCTOR and CO. PVT.LTD , Kolkata	Accepted
		HYDERABAD POLLUTION CONTROLS LIMITED, HYDERABAD	Accepted
		STERLING AND WILSON PRIVATE LIMITED	Accepted
		ROOTS COOLING SYSTEMS PVT. LTD., Noida	DR
		VOLTAS LTD. , THANE WEST	Accepted
3	AIR WASHER & UAF	HYDERABAD POLLUTION CONTROL	Approved
		ADVANCE VENTILATION	Approved
		DRAFT AIR	Approved
		BLUE STAR	Approved
		VOLTAS	Approved
		STERLING WILSON	Approved
		ROOTS COOLING SYSTEM	Approved
		C DOCTOR	Approved
4	CENTRIFUGAL FAN	FLAKT	Approved
		KRUGER	Approved
		DRAFT AIR	Approved
		HYDERABAD POLLUTION CONTROL	Approved
		ADVANCE VENTILATION	Approved
		PATEL AIR	Approved
		MARATHON	Approved
		C DOCTOR	Approved
		SARLA	Approved
5	FRESH AIR/ SUPPLY/ EXHAUST/ RE UNIT FANS / PROPELLAR	HYDERABAD POLLUTION CONTROL	Approved
		ADVANCE VENTILATION	Approved
		KRUGER	Approved
		NICOTRA	Approved
		MARATHON	Approved
		FLAKT	Approved
		C DOCTOR	Approved
		KHAITAN	Approved
6	PUMPS	BEST & CROMPTON	Approved
		JYOTI	Approved
		SAM TURBO	Approved
		KBL	Approved
		KSB	Approved
		M&P	Approved
		VOLTAS	DR
		WORTHINGTON	Approved
		SAGARDIGHI EXTENSION (PROJ3)	Approved
		SULZER PUMPS INDIA LTD.	Approved

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

Sl. No.	Item Description		Remarks
1	AIRCONDITIONING SYSTEM	Blue Star Ltd.	Accepted
		ADVANCE VENTILATION PVT.LTD.	DR
		ROOTS COOLING SYSTEMS PVT. LTD.	DR
		STERLING AND WILSON PRIVATE LIMITED	Accepted
		VOLTAS LTD.	Accepted
2	VENTILATION SYSTEM	ADVANCE VENTILATION PVT.LTD.,Sonepat	DR
		C.DOCTOR and CO. PVT.LTD , Kolkata	Accepted
		HYDERABAD POLLUTION CONTROLS LIMITED, HYDERABAD	Accepted
		STERLING AND WILSON PRIVATE LIMITED	Accepted
		ROOTS COOLING SYSTEMS PVT. LTD., Noida	DR
		VOLTAS LTD. , THANE WEST	Accepted
		FLOWSERVE INDIA CONTROL PVT LTD	Approved
7	LV MOTORS (NON FLAME PROOF)	SIEMENS	Approved
		ABB	Approved
		CGL	Approved
		MARATHON	Approved
		KEC	DR
		BHARAT BIJLEE	Approved
		NGEF	Approved
8	AIR FILTER	PUROLATOR	Approved
		FMI	Approved
		ANFILCO	Approved
		JOHN FOWLER	Approved
		SPECTRUM	Approved
		AIR TECH	Approved
		PUROMATIC	Approved
9	INSULTATION MATERIAL	BEARDSHEL	Approved
		ARMAFLEX	Approved
		LLOYDS	Approved
		UP TWIGA	Approved
		AEROCCELL	Approved
10	FIRE DAMPER	CARRYAIRE	Approved
		RAVISTAR (SYSTEM AIR)	Approved
11	GRILL/ DIFFUSER/ VOLUME CONTROL DAMPER	CARRYAIRE	Approved
		RAVISTAR (SYSTEM AIR)	Approved
12	HUMIDISTAT	JHONSON CONTROL	Approved
		HONEYWELL AUTOMATION	Approved
		PENN	Approved
		CARRIER	Approved
		BLUE STAR	Approved

Sagardighi Extension (11/5/2013)

HVAL System

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**SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)**

Sl. No.	Item Description		Remarks
1	AIRCONDITIONING SYSTEM	Blue Star Ltd.	Accepted
		ADVANCE VENTILATION PVT.LTD.	DR
		ROOTS COOLING SYSTEMS PVT. LTD.	DR
		STERLING AND WILSON PRIVATE LIMITED	Accepted
		VOLTAS LTD.	Accepted
2	VENTILATION SYSTEM	ADVANCE VENTILATION PVT.LTD.,Sonepat	DR
		C.DOCTOR and CO. PVT.LTD , Kolkata	Accepted
		HYDERABAD POLLUTION CONTROLS LIMITED, HYDERABAD	Accepted
		STERLING AND WILSON PRIVATE LIMITED	Accepted
		ROOTS COOLING SYSTEMS PVT. LTD., Noida	DR
		VOLTAS LTD. , THANE WEST	Accepted
13	SCREW CHILLER	VOLTAS	Approved
		MCQUAY (DAIKIN)	Approved
		CLIMAVENETA	Approved
14	PRECISION AC	UNIFLAIR	Approved
		BLUEBOX	Approved
		EMERSON PROCESS MANAGEMENT	Approved
		CLIMAVENETA	Approved
15	SPLIT AC	VOLTAS	Approved
		BLUE STAR	Approved
		CARRIER	Approved
		HITACHI	Approved
		DAIKIN	Approved
16	AIR HANDLING UNITS	ZECO	Approved
		CARRYAIRE (flakt)	Approved
		EDGETECH	Approved
		SYSTEM AIR	Approved
17	AHU FAN (CENTRIFUGAL FAN)	C DOCTOR	Approved
		FLAKT	Approved
		KRUGER	Approved
		NICOTRA	Approved
		COMEFRI	Approved
		MARATHON	Approved
		ADVANCE	Approved
		DRAFT AIR	Approved
18	PUMPS	HYDERABAD POLLUTION	Approved
		JYOTI	Approved
		SAM TURBO	Approved
		KBL	Approved
		KSB	Approved
		M&P	Approved
		VOLTAS	Approved

Sagardighi Extn. Unit#5 (P-ROJ3)

HVAC System

219 of 433

**SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)**

Sl. No.	Item Description		Remarks
1	AIRCONDITIONING SYSTEM	Blue Star Ltd.	Accepted
		ADVANCE VENTILATION PVT.LTD.	DR
		ROOTS COOLING SYSTEMS PVT. LTD.	DR
		STERLING AND WILSON PRIVATE LIMITED	Accepted
		VOLTAS LTD.	Accepted
2	VENTILATION SYSTEM	ADVANCE VENTILATION PVT.LTD.,Sonepat	DR
		C.DOCTOR and CO. PVT.LTD , Kolkata	Accepted
		HYDERABAD POLLUTION CONTROLS LIMITED, HYDERABAD	Accepted
		STERLING AND WILSON PRIVATE LIMITED	Accepted
		ROOTS COOLING SYSTEMS PVT. LTD., Noida	DR
		VOLTAS LTD. , THANE WEST	Accepted
		BEACON-WEIR	Approved
		WORTHINGTON	Approved
		SULZER PUMPS INDIA LTD.	Approved
		FLOWSERVE INDIA CONTROL PVT LTD	Approved
19	COOLING TOWER	PAHARPUR COOLING TOWER	Approved
20	LV MOTORS (NON FLAME PROOF)	SIEMENS	Approved
		ABB	Approved
		CGL	Approved
		MARATHON	Approved
		BHARAT BIJLEE	Approved
		NGEF	Approved
		JYOTI	Approved
21	AIR FILTER	PUROLATOR	Approved
		FMI	Approved
		ANFILCO	Approved
		TENACITY	Approved
		JOHN FOWLER	Approved
		SPECTRUM	Approved
		AIR TECH	Approved
		PUROMATIC	Approved
22	BALANCING VALVE	ADVANCE	Approved
23	4 WAY MIXING VALVE WITH ACTUATING MOTOR	SIEMENS BUILDING TECHNOLOGY	Approved
		JOHNSON	Approved
		HONEYWELL AUTOMATION	Approved
24	Y / POT STRAINER	MULTITEX	Approved
		GREAVES COTTON	Approved
		JAYPEE	Approved
		OTOKLIN	Approved
		GUJARAT OTOFILT	Approved
		SAROJINI ENTERPRISE	Approved

Sagardighi Extension Unit#5 (PROJ)

HVA System

**SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)**

Sl. No.	Item Description		Remarks
1	AIRCONDITIONING SYSTEM	Blue Star Ltd.	Accepted
		ADVANCE VENTILATION PVT.LTD.	DR
		ROOTS COOLING SYSTEMS PVT. LTD.	DR
		STERLING AND WILSON PRIVATE LIMITED	Accepted
		VOLTAS LTD.	Accepted
2	VENTILATION SYSTEM	ADVANCE VENTILATION PVT.LTD.,Sonepat	DR
		C.DOCTOR and CO. PVT.LTD , Kolkata	Accepted
		HYDERABAD POLLUTION CONTROLS LIMITED, HYDERABAD	Accepted
		STERLING AND WILSON PRIVATE LIMITED	Accepted
		ROOTS COOLING SYSTEMS PVT. LTD., Noida	DR
		VOLTAS LTD. , THANE WEST	Accepted
		FILTERATION ENGINEERS INDIA PVT LTD	Approved
25	STRIP HEATER	ESCORTS	Approved
		RACOLDS	Approved
		ALCO	Approved
		HEATCO	Approved
26	PAN HUMIDIFIER	RAPID COOL	Approved
		HOTSET	Approved
		ALCO	Approved
27	RELIEF / PURGE VALVE	BRASSOMATIC	Approved
28	THERMOSTATS	HONEYWELL AUTOMATION	Approved
		RANCO	Approved
		PENN	Approved
		DANFOSS	Approved
		RANUTROL	Approved
		INDFOSS JHONSON CONTROL	Approved
29	ANTI FREEZE THERMOSTAT	RANCO	Approved
		HONEYWELL AUTOMATION	Approved
		PENN	Approved
		DANFOSS	Approved
		INDFOSS	Approved
30	RH SENSOR/TEMP SENSOR	HONEYWELL AUTOMATION	Approved
		JOHNSON	Approved
		SIEMENS	Approved
		GENERAL INSTRUMENT CONSORTIUM	Approved
31	WATER SOFTENING PLANT	THERMAX	Approved
		ION EXCHANGE	Approved

**SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)**

Sl. No.	Package Description	Vendor Name	Remarks
1	Civil Sub-structure pkg. (Piling & pile cap)	M/s SIMPLEX INFRASTRUCTURES LIMITED	Approved
		BRIDGE & ROOF CO. (INDIA) LTD.	Approved
		PARESH CONSTRUCTION AND FOUNDATIONS PVT. LTD.	Approved
		L&T GEOSTRUCTURE LLP.	Approved
		AKASHGANGA INFRAVENTURES INDIA LTD.	Approved
		M/s NAVAYUGA ENGINEERING COMPANY LIMITED	DR
2	Civil Super-structure pkg.	M/s JMC PROJECTS (INDIA) LIMITED.	DR
		M/s SIMPLEX INFRASTRUCTURES LIMITED	Approved
		M/s BRIDGE & ROOF CO. (INDIA) LIMITED	Approved
3	Boiler Aux.	M/s POWER MECH PROJECTS LIMITED	Approved
		M/s BRIDGE & ROOF CO. (INDIA) LIMITED	Approved
		M/s INDWELL CONSTRUCTIONS PVT. LIMITED	Approved
		M/s BHAVANI ERECTORS PVT. LIMITED	Approved
4	STG & Aux.	M/s POWER MECH PROJECTS LIMITED	Approved
		M/s INDWELL CONSTRUCTIONS PVT. LIMITED	Approved
5	C&I	M/s POWERTRONIX ENGINEERING PVT. LIMITED	Approved
		M/s EDAC ENGINEERING LIMITED	Approved
6	Electrical	M/s POWERTRONIX ENGINEERING PVT. LIMITED	Approved
		M/s PRV CONSTRUCTIONS PVT LIMITED	Approved
		M/s SIGMA CONSTRUCTION	Approved
		M/s TECHNO ELECTRIC & ENGINEERING CO LIMITED	Approved
		M/s EDAC ENGINEERING LIMITED	Approved
		M/s PACE PROCESS CONTROLS PVT. LIMITED	DR

Sagardighi Ext'n. U-45 (PROJ3)

PSER ERECTION

Ref: SCMP03/AV/8/047

Annexure - 2

MANUFACTURER'S		STANDARD QUALITY PLAN				PROJECT		1x660 MW SAGARDIGHI TPS		
NAME & ADDRESS :										
ITEM : CW CHEMICAL TREATMENT.		QP.NO :				PACKAGE				
		REV. : 0				CONTRACT NO.				
		DATE :				COTRACTOR				
		PAGE : 1 OF 10								
S.NO.	COMPONENTS/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/ METHOD CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY** M C N	REMARKS
1	2	3	4	5	6	7	8	9	D* 10	11
1.0	WELDER'S QUALIFICATION									
1.1	WELDING PROCEDURE SPECIFICATION (WPS)	CORRECTNESS	MA	SCRUTINY	100%	ASME IX	ASME IX	QW 482	P V V	
1.2	WELDER PERFORMANCE QUALIFICATION RECORD (PQR)	WELD SOUNDNESS	MA	PHYSICAL TEST	ASME IX	ASME IX	ASME IX	QW 483 QW 484	P V V	
2.0	TANKS, BOTTOM ENDS, FLANGES									
2.1	RAW MATERIAL :									
2.1.1	PLATE	CHEMICAL & PHY. PROPERTIES	MA	CHEMICAL & PHY. TEST	1/PLATE	APPD. DWG/DATA SHEET	APPD. DWG/DATA SHEET	MFG.TC/LAB REPORT	P V V	IDENTIFICATION BY BHEL
		INTERGRANULAR CORROSION TEST	MI	CORROSION TEST	1/PLATE	APPD. DWG/DATA SHEET	APPD. DWG/DATA SHEET			
2.1.2	PIPE FOR NOZZLE	CHEMICAL & PHY. PROPERTIES	MA	CHEMICAL & PHY. TEST	1/HEAT/SIZE	APPD. DWG/DATA SHEET	APPD. DWG/DATA SHEET	MFG.TC/LAB REPORT	P V V	
		MICRO STRUCTURE	MI	GRAIN STRUCTURE	1/HEAT/SIZE	FOR HEAT TREATMENT	FOR HEAT TREATMENT	DO DO	P V V P V V	\$ REFER NOTE-6
		CORROSION TEST HYDRO TEST	MI NA	CORROSION TEST LEAKAGE	1/HEAT/SIZE 100%	ASTM A 262 PR.'E' NO LEAKAGE	ASTM A 262 PR.'E' NO LEAKAGE	DO MFG. TC/IR	P V V P V V	
		FOR BHEL	LEGEND :				FOR CUSTOMER USE	DOC NO.		
		* RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.								
		** M : MANUFACUTRER/SUB-CONTRACTOR								
		C : CONTRACTOR/NOMINATED INSPECTION AGENCY				N: OWNER				
MANUFACTURER/ SUB CONTRACTOR	CONTRACTOR	INDICATE "P" PERFORM, "W" WITNESS, AND "V" VERIFICATION								
SIGNATURE		AS APPROPRIATE, "CHP" CUSTOMER SHALL IDENTIFIED IN COLUMN "N".				REVIEWED BY		NAME & SIGN OF APPROVING AUTHORITY		

MANUFACTURER'S		STANDARD QUALITY PLAN				PROJECT		1x660 MW SAGARDIGHI TPS		
NAME & ADDRESS :										
		ITEM : CW CHEMICAL TREATMENT.		QP.NO :		PACKAGE				
				REV. : 0		CONTRACT NO.				
				DATE :		COTRACTOR				
				PAGE : 2 OF 10						
S.NO.	COMPONENTS/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/ METHOD CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY** M C N	REMARKS
1	2	3	4	5	6	7	8	9	D* 10	11
2.2	IN PROCESS									
2.2.1	BOTTOM ENDS	DIMENSIONS	MA	MEASUREMENT WITH TEMPLATE	100%	APPD.DWG.	APPD.DWG.	MFG.TC./LAB REPORT	P V V	
		SURFACE DEFECTS		DP TEST	100%	ASTM E 165	NO SURFACE DEFECTS	MFG.TC	P V V	
		ON WELDMENTS								
2.3	FINAL ASSEMBLY :	DIMENSIONS & ORIENTATION	MA	MEASUREMENT	100%	APPD.DWG.	APPD.DWG.	MFG.TC	P V V	
2.3.1		LEAKAGE	MA	WATER FILL FOR 2 HOURS	100%	APPD.DWG.(BY BHEL)	NO LEAKAGE	MFG.TC	P V V	
3.0	STIRRER :									
3.1	RAW MATERIAL FOR SHAFT	CHEMICAL & PHY. PROPERTIES	MA	CHEMICAL & PHY. TEST	1/BAR/ HEAT	APPD. DWG/DATA SHEET	APPD. DWG/DATA SHEET	MFG.TC/LAB REPORT	P V V	
		INTERGRANULAR CORROSION TEST	MA	CORROSION TEST	DO	ASTM A 262 PR.'E'	ASTM A 262 PR.'E'	DO		
3.2	IMPELLER	CHEMICAL PROP.	MA	CHEMICAL MECHANICAL TEST	1/PLATE	ASTM A 240 GR.TP 304	ASTM A 240 GR.TP 304	MFG.TC/LAB REPORT	P V V	
		FOR BHEL	LEGEND :					DOC NO.		
		* RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.				FOR CUSTOMER USE				
		** M : MANUFACUTRER/SUB-CONTRACTOR								
		C : CONTRACTOR/NOMINATED INSPECTION AGENCY				N: OWNER				
MANUFACTURER/ SUB CONTRACTOR		CONTRACTOR		INDICATE "P" PERFORM, "W" WITNESS, AND "V" VERIFICATION						
SIGNATURE		AS APPROPRIATE, "CHP" CUSTOMER SHALL IDENTIFIED IN COLUMN "N".				REVIEWED BY		NAME & SIGN OF APPROVING AUTHORITY		

MANUFACTURER'S		STANDARD QUALITY PLAN				PROJECT		:		1x660 MW SAGARDIGHI TPS		
NAME & ADDRESS :		ITEM : CW CHEMICAL TREATMENT.		QP.NO :		PACKAGE		:				
				REV. : 0		CONTRACT NO.		:				
				DATE :		COTRACTOR		:				
				PAGE : 3 OF 10								
S.NO.	COMPONENTS/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/ METHOD CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY**		REMARKS
1	2	3	4	5	6	7	8	9	D*	10		11
3.3	COMPLETE UNIT WITH MOTOR	PERFORMANCE IN WATER FILL TANK	MA									
		- VIBRATION		MEASUREMENT	100%	APPD.DWG/DATA SHEET	APPD.DWG/DATA SHEET	MFG.TC		P	V	V
		- WOBBLING		VISUAL	100%							
		- POWER CONSUMPTION OR CURRENT DRAWN		MEASUREMENT	100%	APPD.DWG/DATA SHEET	APPD.DWG/DATA SHEET	MFG.TC				
4.0	MOTORS :											
		ROUTINE & TYPE TEST,	MA	VERIFICATION OF	100% FOR	APPD.DATA SHEET	APPD.DATA SHEET	MFG.TC/LAB		P	V	V
		DEGREE OF		TEST CERTIFICATES	ROUTINE TEST			REPORT				SHALL BE AS
		PROTECTION			& 1/SIZE FOR							PER APPD.LIST
					TYPE TEST							
					& DEGREE OF							
					PROTECTION							
5.0	METERING PUMP & PRESSURE RELIEF VALVE :											
	(PUMPS SHALL BE PROCURED FROM BHEL APPD.SOURCE)											
5.1	RAW MATERIAL :											
5.1.1	WETTED PARTS	CHEMICAL & PHY.	MA	CHEMICAL. & MECH.	1/BAR	APPD.DWG./DATA SHEET	APPD.DWG./DATA SHEET	MFG.TC/LAB REPORT		P	V	V
		PROPERTIES		TEST								
		SURFACE TEST		UT ON BAR>25 MM DIA	100%	ASTM A 388	REF. NOTE # 1	MFG.TC/LAB REPORT				
				DP ON M/C SURFACE	100%	ASME - E - 165	NO SURFACE DEFECTS	MFG.TC/LAB REPORT				
		FOR BHEL	LEGEND :									
			* RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY				FOR CUSTOMER USE					
			INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.									
			** M : MANUFACUTRER/SUB-CONTRACTOR									
			C : CONTRACTOR/NOMINATED INSPECTION AGENCY				N: OWNER					
MANUFACTURER/ SUB CONTRACTOR	CONTRACTOR	INDICATE "P" PERFORM, "W" WITNESS, AND "V" VERIFICATION										
SIGNATURE		AS APPROPRIATE, "CHP" CUSTOMER SHALL IDENTIFIED IN COLUMN "N".					REVIEWED BY		NAME & SIGN OF APPROVING AUTHORITY			

MANUFACTURER'S		STANDARD QUALITY PLAN				PROJECT		:		1x660 MW SAGARDIGHI TPS	
NAME & ADDRESS :											
		ITEM : CW CHEMICAL TREATMENT.		QP.NO :				PACKAGE :			
				REV. :		0		CONTRACT NO. :			
				DATE :				COTRACTOR :			
				PAGE :		4 OF 10					
S.NO.	COMPONENTS/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/ METHOD CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY** M C N	
1	2	3	4	5	6	7	8	9	D*	10	
5.2 FINAL INSPECTION											
5.2.1	PUMP WITH MOTOR	CAP/STROKE	MA	PERFORMANCE	100%	APPD DRG/. DATA SHEET	APPD DRG/. DATA SHEET	INSPECTION REPORT		P	W V
		ACCURACY		SHOP TEST		(BY OWNER), API-675	(BY OWNER), API-675				
		REPEATABILITY		SHOP TEST							
		POWER DRAWN @		MEASURED AT WORK							
		100% STROKE									
		LEAKAGE &		HYDRO TEST			1.5X DES. PRSS.				
		DIMENSIONS,		MEASUREMENT							
		NOISE,		MEASUREMENT			NOISE < 85 dbA				
		VIBRATION		MEASUREMENT			≤45 MICRONS				
							(PEAK TO PEAK)				
5.2.2 RELIEF VALVE											
		PERFORMANCE	MA	SET & RESET PR.	100%	APPD DRG/. DATA SHEET	APPD DRG/. DATA SHEET	INSPECTION		P	V V
						(BY OWNER)	(BY OWNER)	REPORT			
		DIMENSIONS		MEASUREMENT		APPD DRG/. DATA SHEET	APPD DRG/. DATA SHEET	INSPECTION			
						(BY OWNER)	(BY OWNER)	REPORT			
		LEAKAGE DURING		VISUAL		NO LEAKAGE	NO LEAKAGE	INSPECTION REPORT			
		PERFORMANCE TEST									
		HYDRO TEST				APPD DRG/. DATA SHEET	APPD DRG/. DATA SHEET				
		FOR BHEL	LEGEND :								
			* RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY			FOR CUSTOMER USE		DOC NO.			
			INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.								
			** M : MANUFACTURER/SUB-CONTRACTOR								
			C : CONTRACTOR/NOMINATED INSPECTION AGENCY		N: OWNER						
MANUFACTURER/		CONTRACTOR									
SUB CONTRACTOR				INDICATE "P" PERFORM, "W" WITNESS, AND "V" VERIFICATION							
SIGNATURE		AS APPROPRIATE, "CHP" CUSTOMER SHALL IDENTIFIED IN COLUMN "N".				REVIEWED BY		NAME & SIGN OF APPROVING AUTHORITY			

MANUFACTURER'S		STANDARD QUALITY PLAN				PROJECT		:		1x660 MW SAGARDIGHI TPS			
NAME & ADDRESS :		ITEM : CW CHEMICAL TREATMENT.				OP.NO :		PACKAGE					
						REV. : 0		CONTRACT NO.					
						DATE :		COTRACTOR					
						PAGE : 5 OF 10							
S.NO.	COMPONENTS/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/ METHOD CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY**			REMARKS
										M	C	N	
1	2	3	4	5	6	7	8	9	D*	10			11
6	VALVES												
6.1	RAW MATERIAL :												
6.1.1	BODY, BONNET COVER	CHEMICAL & MECH PROPERTIES	MA	CHEMICAL & MECH TEST	1/HEAT	APPD.DWG./DATA SHEET (BY BHEL)	APPD.DWG./DATA SHEET (BY BHEL)	MFG. TC/LAB REPORT	}	P	V	V	
		HEAT TREATMENT	MA	HEAT TREATMENT	1/HEAT	DO	DO						
6.1.2	TRIM MATERIAL	CHEMICAL PROPERTIES	MA	CHEMICAL TEST	1/BAR/SIZE	APPD. DATA SHEET BY BHEL	APPD. DATA SHEET BY BHEL	LAB REPORT/MGF TC					
6.2	ASSEMBLY								}				
		HYDRO TEST		LEAKAGE (BODY SEAT, AIR SEAT)	100%	APPD.DWG./DATA SHEET (BY BHEL)	NO LEAKAGE NO LEAKAGE	MFG TC MFG TC		P	V	V	
		DIMENSIONS		MEASUREMENT			APPD.DWG./DATA SHEET (B	MFG TC					
7.0	FITTING :												
7.1	RAW MATERIAL	CHEMICAL & MECH PROPERTIES	MA	CHEMICAL & MECH TEST	1/HEAT	APPD DRG/. DATA SHEET	APPD DRG/. DATA SHEET	MFG.TC/LAB REPORT	}	P	V	V	
		HEAT TREATMENT	MA	HEAT TREATMENT	100%	APPD DRG/. DATA SHEET	APPD DRG/. DATA SHEET	MFG.TC/LAB REPORT					
		INTERGRANULAR CORROSION TEST	MI	CORROSION TEST	1/HEAT	ASTM A 262 PR. 'E'		MFG.TC/LAB REPORT MFG.TC/INSP REPORT					
	FINAL INSPECTION	DIMENSIONS	NA	MEASUREMENT	100%	APPD.DWG./DATA SHEETS/ANSI B 16.11/16.5	APPD.DWG./DATA SHEETS/ANSI B 16.11/16.5	MFG.TC/INSP.REPORT	}				
		FOR BHEL	LEGEND :										
		* RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.					FOR CUSTOMER USE	DOC NO.					
		** M : MANUFACUTRER/SUB-CONTRACTOR											
		C : CONTRACTOR/NOMINATED INSPECTION AGENCY				N: OWNER							
MANUFACTURER/		CONTRACTOR											
SUB CONTRACTOR				INDICATE "P" PERFORM, "W" WITNESS, AND "V" VERIFICATION AS APPROPRIATE, "CHP" CUSTOMER SHALL IDENTIFIED IN COLUMN "N".				REVIEWED BY		NAME & SIGN OF APPROVING AUTHORITY			
SIGNATURE													

MANUFACTURER'S		STANDARD QUALITY PLAN				PROJECT		1x660 MW SAGARDIGHI TPS		
NAME & ADDRESS :		ITEM : CW CHEMICAL TREATMENT.		QP.NO :		PACKAGE				
				REV. : 0		CONTRACT NO.				
				DATE :		COTRACTOR				
				PAGE : 6 OF 10						
S.NO.	COMPONENTS/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/ METHOD CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY**	REMARKS
1	2	3	4	5	6	7	8	9	D*	10
8.0	STRAINERS :									
8.1	RAW MATERIAL FOR BODY	PHY.& CHEM. PROPERTIES	MA	PHY. & CHEM.TEST	1/BAR/SIZE	APPD.DWG./DATA SHEETS	APPD.DWG./DATA SHEETS	LAB REPORT	P	V
8.2	SCREEN	CHEMICAL	MA	CHEMICAL	1/SIZE	APPD.DWG./DATA SHEETS	APPD.DWG./DATA SHEETS	MFG.TC/LAB REPORT	P	V
		MESH SIZE	MA	MEASUREMENT	1/SIZE	APPD.DWG./DATA SHEETS	APPD.DWG./DATA SHEETS	MFG.TC/LAB REPORT		
8.3	FINAL INSPECTION	DIMENSIONS	MA	MEASUREMENT	100%	APPD.DWG./DATA SHEETS	APPD.DWG./DATA SHEETS	MFG.TC	P	V
		LEAKAGE		HYDRO TEST	100%	APPD.DWG./DATA SHEETS	NO LEAKAGE	MFG.TC		
9.0	PIPE (SEAMLESS)									
	MATERIAL (REF. NOTE -2)	CHEMICAL	MA	CHEMICAL	1/HEAT/SIZE	APPD.DWG./DATA SHEETS	APPD.DWG./DATA SHEETS	MFG.TC/LAB REPORT	P	V
		MENICICAL TEST		MENICICAL TEST	1/HEAT/SIZE	APPD.DWG./DATA SHEETS	APPD.DWG./DATA SHEETS	MFG.TC/LAB REPORT	P	V
		MICRO STRUCTURE		GRAINS STRUCTURE	1/HEAT/SIZE	FOR HEAT TREATMENT	FOR HEAT TREATMENT	MFG.TC/LAB REPORT	P	V
		INTERGRANULAR		CORROSION TEST	1/HEAT/SIZE	ASTM A 262 PR 'E'	ASTM A 262 PR 'E'	MFG.TC/LAB REPORT	P	V
		CORROSION TEST							P	V
		HTDRO TEST		LEAKAGE	100%	NO LEAKAGE	NO LEAKAGE	MFG.TC/LAB REPORT	P	W
		FOR BHEL	LEGEND :					DOC NO.		
			* RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY			FOR CUSTOMER USE				
			INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.							
			** M : MANUFACUTRER/SUB-CONTRACTOR							
			C : CONTRACTOR/NOMINATED INSPECTION AGENCY		N: OWNER					
MANUFACTURER/	CONTRACTOR									
SUB CONTRACTOR		INDICATE "P" PERFORM, "W" WITNESS, AND "V" VERIFICATION								
SIGNATURE		AS APPROPRIATE, "CHP" CUSTOMER SHALL IDENTIFIED IN COLUMN "N".				REVIEWED BY		NAME & SIGN OF APPROVING AUTHORITY		

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MANUFACTURER'S		STANDARD QUALITY PLAN				PROJECT		1x660 MW SAGARDIGHI TPS		
NAME & ADDRESS :		ITEM : CW CHEMICAL TREATMENT.		QP.NO :		PACKAGE				
				REV. : 0		CONTRACT NO.				
				DATE :		COTRACTOR				
				PAGE : 8 OF 10						
S.NO.	COMPONENTS/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/ METHOD CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY** M C N	REMARKS
1	2	3	4	5	6	7	8	9	D*	10
12.0	LEVEL SWITCH :									
12.1	MAT. FOR WETTED	CHEM.PROPERTIES	MA	CHEM.TEST	1/HEATR	APPD.DATA SHEET/DWG.	APPD.DATA SHEET/DWG.	MFG.TC/LAB REPORT	P V V	
	PARTS INCLUDING									
	FLOAT									
12.2	PERFORMANCE	FUNCTIONAL	MA	VISUAL	100%	APPD.DATA SHEET/DWG.	APPD.DATA SHEET/DWG.	MFG.TC	P V V	
		IR-HV-IR		ELECTRICAL		DO	DO	MFG.TC		
		DIMENSIONS		MEASUREMENT		DO	DO	MFG.TC		
		DEGREE OF PROTEC.		TYPE TEST		DO	DO	MFG.TC/LAB REPORT		
13.0	DIFF PRESSURE SWITCH									
	MATERIAL FOR WETTED		MA	VERIFICATION		APPD.DATA SHEET/DWG.	APPD.DATA SHEET/DWG.	MFG COMPLIANCE	P V V	
								CERTIFICATE		
	PARTS PERFORMANCE	CALIBRATION	MA	PERFORMANCE	100%	APPD.DATA SHEET/DWG.	APPD.DATA SHEET/DWG.	MFG TC	P V V	
14.0	CONTROL PANEL :	DIMENSIONS,	MA	MEASUREMENT,	100%	APPD.DWG./DATA SHEETS	APPD.DWG./DATA SHEETS	LAB REPROT	P W V	\$\$ REFER TEST
		CONTINUITY, IR-HV-IR		ELECTRICAL						PROCEDURE
		FUNCTIONAL, DEGREE .								NOTE-4
		OF PROT, VERIFICATION								
		OF MAKE, RATING OF								
		COMPONENTS								
		SIMULATION TEST \$\$								
		PAINT SHADES, THICK								
		ADHESION								
15.0	COMPLETE SKID	DIMENSIONS &	CR	MEASUREMENT	-100%	APPD.DWG./	APPD.DWG./	INSPECTION	P W W	\$\$ REFER TEST
	ASSEMBLY :	ORIENTATION				DATA SHEET	DATA SHEET	REPORT		PROCEDURE
		LEAKAGE, CHECK		VISUAL &		DISCH.PIPING - 1.5 x	NO LEAKAGE			NOTE-5
		ON WELDMENTS		HYDRO TEST		DISCH.PR. OF PUMP	NO LEAKAGE			
		FUNCTIONAL TEST\$\$				SUCTION PIPING -3 KG/CM2				
		LEGEND :						DOC NO.		
				* RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY			FOR CUSTOMER USE			
				INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.						
				** M : MANUFACUTRER/SUB-CONTRACTOR						
				C : CONTRACTOR/NOMINATED INSPECTION AGENCY	N: OWNER					
MANUFACTURER/	CONTRACTOR									
SUB CONTRACTOR				INDICATE "P" PERFORM, "W" WITNESS, AND "V" VERIFICATION						
SIGNATURE		AS APPROPRIATE, "CHP" CUSTOMER SHALL IDENTIFIED IN COLUMN "N".				REVIEWED BY		NAME & SIGN OF APPROVING AUTHORITY		

MANUFACTURER'S		STANDARD QUALITY PLAN				PROJECT		:		1x660 MW SAGARDIGHI TPS			
NAME & ADDRESS :													
		ITEM : CW CHEMICAL TREATMENT.				QP.NO :		PACKAGE		:			
						REV. : 0		CONTRACT NO.		:			
						DATE :		COTRACTOR		:			
						PAGE : 9 OF 10							
S.NO.	COMPONENTS/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/ METHOD CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY**			REMARKS
1	2	3	4	5	6	7	8	9	D*	M	C	N	11
		PAINTING	MA	VISUAL & MEASUREMENT	-100%	APPD DWN/PAINTING	APPD DWN/PAINTING	INSPECTION		P	V	V	
						SCHEME	SCHEME	REPORT					
		PACKING	MA	VISUAL	-100%	BHEL SPEC	BHEL SPEC	INSPECTION		P	V		
				DFT	-100%	BHEL SPEC	BHEL SPEC	REPORT					
			LEGEND :										
			* RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.				FOR CUSTOMER USE						
			** M : MANUFACUTRER/SUB-CONTRACTOR										
			C : CONTRACTOR/NOMINATED INSPECTION AGENCY				N: OWNER						
MANUFACTURER/		CONTRACTOR											
SUB CONTRACTOR				INDICATE "P" PERFORM, "W" WITNESS, AND "V" VERIFICATION									
SIGNATURE				AS APPROPRIATE, "CHP" NTPC SHALL IDENTIFIED IN COLUMN "N".				REVIEWED BY		NAME & SIGN OF APPROVING AUTHORITY			

MANUFACTURER'S		STANDARD QUALITY PLAN				PROJECT		:		1x660 MW SAGARDIGHI TPS	
NAME & ADDRESS :											
		ITEM : CW CHEMICAL TREATMENT.		QP.NO :		PACKAGE		:			
				REV. : 0		CONTRACT NO.		:			
				DATE :		COTRACTOR		:			
				PAGE : 10 OF 10							
P - PERFORMANCE		W - WITNESS									
V - VARIFICAION		MA - MAJOR		MI - MINOR							
CR - CRITICAL		CHP--D :CUSTOMER(BHEL/OWNER) HOLD POINT									
NOTE:1 ; WHEN BACK WALL ECHO IS SET TO 100% OF FSH IN SOUND AREA, DEFECT ECHO SHALL NOT EXCEED 20% OF FSH. MAX BACH WALL ECHO IS 20% OF FSH. TOTAL NO OF DEFECTS SHALL BE MAX. 5 NO IN ONE METER LENGTH. DISTANCE BETWEEN TWO DEFECTS SAHLLA BE 3 MIN TIMES THE DIA OF BAR.											
NOTE: 2 ; NDT REQUIREMENT ON THE PIPING WELDING SHALL BE AS a) ON BUTT WELD 25% FP AND 25% RT FOR PUMP SUCITON SIDE AND FOR PUMP DISCHARGE SIDE 100% RT AND 100% DP TEST. b) 100% DP ON FILLER WELD JOINTS NORMS SHALL BE AS PER ASME SECTION VIII.											
NOTE-3: LEVEL GAUGE, PRESSURE GAUGE , LEVEL SWITCH, CONTROL PANEL & ALL INSTRUMENTS SHALL BE PROCURED FROM OWNER/BHEL APPROVED MAKE.											
NOTE 4; SIMULATION TEST WILL BER CARRIED OUT WITH 24 VDC SUPPLY TO CONTROL PANEL AT THE CONTROL PANEL MANUGACTURER'S PLACE.											
NOTE 5 FUNTIONAL TEST WILL BE CARRIED OUT WOTHOUT 24 VDC i.e, ONLY CONTINUITY TEST WILL BE SHOWN AT VENDOR WORK.											
NOTE 6 FOR PIPES PURCHASED DIRECTLY FROM MANUFACTURER'S OR AUTHORISED DEALERS, APART FROM TC REVIEW, CHECK WILL BE AS PER CLASS 2.1.2 AND 10.0; HOWEVER FOR HYDRAULIC TEST MANUFACTURER TC SHALL BE REVIEWED . IN CASE ON IMPORTED PIPES PURCHASED FROM OPER MARKET CHECK TESTION AS PER CLAUSE 2.1.2 AND 10.0 (INCLUDING HYDRAULIC TEST) SHALL BE CARRIED OUT ON EACH LENGTH ;P HYDRAULIC TEST SHALL BE WITNESS BY BHEL.											
NOTE 7 FOR RAW MATERIAL (BARS/PIPES/CASTINGS/FORGINGS) WHERE HEAT TREATMENT ARE CARRIED OUT BY MATERIAL OPRODUCERS ON BULK QUANTITIES, THEIR TEAT CERTIFICATE SHALL BE REVIEWD (EXCEPT TIME TEMPERATURE CHART).											
		FOR BHEL		LEGEND :							
				* RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY		FOR CUSTOMER USE		DOC NO.			
				INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.							
				** M : MANUFACUTRER/SUB-CONTRACTOR							
				C : CONTRACTOR/NOMINATED INSPECTION AGENCY		N: OWNER					
MANUFACTURER/		CONTRACTOR									
SUB CONTRACTOR				INDICATE "P" PERFORM, "W" WITNESS, AND "V" VERIFICATION							
SIGNATURE				AS APPROPRIATE, "CHP" CUSTOMER SHALL IDENTIFIED IN COLUMN "N".		REVIEWED BY				NAME & SIGN OF APPROVING AUTHORITY	



QUALITY ASSURANCE REQUIREMENTS

1.00.00 QUALITY ASSURANCE PROGRAMME

1.01.00 To ensure that the equipment and services under the scope of Contract whether manufactured or performed within the Successful Bidder's works or at his Sub-Vendor's premises or at the Owner's site or at any other place or work are in accordance with the specifications, the Successful Bidder shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Successful Bidder and shall be finally accepted by the Owner/Authorised representative after discussions before the award of contract. A quality assurance programme of the Successful Bidder shall generally cover the following :

- a) His organisation structure for the management and implementation of the proposed quality assurance programme.
- b) Documentation control system.
- c) Qualification data for Bidder's key personnel.
- d) The procedure for purchase of materials, parts, components and selection of Sub-Vendor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.
- e) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.
- f) Control of non-conforming items and system for corrective actions.
- g) Inspection and test procedure both for manufacture and all site related works.
- h) Control of calibration and testing of measuring and testing equipments.
- i) System for quality audit.
- j) System for indication and appraisal of inspection status.
- k) System for authorising release of manufactured product to the Owner.
- l) System for handling storage and delivery.
- m) System for maintenance of records.



- n) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per format enclosed at Annexure-A to this section.

2.00.00 GENERAL REQUIREMENTS - QUALITY ASSURANCE

- 2.01.00 All materials, components and equipment covered under this specification shall be procured, manufactured and tested at all the stages, as well as Services provided for erection, commissioning and testing shall be as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the Bidder for some of the major items is given in the respective technical specification. This is however, not intended to form a comprehensive programme as it is the Bidder's responsibility to draw up and implement such programme and reviewed by the Owner/Consultant. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder, separately in the format attached at Annexure-I and will be submitted to Owner/Owner's representative for review. Schedule of finalisation of such quality plans will be finalised before award.
- 2.02.00 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Bidder's Quality Control organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing.
- 2.03.00 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Bidder's site Quality Control organisation, during various stages of site activities from receipt of materials/equipment at site.
- 2.04.00 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality plans and reference documents/standards etc. will be subject to Consultant's approval without which manufacture shall not proceed. In these approved quality plans, Owner/Authorised representative/Consultant shall identify Customer Hold Points (CHP), test/checks which shall be carried out in presence of the Owner/Consultant/Owner's Engineer or his Authorised Representative and beyond which the work will not proceed without consent of Owner/Authorised representative/Consultant in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner/Authorised Representative/Consultant for acceptance and dispositioning.
- 2.05.00 The Bidder shall provide adequate notice to the Owner for inspection before the material is dispatched as per the provisions of the Contract. No material shall be despatched from the manufacturer's works before the same is accepted subsequent to pre-despatch final inspection including verification of records of



all previous tests/inspections by Owner's Owner's Engineer/Authorised representative, and duly authorised for despatch issuance of Material Despatch Clearance Certificate (MDCC).

2.06.00 All materials used or supplied shall be accompanied by valid and approved materials certificates and tests and inspection report. These certificates and reports shall indicate the sheet numbers or other such acceptable identification numbers of the material. The material certified shall also have the identification details stamped on it.

2.07.00 All the individual and assembled rotating parts shall be statically and dynamically balanced in the works.

Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Bidder shall allow for trial assembly prior to despatch from place of manufacture.

2.08.00 Castings and forgings used for construction shall be of tested quality. Details of results of chemical analysis, heat treatment record, mechanical property test results shall be furnished.

2.09.00 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section-IX/BS-4870 or other International equivalent standard acceptable to the Owner.

All brazers, welders etc. employed on any part of the contract at Bidder's/Sub-Vendor's works or at site shall be qualified as per ASME Section-IX or BS-4871 or equivalent international standard approved by the Owner. Such qualification tests shall be conducted in presence of Owner/his authorised representative.

For welding of pressure parts and high pressure piping the requirements of IBR shall also be complied with.

Under no circumstances any repair or welding of castings be carried out without the consent of the Owner. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Owner.

All pressure parts shall be subjected to hydraulic testing as per the requirements of IBR. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than thirty (30) minutes.

2.10.00 All non-destructive examination (NDT) shall be carried out in accordance with approved international standard. The NDT operator shall be qualified as per SNT-TC-IA (of American Society of non- destructive examination). Results of NDT shall be properly recorded and submitted for acceptance.

All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid



penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination and ultrasonic testing shall be employed wherever necessary/ recommended by the applicable code. At least 10% of all major butt welding joints shall be radiographed. Statutory payments in respect of IBR approvals including inspection shall be made by Bidder. Bidder's scope and responsibility shall also include preparation and submission of all necessary documents in the specific formats and manner stipulated by the statutory bodies, coordination and follow up for above approvals.

2.11.00 All the Sub-Vendors proposed by the Bidder for procurement of major bought out items including castings, forgings, semi-finished and finished components/equipment list of which shall be drawn up by the Bidder and finalised with the Owner shall be subject to Owner's review. Quality Plans of the successful Sub-Vendors shall be discussed, finalised and accepted by the Owner/Authorised representative and form part of the Purchase Order between the Bidder and the Sub-Vendor.

2.12.00 All the purchase specifications for the major bought-out items, list of which shall be drawn up by the Bidder and finalised with the Owner shall be furnished to the Owner for comments and subsequent acceptance before orders are placed.

Owner reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Bidder's or their Sub-Vendor's quality management and control activities. The Bidder shall provide all necessary assistance to enable the Owner carry out such audit and surveillance.

Quality audit/acceptance of the results of tests and inspection will not prejudice the right of the Owner to reject equipment not giving the desired performance after erection and shall not in no way limit the liabilities and responsibilities of the Bidder in earning satisfactory performance of equipment as per specification.

2.13.00 Quality requirements for main equipment shall equally apply for spares and replacement items.

2.14.00 Repair/rectification procedures to be adopted to make any job acceptable shall be subject to the acceptance of the Owner.

2.15.00 For quality assurance of all civil works refer to the specifications for civil works.

3.00.00 **QUALITY ASSURANCE DOCUMENTS**

3.01.00 The Bidder shall be required to submit two (2) copies and two (2) sets of microfilms of the following Quality Assurance documents within three (3) weeks after despatch of the equipment:

- a) Material mill test reports on components as specified by the specification.



- b) The inspection plan with verification, inspection plan check points, verification sketches, if used and methods used to verify that the inspection and testing points in the inspection plan were performed satisfactorily.
- c) Non-destructive examination results /reports including radiography interpretation reports.
- d) Factory tests results for testing required as per applicable codes and standards referred in the specification.
- e) Welder identification list listing welder's and welding operator's qualification procedure and welding identification symbols.
- f) Sketches and drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
- g) Stress relief time temperature charts.
- h) Inspection reports duly signed by QA personnel of the Owner and Bidder for the agreed inspection hold points. During the course of inspection, the following will also be recorded :
 - i) When some important repair work is involved to make the job acceptable.
 - ii) The repair work remains part of the accepted product quality.
- i) Letter of conformity certifying that the requirement is in compliance with finalised specification requirements.

4.00.00 INSPECTION, TESTING AND INSPECTION CERTIFICATES

4.01.00 The Successful Bidder shall give the Owner's Engineer/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Successful Bidder's account except for the expenses of the Inspector. The Owner's Engineer/Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is notified as being ready for test/inspection failing which the Successful Bidder may proceed with test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector duly certified copies of test reports in six (6) copies.

4.02.00 The Owner's Engineer or Inspector shall within fifteen (15) days from the date of Inspection as defined herein give notice in writing to the Successful Bidder, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Successful Bidder shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall confirm in writing to the Owner's Engineer/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.



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- 4.03.00 When the factory tests have been completed at the Bidder's or sub-Vendor's works, the Owner/Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Owner/Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Bidder's test certificate by the Owner/Inspector. Failure of the Owner/Inspector to issue such a certificate shall not prevent the Bidder from proceeding with the works. The completion of these tests, or the issue of the certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract.
- 4.04.00 The Bidder shall furnish quarterly inspection programme indicating schedule dates of inspection at customer hold point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.



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**EPC Bid Document
Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase – III**

FORMAT OF QUALITY ASSURANCE PROGRAMME

Name of Company / Successful Bidder	NAME OF CONTRACT PACKAGE			QUALITY PLAN FOR						
	Package No. : _____			QP No. : _____ Date _____						
	Contractor : _____			Rev.No.: _____ Date _____						
Sl. No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check	Reference Document	Acceptance Norm	Format of Record	Agency	Remarks



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EPC Bid Document
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FIELD WELDING SCHEDULE

PROJECT : FWS NO :
CONTRACTOR : REV NO. :
PACKAGE : FIELD WELDING CODE :
SYSTEM : PAGE NO. :

SI No.	Drawing No. for Weld Locations & Identification mark	Description of parts to be welded	Material specification	Dimensions	Process of Welding	Type of Weld	Electrode Filler Specification	WPS No.	Minimum Pre-heat Temperature	Heat Treatment Temperature [Holding Time in secs]	NDT Method	Quantum	NDT Specification Number	Acceptance Norm Ref.	Remarks

The Field Welding Schedule should be submitted for :

- o Pressure Parts
- o Tanks/Vessels
- o Piping
- o Heavy/Important Structural Steel
- o Heat Exchangers
- o Bus Ducts



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Quality Assurance Requirements

WBPDCCL - 1X660 MW Sagardighi TPP, Extension, Unit-5							
MDL FOR CW TREATMENT PLANT							
S. No	Type of Doc D-Drawing Q-Quality Plan V-Vendor List	Title	Area/ System	DRG NO.	Approval/ Information	MDL Schedule date	
1	D	PROCESS SIZING CALCULATIONS OF CW TREATMENT PLANT	WS		Approval		
2	D	Design Philosophy for CW Treatment plant	WS		Approval		
3	D	P&ID OF CW TREATMENT PLANT	WS		Approval		
4	D	EQUIPMENT LAYOUT OF CW TREATMENT PLANT	WS		Approval		
5	D	CIVIL ASSIGNMENT DRG FOR CWTP	WS	RP-DG-445-WTP-A062	Approval		
6	D	DESIGN CALCULATION FOR H2SO4 TANK (STORAGE TANK)	WS		Approval		
7	D	GAD OF BULK H2SO4 STORAGE TANK	WS		Information		
8	D	PLANT & YARD PIPING LAYOUT OF CW TREATMENT PLANT	WS		Approval		
9	D	PG TEST PROCEDURE OF CW TREATMENT PLANT	WS		Approval		
10	D	VALVE SCHEDULE	WS		Approval		
11	D	Datasheet of VALVES	WS		Information		
12	D	PIPING LAYOUT OF CW TREATMENT PLANT	WS		Approval		
13	Q	QAP FOR CW TREATMENT PLANT	QA		Approval		
14	Q	QAP FOR METERING PUMPS WITH MOTOR	QA	RP-MQ-445-WTP-A066	Approval		
15	Q	QAP FOR BULK H2SO4 STORAGE TANK & ACID DOSING TANK, Corrosion inhibitor, Scale inhibitor, Biocide dosing tank	QA		Approval		
16	D	QAP for Corrosion inhibitor, Scale inhibitor, Biocide, Sulphuric acid dosing pump & motors	QA	RP-MQ-445-WTP-A067	Information		
17	D	Sub-Vendor list for Equipment of CW Treatment Plant	WS		Information		
18	D	Datasheet & GAD of Sulphuric acid unloading Pump & Motor	WS		Information		
19	D	Datasheet of Corrosion inhibitor, Scale inhibitor, Biocide, Sulphuric acid Dosing Pump & Motor	WS		Information		
20	D	GAD FOR ACID DOSING TANK/SCALANT INHIBITOR DOSING TANK /BIOCIDE DOSING TANK /CORROSION INHIBITOR DOSING TANK		RP-DG-445-WTP-A119	Approval		
21	D	Datasheet & GAD FOR METERING PUMPS WITH MOTOR	WS		Approval		
22	D	Datasheet & GAD OF LIME PIT PUMP	WS		Approval		
23	D	Electrical Load list for CW Treatment plant	WS	RP-DC-445-WTP-E128	Approval		
24	D	I/O List for CW Treatment plant	WS	RP-DG-445-WTP-I124	Approval		
25	D	Control Philosophy for CW Treatment plant	WS	RP-DC-445-WTP-A059	Approval		
26	D	Control logics and Sequence chart for CW Treatment plant	WS		Information		
27	D	Instrument Schedule for CW Treatment plant	WS	RP-DG-445-WTP-I071	Information		
28	D	Instrument Hookup diagram for CW Treatment plant	WS	RP-DG-445-WTP-I068	Approval		
29	D	Instrument Datasheet for CW Treatment plant	WS	RP-DG-445-WTP-I069	Information		
30	D	Instrument Loop diagram for CW Treatment plant	WS		Information		
31	D	Analyser Datasheet for CW Treatment plant	WS	RP-DG-445-WTP-I070	Approval		
32	D	Power & Control Cable Schedule for CW Treatment plant	WS		Information		
33	D	Instrument Cable Schedule for CW Treatment plant	WS	RP-DG-445-WTP-I122	Information		
34	D	Cable Datasheet for CW Treatment plant	WS		Information		
35	D	Cable Tray & Earthing Layout for CW Treatment plant	WS	RP-DG-445-WTP-E072	Information		
36	D	O&M Manual for CW Treatment plant	WS	RP-OM-445-WTP-A073	Information		
37	D	Datasheet OF Instrument JUNCTION BOX for CW Treatment plant	WS	RP-DG-445-WTP-I120	Approval		
38	D	CABLE TRAY AND EARTHING LAYOUT FOR CWTP	WS	RP-DG-445-WTP-E072	Approval		

Performance Guarantee Test Procedure

- a) CW treatment plant outlet water guarantee shall be as per approved attached Design memorandum document
- b) The duration of the test shall not be less than 72 hours on continuous basis. These tests will be carried out within a reasonable period from the date of commissioning of the System. The test shall be such as to prove beyond doubt that the guaranteed performance of the System under varying flow conditions (within the specified units) to the satisfaction of the Purchaser. The test procedures shall be as per relevant equivalent standards from recognized origins.
- c) Circulating Cooling Water:
 - I. Corrosion rate:
 - On MS < 3.0 mpy
 - On Cu < 0.5 mpy
 - On SS (304) < 0.5 mpy
 - II. Scaling < 15mg/dm²/day
 - III. Ratio of circulation to make-up water total hardness ~ 5.8-6.7
 - IV. Micro/Bio fouling conditions
 - a) Total Viable Count (TVC) < 1x10⁵ Counts/ml
 - b) Sulphate reducing bacteria (SRB) < 1x10⁵ Counts/100ml
 - V. Pitting corrosion rate on MS/Brass < 20 mpy
 - VI. Ni-Cr mesh should be clean when visually inspected.



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**EPC Bid Document
Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase - III**

PERFORMANCE GUARANTEES AND TESTS



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CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	PERFORMANCE GUARANTEES, PERFORMANCE/ ACCEPTANCE TESTS & LIQUIDATED DAMAGES FOR SHORTFALL IN PERFORMANCE
2.00.00	START-UP, INITIAL OPERATION, TRIAL OPERATION AND PERFORMANCE TESTS
3.00.00	SCHEDULE OF GUARANTEES WHICH ATTRACT LIQUIDATED DAMAGES [CATEGORY-A]
4.00.00	SCHEDULE OF GUARANTEES WHICH DO NOT ATTRACT LIQUIDATED DAMAGES [CATEGORY-B]
5.00.00	SCHEDULE OF DEMONSTRATION
6.00.00	PERFORMANCE/ ACCEPTANCE TESTS PROCEDURES





PERFORMANCE GUARANTEES AND TESTS

1.00.00 PERFORMANCE GUARANTEES, PERFORMANCE/ACCEPTANCE TESTS & LIQUIDATED DAMAGES FOR SHORTFALL IN PERFORMANCE

1.01.00 The Bidder shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in this specification. The guarantees are categorised as:

- a) Those, which attract liquidated damages, as listed below (Category-"A"). The Bidder shall furnish signed declarations in the manner prescribed in the bid proposal schedules for these guarantees.
- b) Those, which do not attract liquidated damages, as listed below (Category-"B"). This guarantee list indicated in this section is not exhaustive and the Owner reserves the right to call upon the Bidder to demonstrate any parameter, operation, etc. of any equipment as specified and as required to meet the duty conditions.

1.02.00 The Bidder shall demonstrate all the guarantees as specified in this section. In case during tests it is found that the equipment/system has failed to meet the guarantees, the Contractor shall carry out all necessary modifications to make the equipment/systems comply with guaranteed requirements. However, if the Contractor is not able to demonstrate the guarantees, even after the modifications within ninety (90) days of notification by the Owner, the Owner will at his discretion:

- i) reject the equipment and recover the payment already made or engage other agencies for making good all the deficiencies, the cost to be borne & recovered from the contractor or accept the equipment only after levying liquidated damages upto a ceiling 10% of contract price as identified in this section for those guarantees which are covered under category "A".
- ii) reject the equipment and recover the payment already made or engage other agencies for making good all the deficiencies, the cost to be borne & recovered from the contractor or accept the equipment only after assessing and deducting from the contract price an amount equivalent to the deficiency of the equipment/system as assessed by the Owner, for those guarantees which are covered under Category-B.

For equipment/systems not covered under this section Bidder shall demonstrate the functionality and the rated performance for such equipment/systems before handover to the owner.

1.03.00 All guaranteed parameters shall necessarily be quoted by the Bidder based on the established proven results obtained from similar units in successful operation. Evidence for this shall necessarily include the test codes used, acceptance test results, and accuracies of various instruments used for the





performance test, details of tolerances, if allowed, etc. While quoting the guaranteed parameters, the Bidder shall keep in view the requirements specified in the specification especially regarding the reliability, operability and maintainability of the equipment proposed. The Owner reserves the right to evaluate the parameters quoted by the Bidder based on his experience and published material available.

1.04.00 The liquidated damages shall be calculated prorata for the fractional parts of the unit unless stated otherwise.

1.05.00 The turbine generator, boiler, auxiliaries, and all other plant equipment and system shall perform continuously without the noise level (individual or collectively) exceeding the values specified in respective equipment specification over the entire range of output and operating frequencies.

1.06.00 **Performance/Acceptance Tests**

1.06.01 The performance/acceptance tests for various equipment and systems shall be carried out as specified under the respective equipment specifications and those specified below shall be specifically applicable. All the guarantees shall be tested together as far as practicable.

1.06.02 In case of systems with stand-by equipment the liquidated damages for non-performance will be levied for normal operating number of equipment only. However, for this purpose all the equipment including standby equipment shall be tested and average values arrived at.

1.06.03 For instrument in-accuracies during PG Test, refer subsequent clauses of this section.

1.06.04 For Total Auxiliary Power Consumption of BTG island, Off site BOP facilities and the transformers listed under the respective clauses, shall be taken together for purposes of guarantee and not individually.

2.00.00 **START-UP, INITIAL OPERATION, TRIAL OPERATION AND PERFORMANCE TESTS**

2.01.00 The Contractor shall provide commissioning & start-up supervisory engineering staff specially identified for the period commencing with start-up and extending through initial & trial operation and all performance tests. During this period, the Contractor shall furnish the calibration devices, special test instruments, etc. required to prepare for and conduct the performance tests. The Owner will associate his operating personnel and necessary supporting staff and shall make available fuel, and the system electrical load. Contractor's commissioning, & start-up supervisory engineering personnel shall conduct training for the Owner's personnel prior to and during this period and shall train them so that they will be able to operate and maintain the new equipment satisfactorily after acceptance by the Owner.

2.02.00 The Owner proposes to carry out in association with the Contractor, the following field inspections and tests in the sequence detailed below, and the





successful performance and completion of all the tests taken together shall constitute the Owner acceptance tests. The Contractor shall provide supervisory services during field inspection and tests.

2.02.01 Inspection and Checking of the Unit

After completion of erection and/or installation, and before being put into operation, the unit and all its appurtenances shall be thoroughly cleaned and then inspected, for correctness and completeness of installation and acceptability for placing in operation. All piping system shall be flushed, chemically cleaned; steam blown, air blown as required and cleanliness demonstrated using acceptable industry standards. Procedures to accomplish this work shall be subject to Owner's approval.

The checkouts during the pre-commissioning period should be programmed to follow the construction completion schedule. Each system, as it is completed by construction and turned over to the commissioning (start-up) engineer(s), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed schedule. Also refer specification clause on commissioning management specified elsewhere.

On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the complete equipment shall be placed on Initial Operation during which period the complete equipment shall be operated integral with sub-systems and supporting equipment as a complete plant.

When the equipment is operating properly, its characteristics shall be recorded on the start-up report sheets. Copies of typical start-up report shall be given to the Owner. Start-up reports for all equipment shall be completed before the start of the trial operation period.

2.02.02 Initial Operation, Reliability Run/Trial Run

The plant shall be on Trial Operation during which period all necessary adjustments shall be made while operating over the full load range enabling the plant to be made ready for performance and guarantee tests.

The duration of Trial Operation of the complete equipment, systems, sub-systems and their control system shall be in Automatic mode for fourteen (14) days out of which at least seventy two (72) hours shall be in continuous operation on full load or any other duration as may be agreed to between the Engineer, and the Contractor. The Trial Operation shall be considered successful, provided such item of the equipment can be operated, continuously at the specified operating characteristics for the period of Trial Operation.

For the period of Trial Operation, the time of operation with any load shall be counted; minor interruptions not exceeding four (4) hours at a time caused during the continuous operation shall not affect the total duration of trial operation. However, if in the opinion of the Owner, the interruption is long, the Trial Operation shall be prolonged for the period equivalent to the duration of interruption.



A trial Operation report comprising observations and recordings of various parameters to be measured, in respect of the above Trial Operation shall be prepared by the Contractor. This report besides recording the details of the various observations during trial run shall also include the dates of start and finish of the Trial Operation and shall be signed by the representatives of both the parties. The report shall have sheets, recording and print out of all the details of interruption occurred, adjustments made, any minor repairs done during the Trial Operation. Based on the observations, necessary modifications/ repairs to the plant shall be carried out to the full satisfaction of the Engineer to enable the later to accord permission to carry out Performance and Guarantee Tests on the plant. However, it is the prerogative of the Owner to grant permission for aforesaid test with minor defects, which do not endanger the safe operation of the equipments. .

Should any major failure or interruption occur in any portion of the plant due to or arising from faulty design, materials, workmanship or omissions or incorrect erection, sufficient to prevent safe and full commercial use of the plant, the reliability run shall be considered void and the reliability test period of 14 days shall recommence after the Contractor has remedied the cause of defect to the satisfaction of the owner

2.02.03**Performance and Guarantee Test**

- a) The final tests as to the performance and guarantees shall be conducted at site, by the Contractor with full involvement of the Owner. The necessary operating inputs shall be provided by the Owner. The Contractor's engineering staff for commissioning and start-up shall ensure that the equipment are ready for such tests. The Owner shall associate his necessary supporting staff with the Contractor to carry out the various activities related to P-G tests.

The necessary labour/supporting staff etc. shall be provided by the Contractor. Such tests will be conducted within a period of three (3) months after the successful completion of Trial Operation. Any extension of time beyond the above three (3) months shall be mutually agreed upon.

- b) These tests shall be binding on both the parties of the Contract to determine compliance of the equipment with the performance guarantees.

The Contractor shall submit the test procedure for Owner's approval within thirty six (36) months from the date of letter of award of the contract. The test shall be carried out by the test grade instruments as stipulated in the applicable test code. These instruments shall be calibrated by the Contractor in a laboratory duly approved by Owner. Batch calibration will not be acceptable. The available instrumentation and control equipment in the plant if found suitable could also be used with the prior approval of the Owner after calibrations in the plant/outside laboratory. The tests will be conducted at the specified load points, and as near the specified cycle conditions as practicable. Proper corrections in calculations to take into account the conditions





which do not correspond to the specified conditions will be applied in the test report as brought out under the respective sections of the specification.

- c) All special test grade instruments, equipment, tools and tackles, required for the successful completion of the Performance and Guarantee Tests shall be brought for the purpose of test, free of cost by the Contractor.
- d) The guaranteed performance figures of the equipment shall be proved by the Contractor during these Performance and Guarantee Tests. The Contractor shall submit a detailed test report in the manner, already agreed to within one (1) month time of completion of the test, for Owner's approval. Should the Owner's assessment of these tests show any deterioration from the guaranteed values the Contractor/Owner shall modify the equipment as required to enable it to meet the guarantees to the satisfaction of the Owner. In such case, the Performance and Guarantee Tests shall be repeated within one (1) month, from the date the equipment is ready for retest and all costs for modifications including labour, materials and the cost of additional testing to prove that the equipment meets the guarantees, shall be borne by the Contractor.
- e) The specific tests to be conducted on equipment have been brought out in the technical specifications. The procedure to be submitted by the Contractor should include the detailed methodology to conduct these tests/verify the guarantees offered by the Contractor notwithstanding whether these attract liquidated damages or not.
- f) Instrument accuracies shall be in accordance with the relevant test codes. All instrument in-accuracies if applicable shall be computed as per the code and values will be corrected to the advantage of the Owner. No negative tolerance will be allowed. For example, if the inaccuracy of instrumentation has been worked out to be 1%, the measured values will be assessed to be 1% inferior for purpose of LD.
- g) The Bidder shall establish the following modes of operation to the satisfaction of the Owner before acceptance test :
 - i) Operation of each system by remote manual control.
 - ii) Operation of the entire system in integrated manner on auto control.
 - iii) Operation of the entire plant with auto-control loops fully implemented including different modes of load control with the help of control system.
- h) Ten (10) copies of the test reports are to be furnished by the Contractor to the Owner backed up with jointly signed data sheets.

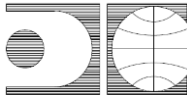
Drawing, Tech specification and Documents to be furnished

DRAWINGS & DOCUMENTS ATTACHED

The following drawing/document are enclosed as a part of the specification:

1. Design Memorandum: BHEL DOC NO.(4-WT-080-01598 Rev:03) WBPDCCL
DOC NO. (RP-DC-445-WTP-A056)
2. P& ID for CWTP System : BHEL DRG NO. (1-WT-080-01064 Rev: 04)
WBPDCCL DRG NO. (RP-DG-445-WTP-A057)
3. Equipment Layout of CWT: BHEL DRG NO. (1-WT-080-01916 Rev: 01)
WBPDCCL DRG NO. (RP-DG-445-WTP-A058)
4. UPVC / CPVC JOINING PROCEDURE (2-WT-220-00057)

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03	14.07.2021	DBN /MEGA	MSM / VNS	MRK	M/s.WBPDCL comments incorporated	
02	26.06.2021	DBN /MEGA	MSM / VNS	MRK	M/s.WBPDCL comments incorporated	
01	25.02.2021	DBN /MEGA	MSM / VNS	MRK	M/s.WBPDCL comments incorporated	
00	06.11.2020	DBN /MEGA	MSM / VNS	MRK	Fresh Issue	
Rev. No	Date	Prepared	Checked	Approved	Remarks	
	WEST BENGAL POWER DISTRIBUTION CORPORATION LTD WEST BENGAL STATE, INDIA 1 X 660 MW UNIT No-5, PHASE-III SAGARDIGHI THERMAL POWER STATION					
	DEVELOPMENT CONSULTANTS PRIVATE LIMITED KOLKATA					
	BHARAT HEAVY ELECTRICALS LTD BOILER AUXILIARIES PLANT RANIPET – 632 406.					
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		9776	PRPD	DBN/HD	Sd/-	06.11.2020
			CHD	MSM	Sd/-	06.11.2020
			APPD	MRK	Sd/-	06.11.2020
TITLE DESIGN PHILOSOPHY FOR CW TREATMENT PLANT			WBPDCCL DOC NO. RP-DC-445-WTP-A056		REV.NO 03	
			BHEL DOCUMENT NO. 4-WT-080-01598			

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1.0 SCOPE

The scope of this design memorandum covers the basis of design, system philosophy, equipment selection and layout aspects and Control Philosophy for CW Treatment which shall comprise of Scale Inhibitor Dosing System, Corrosion Inhibitor Dosing System, Biocide dosing System and H₂SO₄ dosing System for **1 X 660 MW UNIT No-5, PHASE-III, SAGARDIGHI TPS.**

2.0 DESIGN PHILOSOPHY FOR CW TREATMENT

The treatment system is designed to minimize the formation of scale and build-up of micro – organisms, and prevent fouling, and corrosion of the turbine condenser and other heat exchanger.

To inhibit scale formation in the CW system it is proposed to dose Sulphuric acid to convert calcium and magnesium bicarbonates into sulphates, which have higher solubility in water. synthetic polymer based Scale Inhibitor along with Corrosion inhibitor, Biocide and H₂SO₄ dosing Systems have been designed to dose required quantity of chemical to maintain CW quality at CW fore bay.

CW circulation flow	:	80000 m ³ /hr
CW make-up flow	:	1576 m ³ /hr
CW Blow down	:	315 m ³ /hr
COC	:	5
CW fore bay hold up volume	:	20000 m ³

2.1 CAPACITY SELECTION FOR CW TREATMENT PLANT

ACID DOSING (98% SULPHURIC ACID)

Make-up water M-Alkalinity	:	196.5 ppm as CaCO ₃
Desired M Alkalinity in Make-up water	:	150 ppm as CaCO ₃

Acid Dosage Rate	=	[Make-up water M-Alkalinity-(Desired M-Alkalinity in Make-up water/COC)] X Make-up water X 24/1000
	=	[196.5-150/5.0] X 1576 X 24/1000
	=	166.5 x 1576 x 24/1000
	=	6297.7 Kg./day
	=	262.4 Kg/hr
98 % Sulphuric Acid	=	(262.4/0.98)

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		267.8 Kg/hr
Specific Gravity	=	1.84
Acid Dosage Rate	=	(267.8/1.84) LPH 145.5 LPH
Acid Dosing Pumps Selected (0-100% stroke)	=	250 LPH
Qty	=	02 Nos (1W+1S)
Capacity of Sulphuric Acid Day Tank	=	(145.5 X 24) 3493.0 Liters
Day Tank Selected	=	3500 Liters
Capacity of each Sulphuric Acid Bulk Storage Tank for 15 days	=	145.5 X 24 X 15 Liters
	=	52380 Liters
Bulk Storage Tank Selected	=	2 Nos each of 52 M³

SCALE INHIBITOR, CORROSION INHIBITOR & BIOCIDES

Scale inhibitor and corrosion inhibitor are proprietary chemicals and level of its dosage in CW & ACW depends upon the recommendations of the respective chemical manufacturer and based upon plant operation. However, the Plant will be designed for 10-ppm dosage of both scale inhibitor & corrosion inhibitors, & for biocide dosing rate is minimum 3 ppm.

(a) Scale Inhibitor Dosing Rate	=	[CW Blowdown water(m³/hr)+ Drift loss X Dosage (ppm)] /1000
Dosing rate	=	10 ppm
Chemical dosing rate	=	(315+5.6X 10)/1000 3.21 Kg/hr of 100 % Solution (commercial grade)
Specific Gravity of Chemical	=	1 (approx.)
Chemical Dosage Rate	=	3.21/1 LPH (Approx.) 3.21 LPH
Chemical Dosing Pump Considered (0-100% stroke)	=	50 LPH
Qty	=	02 Nos (1W+1S)
Day Tank capacity for each Scale & Corrosion Inhibitor	=	3.21*24 77.0 Litres
Therefore Day Tank Selected as per Technical specification.		1000 Litres
(b) Corrosion Inhibitor Dosing Rate	=	[CW Blowdown water(m³/hr)+Drift loss X Dosage (ppm)] /1000
Dosing rate	=	10 ppm
Chemical dosing rate	=	((315+5.6) X 10)/1000 3.21 Kg/hr of 100 % Solution (commercial grade)

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Specific Gravity of Chemical	=	1 (approx.)
Chemical Dosage Rate as 100% conc.	=	3.21/ 1 LPH (Approx.) 3.21 LPH
Chemical Dosing Pump Considered (0-100% stroke)	=	50 LPH
Qty.	=	02 Nos (1W+1S)
Day Tank capacity for each Scale & Corrosion Inhibitor	=	3.21*24 77.0 Litres
Therefore Day Tank Selected as per Technical specification.		1000 Litres
(c) Biocide Dosing Rate	=	[Total CW + ACW flow (m3/hr) X Dosage (ppm)] /1000
Dosing rate (for flow 80000 m3/hr)	=	3 ppm
	=	(80000X 3)/1000 240 Kg/hr of 100 % Solution commercial grade
Specific Gravity of Chemical (Commercial grade)	=	1 (approx.)
Chemical Dosage Rate	=	240/1 LPH (Approx.) 240 LPH
Chemical Dosing Pump Considered (0-100% stroke)	=	500 LPH
Qty.	=	02 Nos (1W+1S)
Day Tank capacity for Biocide		240*12 Litres = 2880 ltrs
Therefore Day Tank Selected		6000 Litres

Note: Biocide dosing will be done once in two weeks for a duration of 1-2 hrs.

3.0 EQUIPMENT DESIGN CRITERIA FOR CW TREATMENT SYSTEM

CW Treatment Plant have been provided as detailed below.

3.1 SCALE INHIBITOR, CORROSION INHIBITOR & BIOCIDES DOSING

The chemical is dosed in CW fore bay to control scaling and corrosion and to prevent bio growth in the system. For this purpose, Scale Inhibitor /corrosion inhibitor /biocide dosing system has been provided. The dosing system shall mainly consist of the following equipment:

(1). Scale Inhibitor Dosing

- One (1) number Scale Inhibitor Tank, each complete with all necessary accessories.
- Two (2x100%) numbers Scale Inhibitor Injection Pumps (SS 316), each complete with drive motor and all other necessary accessories.
- One (1) number SS-316 Pipe Diffuser for Scale Inhibitor.
- 1x100% pulsating dampener at each pump discharge
- 1x100% "Y" strainer at each pump suction.

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- f) All integral & interconnected piping including pipe fittings, valves, stubs for instrumentation, pipe supports, specialties etc.,
- (2). Corrosion Inhibitor Dosing
 - a) One (1) number Corrosion Inhibitor Tank, each complete with all necessary accessories.
 - b) Two (2x100%) numbers Corrosion Inhibitor Injection Pumps (SS 304), each complete with drive motor and all other necessary accessories.
 - c) One (1) number SS-316 Pipe Diffuser for Corrosion Inhibitor.
 - d) 1x100% pulsating dampener at each pump discharge
 - e) 1x100% "Y" strainer at each pump suction.
 - f) All integral & interconnected piping including pipe fittings, valves, stubs for instrumentation, pipe supports, specialties etc.,
- (3). Biocide Dosing
 - a) One (1) number Biocide dosing tank, each complete with all necessary accessories
 - b) Two (2x100%) numbers Biocide Injection Pumps (SS 304), each complete with drive motor and all other necessary accessories.
 - c) One (1) number SS-316 Pipe Diffuser for Biocide.
 - d) 1x100% pulsating dampener at each pump discharge
 - e) 1x100% "Y" strainer at each pump suction.
 - f) All integral & interconnected piping including pipe fittings, valves, stubs for instrumentation, pipe supports, specialties etc.,

3.2 SULPHURIC ACID DOSING

H₂SO₄ is dosed to control the pH in the cooling water cycle. For this purpose, one (1) no. H₂SO₄ dosing system has been provided. The H₂SO₄ dosing system shall consist of the following:

- a) One (1) number hose station for unloading 98% Sulfuric Acid. The hose station shall have two (2) numbers HDPE hose connections (80 mm NB each).
- b) Two (2x100%) numbers Sulfuric Acid Unloading Pumps, each complete with drive motor and all other necessary accessories.
- c) Two (2) numbers Sulfuric Acid Storage Tanks, each complete with all necessary Accessories.
- d) One (1) number Sulfuric Acid Day Tank, each complete with all necessary accessories.
- e) Two (2x100%) numbers Sulfuric Acid Injection Pumps, each complete with drive motor and all other necessary accessories.
- f) One (1) number CPVC Pipe Diffuser for Sulphuric Acid.
- g) All necessary piping, valves, fittings, instrumentation etc.
- h) 'Y' type strainer (1 x100%) for each of the unloading pump.

Flow of sulphuric acid from bulk storage tank to acid day tank shall be by gravity.

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4.0 OPERATION CONTROL PHILOSOPHY & INSTRUMENTATION

The operation of the Circulating Water Treatment System (including Scale Inhibitor Injection System, Corrosion Inhibitor Injection System, Biocide Injection System & Sulphuric Acid Injection System) shall be from DCS with its OWS, OEWS and A3 Laser printer located in CW Pump house control room. The OWS shall have 23" colour LED monitor, keyboard, mouse etc.

All the dosing/injection Pumps shall be operated from OWS. Normally one (1) no. pump will be in service and one (1) no. will be as stand-by pump selection through OWS.

Sulphuric acid will be unloaded from road tankers by Sulphuric Acid unloading Pumps into over ground Sulphuric Acid Storage Tanks kept at suitable elevation to enable transfer of acid from Acid Storage tank to Acid Day Tank. The starting & stopping of Sulphuric acid unloading Pump Shall be from OWS in Manual mode. Local Push Button provided near to the pumps for Start/ Stop. The Acid Storage tank is equipped with the instruments such as level indicator and the level Transmitter which will generate Low level alarm & High level alarm for low level & high level indication respectively. The high level interlock in the Storage tank shall be used for tripping of Sulphuric Acid Unloading Pump to prevent tank Overflow. The high level is interlocked when pump is operated either from LPBS or OWS.

The Sulphuric Acid Injection Pumps shall be operated from OWS in Auto/Manual mode. In the auto mode, the stroke shall be adjusted by sensing pH of Circulating Water. During normal operation, Sulphuric Acid Injection Pumps will operate in the auto-mode and inject sulphuric acid to maintain the pH of circulating water at a desired level to control scale deposition or corrosion. Adjustment of stroke/speed shall be possible from remote as well as local manually.

Normally one (1) no. pump will be in service and one (1) no. will be as stand-by pump selection through OWS. The Standby pump will run after the service pump trips.

All effluents from Sulphuric Acid storage tank and Injection area will pass through a Lime/Neutralization Pit for neutralization before discharge into CW forebay.

The operation of Scale Inhibitor Injection Pumps shall be manual from OWS. Normally one (1) no. pump will be in service and one (1) no. will be as stand-by pump selection through OWS.

The operation of Corrosion Inhibitor Injection Pumps shall be manual from OWS. Normally one (1) no. pump will be in service and one (1) no. will be as stand-by pump selection through OWS.

Monitoring equipment with reference to scale formation, corrosion and biological growth shall be provided to supervise the performance of the treatment systems.

ON/OFF/TRIP status of all drive motors shall be displayed in OWS. Signal exchange between MCC and DCS shall be as per Drive control philosophy applicable for the project.

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All dosing pumps (scale inhibitor/corrosion inhibitor/Biocide/H₂SO₄) shall be tripped at Low Low level in respective day tank. Acid unloading pumps shall be tripped at high level of bulk acid storage tank. High and Low Level alarm shall be provided in each tank.

Annunciation showing tripping of different motors, level alarms from level transmitters shall be located in the Operating Station.

The measurement of all Instruments (except gauges) and operation of motors shall be through DCS, with its OWS placed in CWPH control room in line with Drawing for Control System for Mechanical auxiliary packages.

RIO and MCC for CWTP will be placed in Cooling water pump house building. The Power, instrument and control cables are supplied by BHEL-Ranipet.

Note: Detailed philosophy will be available in Drg no. RP-DC-445-WTP-A059

5.0 PERFORMANCE GURANTEE PARAMETERS FOR CIRCULATING WATER TREATMENT SYSTEM

i) Corrosion rate:

- On MS < 3.0 mpy
- On Cu < 0.5 mpy
- On SS (304) < 0.5 mpy

ii) Scaling < 15mg/dm²/day

iii) Ratio of circulation to make-up water total hardness ~ 5.8-6.7

iv) Micro/Bio fouling conditions

a) Total Viable Count (TVC) < 1x10⁵ Counts/ml

b) Sulphate reducing bacteria (SRB) < 1x10⁵ Counts/100ml

v) Pitting corrosion rate on MS/Brass < 20 mpy

NOTE-1: - One number safety shower and eye wash will be provided near each sulphuric acid handling area.

NOTE-2: The system will be designed based on the dosing rate indicated in this document. However, the dosing rate shall be done on the actual water analysis

NOTE-3: Dyke will be provided around the acid storage tank. The dyke will be capable to hold one Bulk acid storage tank spillage.

NOTE-4: One number lime pit of 1 Cu.M Capacity shall be provided to neutralize leaked sulphuric acid.

NOTE-5: Painting shall be as per customer painting specification.

NOTE-6: All individual effluents from scale inhibitor, corrosion inhibitor & biocide dosing shall lead to drain trench. This drain trench will be connected to Lime pit.

Note-7: All the three dosing skids shall be located indoor inside the CW treatment building.

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Note-8: All effluents from Sulphuric Acid Acid injection system will pass through a lime pit for neutralization before discharge into plant drain/fore bay. This neutralizing pit effluent pH shall be measured in lab. From Lime pit effluent will be discharged with the help of portable pump (1x100%) into CW fore bay. For portable pump details refer clause 11.4 of technical data sheet.

Note-9: Ni-Cr mesh should be clean when visually inspected.

6.0 DESIGN CLARIFIED WATER ANALYSIS (MAKE UP WATER)

S.No.	CONSTITUENTS	As	CONTENT
1.	Calcium	CaCO ₃	105 ppm
2.	Magnesium	CaCO ₃	52 ppm
3.	Sodium & Potassium	CaCO ₃	138 ppm
	TOTAL CATIONS	CaCO₃	295 ppm
4.	Bicarbonate	CaCO ₃	196.5 ppm
5.	Carbonate	CaCO ₃	-
6.	Chloride	CaCO ₃	41 ppm
7.	Sulphate	CaCO ₃	57.5 ppm
8.	Nitrate	CaCO ₃	-
	TOTAL ANIONS	CaCO₃	295 ppm
9	M.O. Alkalinity	CaCO ₃	196.5 ppm
10	P. Alkalinity	CaCO ₃	-
11	Total Hardness	CaCO ₃	157 ppm
12	Carbon-di-oxide	CO ₂	3.5
13	Dissolved Silica	SiO ₂	20 ppm
14	Total Iron	Fe	1 ppm
15	pH value	-	7.9 – 8.0
16	Turbidity		20 NTU
17	Organic Matter Content in terms of Oxygen in absorbed from (KMnO ₄ (4 Hrs.)		5 ppm

NOTE:

- THE CYCLE OF CONCENTRATION (COC) SHALL BE CONSIDERED AS 5.0** for sets of cooling water systems.
- DATA FOR COOLING TOWER:**
 - Recirculation Volume of Cooling Tower is 80000 cum/hr (approx.).
 - Storage/Holdup volume of cooling tower basin=20000 Cu. m
 - Blow down=315 Cu.m/Hr.
 - Make up water=1576 Cu.m/Hr.

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7.0 DATA SHEETS FOR CW TREATMENT PLANT

Sl no.	Description	Parameters
1.0	SULPHURIC ACID STORAGE TANK (Design code: ASME SEC-VIII-DIV-I/IS-2825)	
1.1	Numbers	2 Nos.
1.2	Type	Horizontal cylindrical with dished ends.
1.3	Type of fluid to be handled	98 % Sulphuric Acid.
1.4	Effective capacity, in m3	52 m3 (each)
1.5	Minimum Free Board	300 mm
1.6	Material of Construction	
1.6.1	Shell	Carbon steel as per IS 2062 or ASTM A 515 Gr.70.
1.6.2	Dished Ends	Carbon steel as per IS 2002 or ASTM A 515 Gr.70.
1.7	Design Temperature	80 Deg. C
1.8	Tank thickness	ASME SEC VIII DIV I /IS 2825. Thickness of each acid storage tank will be 10 mm (minimum).
1.9	Instruments	As per P& ID and system requirement.
1.10	Accessories for each tank	Fume absorbers, breather, manhole (2 nos), vent, drain, sample connection, level transmitter, operating platform, ladders etc.
1.11	Manhole	2 Nos in each tank each of 600 mm dia.
2.0	SULPHURIC ACID UNLOADING PUMPS	
2.1	Number	2 Nos (1 W +1 S)
2.2	Location	Outdoor.
2.3	Fluid to be handled	98% w/w Commercial Sulphuric Acid.
2.4	Service	To unload Concentrated Sulphuric Acid from Tanker to Sulphuric Acid Storage Tank.
2.5	Duty	Intermittent operation
2.6	Type of Pump	Horizontal Centrifugal Non Clog type
2.7	Design standard	As per IS-5659 /IS-5120/
2.8	Rated Capacity, in m3/hr	10 m3/hr
2.9	Range of operation	20 % - 120 %.
2.10	Type of impeller	As per manufacturer standard
2.11	Head to be developed at rated capacity	20 mWC min or as per system requirement.
2.12	Accessories	As per tender specification, P&ID and system requirement.
2.13	Design standard and design temp	As per IS-5659 & IS-5120 and 80 Deg C.
2.14	Material of construction	
2.12.1	Casing	Alloy-20.
2.12.2	Impeller	Alloy-20.
2.12.3	Shaft	EN-8 to BS-970.

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Sl no.	Description	Parameters
2.12.4	Mechanical Seal	Alloy-20.
2.12.5	Common Base plate	Fabricated Steel as per IS 2062.
2.12.6	Nuts and bolts	Alloy-20.
2.15	Type of drive	Electrical Motor
2.16	Criteria of selection of drive motor	Minimum 15 % margin over BkW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
2.17	Rated speed (RPM)	1500 (Sync.) max
2.18	Voltage, Phase & Frequency ($\pm$ % Variation)	415 V ($\pm 10\%$), 3 Phase, 50 HZ (+10 to -10%).
2.19	Type of coupling between Pump & Motor	Flexible Spacer.
2.20	Noise level (for complete set of Pump & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
2.21	HDPE Hose along with manifold	Two (2) numbers, each min 80 NB and 10 m long type-2 HDPE hose as per IS-7654/1989 with isolation hose. Manifold MOC-MS
2.22	Accessories required for each pump	Coupling guard, drain plug, vent valve, suction hoses, isolation valves, Y- type strainers, pressure gauges, pulsation dampener.
2.23	Suction strainer	PP/HDPE/PVDF (2X100 %) for Acid application. Body: PP/HDPE/PVDF Mesh: Polypropylene or HDPE wire cloth - Mesh 30 Plug: PP/HDPE/PVDF
2.24	a) Material Test required for	Casing, Impeller, Shaft and Shaft Sleeve.
2.25	b) Hydro-test	Shall be provided Tender Specification
2.26	c) Dynamic Balancing Test	Shall be provided
2.27	Performance Test	Shall be provided Tender Specification
3.0	SULPHURIC ACID DOSING PUMPS	
3.1	Number	02 Nos (1W+1S)
3.2	Rated Capacity of Pump, in LPH	250 LPH
3.3	Fluid to be handled	98% w/w sulphuric acid.
3.4	Service	To inject concentrated sulphuric acid into CW Fore bay.
3.5	a. Duty b. Location	a. Continuous and to be suitable for parallel Operation. b. Indoor
3.6	Type of Pump	Electromechanical, Positive displacement, constant speed, variable stroke and plunger operated

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Sl no.	Description	Parameters
		reciprocating type.
3.7	Facility for Capacity Adjustment	Local manual through Micrometre Dial and remote from Control Room in CWPH through OWS
3.8	Range of Capacity Adjustment	0 % - 100 %.
3.9	Head to be developed at rated capacity	As per system requirement. However it shall not be less than 250 lph & 20 mlc
3.10	Y- type strainers for each pump	PP/HDPE/PVDF (2X100 %) for Acid application. (2X100 %). Body: PP/HDPE/PVDF Mesh: Polypropylene or HDPE wire cloth - Mesh 30 Plug: PP/HDPE/PVDF
3.11	Suction condition	Flooded
3.12	Material of construction	
3.12.1	Housing	Alloy-20.
3.12.2	Pump head	Alloy-20.
3.12.3	Plunger	Alloy-20.
3.12.4	Worm	Manganese Bronze / Cast Iron.
3.12.5	Worm Wheel	Manganese Bronze / Cast Iron.
3.12.6	Shafts (worm)	Hardened Steel (EN 19 / ASTM A 276 Gr.410).
3.12.7	Base plate	MS.
3.12.8	Foundation bolts	Alloy-20.
3.13	Type of drive	Electrical Motor with Variable Frequency Drive
3.14	Criteria of selection of drive motor	Minimum 15 % margin over BkW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
3.15	Rated speed (RPM)	1500 (Sync.) max.
3.16	Voltage, Phase & Frequency ($\pm$ % Variation)	415 V (+10%), 3 Phase, 50 HZ (+10 to -10%).
3.17	Type of coupling between Pump & Motor	As per manufacturer standard.
3.18	Noise level (for complete set of Pump & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
3.19	Tests and Inspection	
	a) Material Test	Required for Pump Head and Plunger.
	b) Hydro-Test	Test Pressure - 200% of pump operating pressure or 15 kg/cm ² (g) whichever is higher. Test Duration - Half an hour (minimum).
	c) Dynamic Balancing Test	Static Balancing for all rotating parts of pumps required.
	Performance Test	

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Sl no.	Description	Parameters
	a) Test Code	Hydraulic Institute Standard and API-675.
	b) Tests to be done for determination of	Capacity, Volumetric Accuracy, Volumetric Efficiency and Power Consumption.
	c) Test to be carried out	Capacity, Volumetric Accuracy, Volumetric Efficiency and Power Consumption.
	d) Test for satisfactory operation of pump at site	Shall be provided.
3.20	Design Temperature	80 Deg.C.
3.21	Accessories	As per tender specification, P&ID and system requirement.
4.0	SULPHURIC ACID DAY TANK	
4.1	Numbers To be provided	1 W
4.2	Type	Vertical cylindrical with dished bottom.
4.4	Effective capacity, in m3.	3.5 Cu. m.
4.5	Type of fluid to be handled	98 % Sulphuric Acid.
4.6	Material of Construction	Carbon steel as per IS 2062 or ASTM A 515 Gr.70.
4.7	Thickness, in mm	Not less than 6.0 (minimum)
4.8	Design Temperature	80 Deg C
4.9	Design Pressure	Atmospheric
4.10	Minimum Free board	300 mm
4.11	Design Code	IS 803
4.12	Codes for Test -	Water fill test
4.13 (a)	Painting - i) Internal -	As per system supplier recommendations
4.13 (b)	ii) External -	Epoxy paint
4.14	Instruments	As per P&ID
5.0	SCALE INHIBITOR DOSING TANK	
5.1	Numbers To be provided	One (1) number, Cap:1000 ltrs.
5.2	Type for each Tank	Vertical cylindrical with dished bottom and bolted top flange cover..
5.3	Type of fluid to be handled	Commercial Scale Inhibitor Solution.
5.4	Effective capacity of each tank, m ³	Minimum 1000 Litres or twelve (12) hours storage requirement based on minimum 10 ppm dosage rate or as per system requirement, whichever higher
5.5	Minimum Free Board, in mm	300
5.6	Material of Construction	SS-304
5.7	Thickness, in mm	Not less than 6 mm min.
5.8	Design Temperature	60 Deg C
5.9	Feed funnel	Shall be provided over the top cover to feed scale inhibitor.

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Sl no.	Description	Parameters
5.10	Codes for test & inspection	Hydrostatic fill test
5.11	Accessories	Inlet, outlet, drain, overflow lines & Platform along with handrails shall be provided for charging the chemicals.
5.12	Instruments	As per P&ID.
6.0	SCALE INHIBITOR DOSING PUMPS	
6.1	Number	Two (2) [1W+1S]
6.2	Location	Indoor
6.3	Capacity of Pump	50 LPH (each).
6.4	Service	To inject Scale Inhibitor Solution into CW forebay.
6.5	Type of Pump	Electro Mechanical, Positive displacement, constant speed, variable stroke and plunger operated reciprocating type.
6.6	Facility for Capacity Adjustment	Local manual through Micrometer Dial.
6.7	Range of Capacity Adjustment	0 % - 100 %.
6.8	Suction Condition	Flooded.
6.9	Head to be developed at rated capacity	As per system requirement. However it shall not be less than 20 mlc
6.10	Material of construction	
6.10.1	Housing	SS 316
6.10.2	Pump head	SS 316
6.10.3	Plunger	SS 316
6.10.4	Worm	Manganese Bronze / Cast Iron.
6.10.5	Worm Wheel	Manganese Bronze / Cast Iron.
6.10.6	Shafts (worm)	Hardened Steel (EN 19 / ASTM A 276 Gr.410).
6.10.7	Base plate	MS.
6.11	Foundation bolts and nuts	SS 316
6.12	Type of drive	Electrical Motor with Variable Frequency Drive
6.13	Criteria of selection of drive motor	Minimum 15 % margin over BkW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
6.14	Rated speed (RPM)	1500 (Sync.) maximum.
6.15	Voltage, Phase & Frequency ($\pm$ % Variation)	415 V (+10%), 3 Phase, 50 HZ (+10 to -10%).
6.16	Type of coupling between Pump & Motor	Flexible Spacer.
6.17	Noise level (for complete set of	Not more than 85 db (At a distance of 1.0 m from

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Sl no.	Description	Parameters
	Pump & Motor)	the outer surface of Motor).
6.18	Tests and Inspection	
	a) Material Test	Required for Pump Head and Plunger.
	b) Hydro-Test	Test Pressure - 200% of pump operating pressure or 15 kg/cm ² (g) whichever is higher. Test Duration - Half an hour (minimum).
	c) Dynamic Balancing Test	Static Balancing for all rotating parts of pumps required.
	Performance Test	
	a) Test Code	Hydraulic Institute Standard and API-675.
	b) Tests to be done for determination of	Capacity, Volumetric Accuracy, Volumetric Efficiency and Power Consumption.
	c) Test to be carried out	Capacity, Volumetric Accuracy, Volumetric Efficiency and Power Consumption.
	d) Test for satisfactory operation of pump at site	Shall be provided.
6.19	Design Temperature	60 Deg.C.
6.20	Accessories	As per tender specification, P&ID and system requirement.
6.21	Painting	Primer: Two coats of epoxy zinc phosphate primer. DFT per coat – 30 microns. Finish paint: Two coats of amine-cured epoxy high build paint. DFT per coat – 125 microns.
7.0	CORROSION INHIBITOR TANKS	
7.1	Numbers to be provided	One (1) number.
7.2	Type for each Tank	Vertical cylindrical with dished bottom and bolted top flange cover.
7.3	Type of fluid to be handled	Commercial Scale Inhibitor Solution.
7.4	Effective capacity of tank, m ³	Minimum 1000 Litres
7.5	Minimum Free Board, in mm	300
7.6	Material of Construction	SS-304
7.7	Thickness, in mm	Not less than 6 (min)
7.8	Design Temperature	80 Deg C
7.9	Feed funnel	Shall be provided over the top cover to corrosion inhibitor.
7.10	Codes for test & inspection	Hydrostatic fill test
7.11	Accessories	Inlet, outlet, drain, overflow lines & Platform

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Sl no.	Description	Parameters
		along with handrails shall be provided for charging the chemicals.
	Instruments	As per P&ID.
8.0	CORROSION INHIBITOR DOSING PUMPS	
8.1	Number	Two (2) [1W+1S]
8.2	Location	Indoor
8.3	Capacity	50 LPH (each).
8.4	Service	To inject Corrosion Inhibitor Solution into CW forebay.
8.5	Type of Pump	Electro mechanical, Positive displacement, constant speed, variable stroke and plunger operated reciprocating type.
8.6	Facility for Capacity Adjustment	Local manual through Micrometre Dial.
8.7	Range of Capacity Adjustment	0 % - 100 %.
8.8	Suction Condition	Flooded.
8.9	Head to be developed at rated capacity	As per system requirement. However it shall not be less than 20 mlc
8.10	Material of construction	
8.10.1	Housing	SS 304
8.10.2	Pump head	SS 304
8.10.3	Plunger	SS 304
8.10.4	Worm	Manganese Bronze / Cast Iron.
8.10.5	Worm Wheel	Manganese Bronze / Cast Iron.
8.10.6	Shafts (worm)	Hardened Steel (EN 19 / ASTM A 276 Gr.410).
8.10.7	Base plate	MS.
8.11	Foundation bolts and nuts	SS 316
8.12	Type of drive	Electrical Motor with Variable Frequency Drive
8.13	Criteria of selection of drive motor	Minimum 15 % margin over BkW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
8.14	Rated speed (RPM)	1500 (Sync.) maximum.
8.15	Voltage, Phase & Frequency ($\pm$ % Variation)	415 V (+10%), 3 Phase, 50 HZ (+10 to -10%).
8.16	Type of coupling between Pump & Motor	Flexible Spacer.
8.17	Noise level (for complete set of Pump & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
8.18	Tests and Inspection	

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Sl no.	Description	Parameters
	a) Material Test	Required for Pump Head and Plunger.
	b) Hydro-Test	Test Pressure - 200% of pump operating pressure or 15 kg/cm ² (g) whichever is higher. Test Duration - Half an hour (minimum).
	c) Dynamic Balancing Test	Static Balancing for all rotating parts of pumps required.
	Performance Test	
	a) Test Code	Hydraulic Institute Standard and API-675.
	b) Tests to be done for determination of	Capacity, Volumetric Accuracy, Volumetric Efficiency and Power Consumption.
	c) Test to be carried out	Capacity, Volumetric Accuracy, Volumetric Efficiency and Power Consumption.
	d) Test for satisfactory operation of pump at site	Shall be provided.
8.20	Design Temperature	60 Deg.C
8.21	Accessories	As per tender specification, P&ID and system requirement.
9.0	BIOCIDE TANKS	
9.1	Numbers To be provided	One (1) numbers, each tank capacity of 12 hours storage, complete with feed funnel, Overflow, drain, vent, level indicators & other necessary accessories as required.
9.2	Type for each Tank	Vertical cylindrical with dished bottom and bolted top flange cover.
9.2	Type of fluid to be handled	Commercial Biocide Solution.
9.3	Effective capacity of each tank, m ³	Minimum 6000 Litres or twelve (12) hours storage requirement based on minimum 3.0 ppm dosage rate or as per system requirement, whichever higher.
9.4	Minimum Free Board, in mm	300
9.5	Material of Construction	SS-304
9.6	Thickness, in mm	Not less than 6
9.7	Design Temperature	80 Deg C
9.8	Feed funnel	Shall be provided over the top cover to feed Biocide.
9.9	Codes for test & inspection	Hydrostatic fill test
9.10	Accessories	Inlet, outlet, drain, overflow lines & Platform along with handrails shall be provided for charging the chemicals.
9.11	Instruments	As per P&ID.
10.0	BIOCIDE INJECTION PUMPS	
10.1	Number	Two (2) [1W+1S]

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Sl no.	Description	Parameters
10.2	Location	Indoor
10.3	Capacity	500 LPH (each).
10.4	Service	Commercial Biocide Solution. To inject Biocide Solution into CW Pump House Fore-Bay.
10.5	Type of Pump	Positive displacement, constant speed, variable stroke and plunger operated reciprocating type (Electro mechanical type).
10.6	Facility for Capacity adjustment	Local manual through Micrometre Dial.
10.7	Range of Capacity adjustment	0 % - 100 %.
10.8	Suction Condition	Flooded.
10.9	Head to be developed at rated capacity	As per system requirement. However it shall not be less than 20 mWC
10.10	Material of construction	
10.10.1	Housing	SS 304
10.10.2	Pump head	SS 304
10.10.3	Plunger	SS 304
10.10.4	Worm	Manganese Bronze / Cast Iron.
10.10.5	Worm Wheel	Manganese Bronze / Cast Iron.
10.10.6	Shafts (worm)	Hardened Steel (EN 19 / ASTM A 276 Gr.410).
10.10.7	Base plate	MS.
10.11	Foundation bolts and nuts	SS 316
10.12	Type of drive	Electrical Motor with Variable Frequency Drive
10.13	Criteria of selection of drive motor	Minimum 15 % margin over BkW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
10.14	Rated speed (RPM)	1500 (Sync.) maximum.
10.15	Voltage, Phase & Frequency ($\pm$ % Variation)	415 V (+10%), 3 Phase, 50 HZ (+10 to -10%).
10.16	Type of coupling between Pump & Motor	Flexible Spacer.
10.17	Noise level (for complete set of Pump & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
10.18	Tests and Inspection	
	a) Material Test	Required for Pump Head and Plunger.
	b) Hydro-Test	Test Pressure - 200% of pump operating pressure or 15 kg/cm ² (g) whichever is higher. Test Duration - Half an hour (minimum).
	c) Dynamic Balancing Test	Static Balancing for all rotating parts of pumps required.
10.19	Performance Test	
	a) Test Code	Hydraulic Institute Standard and API-675.

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Sl no.	Description	Parameters
	b) Tests to be done for determination of	Capacity, Volumetric Accuracy, Volumetric Efficiency and Power Consumption.
	c) Test to be carried out	Capacity, Volumetric Accuracy, Volumetric Efficiency and Power Consumption.
	d) Test for satisfactory operation of pump at site	Shall be provided.
10.20	Design Temperature	60 Deg.C
10.21	Accessories	As per tender specification, P&ID and system requirement.
11.0	LIME PIT	
11.1	Quantity	One number.
11.2	Capacity	1 Cu.m
11.3	MOC	RCC with acid alkali protection.
11.4	PORTABLE PUMP FOR LIME PIT	
a.	Number	One (1)
b.	Purpose To handle neutralized acid	Purpose To handle neutralized acid
c.	Suction Condition Flooded	Suction Condition Flooded
d.	Flow & Head to be developed at rated capacity	Flow: 10 m3/hr. Head: Min. 20 meter or as per system requirement.
e.	Material of construction	
1	Housing	Alloy-20
2	Pump head & other components	Alloy-20 or equivalent.
3	Type of drive	Electrical Motor
4	Criteria of selection of for Drive motor	As per system requirement
5	Rated speed (RPM)	1500
6	Hose pipe (Size: 50 mm)	Hose pipe (Size:50 mm), approx.-80 mtrs.
12.0	PIPE, VALVES, STRAINER AND DIFFUSER	
12.1	Pipe MOC	For 98% H2SO4 application-Seamless Carbon Steel pipe to ASTM A53 Gr. B /IS: 1239 Part- I, Heavy grade. For Scale & Corrosion Inhibitor and Biocide application-Stainless Steel to ASTM 312 Type SS 316.
12.2(a)	Valves (Ball & Gate valves)	For Scale & Corrosion Inhibitor and Biocide application-SS 316 PN10.
12.2(b)	Valves (Diaphragm)	For 98% H2SO4 application, Rubber lined Diaphragm valves.
12.3	Strainer	For 98% H2SO4 application-PVDF (50 BS). For Scale & Corrosion Inhibitor and Biocide application- Stainless Steel to ASTM 312 Type 316

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Sl no.	Description	Parameters
		(50 BS).
12.4	Diffuser	SS-316 (except sulfuric acid, for sulfuric acid the MOC is CPVC).
12.5	Supply of chemical	Supply of Sulphuric Acid, lubricating oil for dosing pumps, Scale inhibitor, Corrosion inhibitor & Biocide chemicals for first charge and upto six (6) months operational requirement after successful commissioning of CW treatment plant.

NOTES:

- Individual drains of each skid (scale inhibitor, corrosion inhibitor & biocide dosing) shall be provided in CWTP Equipment & control room layout Drg. RP-DG-445-WTP-A058
- All the three dosing skids shall be located indoor inside the CW treatment building
- All accessories for each equipment shall be as per tender specification.
- All instrument and interlocks as addressed in tender specification along with it shall be provided for each equipment/items.
- All instrument and interlocks as addressed in tender specification along with it shall be provided for each equipment/items.
- All instrument and interlocks as addressed in tender specification along with it shall be provided for each equipment/items.
- Noise level of all equipment shall be within 85 dbA and vibration level shall be within 5.1mm/s.
- Provision to transfer sulphuric acid from one bulk storage tank to the other tank is provided. Refer P&ID: RP-DG-445-WTP-A057 (BHEL:1-WT-080-01915)
- Flow of sulphuric acid from bulk storage tank to acid day tank shall be by gravity.
- Drains from Sulphuric acid bulk storage tanks and day tanks, effluent from flushing line of pumps, and other effluents from Sulphuric Acid handling area shall be led to Lime Pit.
- Silica Gel Breather shall be provided for sulphuric acid storage tank.
- One number safety shower shall be provided near Sulphuric acid handling area. Details incorporated in CWTP Equipment & Control room layout Drg. NO. RP-DG-445-WTP-A058
- Sulphuric acid bulk storage tanks shall be located outdoor without any cover and sulphuric acid unloading pumps shall be located outdoor and covered on top by canopy. Sulphuric acid day tanks and dosing pumps shall be located inside the CW treatment plant building.
- All pipe fittings, stubs for instrumentations, pipe supports, specialties, etc.

8.0 REFERENCE DRAWINGS

- P&ID FOR CW & ACW SYSTEM: PE-DG-445-165-N001
- P&ID FOR CW TREATMENT PLANT: RP-DG-445-WTP-A057 (BHEL:1-WT-080-01915)

1-WT-080-01915
BHEL DRAWING NO.
RP-DG-445-WTP-A057
WBPDCI, DOC NO.

ALL DIMENSIONS ARE IN MILLIMETRES

EQUIPMENT LIST			
KKS TAG NO.	DESCRIPTION	SIZE/CAP./NOS.	MOC
90PB003-04 AP001	SULPHURIC ACID UNLOADING PUMPS	10 m ³ /hr	02(1W+1S) ALLOY 20
90PB001-02 BB001	SULPHURIC ACID STORAGE TANKS	52 m ³	02 MS
90PB005 BB001	SULPHURIC ACID DAY TANK	3.5 m ³	01 CS
90PB006-07 AP001	SULPHURIC ACID DOSING PUMPS	250 LPH	02(1W+1S) ALLOY 20
90PB012-13 BB001	CORROSION INHIBITOR DOSING TANK	1 m ³	01 SS-304
90PB014-15 AP001	CORROSION INHIBITOR DOSING PUMP	50 LPH	02(1W+1S) SS-304
90PB008-09 BB001	SCALE INHIBITOR DOSING TANK	1 m ³	01 SS-304
90PB010-11 AP001	SCALE INHIBITOR INJECTION PUMP	50 LPH	02(1W+1S) SS-316
90PB016-17 BB001	BIOCIDE DOSING TANK	6 m ³	02 SS-304
90PB018-19 AP001	BIOCIDE INJECTION PUMP	500 LPH	02(1W+1S) SS-304
90PB020 AP001	PORTABLE PUMP FOR LIME PIT	10 m ³ /hr	01(1W) ALLOY-20

LEGEND	
	DIAPHRAGM VALVE
	GATE VALVE
	NON RETURN VALVE
	BALL VALVE
	PRESSURE RELIEF VALVE
	VENT TO ATMOSPHERE
	GRAVITY DRAIN/SAMPLING
	DRAIN TRENCH
	PRESSURE GAUGE WITH DIAPHRAGM SEAL
	LEVEL GAUGE
	LEVEL TRANSMITTER (ULTRASONIC TYPE)
	Y TYPE STRAINER
	CENTRIFUGAL PUMP
	METERING PUMP
	THREE WAY VALVE
	SILICA GEL BREATHER
	FLEXIBLE PIPE
	TERMINATION POINT & BATTERY LIMIT SCOPE
	PULSATION DAMPNER (PD)
	OVER FLOW BREATHER
	METAL TUBE ROTAMETER
	FOOT VALVE

PIPING MATERIAL SPECIFICATION			
No.	Size	Material	Thk.
01	25NB	SS 316	As per SCH40
02	25NB	CS	As per SCH40
03	50NB	CS	ERW HEAVY

NOTES:

- BUND/DYKE WALL SHALL BE CONSTRUCTED FOR H2SO4 UNLOADING PUMP, BULK STORAGE DOSING TANK AND DOSING PUMP AREA. LEAKAGES SHALL BE COLLECTED THROUGH DRAIN WHICH LEADS TO N-PIT.
- FOR THE DOSING TANK, NORMALLY 1NO LG IS PROVIDED. IF TANK HEIGHT IS MORE THAN 1200MM 2NOS LG WILL BE PROVIDED.
- DRAINS FROM SCALE INHIBITOR, CORROSION INHIBITOR & BIOCIDE SKIDS SHALL BE CONNECTED TO LIME/N-PIT BY CIVIL TRENCH (AR TILED)
- DIAPHRAGM VALVES ARE CONSIDERED FOR H2SO4 APPLICATIONS
- PAINTING SCHEME WILL BE FOLLOWED AS PER TENDER SPECIFICATION

CUSTOMER No. : R4W2

CUSTOMER:



THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.(WBPDCL)
1X660MW,SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)

CONSULTANT:



DEVELOPMENT CONSULTANTS PRIVATE LIMITED
KOLKATA



BHARAT HEAVY ELECTRICALS LTD.
BOILER AUXILIARIES PLANT
RANIPET - 632 406

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TITLE

P&ID FOR CW TREATMENT PLANT

DEPT	CODE	NAME	SIGN	DATE
DRN	PP/HD		Sd/-	12.11.2020
DESN	DBN/MR		Sd/-	12.11.2020
CHD	MSM/VSN		Sd/-	12.11.2020
APPD	MRK		Sd/-	12.11.2020
WBPDCL DOC NO. RP-DG-445-WTP-A057 BHEL DRAWING NO. 1-WT-080-01915 SHEET - REV. 04				

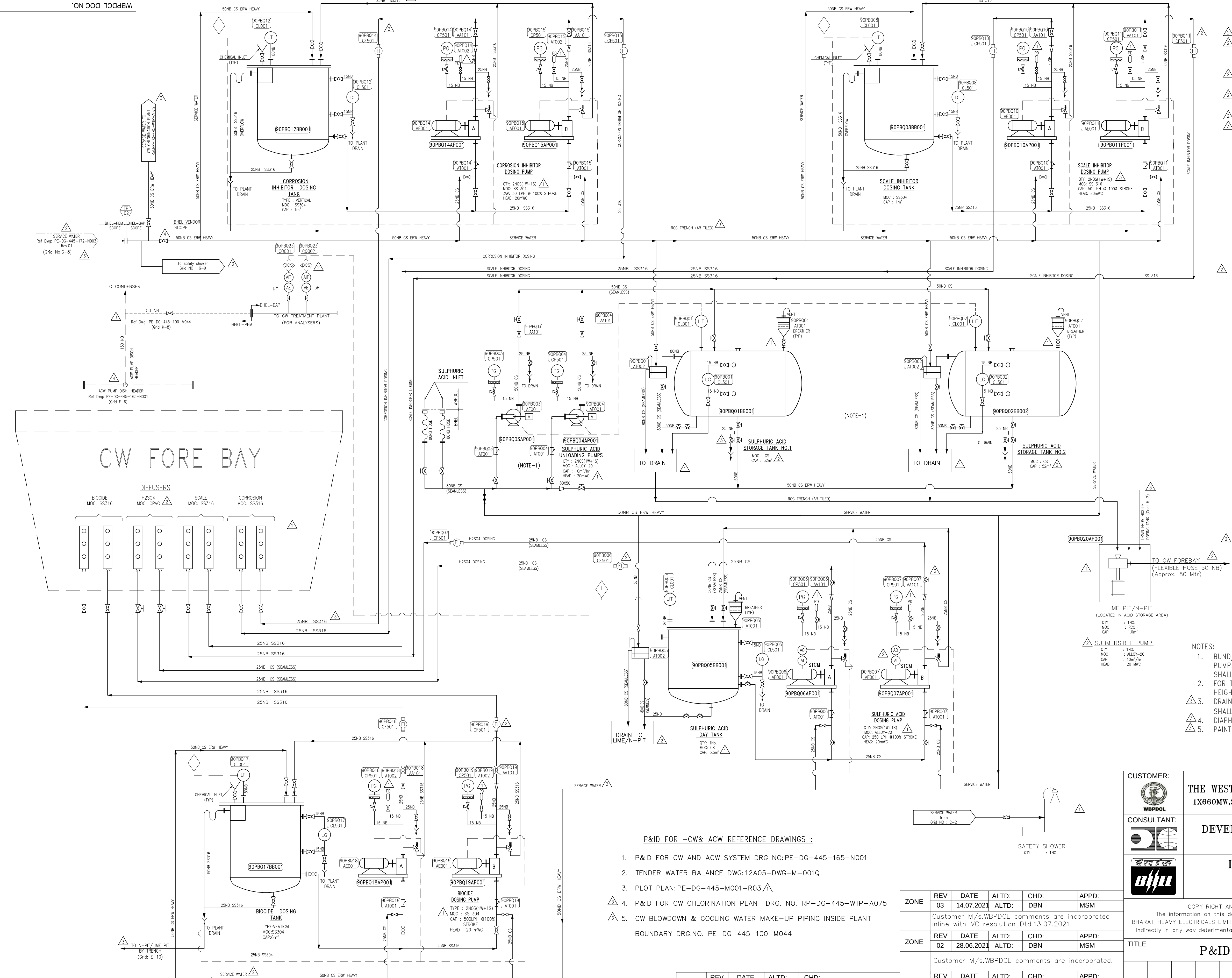
P&ID FOR -CW& ACW REFERENCE DRAWINGS :

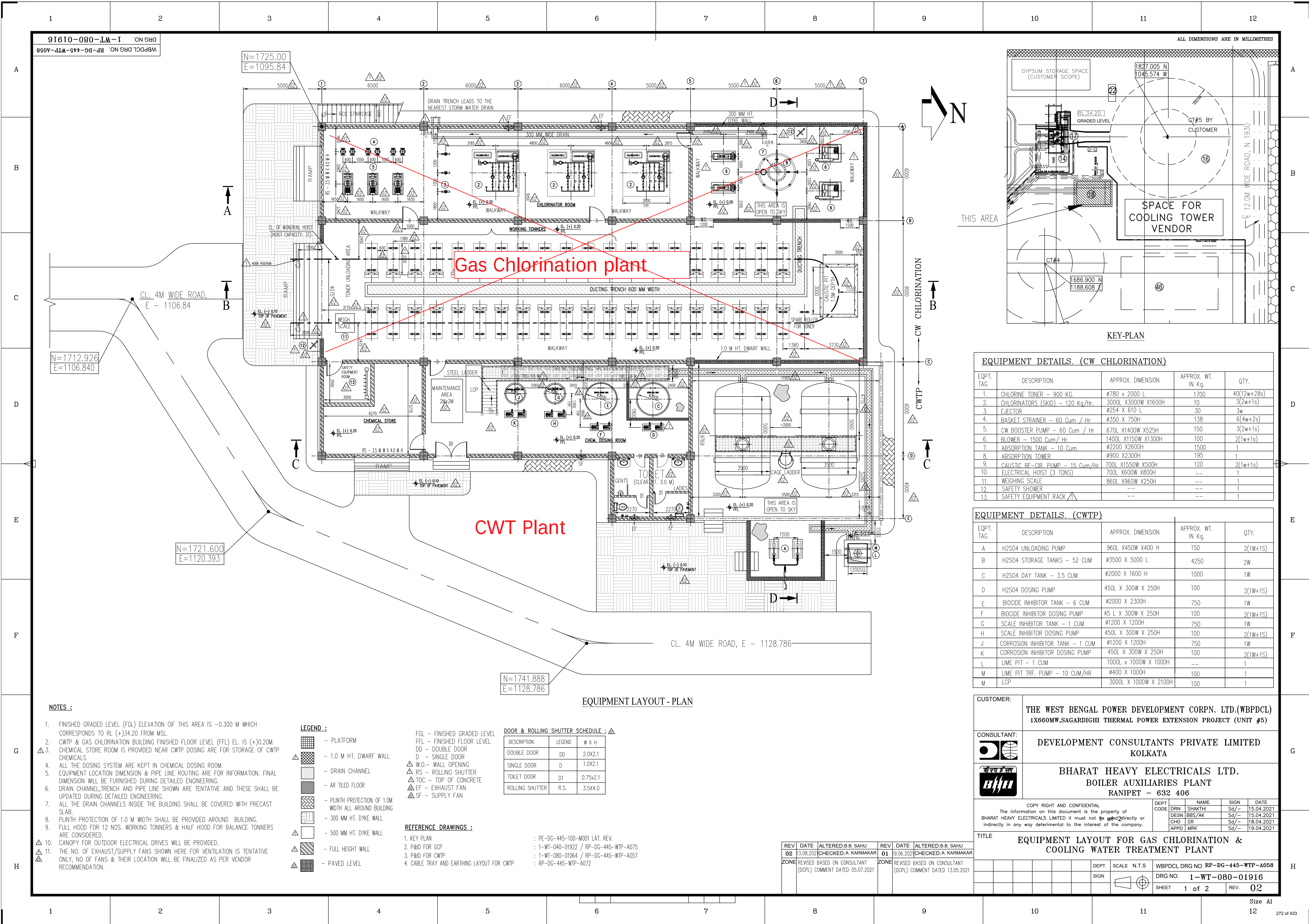
- P&ID FOR CW AND ACW SYSTEM DRG NO:PE-DG-445-165-N001
- TENDER WATER BALANCE DWG:12A05-DWG-M-O01Q
- PLOT PLANE:PE-DG-445-M001-R03
- P&ID FOR CW CHLORINATION PLANT DRG. NO. RP-DG-445-WTP-A075
- CW BLOWDOWN & COOLING WATER MAKE-UP PIPING INSIDE PLANT

BOUNDARY DRG.NO. PE-DG-445-100-M044

ZONE	REV	DATE	ALTD:	CHD:	APPD:
	04	26.07.2021	ALTD:	DBN	
Customer M/s.WBPDCI comments are incorporated					

ZONE	REV	DATE	ALTD:	CHD:	APPD:
	03	14.07.2021	ALTD:	DBN	MSM
Customer M/s.WBPDCI comments are incorporated inline with VC resolution Dtd:13.07.2021					
ZONE	REV	DATE	ALTD:	CHD:	APPD:
	02	28.06.2021	ALTD:	DBN	MSM
Customer M/s.WBPDCI comments are incorporated.					
ZONE	REV	DATE	ALTD:	CHD:	APPD:
	01	11.01.2021	ALTD:	DBN	MSM
Customer M/s.WBPDCI comments are incorporated.					









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**EPC Bid Document
Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase - III**

Annexure 6

QUALITY ASSURANCE REQUIREMENTS



Development Consultants Pvt. Ltd.

**Volume : II-A
Section : VIII
Quality Assurance Requirements**



CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	QUALITY ASSURANCE PROGRAMME
2.00.00	GENERAL REQUIREMENTS QUALITY ASSURANCE
3.00.00	QUALITY ASSURANCE DOCUMENTS
4.00.00	INSPECTION, TESTING & INSPECTION CERTIFICATES



QUALITY ASSURANCE REQUIREMENTS

1.00.00 QUALITY ASSURANCE PROGRAMME

1.01.00 To ensure that the equipment and services under the scope of Contract whether manufactured or performed within the Successful Bidder's works or at his Sub-Vendor's premises or at the Owner's site or at any other place or work are in accordance with the specifications, the Successful Bidder shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Successful Bidder and shall be finally accepted by the Owner/Authorised representative after discussions before the award of contract. A quality assurance programme of the Successful Bidder shall generally cover the following :

- a) His organisation structure for the management and implementation of the proposed quality assurance programme.
- b) Documentation control system.
- c) Qualification data for Bidder's key personnel.
- d) The procedure for purchase of materials, parts, components and selection of Sub-Vendor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.
- e) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.
- f) Control of non-conforming items and system for corrective actions.
- g) Inspection and test procedure both for manufacture and all site related works.
- h) Control of calibration and testing of measuring and testing equipments.
- i) System for quality audit.
- j) System for indication and appraisal of inspection status.
- k) System for authorising release of manufactured product to the Owner.
- l) System for handling storage and delivery.
- m) System for maintenance of records.



- n) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per format enclosed at Annexure-A to this section.

2.00.00 GENERAL REQUIREMENTS - QUALITY ASSURANCE

- 2.01.00 All materials, components and equipment covered under this specification shall be procured, manufactured and tested at all the stages, as well as Services provided for erection, commissioning and testing shall be as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the Bidder for some of the major items is given in the respective technical specification. This is however, not intended to form a comprehensive programme as it is the Bidder's responsibility to draw up and implement such programme and reviewed by the Owner/Consultant. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder, separately in the format attached at Annexure-I and will be submitted to Owner/Owner's representative for review. Schedule of finalisation of such quality plans will be finalised before award.
- 2.02.00 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Bidder's Quality Control organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing.
- 2.03.00 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Bidder's site Quality Control organisation, during various stages of site activities from receipt of materials/equipment at site.
- 2.04.00 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality plans and reference documents/standards etc. will be subject to Consultant's approval without which manufacture shall not proceed. In these approved quality plans, Owner/Authorised representative/Consultant shall identify Customer Hold Points (CHP), test/checks which shall be carried out in presence of the Owner/Consultant/Owner's Engineer or his Authorised Representative and beyond which the work will not proceed without consent of Owner/Authorised representative/Consultant in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner/Authorised Representative/Consultant for acceptance and dispositioning.
- 2.05.00 The Bidder shall provide adequate notice to the Owner for inspection before the material is dispatched as per the provisions of the Contract. No material shall be despatched from the manufacturer's works before the same is accepted subsequent to pre-despatch final inspection including verification of records of



all previous tests/inspections by Owner's Owner's Engineer/Authorised representative, and duly authorised for despatch issuance of Material Despatch Clearance Certificate (MDCC).

2.06.00 All materials used or supplied shall be accompanied by valid and approved materials certificates and tests and inspection report. These certificates and reports shall indicate the sheet numbers or other such acceptable identification numbers of the material. The material certified shall also have the identification details stamped on it.

2.07.00 All the individual and assembled rotating parts shall be statically and dynamically balanced in the works.

Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Bidder shall allow for trial assembly prior to despatch from place of manufacture.

2.08.00 Castings and forgings used for construction shall be of tested quality. Details of results of chemical analysis, heat treatment record, mechanical property test results shall be furnished.

2.09.00 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section-IX/BS-4870 or other International equivalent standard acceptable to the Owner.

All brazers, welders etc. employed on any part of the contract at Bidder's/Sub-Vendor's works or at site shall be qualified as per ASME Section-IX or BS-4871 or equivalent international standard approved by the Owner. Such qualification tests shall be conducted in presence of Owner/his authorised representative.

For welding of pressure parts and high pressure piping the requirements of IBR shall also be complied with.

Under no circumstances any repair or welding of castings be carried out without the consent of the Owner. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Owner.

All pressure parts shall be subjected to hydraulic testing as per the requirements of IBR. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than thirty (30) minutes.

2.10.00 All non-destructive examination (NDT) shall be carried out in accordance with approved international standard. The NDT operator shall be qualified as per SNT-TC-IA (of American Society of non- destructive examination). Results of NDT shall be properly recorded and submitted for acceptance.

All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid

penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination and ultrasonic testing shall be employed wherever necessary/ recommended by the applicable code. At least 10% of all major butt welding joints shall be radiographed. Statutory payments in respect of IBR approvals including inspection shall be made by Bidder. Bidder's scope and responsibility shall also include preparation and submission of all necessary documents in the specific formats and manner stipulated by the statutory bodies, coordination and follow up for above approvals.

2.11.00 All the Sub-Vendors proposed by the Bidder for procurement of major bought out items including castings, forgings, semi-finished and finished components/equipment list of which shall be drawn up by the Bidder and finalised with the Owner shall be subject to Owner's review. Quality Plans of the successful Sub-Vendors shall be discussed, finalised and accepted by the Owner/Authorised representative and form part of the Purchase Order between the Bidder and the Sub-Vendor.

2.12.00 All the purchase specifications for the major bought-out items, list of which shall be drawn up by the Bidder and finalised with the Owner shall be furnished to the Owner for comments and subsequent acceptance before orders are placed.

Owner reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Bidder's or their Sub-Vendor's quality management and control activities. The Bidder shall provide all necessary assistance to enable the Owner carry out such audit and surveillance.

Quality audit/acceptance of the results of tests and inspection will not prejudice the right of the Owner to reject equipment not giving the desired performance after erection and shall not in no way limit the liabilities and responsibilities of the Bidder in earning satisfactory performance of equipment as per specification.

2.13.00 Quality requirements for main equipment shall equally apply for spares and replacement items.

2.14.00 Repair/rectification procedures to be adopted to make any job acceptable shall be subject to the acceptance of the Owner.

2.15.00 For quality assurance of all civil works refer to the specifications for civil works.

3.00.00 **QUALITY ASSURANCE DOCUMENTS**

3.01.00 The Bidder shall be required to submit two (2) copies and two (2) sets of microfilms of the following Quality Assurance documents within three (3) weeks after despatch of the equipment:

- a) Material mill test reports on components as specified by the specification.

- b) The inspection plan with verification, inspection plan check points, verification sketches, if used and methods used to verify that the inspection and testing points in the inspection plan were performed satisfactorily.
- c) Non-destructive examination results /reports including radiography interpretation reports.
- d) Factory tests results for testing required as per applicable codes and standards referred in the specification.
- e) Welder identification list listing welder's and welding operator's qualification procedure and welding identification symbols.
- f) Sketches and drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
- g) Stress relief time temperature charts.
- h) Inspection reports duly signed by QA personnel of the Owner and Bidder for the agreed inspection hold points. During the course of inspection, the following will also be recorded :
 - i) When some important repair work is involved to make the job acceptable.
 - ii) The repair work remains part of the accepted product quality.
- i) Letter of conformity certifying that the requirement is in compliance with finalised specification requirements.

4.00.00 **INSPECTION, TESTING AND INSPECTION CERTIFICATES**

4.01.00 The Successful Bidder shall give the Owner's Engineer/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Successful Bidder's account except for the expenses of the Inspector. The Owner's Engineer/Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is notified as being ready for test/inspection failing which the Successful Bidder may proceed with test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector duly certified copies of test reports in six (6) copies.

4.02.00 The Owner's Engineer or Inspector shall within fifteen (15) days from the date of Inspection as defined herein give notice in writing to the Successful Bidder, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Successful Bidder shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall confirm in writing to the Owner's Engineer/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.

- 4.03.00 When the factory tests have been completed at the Bidder's or sub-Vendor's works, the Owner/Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Owner/Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Bidder's test certificate by the Owner/Inspector. Failure of the Owner/Inspector to issue such a certificate shall not prevent the Bidder from proceeding with the works. The completion of these tests, or the issue of the certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract.
- 4.04.00 The Bidder shall furnish quarterly inspection programme indicating schedule dates of inspection at customer hold point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.

FORMAT OF QUALITY ASSURANCE PROGRAMME

Name of Company / Successful Bidder	NAME OF CONTRACT PACKAGE			QUALITY PLAN FOR						
	Package No. : _____			QP No. : _____ Date _____						
	Contractor : _____			Rev.No.: _____ Date _____						
Sl. No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check	Reference Document	Acceptance Norm	Format of Record	Agency	Remarks

FIELD WELDING SCHEDULE

PROJECT : FWS NO :

CONTRACTOR : REV NO. :

PACKAGE : FIELD WELDING CODE :

SYSTEM : PAGE NO. :

SI No	Drawing No. for Weld Locations & Identification mark	Description of parts to be welded	Material specification	Dimensions	Process of Welding	Type of Weld	Electrode Filler Specification	WPS No.	Minimum Pre-heat Temperature	Heat Treatment Temperature [Holding Time in secs]	NDT Method	Quantum	NDT Specification Number	Acceptance Norm Ref.	Remarks

The Field Welding Schedule should be submitted for :

- ☐ Pressure Parts
- ☐ Tanks/Vessels
- ☐ Piping
- ☐ Heavy/Important Structural Steel
- ☐ Heat Exchangers
- ☐ Bus Ducts

DRAWINGS & DOCUMENTS TO BE SUBMITTED

DRAWING DOCUMENTS REQUIREMENT (FOR MECHANICAL / ELECTRICAL / C&I / ETC)

After award of LOI, following drawings /documents shall be submitted by the bidder for BHEL/Customer approval. However, any additional drawing/document if found necessary for completion of the engineering, the same shall be submitted by bidder without any commercial implication.

- a) Detailed piping and instrument or engineering P&ID for process and utility, showing all equipment's, machinery, piping and instruments. All pipes should be indicated with diameter, pipe class, pipe number, fluid flowing through it as per the Employer's legend to be furnished later.
- b) Detailed configuration drawings, BOMs, Data Sheets, General arrangements and cross-sectional/assembly drags, along with the manufacturer's catalogue for all the items/equipment including control & instrumentation supplied by the bidder.
- c) Detailed installation drawings for all instruments and instrumentation schedule.
- d) Preparation and finalization of functional write-up and detailed logic diagram, for all control system, electrical wiring and schematic drgs for the development of logic diagrams, GA and layout drgs of control panels, junction boxes, bill of material for panel drgs and terminal, chart for all the panel drgs, inter connection diagram for cabling, cable schedule, earthing layout and cable tray layout drawings.
- e) Design calculation of process and mechanical design, equipment and systems. The bidder shall show, explain and prove the validity of the basis/procedures and methods used in these calculations.
- f) Details civil scope drawing for all civil works.
- g) Detailed piping layout drawings, pipe support drawings, complete bill of materials of the piping, valve schedule etc.
- h) Submission of O&M manual.
- i) P.G Test procedure shall be submitted by bidder during detail engineering and shall be subject to approval by BHEL/Customer.
- j) Against customer / BHEL comments bidder has to give replies point wise during detailed engineering after award of contract.
- k) Spec. for acid/alkali resistant lining and areas requiring such lining.
- l) Cable schedule in BHEL format (shall be handed over after award of contract)
- m) Project schedule shall be submitted.

DRAWING/DOCUMENTS REQUIRED ALONG WITH THE BID (Please refer Electrical and C&I portion also).

- Technical Offer (including List of chemicals, Quantity of chemicals, Dosage rate, calculation, pump capacity etc.)
- Deviation/clarification, if any, in the BHEL format only (Annexure -A).
- Unpriced Schedule duly filled.
- Electrical load data format (filled).
- Documents in support of meeting the Qualification Requirement.
- Electrical Load List.
- Valve Schedule.
- Pipe Schedule.

NOTE-1: - Any item/work either supply of equipment or erection material, which have not been specifically mentioned in but are necessary to complete the works for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The bidder shall provide the same without any extra charge.

Note-2: All major drawings/documents shall be approved by BHEL/Customer during detailed engineering Stage. Successful vendor shall comply with the comment of the BHEL/Customer without price & delivery implication.

Note-3: The above Note-1 and 2 shall be applicable for Electrical and C&I also.

Note-4: Chlorine is being dosed @ 5 ppm shock for half an hour once in 8 hrs. in each pump CW Pump pit and continuous dosing 1 ppm in CW Forebay by BHEL (Chlorination plant supplier).



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**EPC Bid Document
Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase - III**

Annexure 8

TECHNICAL SPECIFICATION FOR PROTECTIVE LINING AND PAINTING



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**EPC Bid Document
Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase - III**

CONTENTS

CLAUSE NO	DESCRIPTION
1.00.00	INTENT OF SPECIFICATION
2.00.00	CODES & STANDARDS
3.00.00	GENERAL REQUIREMENTS
4.00.00	EQUIPMENT, MATERIAL AND SERVICES TO BE FURNISHED BY THE BIDDER
5.00.00	COATING PROCEDURE AND APPLICATION
6.00.00	TEST REQUIREMENTS
7.00.00	INFORMATION / DATA REQUIRED



PROTECTIVE LINING AND PAINTING

1.00.00 INTENT OF SPECIFICATION

- 1.01.00 This specification addresses the requirements of all labour, material, and appliances necessary with reference to preparations for lining / painting, application as well as finishing of all lining / painting for all mechanical and electrical equipment, piping and valves, structures etc. included under the scope of this Package.
- 1.02.00 The Bidder shall furnish and apply all lining, primers including wash primers if required, under-coats, finish coats and colour bands as described hereinafter or necessary to complete the work in all respects.

2.00.00 CODES & STANDARDS

- 2.01.00 The Bidder shall follow relevant Indian and International Standards wherever applicable in cleaning of surface, selection of lining material / paints and their application. The entire work shall conform to the following standards / specifications (latest revision or as specified).
- a) SSPC SP 10 / NACE 2 / : Near White Blast Cleaning
 - b) SSPC PA 2 : Measurement of dry film Coating Thickness with magnetic gauges.
 - c) ASTM D 4541 : Method for pull off strength using portable Adhesion Tester.
 - d) NACE RP 0274 – 2004 : High-Voltage Electrical Inspection of Pipeline Coatings
 - e) NACE SP 0188 – 2006 : Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
 - f) NACE RP 0169 – 2002 : Control of External Corrosion on Underground or Submerged Metallic Piping Systems
 - g) AWWA C 210 – 2007 : Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
 - h) IS 3589:2001 Annexure B : Steel Pipes for Water and Sewage Specification.



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**EPC Bid Document
Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase - III**

- i) AWWA C222-2000 : Polyurethane Coating for the Interior and Exterior of Steel Water Pipe and Fittings.
- j) IS 13213 : 2000 : Polyurethane Full Gloss Enamel (Two pack)

3.00.00 GENERAL REQUIREMENTS

- 3.01.00 The steel surface preparation prior to actual commencement of coating shall conform to SSPC SP 10 / NACE 2 / Sa2½ (near white metal) with sand blasting.
- 3.02.00 The contractor shall submit a detailed written description in the form of a manual covering coating equipment, procedures, materials inspection test, and repair etc. to Owner/Consultant for approval.
- 3.03.00 The contractor shall also provide copies of test reports from NABL approved laboratory (like National Test House, Kolkata) in support of the paint/primer materials to be used shall conform to the specification requirement.
- 3.04.00 The contractor shall also provide certificates from paint/primer manufacturer mentioning the batch numbers, date of manufacture and shelf life etc. of the materials to be used. In addition to that Manufacturing Quality Plan (MQP) and Field Quality Plan (FQP) shall also be submitted prior to commencement of supply of material and field application.
- 3.05.00 Paint/coating application work at site shall be done either by paint manufacturer or by their authorized applicator. The authorized applicator shall have proper training & certification from manufacturer. Applicator shall possess all the necessary specialized equipment and manpower experienced in similar job.
- 3.06.00 Applied coating shall be tested for dry film thickness, holiday (electrical inspection for continuity) and adhesion as per relevant standard such as SSPC PA 2, NACE RP 0274 and ASTM D 4541.
- 3.07.00 If necessary, the material may be heated and applied by airless spray / plural component spray system.
- 3.08.00 Manufacturer's specific recommendation, if any, shall be followed during application of lining / paints.
- 3.09.00 In areas where there is danger of spotting automobiles or other finally finished equipment or building by wind borne particles from paint spraying, a Purchaser approved method shall be adopted.
- 3.10.00 The colour scheme of the entire Plant, covered under this specification shall be approved by the Purchaser in advance before application.



Development Consultants Pvt. Ltd.

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**Volume : II-II2
Section : XIII
Protective Lining and Painting**



- 3.11.00 All indoor and outdoor piping, insulated as well as uninsulated will have approved colour bands painted on the pipes at conspicuous places throughout the system, as approved by Purchaser.
- 3.12.00 Inside surfaces of vessels / tanks shall be protected by anticorrosive paints or rubber lining as required / specified elsewhere in the specification. External surfaces of all vessels / tanks shall be protected by anti corrosive painting.
- 3.13.00 For vessels / tanks requiring lining and epoxy painting all inside surface shall be blast cleaned using non-siliceous abrasive after usual wire brushing.
- 3.14.00 Natural rubber lining shall be provided on the inside of vessels / tanks as required / specified elsewhere in the specification, in three layers resulting in a total thickness not less than 4.5 mm.
- 3.15.00 Surface hardness of rubber lining shall be 65 +/- 5 deg. A (shore).
- 3.16.00 After the lining is completed, the vessels / tanks shall not be subjected to any prolonged exposure to direct sunlight in course of its transportation, erection etc. They shall not be stored in direct sunlight. No further lining or burning shall be carried out on the vessel, after application of the lining.
- 3.17.00 All lining projecting outside of the vessel shall be protected adequately from mechanical damages during shipment, handling storage etc.
- 3.18.00 Suitable warnings, indicating the special care that must be taken with respect to these lined vessels shall be stenciled on their outside surface with the letters at least 12 mm high.
- 3.19.00 All insulated piping shall have aluminium sheet jacketing.

4.00.00 EQUIPMENT, MATERIAL AND SERVICES TO BE FURNISHED BY THE BIDDER

- 4.01.00 After erection at site, the outside surfaces of all equipment having a shop coat shall be given further priming coat and finished coats of paint as detailed in following clauses. However, if the painting system is such that the shop coat and primer coat to be applied at site are not compatible, then shop coat has to be removed from the surface of equipment before application of primer coat with prior blasting.

All factory finished paints shall be touched up at site as required.

All uninsulated piping shall be finished with final paintings after use of proper wash primer and primer. Aluminium sheet jacketed piping need not be painted.



Colour bands of Purchaser's approved shade shall however be applied on jacketed piping near walls or partitions, at all junctions, near valves and all other places as instructed by the Purchaser. All structures shall be painted with approved paint.

4.02.00 Surface Preparation

4.02.01 Unless mentioned otherwise, all rust and mill scale shall be removed by blasting to Sa 2-1/2 Swiss Standard before applying the primer.

4.02.02 Special care shall be taken to remove grease and oil by means of suitable solvents like Trichloroethylene or Carbon Tetrachloride.

4.02.03 The minimum degree of surface preparations for all equipment, piping, fittings, valves, structures etc. shall be "Near White" according to Steel Structure, Painting Council-SSPC-SP-10 before application of any primer/paint.

4.03.00 Painting

4.03.01 Specification for application of paints for external surfaces protection of vessels / tanks / equipment / piping / fittings / valves etc. to be installed indoor shall be as follows :

- a) Surface preparation shall be done either manually or by any other approved method.
- b) Primer Coat shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber based zinc phosphate.
- c) Intermediate Coat (or Under Coat) shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber based paint pigmented with Titanium Dioxide.
- d) Top Coat shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber paint of approved shade and colour with glossy finish.
- e) Total DFT of paint system shall not be less than 150 microns.

4.03.02 Specification for application of paints for external surfaces protection of vessels / tanks / equipment / piping / fittings / valves etc to be installed **outdoor** shall be as follows :

- a) Surface preparation shall be done by means of sand blasting, which shall conform to Sa 2-1/2 Swiss Standard.
- b) Primer Coat shall consist of one coat (minimum DFT of 100 microns) of epoxy resin based zinc phosphate primer.



- c) Intermediate Coat (or Under Coat) shall consist of one coat (minimum DFT of 100 microns) epoxy resin based paint pigmented with Titanium Dioxide.
- d) Top Coat shall consist of one coat (minimum DFT of 75 microns) of epoxy paint of approved shade and colour with glossy finish. Additional one coat (minimum DFT of 25 microns) of Finish Coat of polyurethane shall be provided.
- e) Total DFT of paint system shall not be less than 300 microns.

4.03.03 Specification for application of paints for external surfaces protection of steel pipes and fittings which are **buried underground / laid inside a huge pipe & or submerged Under Water and laid under Pipe Trenches** (in road/rail/pipe or trench crossings) shall be as follows :

External surface of the pipe, fittings, specialties etc. handling raw water/clarified water/filter water shall be painted with one coat of two part chemically cured polyurethane primer of min 50 micron dry film thickness followed by three or maximum four coats of two part solvent less polyurethane to build up coating of dry film thickness of 2000 micron including primer coat.

4.03.04 Specification for application of paints for **internal surface protection of large diameter pipes** (sizes above 600 mm NB and above) if any, shall be as follows :

- a) All Internal surfaces of steel pipes, fittings, specialties etc. buried underground or located within pipe trenches shall be given epoxy coating to protect them from (except for drinking water service, where the compatible painting shall be so selected to meet relevant quality standards) corrosion.
- b) Internal surface of the pipe should be coated with one coat of two part epoxy primer with not less than 50 micron DFT (dry film thickness) followed by two part polyamide cured solvent less epoxy.
- c) The minimum dry film thickness (DFT) of internal lining shall be 600 micron.

4.03.05 Specification for application of paints for protection of **internal surfaces of DM Water Storage Tank(s)** shall be as follows :

- a) Primer - One coat of epoxy primer containing high level of Zinc Phosphate anticorrosive pigment. Total Dry Film Thickness (DFT) of primer shall not be less than 125 microns.
- b) Finish Paint - Three (3) coats Polyamine HB Epoxy Paint. Total Dry Film Thickness (DFT) of finish paint shall not be less than 125 microns per coat.
- c) Total thickness of primer and paint should not be less than 500 microns.

4.03.06 All motors, local push button stations, cable racks, structures used for supports etc. are to be painted with acid proof paint.





- 4.03.07 The following surfaces shall not be painted - stainless steel, galvanized steel, aluminum, copper, brass, bronze and other nonferrous materials.
- 4.03.08 No painting or filler shall be applied until all repairs, hydrostatic tests and final shop inspection are completed.
- 4.03.09 All machined surfaces shall have two (2) coats of water repellant grease after thorough cleaning.

5.00.00 COATING PROCEDURE AND APPLICATION

5.01.00 Surface Preparation :

Pipe shall be blast cleaned by sand. The cleanliness achieved prior to application shall be in accordance with the requirement of SSPC SP 10 / NACE 2 / Sa2½ of ISO 8501 (near white metal)

- a) The blast pattern or profile depth shall be 40 to 100 micron and shall be measured by dial micrometer.
- b) Before sand blasting is started or during blasting or coating, temperature of the pipe surface should be more than 3°C above dew point temperature. Blast cleaned surface should be primed within 4 hours and shall be protected from rainfall or surface moisture and shall not be allowed to flash rust. If the rust occurs, the surface again to be prepared by sand blasting or wire brushing.

5.02.00 Application of Epoxy Coating

- a) Coating shall be applied when
 - i) When the pipe surface temperature shall be atleast 3°C above dew point temperature.
 - ii) The temperature of mixed coating material and the pipe at the time of application shall not be lower than 10°C or greater than 50°C.
- b) Material preparation shall be in accordance with manufacturer's recommendations.
- c) Application of epoxy coating system :

The epoxy coating system shall be applied as per recommendation of the manufacturer and shall be applied by airless spray / plural component spray machine. For more than one coat, the second shall be applied with the time limits as recommended by the manufacturer.

5.03.00 Application of PU Coating

- a) PU coating shall be applied when the pipe surface temperature atleast 3°C above dew point temperature (when R.H is more than 85%).
- b) Material preparation and application shall be done as per manufacturer recommendation.

6.00.00 TEST REQUIREMENTS

6.01.00 Measurement of dry film thickness

Measurement of dry film thickness of coating : Coating thickness shall be in the range of $\pm 20\%$ and as per SSPC PA 2.

6.01.01 Apparatus / Instrument:-

The instrument used for dry film thickness may be Type 1 pull of gauges or Type 2 electronic gauges.

6.01.02 Procedures:-

- a) Number of measurements:
For 100 square feet (9.29 square meters), five (5) spots per test area (each spot is 3.8 cm) in diameter. Three gauge readings per spot (average becomes the spot measurement).
- b) If the structure is less than 300 square feet, each 100 square feet should be measured.
- c) If the structure is between 300 and 1000 sq ft, select 3 random 100 square feet test areas and measure.
- d) For structure exceeding 1000 square feet, select 3 random 100 square feet testing areas for the first 1000 sq ft and select 1 random 100 square feet testing area for each additional 1000 square feet
- e) Coating thickness Tolerance: Individual reading taken to get a representative measurement for the spot are unrestricted (usually low or high readings are discarded). Spot measurements (the average of 3 gauge readings) must be within 80% of the minimum thickness and 120% of the maximum thickness. Area measurement must be within specified range.

6.02.00 ELECTRICAL INSPECTION (HOLIDAY) TESTS

6.02.01 All the coated / lined pipes shall be tested with an approved high voltage holiday detector preferably equipped with an audio visual signaling device to indicate any faults, holes, breaks or conductive particles in the protective coating.



- 6.03.00 The applied output voltage of holiday detector shall have a spark discharge of thickness equal to at least twice the thickness of the coating to assure adequate inspection voltage and compensate for any variation in coating thickness. The electrode shall be passed over the coated surface at approximately half the spark discharge distance from the coated surface only one time at the rate of approximately 10 to 20m/min. The edge effect shall be ignored. Excessive voltage shall be avoided as it tends to induce holiday in the coated surface thereby giving erroneous readings.
- 6.04.00 While selecting test voltages, consideration should be given to the tolerance on coating thickness and voltage should be selected on the basis of maximum coating thickness likely to be encountered during testing of a particular pipe.
- The testing voltage shall be calculated by using following formula. (as per NACE 0274 : 2004)
- Testing Voltage $V = 7900 \sqrt{T} \pm 10$ percent where T is the average coating thickness in mm.
- 6.05.00 Any audio visual sound or spark leads to indicate pinhole, break or conductive particle.
- 6.06.00 **ADHESION PULL OFF TEST**
- After holiday the coated surface is subjected to adhesion pull off test as per ASTM D 4541.
- 6.06.01 Apparatus / Instrument: Adhesion tester consists of three basic components:
- A hand wheel, a black column containing a dragging indicator pin and scale in the middle and a base containing three legs and a pulling "Jaw" at the bottom and also dollies.
- 6.06.02 Prepare the test surface
- Once test area is selected, test area shall be free of grease, oil, dirt, water. The area should be flat surfaces and large enough to accommodate the specified number of replicate test.
- 6.06.03 Prepare Dolly (Test Pull Stub)
- The dolly is a round, two sided aluminium fixture. Both sides of the dolly looks same, however, one side sloped on top surface while flat on bottom surface. As the surface of the dolly is polished aluminium, roughen the same using a coarse sand paper.



6.07.00 Select an adhesive:

Use araldite, a 100% solid epoxy adhesive. This adhesive requires at least 24 hours at room temperature to cure.

6.08.00 Attach the dolly to the surface.

- a) Using a wooden stick, apply an even layer of adhesive to the entire contact surface area of the dolly.
- b) Carefully remove the excessive adhesive by using a cotton swab. Allow the adhesive to fully cure before performing the adhesion test.
- c) Attach the dolly to the coated surface and gently push downward to displace any excessive adhesive.
- d) Push the dolly inward against the surface, then apply tape across the head of the dolly.

6.09.00 Adhesion Test Procedure

- a) Attach the adhesion tester to the dolly by rotating the hand wheel counter clockwise to lower the jaw of the device.
- b) Slide the jaw completely under the head of the dolly. Position the three legs of the instruments so that they are sitting flat on the coated surface.
- c) Slide the dragging indicator pin on the black column to zero by pushing it downward.
- d) Firmly hold the base of the instrument in one hand and rotate the handwheel clockwise to raise the jaw of the device that is attached to the head of the dolly. The dragging indicator pin will move upward on the black column as the force is increased and will hold the reading. Apply the tension using a moderate speed. Continue to increase the tension on the head of the dolly until (a) the minimum PSI/MPa/Kg/cm² required by project specification is exceeded and the test is discontinued, (b) the maximum PSI/MPa/Kg/cm² of adhesion tester has been achieved and dolly is still attached, (c) The force applied by the adhesion tester causes the dolly to dislodge.
- e) Read the scale and record the adhesion value.

6.10.00 **COATING REPAIR**

Defective Coating shall be repaired in accordance with the following subsections.

6.10.01 Surface Preparation:

Accessible areas of pipe requiring coating repairs shall be cleaned to remove debris and damaged coating using surface grinders or other means. The





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adjacent coating shall be feathered by sanding, grinding or other method. Accumulated debris shall be removed by blowing with contaminant free air or wiping with clean rags.

6.10.02 Areas not accessible for coating repair such as interior surfaces of small diameter pipe shall be reprocessed and recoated.

6.11.00 Coating Application

The coating system shall be applied to the prepared areas in accordance with procedure.

6.12.00 Repair Inspection

Repaired portion shall be electrically inspected using a holiday detector.

6.13.00 **WELDED FIELD JOINTS**

6.13.01 Preparation :

The weld joints shall be cleaned so as to be free from mud, oil, grease, welding flux, weld spatter and other foreign contaminants. The cleaned metal surfaces of the weld joint shall then be blasted or abraded using rotary abrading pads. The adjacent liquid Epoxy / PU coating shall be feathered by abrading the coating surface for a distance of 25 mm.

6.13.02 Electrical Inspection :

After curing the coating system applied to the welding joints shall be holiday tested. Any holidays indicated by the detector shall be marked with chalk to identify the area of repair.

7.00.00 INFORMATION/DATA REQUIRED

The Bidder shall submit complete list of paints and primers proposed, giving detail information, such as, chemical composition, drying time etc. and also unit rates for application of each type of paint along with supply shall be furnished.





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PLAN FOR
SITE OPERATION by SUBCONTRACTORS**

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REV: 00

Date: 12.08.2014

POWER SECTOR

DOCUMENT ISSUE SHEET

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Signature			
Date	12/8/14	12/8/14	12/8/14

HSE PLAN FOR SITE OPERATIONS BY BHEL'S SUBCONTRACTORS

AT A GLANCE

BEFORE START	SIGNING OF MOU	
	Agree to comply to HSE requirement- Statutory and BHEL's	
PLAN	HSE ORGANISATION	
	Manpower 1 (one) safety officer for every 500 workers or part thereof 1(one) safety-steward/ supervisor for every 100 workers Qualification As per Cl. 7.1	HSE Roles and responsibilities - Site In-charge- As per clause 7.2.1 - Safety officer- As per clause 7.2.2
PROVIDE	HSE Planning	
	for Man , Machinery/Equipment/Tools & Tackles	
TRAIN	HSE INFRASTRUCTURE	
	- PPEs - Drinking Water - Washing Facilities - Latrines and Urinals - Provision of shelter for rest - Medical facilities	- Canteen facilities - Labour Colony - Emergency Vehicle - Pest Control - Scrapyard - Illumination
COMMUNICATE	HSE TRAINING , AWARENESS & PROMOTION	
	Training - Induction training - Height work and other critical areas - Tool Box talk & Pep Talk	Awareness & Promotion - Signage - Poster - Banner - Competition - Awards
	HSE COMMUNICATION	
	Incident Reporting - Accident- Fatal & Major - Property damage - Near Miss	Event Reporting - Celebrations - Training - Medical camp

EXECUTE SAFELY

OPERATIONAL CONTROL PROCEDURES

PERMIT TO WORK

Height work (above 2 metres), Hot Work, Heavy Lifting, Confined Space, Radiography, excavation(More than 4 metres)

SAFETY DURING WORK EXECUTION

• Welding • Rigging • Cylinder- storage & Movement • Demolition work • T&Ps • Chemical Handling • Electrical works	• Fire • Scaffolding • Height work • Working Platform • Excavation • Ladder • Lifting • Hoisting appliance

HOUSE KEEPING

WASTE MANGEMENT

TRAFFIC MANAGEMENT

ENVIRONMENTAL CONTROL

EMERGENCY PREPAREDNESS AND RESPONSE PLAN

CHECKS

HSE AUDITS & INSPECTION

• Daily Checks • Inspection of PPEs • Inspection of T& Ps • Inspection of Cranes & Winches	• Inspection of Height work • Inspection of Welding and Gas cutting • Inspection of elevators etc

HSE PERFORMANCE EVALUATION PARAMETERS

NON CONFORMANCE

PENALTY for NON CONFORMANCE

Refer Clause 16

Incremental penalty

For repeated violation by the same person, the penalty would be double of the previous penalty

For repeated fatal incident in the same Unit incremental penalty to be imposed. The subcontractor will pay 2 times the penalty compared to previously paid in case there are repeated cases of fatal incidents under the same subcontractor for the same package in the same unit.



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1.0 PURPOSE

- 1.1 The purpose of this HSE Plan is to provide for the systematic identification, evaluation, prevention and control of general workplace hazards, specific job hazards, potential hazards and environmental impacts that may arise from foreseeable conditions during installation and servicing of industrial projects and power plants.
- 1.2 This document shall be followed by BHEL's subcontractors at all installation and servicing sites. In case customer specific documents are to be implemented, this document will be followed in conjunction with customer specific documents.
- 1.3 Although every effort has been made to make the procedures and guidelines in line with statutory requirements, in case of any discrepancy relevant statutory guidelines must be followed.
- 1.4 In case the customer has any specific requirement, the same is to be fulfilled.

2.0 SCOPE

The document is applicable for BHEL's Subcontractors at all installation / servicing activities of BHEL Power Sector as per the relevant contractual obligations.

3.0 OBJECTIVES AND TARGETS

The HSE Plan reflects that BHEL places high priority upon the Occupational Health, Safety and Environment at workplaces.

- Ensure the Health and Safety of all persons at work site is not adversely affected by the work.
- Ensure protection of environment of the work site.
- Comply at all times with the relevant statutory and contractual HSE requirements.
- Provide trained, experienced and competent personnel. Ensure medically fit personnel only are engaged at work.
- Provide and maintain plant, places and systems of work that are safe and without risk to health and the environment.
- Provide all personnel with adequate information, instruction, training and supervision on the safety aspect of their work.
- Effectively control, co-ordinate and monitor the activities of all personnel on the Project sites including subcontractors in respects of HSE.
- Establish effective communication on HSE matters with all relevant parties involved in the Project works.
- Ensure that all work planning takes into account all persons that may be affected by the work.
- Ensure fitness testing of all T&Ps/Lifting appliances like cranes, chain pulley blocks etc. are to be certified by competent person.
- Ensure timely provision of resources to facilitate effective implementation of HSE requirements.
- Ensure continual improvements in HSE performance
- Ensure conservation of resources and reduction of wastage.
- Capture the data of all incidents including near misses, process deviation etc. Investigate and analyze the same to find out the root cause.
- Ensure timely implementation of correction, corrective action and preventive action.



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HSE TARGETS

EXPLOSION	ZERO
FATALITY	ZERO
LOST TIME INJURY	ZERO
FIRE	ZERO
VEHICLE INCIDENTS	ZERO
ENVIRONMENTAL INCIDENTS	ZERO

4.0 BHEL POWER SECTOR HEALTH, SAFETY & ENVIRONMENT POLICY

Power Sector HSE Policy

We, at BHEL Power Sector, reaffirm our belief that the Health and Safety of our stakeholders and conservation of Environment is of utmost importance and takes precedence in all our business decisions. In pursuit of this belief and commitment, we strive to:

- ✓ Ensure total compliance with applicable legislation, regulations and other requirements concerning Occupational Health, Safety and Environment.
- ✓ Ensure continual improvement in the Occupational Health, Safety and Environment Management System performance.
- ✓ Enhance Occupational Health, Safety and Environment awareness amongst employees, customers and suppliers by proactive communication and training.
- ✓ Review periodically and improve Occupational Health, Safety and Environment Management System to ensure its continuing suitability, adequacy and effectiveness in a continuously changing business environment.
- ✓ Develop a culture of safety through active leadership and provide appropriate training at all levels to enable employees to fulfill their Health, Safety and Environmental obligations.
- ✓ Incorporate appropriate Occupational Health, Safety and Environmental criteria into business decisions for selection of plant, technology and services as well as appointment of key personnel.
- ✓ Ensure availability at all times of appropriate resources to fully implement the Occupational Health, Safety and Environmental policy of the company.

This policy will be communicated to all employees and made available to interested parties.

Sd/-

Date: 01.05.2013

Director (Power)

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5.0 MEMORANDUM OF UNDERSTANDING:

After award of work, subcontractors are required to enter into a memorandum of understanding as given below:

Memorandum of Understanding

BHEL, Power Sector _____ Region is committed to Health, Safety and Environment Policy (HSE Policy).

M/s _____ do hereby also commit to comply with the same HSE Policy while executing the Contract Number _____

M/s _____ shall ensure that safe work practices as per the HSE plan. Spirit and content therein shall be reached to all workers and supervisors for compliance.

In addition to this, M/S _____ shall comply to all applicable statutory and regulatory requirements which are in force in the place of project and any special requirement specified in the contract document of the principal customer.

M/s _____ shall co-operate in HSE audits/inspections conducted by BHEL /customer/ third party and ensure to close any non-conformity observed/reported within prescribed time limit.

Signed by authorized representative of M/s -----

Name :

Place & Date:

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6.0 TERMS AND DEFINITIONS

6.1 DEFINITIONS

6.1.1 INCIDENT

Work- related or natural event(s) in which an injury , or ill health (regardless of severity), damage to property or fatality occurred, or could have occurred.

6.1.2 NEAR MISS

An incident where no ill health, injury, damage or other loss occurs, but it had a potential to cause, is referred to as "Near-Miss".

6.1.3 MAN-HOUR WORKED

The total number of man hours worked by all employees including subcontractors working in the premises. It includes managerial, supervisory, professional, technical, clerical and other workers including contract labours. Man-hours worked shall be calculated from the payroll or time clock recorded including overtime. When this is not feasible, the same shall be estimated by multiplying the total man-days worked for the period covered by the number of hours worked per day. The total number of workdays for a period is the sum of the number of men at work on each day of period. If the daily hours vary from department to department separate estimate shall be made for each department and the result added together.

6.1.4 FIRST AID CASES

First aids are not essentially all reportable cases, where the injured person is given medical treatment and discharged immediately for reporting on duty, without counting any lost time.

6.1.5 LOST TIME INJURY

Any work injury which renders the injured person unable to perform his regular job or an alternative restricted work assignment on the next scheduled work day after the day on which the injury occurred.

6.1.6 MEDICAL CASES

Medical cases come under non-reportable cases, where owing to illness or other reason the employee was absent from work and seeks Medical treatment.

6.1.7 TYPE OF INCIDENTS & THEIR REPORTING:

The three categories of Incident are as follows:

Non-Reportable Cases:

An incident, where the injured person is given medical help and discharged for work without counting any lost time.

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Reportable Cases:

In this case the injured person is disable for 48 hours or more and is not able to perform his duty.

Injury Cases:

These are covered under the heading of non-reportable cases. In these cases the incident caused injury to the person, but he still continues his duty.

6.1.8 TOTAL REPORTABLE FREQUENCY RATE

Frequency rate is the number of Reportable Lost Time Injury (LTI) per one Million Man hours worked. Mathematically, the formula read as:

$$\frac{\text{Number of Reportable LTI} \times 1,000,000}{\text{Total Man Hours Worked}}$$

6.1.9 SEVERITY RATE

Severity rate is the Number of days lost due to Lost Time Injury (LTI) per one Million Man hours worked. Mathematically, the formula reads as:

$$\frac{\text{Days lost due to LTI} \times 1,000,000}{\text{Total Man Hours Worked}}$$

6.1.10 INCIDENCE RATE

Incidence Rate is the Number of LTI per one thousand manpower deployed. Mathematically, the formula reads as:

$$\frac{\text{Number of LTI} \times 1000}{\text{Average number of manpower deployed}}$$

7.0 HSE ORGANISATION

Number of safety officers:

The subcontractor must deploy one safety officer for every 500 workers or part thereof in each package. In addition, there must be one safety-steward/safety-supervisor for every 100 workers.

Deployment: The subcontractor should deploy sufficient safety officers and safety-steward/Safety-supervisor, as per requirement given above, since initial stage and add more in proportion to the added strength in work force. Any delay in deployment will attract a penalty of Rs.30,000/- per man month for the delayed period.

7.1 QUALIFICATION FOR HSE PERSONNEL

Sl.no	Designation	Qualification	Experience
1	Safety officer (Construction Agency)	Degree or Diploma in Engineering with full time diploma in Industrial Safety with construction safety as one of the subjects	Minimum two years for degree holder and five years for diploma holder in the field of Construction of power plant/ major industries



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2	Safety-Steward/ Supervisor	Safety- Supervisor	Degree or diploma in any discipline with full time diploma in Industrial Safety with construction safety as one of the subjects	Minimum two years

7.2 RESPONSIBILITIES

7.2.1 SITE IN -CHARGE OF SUBCONTRACTOR

- Shall sign Memorandum of Understanding (MoU) for compliance to BHEL's HSE Plan for Site Operations as per clause 5.0
- Shall engage qualified safety officer(s) and steward (s) as per clause 7.0
- Shall adhere to the rules and regulations mentioned in this code, practice very strictly in his area of work in consultation with his concerned engineer and the safety coordinator.
- Shall screen all workmen for health and competence requirement before engaging for the job and periodically thereafter as required.
- Shall not engage any employee below 18 years.
- Shall arrange for all necessary PPEs like safety helmets, belts, full body harness, shoes, face shield, hand gloves etc. before starting the job. Shall ensure that no working men/women carry excessive weight more than stipulated in Factory Rule Regulation R57.
- Shall ensure that all T&Ps engaged are tested for fitness and have valid certificates from competent person.
- Shall ensure that provisions stipulated in contract Labour Regulation Act 1970, Chapter V C.9, canteen, rest rooms/washing facilities to contracted employees at site.
- Shall adhere to the instructions laid down in Operation Control Procedures (OCPs) available with the site management.
- Shall ensure that person working above 2.0 meter should use Safety Harness tied to a life line/stable structure.
- Shall ensure that materials are not thrown from height. Cautions to be exercised to prevent fall of material from height.
- Shall report all incidents(Fatal/Major/Minor/Near Miss)to the Site engineer /HSE officer of BHEL.
- Shall ensure that Horseplay is strictly forbidden.
- Shall ensure that adequate illumination is arranged during night work.
- Shall ensure that all personnel working under subcontractor are working safely and do not create any Hazard to self and to others.
- Shall ensure display of adequate signage/posters on HSE.
- Shall ensure that mobile phone is not used by workers while working.
- Shall ensure conductance of HSE audit, mockdrill, medical camps, induction training and training on HSE at site.
- Shall ensure full co-operation during HQ/External /Customer HSE audits.

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- Shall ensure submission of look-ahead plan for procurement of HSE equipment's and PPEs as per work schedule.
- Shall ensure good housekeeping.
- Shall ensure adequate valid fire extinguishers are provided at the work site.
- Shall ensure availability of sufficient number of toilets /restrooms and adequate drinking water at work site and labour colony.
- Shall ensure adequate emergency preparedness.
- Shall be member of site HSE committee and attend all meetings of the committee
- Power source for hand lamps shall be maximum of 24 v.
- Temporary fencing should be done for open edges if Hand – railings and Toe-guards are not available.

7.2.2 HEALTH, SAFETY AND ENVIRONMENT OFFICER OF SUBCONTRACTOR

- Carry out safety inspection of Work Area, Work Method, Men, Machine & Material, P&M and other tools and tackles.
- Facilitate inclusion of safety elements into Work Method Statement.
- Highlight the requirements of safety through Tool-box / other meetings.
- Help concerned HOS to prepare Job Specific instructions for critical jobs.
- Conduct investigation of all incident/dangerous occurrences & recommend appropriate safety measures.
- Advice & co-ordinate for implementation of HSE permit systems, OCPs & MPs.
- Convene HSE meeting & minute the proceeding for circulation & follow-up action.
- Plan procurement of PPE & Safety devices and inspect their healthiness.
- Report to PS Region/HQ on all matters pertaining to status of safety and promotional program at site level.
- Facilitate administration of First Aid
- Facilitate screening of workmen and safety induction.
- Conduct fire Drill and facilitate emergency preparedness
- Design campaigns, competitions & other special emphasis programs to promote safety in the workplace.
- Apprise PS– Region on safety related problems.
- Notify site personnel non-conformance to safety norms observed during site visits / site inspections.
- Recommend to Site In charge, immediate discontinuance of work until rectification, of such situations warranting immediate action in view of imminent danger to life or property or environment.
- To decline acceptance of such PPE / safety equipment that do not conform to specified requirements.
- Encourage raising Near Miss Report on safety along with, improvement initiatives on safety.
- Shall work as interface between various agencies such customer, package-in-charges, subcontractors on HSE matters

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8.0 PLANNING BY SUBCONTRACTOR

8.1 MOBILISATION OF MACHINERY/EQUIPMENT/TOOLS BY SUBCONTRACTOR

- As a measure to ensure that machinery, equipment and tools being mobilized to the construction site are fit for purpose and are maintained in safe operating condition and complies with legislative and owner requirement, inspection shall be arranged by in-house competent authority for acceptance as applicable.
- The machinery and equipment to be embraced for this purpose shall include but not limited to the following:
 - Mobile cranes.
 - Side Booms.
 - Forklifts.
 - Grinding machine.
 - Drilling machine.
 - Air compressors.
 - Welding machine.
 - Generator sets.
 - Dump Trucks.
 - Excavators.
 - Dozers
 - Grit Blasting Equipment.
 - Hand tools.
- Subcontractor shall notify the engineer, of his intention to bring on to site any equipment or any container, with liquid or gaseous fuel or other substance which may create a hazard. The Engineer shall have the right to prescribe the condition under which such equipment or container may be handled and used during the performance of the works and the subcontractor shall strictly adhere to such instructions. The Engineer shall have the right to inspect any construction tool and to forbid its use, if in his opinion it is unsafe. No claim due to such prohibition will be entertained.

8.2 MOBILISATION OF MANPOWER BY SUBCONTRACTOR

- The subcontractor shall arrange induction and regular health check of their employees as per schedule VII of BOCW rules by a registered medical practitioner.
- The subcontractor shall take special care of the employees affected with occupational diseases under rule 230 and schedule II of BOCW Rules. The employees not meeting the fitness requirement should not be engaged for such job.
- Ensure that the regulatory requirements of excessive weight limit (to carry/lift/ move weights beyond prescribed limits) for male and female workers are complied with.
- Appropriate accommodation to be arranged for all workmen in hygienic condition.



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8.3 PROVISION OF PPEs

- Personnel Protective Equipment (PPEs), in adequate numbers, will be made available at site & their regular use by all concerned will be ensured
- The following matrix recommends usage of minimum PPEs against the respective job.

Sl. No	Type of work	PPEs
1	Concrete and asphalt mixing	Nose mask, hand glove, apron and gum boot
2	Welders/Grinders/ Gas cutters	Welding/face screen, apron, hand gloves, nose mask and ear muffs if noise level exceeds 90dB. Helmet fitted with welding shield is preferred for welders
3	Stone/ concrete breakers	Ear muffs, safety goggles, hand gloves
4	Electrical Work	Rubber hand glove, Electrical Resistance shoes
5	Insulation Work	Respiratory mask, Hand gloves, safety goggles
6	Work at height	Double lanyard full body harness, Fall arrestor (specific cases)
7	Grit/Sand blasting	Blast suit, blast helmet, respirator, leather gloves
8	Painting	Plastic gloves, Respirators (particularly for spray painting)
9	Radiography	As per BARC guidelines

- The PPEs shall conform to the relevant standards as below and bear ISI mark.

Relevant is-codes for personal protection

IS: 2925 – 1984	Industrial Safety Helmets.
IS: 4770 – 1968	Rubber gloves for electrical purposes.
IS: 6994 – 1973 (Part-I)	Industrial Safety Gloves (Leather & Cotton Gloves).
IS: 1989 – 1986 (Part-I-II)	Leather safety boots and shoes.
IS: 5557 – 1969	Industrial and Safety rubber knee boots.
IS: 6519 – 1971	Code of practice for selections care and repair of Safety footwear.
IS: 11226 – 1985	Leather Safety footwear having direct molding sole.
IS: 5983 – 1978	Eye protectors.
IS: 9167 – 1979	Ear protectors.
IS: 1179-1967	Eye & Face protection during welding
IS: 3521 – 1983	Industrial Safety Belts and Harness
IS: 8519 -1977	Guide for selection of industrial Safety equipment for body protection
IS: 9473-2002, 14166-1994, 14746-1999	Respiratory Protective Devices

The list is not exhaustive. The safety officer may demand additional PPEs based on specific requirement.



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- Where workers are employed in sewers and manholes, which are in use, the subcontractor shall ensure that the manhole covers are opened and ventilated at least for an hour before the workers are allowed to get into manhole, and the manholes so opened shall be cordoned off with suitable railing and provided with warning signals or boards to prevent incident to the public
- Besides the PPEs mentioned above, the persons shall use helmet and safety shoe. The visitors shall use Helmet and any other PPEs as deemed appropriate for the area of work.

Colour scheme for Helmets:

- Workmen: Yellow
 - Safety staff: Green or white with green band
 - Electrician: Red
 - Others including visitors: White
- All the PPEs shall be checked for its quality before issue and the same shall be periodically checked. The users shall be advised to check the PPEs themselves for any defect before putting on. The defective ones shall be repaired/ replaced.
 - The issuing agency shall maintain register for issue and receipt of PPEs.
 - The Helmets shall have logo or name (abbreviation of agency name permitted) affixed or printed on the front.
 - The body harnesses shall be serial numbered.

8.4 ARRANGEMENT OF INFRASTRUCTURE

8.4.1 DRINKING WATER

- Drinking water shall be provided and maintained at suitable places at different elevations.
- Container should be labeled as " Drinking Water"
- Cleaning of the storage tank shall be ensured atleast once in 3 months indicating date of cleaning and next due date.
- Potability of water should be tested as per IS10500 at least once in a year.

8.4.2 WASHING FACILITIES

- In every workplace, adequate and suitable facilities for washing shall be provided and maintained.
- Separate and adequate cleaning facilities shall be provided for the use of male and female workers. Such facilities shall be conveniently accessible and shall be kept in clean and hygienic condition and dully illuminated for night use.
- Overalls shall be supplied by the subcontractor to the workmen and adequate facilities shall be provided to enable the painters and other workers to wash during the cessation of work.

8.4.3 LATRINES AND URINALS

- Latrines and urinals shall be provided in every work place.
- Urinals shall also be provided at different elevations.
- They shall be adequately lighted and shall be maintained in a clean and sanitary condition at all times, by appointing designated person.
- Separate facilities shall be provided for the use of male and female worker if any.

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8.4.4 PROVISION OF SHELTER DURING REST

Proper Shed & Shelter shall be provided for rest during break

8.4.5 MEDICAL FACILITIES

8.4.5.1 MEDICAL CENTRE (As per Schedule V, X and XI of BOCW central Rules, 1998)

- A medical centre shall be ensured/identified at site with basic facilities for handling medical emergencies. The medical center can be jointly developed on proportionate sharing basis with permission from BHEL
- A qualified medical professional, not less than MBBS, shall be deployed at the medical centre
- The medical centre shall be equipped with one ambulance, with trained driver and oxygen cylinder.
- Medical waste shall be disposed as per prevailing legislation (Bio-Medical Waste –Management and Handling Rules, 1998)

8.4.5.2 FIRST AIDER

- Ensure availability of Qualified First-aider throughout the working hours.
- Every injury shall be treated, recorded and reported.
- Refresher course on first aid shall be conducted as necessary.
- List of Qualified first aiders and their contact numbers should be displayed at conspicuous places.

8.4.5.3 FIRST AID BOX (as per schedule III of BOCW)

- The subcontractor shall provide necessary first aid facilities as per schedule III of BOCW. At every work place first aid facilities shall be provided and maintained.
- The first aid box shall be kept by first aider who shall always be readily available during the working hours of the work place. His name and contact no to be displayed on the box.
- The first aid boxes should be placed at various elevations so as to make them available within the reach and at the quickest possible time.
- The first aid box shall be distinctly marked with a Green Cross on white background.
- Details of contents of first aid box is given in Annexure No. 01
- Monthly inspection of First Aid Box shall be carried out by the owner as per format no. HSEP:13-F01
- The subcontractor should conduct periodical first –aid classes to keep his supervisor and Engineers properly trained for attending to any emergency.

8.4.5.4 HEALTH CHECK UP (As per schedule VII and Form XI)

The persons engaged at the site shall undergo health checkup as per the format no. HSEP:13-F02 before induction. The persons engaged in the following works shall undergo health checkup at least once in a year:

- a. Height workers
- b. Drivers/crane operators/riggers



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- c. Confined space workers
- d. Shot/sand blaster
- e. Welding and NDE personnel

8.4.6 PROVISION OF CANTEEN FACILITY

- Canteen facilities shall be provided for the workmen of the project inside the project site.
- Proper cleaning and hygienic condition shall be maintained.
- Proper care should be taken to prevent biological contamination.
- Adequate drinking water should be available at canteen.
- Fire extinguisher shall be provided inside canteen.
- Regular health check-up and medication to the canteen workers shall be ensured.

8.4.7 PROVISION OF ACCOMODATION/LABOUR COLONY

- The subcontractor shall arrange for the accommodation of workmen at nearby localities or by making a labour colony.
- Regular housekeeping of the labour colony shall be ensured.
- Proper sanitation and hygienic conditions to be maintained.
- Drinking water and electricity to be provided at the labour colony.
- Bathing/ washing bay
- Room ventilation and electrification.

8.4.8 PROVISION OF EMERGENCY VEHICLE

- Dedicated emergency vehicle shall be made available at workplace by each subcontractor to handle any emergency

8.4.9 PEST CONTROL

Regular pest control should be carried out at all offices, mainly laboratories, canteen, labour colony and stores.

8.4.10 SCRAPYARD

- In consultation with customer, scrapyard shall be developed to store metal scrap, wooden scrap, waste, hazardous waste.
- Scrap/Waste shall be segregated as Bio-degradable and non-bio-degradable and stored separately.

8.4.11 ILLUMINATION

- The subcontractor shall arrange at his cost adequate lighting facilities e.g. flood lighting, hand lamps, area lighting etc. at various levels for safe and proper working operations at dark places and during night hours at the work spot as well as at the pre-assembly area.
- Adequate and suitable light shall be provided at all work places & their approaches including passage ways as per IS: 3646 (Part-II). Some recommended values are given below:



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S. No.	Location	Illumination (Lux)
A. Construction Area		
1.	Outdoor areas like store yards, entrance and exit roads	20
2.	Platforms	50
3.	Entrances, corridors and stairs	100
4.	General illumination of work area	150
5.	Rough work like fabrication, assembly of major items	150
6.	Medium work like assembly of small machined parts	300
	rough measurements etc.	
7.	Fine work like precision assembly, precision measurements etc.	700
8.	Sheet metal works	200
9.	Electrical and instrument labs	450
B. Office		
1.	Outdoor area like entrance and exit roads	20
2.	Entrance halls	150
3.	Corridors and lift cars	70
4.	Lift landing	150
5.	Stairs	100
6.	Office rooms, conference rooms, library reading tables	300
7.	Drawing table	450
8.	Manual telephone exchange	200

- Lamp (hand held) shall not be powered by mains supply but either by 24V or dry cells.
- Lamps shall be protected by suitable guards where necessary to prevent danger, in case of breakage of lamp.
- Emergency lighting provision for night work shall be made to minimise danger in case of main supply failure.

If the subcontractor fails to take appropriate safety precautions or to provide necessary safety devices and equipment or to carry out instructions issued by the authorized BHEL official, BHEL shall have the right to take corrective steps at the risk and cost of the subcontractor

9.0 HSE TRAINING& AWARENESS

9.1 HSE INDUCTION TRAINING

All persons entering into project site shall be given HSE induction training by the HSE officer of BHEL /subcontractor before being assigned to work.

In-house induction training subjects shall include but not limited to:

- Briefing of the Project details.
- Safety objectives and targets.
- Site HSE rules.
- Site HSE hazards and aspects.
- First aid facility.
- Emergency Contact No.
- Incident reporting.
- Fire prevention and emergency response.
- Rules to be followed in the labour colony (if applicable)

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- Proper safety wear & gear must be issued to all the workers being registered for the induction (i.e., Shoes/Helmets/Goggles/Leg guard/Apron etc.)
- They must arrive fully dressed in safety wear & gear to attend the induction.
- Any one failing to conform to this safety wear& gear requirement shall not qualify to attend.
- On completing attending subcontractor's in-house HSE induction, each employee shall sign an induction training form (format no. HSEP:13-F03) to declare that he had understood the content and shall abide to follow and comply with safe work practices. They may only then be qualified to be issued with a personal I.D. card, for access to the work site.

9.2 HSE TOOLBOX TALK

- HSE tool Box talk shall be conducted by frontline foreman/supervisor of subcontractor to specific work groups prior to the start of work. The agenda shall consist of the followings:
 - Details of the job being intended for immediate execution.
 - The relevant hazards and risks involved in executing the job and their control and mitigating measures.
 - Specific site condition to be considered while executing the job like high temperature, humidity, unfavorable weather etc.
 - Recent non-compliances observed.
 - Appreciation of good work done by any person.
 - Any doubt clearing session at the end.
- Record of Tool box talk shall be maintained as per format no. HSEP:13-F04
- Tool box talk to be conducted at least once a week for the specific work.

9.3 TRAINING ON HEIGHT WORK

Training on height work shall be imparted to all workers working at height by in-house/external faculty at least twice in a year. The training shall include following topics:

- Use of PPEs
- Use of fall arrester, retractable fall arrester, life line, safety nets etc.
- Safe climbing through monkey ladders.
- Inspection of PPEs.
- Medical fitness requirements.
- Mock drill on rescue at height.
- Dos & Don'ts during height work.

9.4 HSE TRAINING DURING PROJECT EXECUTION

- Other HSE training shall be arranged by BHEL/ subcontractor as per the need of the project execution and recommendation of HSE committee of site.
- The topics of the HSE training shall be as follows but not limited to:
 - Hazards identification and risk analysis (HIRA)
 - Work Permit System
 - Incident investigation and reporting
 - Fire fighting
 - First aid
 - Fire-warden training
 - EMS and OHSMS
 - T & Ps fitness and operation

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- Electrical safety
- Welding, NDE & Radiological safety
- Storage, preservation & material handling.
- A matrix shall be maintained to keep an up-to-date record of attendance of training sessions carried out.

9.5 HSE PROMOTION-SIGNAGE, POSTERS, COMPETITION, AWARDS ETC

9.5.1 Display of HSE posters and banners

- Site shall arrange appropriate posters, banners, slogans in local/Hindi/English languages at work place

9.5.2 Display of HSE signage

- Appropriate HSE signage shall be displayed at the work area to aware workmen and passersby about the work going on and do's and don'ts to be followed

9.5.3 Competition on HSE and award

- Site will arrange different competition (slogan, poster, essay etc.) on HSE time to time (Safety day, BHEL day, World Environment Day etc.) and winners will be suitably awarded.

9.5.4 HSE awareness programme

- Subcontractor shall arrange HSE awareness programme periodically on different topics including medical awareness for all personnel working at site

10.0 HSE COMMUNICATION

10.1 INCIDENT REPORTING

- The subcontractor shall submit report of all incidents, fires and property damage etc to the Engineer immediately after such occurrence, but in any case not later than 24 hours of the occurrence. Such reports shall be furnished in the manner prescribed by BHEL. (Refer HSE procedure for incident investigation, analysis and reporting for details)
- In addition, periodic reports on safety shall also be submitted by the subcontractor to BHEL from time to time as prescribed by the Engineer. Compiled monthly reports of all kinds of incidents, fire and property damage to be submitted to BHEL safety officer as per prescribed formats.
- HSE incidents of site shall be reported to BHEL site Management as per Procedure for Incident Investigation and Reporting in format no. HSEP:14-F15. Corrective action shall be immediately implemented at the work place and compliance shall be verified by BHEL HSE officer and until then, work shall be put on hold by Construction Manager.

10.2 HSE EVENT REPORTING

- Important HSE events like HSE training, Medical camp etc. organized at site shall be reported to BHEL site management in detail with photographs for publication in different in-house magazines
- Celebration of important days like National Safety Day, World Environment Day etc. shall also be reported as mentioned above.



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11.0 OPERATIONAL CONTROL

All applicable OCPs (Operational control procedures) will be followed by subcontractor as per BHEL instructions. This will be done as part of normal scope of work. List of such OCPs is given below. In case any other OCP is found to be applicable during the execution of work at site, then subcontractor will follow this as well, within quoted rate. These OCPs (applicable ones) will be made available to subcontractor during work execution at site. However for reference purpose, these are kept with Safety Officer of BHEL at the Power Sector Regional HQ, or available in downloadable format in the website, which may be referred by subcontractor, if they so desire.

LIST OF OCPs

Safe handling of chemicals	Safety in use of cranes	Hydraulic test
Electrical safety	Storage and handling of gas cylinders	Spray insulation
Energy conservation	Manual arc welding	Trial run of rotary equipment
Safe welding and gas cutting operation	Safe use of helmets	Stress relieving
Fire safety	Good house keeping	Material preservation
Safety in use of hand tools	Working at height	Cable laying/tray work
First aid	Safe excavation	Transformer charging
Food safety at canteen	Safe filling of hydrogen in cylinder	Electrical maintenance
Illumination	Vehicle maintenance	Safe handling of battery system
Handling and erection of heavy metals	Safe radiography	Computer operation
Safe acid cleaning	Waste disposal	Storage in open yard
Safe alkali boil out	Working at night	For sanitary maintenance
Safe oil flushing	Blasting	Batching
Steam blowing	DG set	Piling rig operation
Safe working in confined area	Handling & storage of mineral wool	Gas distribution test
Safe operation of passenger lift, material hoists & cages	Drilling, reaming and grinding(machining)	Cleaning of hotwell / deaerator
Electro-resistance heating	Compressor operation	O&M of control of AC plant & system
Air compressor	Passivation	Safe Loading of Unit
Safe EDTA Cleaning	Safe Chemical cleaning of Pre boiler system	Safe Boiler Light up
Safe Rolling and Synchronisation		

11.1 HSE ACTIVITIES

HSE activities shall be conducted at site based on the HSEMSM developed by Power Sector and issued to site by Regions.

While planning for any activity the following documents shall be referred for infrastructural requirements to establish control measures:

- 1) HSE Procedure for Register of OHS Hazards and Risks
- 2) HSE Procedure for Register of Environmental Aspects and Impacts
- 3) HSE Procedure for Register of Regulations



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- 4) Operational Control Procedures
- 5) HSE Procedure for Emergency Preparedness and Response Plan
- 6) Contract documents

11.2 WORK PERMIT SYSTEM

- The following activities shall come under Work Permit System
 - a. Height working above 2 metres
 - b. Hot working at height
 - c. Confined space
 - d. Radiography
 - e. Excavation more than 4 meter depth
 - f. Heavy lifting above 50 tonRefer Annexure 05 for Work permit formats.
- "HSE Procedure for Work Permit System" shall be followed while implementing permit system. Where customer is having separate Work Permit System the same shall be followed.
- Permit applicant shall apply for work permit of particular work activity at particular location before starting of the work with Job Hazard Analysis.
- Permit signatory shall check that all the control measures necessary for the activity are in place and issue the permit to the permit holder.
- Permit holder shall implement and maintain all control measures during the period of permit .He will close the permit after completion of the work. The closed permit shall be archived in HSE Department of site.

11.3 SAFETY DURING WORK EXECUTION

Respective OCPS are to be followed and adherence to the same would be contractually binding

11.3.1 WELDING SAFETY

All safety precautions shall be taken for welding and cutting operations as per IS-818. All safety precautions shall be taken for foundation and other excavation marks as per IS-3764.

11.3.2 RIGGING

Rigging equipment shall not be loaded in excess of its recommended safe working load. Rigging equipment, when not in use, shall be removed from the original work area so as not to present a hazard to employees.

11.3.3 CYLINDERS STORAGE AND MOVEMENT

All gas cylinders shall be stored in upright position. Suitable trolley shall be used. There shall be flash-back arrestors conforming to IS-11006 at both cylinder and burner ends. Damaged tube and regulators must be immediately replaced. No of cylinders shall not exceed the specified quantity as per OCP

Cylinders shall be moved by tilting and rolling them on their bottom edges. They shall not be intentionally dragged, struck or permitted to strike each other violently.

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When cylinders are transported by powered vehicle they shall be secured in a vertical position.

11.3.4 DEMOLITION WORK

Before any demolition work is commenced and also during the process of the work the following shall be ensured:

- All roads and open areas adjacent to the work site shall either be closed or suitably protected.
- No electric cable or apparatus which is liable to be a source of danger nor a cable or an apparatus used by the operator shall remain electrically charged.
- All practical steps shall be taken to prevent danger to persons employed from the risks of fire or explosion or flooding. No floor, roof or other part of the building shall be so overloaded with debris or materials as to render them unsafe.

11.3.5 T&Ps

All T&Ps/ MMEs should be of reputed brand/appropriate quality & must have valid test/calibration certificates bearing endorsement from competent authority of BHEL..Subcontractor to also submit monthly reports of T&Ps deployed and validity test certificates to BHEL safety Officer as per the format/procedure of BHEL.

11.3.6 CHEMICAL HANDLING

Displaying safe handling procedures for all chemicals such as lube oil, acid, alkali, sealing compounds etc , at work place.Where it is necessary to provide and/or store petroleum products or petroleum mixture & explosives, the subcontractor shall be responsible for carrying out such provision / storage in accordance with the rules & regulations laid down in the relevant petroleum act, explosive act and petroleum and carbide of calcium manual, published by the chief inspector of explosives of India. All such storage shall have prior approval if necessary from the chief inspector of explosives or any other statutory authority. The subcontractor shall be responsible for obtaining the same.

11.3.7 ELECTRICAL SAFETY

- Providing adequate no. of 24 V sources and ensure that no hand lamps are operating at voltage level above 24 Volts.
- Fulfilling safety requirements at all power tapping points.
- High/ Low pressure welders to be identified with separate colour clothings. No welders will be deployed without passing appropriate tests and holding valid welding certificates. Approved welding procedure should be displayed at work place.
- The subcontractor shall not use any hand lamp energized by Electric power with supply voltage of more than 24 volts in confined spaces like inside water boxes, turbine casings, condensers etc.
- All portable electric tools used by the subcontractor shall have safe plugging system to source of power and be appropriately earthed. Only electricians licensed by appropriate statutory authority shall be employed by the subcontractor to carry out all types of electrical works. Details of earth resource and their test date to be given to BHEL safety officer as per the prescribed formats of BHEL
- The subcontractor shall use only properly insulated and armored cables which conform to the requirement of Indian Electricity Act and Rules for all wiring, electrical applications at site.



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- BHEL reserves the right to replace any unsafe electrical installations, wiring, cabling etc. at the cost of the subcontractor.
- All electrical appliances used in the work shall be in good working condition and shall be properly earthed.
- No maintenance work shall be carried out on live equipment.
- The subcontractor shall maintain adequate number of qualified electricians to maintain his temporary electrical installations.
- Area wise Electrical safety inspection is to be carried out on monthly basis as per "Electrical Safety Inspection checklist" and the report is to be submitted to BHEL safety officer
- Adequate precautions shall be taken to prevent danger for electrical equipment. No materials on any of the sites of work shall be so stacked or placed as to cause danger or inconvenience to any person or the public
- The subcontractor shall carefully follow the safety requirement of BHEL/ the purchaser with the regard to voltages used in critical areas.

11.3.8 FIRE SAFETY

- Providing appropriate fire fighting equipment at designated work place and nominate a fire officer/warden adequately trained for his job.
- Subcontractor shall provide enough fire protecting equipment of the types and numbers at his office, stores, temporary structure in labor colony etc. Such fire protection equipment shall be easy and kept open at all times.
- The fire extinguishers shall be properly refilled and kept ready which should be certified at periodic intervals. The date of changing should be marked on the Cylinders.
- All other fire safety measures as laid down in the "codes for fire safety at construction site" issued by safety coordinator of BHEL shall be followed.
- Non-compliance of the above requirement under fire protection shall in no way relieve the subcontractor of any of his responsibility and liabilities to fire incident occurring either to his materials or equipment or those of others.
- Emergency contacts nos must be displayed at prominent locations
- Tarpaulin being inflammable should not be used (instead, only non infusible covering materials shall be used) as protective cover while preheating, welding, stress relieving etc. at site.

11.3.9 SCAFFOLDING

- Suitable scaffolds shall be provided for workman for all works that cannot safely be done from the ground, or from solid construction except in the case of short duration of work which can be done safely from ladders.
- When a ladder is used, it shall be of rigid construction made of steel. The steps shall have a minimum width of 45 cm and a maximum rise of 30 cm. Suitable handholds of good quality wood or steel shall be provided and the ladder shall be given an inclination not steeper than 1/4 horizontal and 1 vertical.
- Scaffolding or staging more than 3.6 m above the ground floor, swung or suspended from an overhead support or erected with stationery support shall have a guard rail properly bolted, braced or otherwise secured, at least 90 cm above the floor or platform of such scaffolding or staging and extending along the entire length of the out side and ends thereof with only such openings as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from savor, from swaying, from the building or structure.

11.3.10 WORK AT HEIGHT:

- Guardrails and toe-board/barricades and sound platform conforming to IS:4912-1978 should be provided.



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- Wherever necessary, life-line(pp or metallic) and fall arrestor along with Polyamide rope or Retractable lifeline should be provided.
- Safety Net as per IS:11057:1984 should be used extensively for prevention/ arrest of men and materials falling from height. The safety nets shall be fire resistant, duly tested and shall be of ISI marked and the nets shall be located as per site requirements to arrest or to reduce the consequences of a possible fall of persons working at different heights.
- Reaching beyond barricaded area without lifeline support, moving with support of bracings, walking on beams without support, jumping from one level to another, throwing objects and taking shortcut must be discouraged.
- Use of Rebar steel for making Jhoola and monkey-ladder (Rods welded to vertical or inclined structural members), temporary platform etc. must be avoided.
- Monkey Ladder should be properly made and fitted with cages.
- Jhoola should be made with angles and flats and tested like any lifting tools before use.
- Lanyard must be anchored always and in case of double lanyard, each should be anchored separately.
- In case of pipe-rack, persons should not walk on pipes and walk on platforms only.
- In case of roof work, walking ladder/ platform should be provided along with lifeline and/ or fall arrestor.
- Empty drums must not be used.
- For chimney or structure painting, both hanging platform and men should be anchored separately to a firm structure alongwith separate fall arrestor. Rope ladder should be discouraged.

11.3.11 WORKING PLATFORM

Working platforms, gangways and stairways shall be so constructed that they do not sag unduly or unequally and if the height of the platform gangways provided is more than 3.6 m above ground level or floor level, they shall be closely boarded and shall have adequate width which shall not be less than 750 mm and be suitably fenced as described above. Every opening in the floor or a building or in a working platform shall be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be 90 cm.

11.3.12 EXCAVATION

Wherever there are open excavation in ground, they shall be fenced off by suitable railing and danger signals installed at night so as to prevent persons slipping into the excavations.

11.3.13 LADDER SAFETY

Safe means of access shall be provided to all working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9 m in the length while the width between side rails in rung ladder shall in no case be less than app. 29.2 cm for ladder upto and including 3 m in length. For longer ladders this width shall be increased at least 1/4" for each additional foot of length.

A sketch of the ladders and scaffolds proposed to be used shall be prepared and approval of the Engineer obtained prior to Construction.

11.3.14 LIFTING SAFETY

- It will be the responsibility of the subcontractor to ensure safe lifting of the equipment, taking due precaution to avoid any incident and damage to other equipment and personnel.



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- All requisite tests and inspection of handling equipment, tools & tackle shall be periodically done by the subcontractor by engaging only the Competent Persons as per law.
- Defective equipment or uncertified shall be removed from service.
- Any equipment shall not be loaded in excess of its recommended safe working load.

11.3.15 HOISTING APPLIANCE

- Motors, gearing, transmission, electric wiring and other dangerous parts of hoisting appliances should be provided with efficient safe guards.
- Hoisting appliance should be provided with such means as will reduce to the minimum the risk of any part of a suspended load becoming incidentally displaced.
- When workers employed on electrical installations which are already energized, insulating mats, wearing apparel, such as gloves, sleeves and boots as may be necessary should be provided.
- The worker should not wear any rings, watches and carry keys or other materials which are good conductor of electricity.

11.4 ENVIRONMENTAL CONTROL

Environment protection has always been given prime importance by BHEL. Environmental damage is a major concern of the principal subcontractor and every effort shall be made, to have effective control measures in place to avoid pollution of Air, Water and Land and associated life. Chlorofluorocarbons such as carbon tetrachloride and trichloroethylene shall not be used. Waste disposal shall be done in accordance with the guidelines laid down in the project specification.

Any chemical including solvents and paints, required for construction shall be stored in designated bonded areas around the site as per Material Safety Data Sheet (MSDS).

In the event of any spillage, the principle is to recover as much material as possible before it enters drainage system and to take all possible action to prevent spilled materials from running off the site. The subcontractor shall use appropriate MSDS for clean-up technique

All subcontractors shall be responsible for the cleanliness of their own areas.

The subcontractors shall ensure that noise levels generated by plant or machinery are as low as reasonably practicable. Where the subcontractor anticipates the generation of excessive noise levels from his operations the subcontractor shall inform to Construction Manager of BHEL accordingly so that reasonable & practicable precautions can be taken to protect other persons who may be affected.

It is imperative on the part of the subcontractor to join and effectively contribute in joint measures such as tree plantation, environment protection, contributing towards social upliftment, conversion of packing woods to school furniture, keeping good relation with local populace etc.

The subcontractor shall carry out periodic air and water quality check and illumination level checking in his area of work place and take suitable control measure.

11.5 HOUSEKEEPING

- Keeping the work area clean/ free from debris, removed scaffoldings, scraps, insulation/sheeting wastage /cut pieces, temporary structures, packing woods etc. will be in the scope of the subcontractor. Such cleanings has to be done by



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subcontractor within quoted rate, on daily basis by an identified group. If such activity is not carried out by subcontractor / BHEL is not satisfied, then BHEL may get it done by other agency and actual cost along with BHEL overheads will be deducted from contractor's bill. Such decisions of BHEL shall be binding on the subcontractor

- Proper housekeeping to be maintained at work place and the following are to be taken care of on daily basis.
- All surplus earth and debris are removed/disposed off from the working areas to identified locations.
- Unused/Surplus cables, steel items and steel scrap lying scattered at different places/elevation within the working areas are removed to identified locations.
- All wooden scrap, empty wooden cable drums and other combustible packing materials, shall be removed from workplace to identified locations. Sufficient waste bins shall be provided at
- Different work places for easy collection of scrap/waste. Scrap chute shall be installed to remove scrap from high location.
- Access and egress (stair case, gangways, ladders etc.) path should be free from all scrap and other hindrances.
- Workmen shall be educated through tool box talk about the importance of housekeeping and encourage not to litter.
- Labour camp area shall be kept clear and materials like pipes, steel, sand, concrete, chips and bricks, etc. shall not be allowed in the camp to obstruct free movement of men and machineries.
- Fabricated steel structures, pipes & piping materials shall be stacked properly.
- No parking of trucks/trolleys, cranes and trailers etc. shall be allowed in the camp, which may obstruct the traffic movement as well as below LT/HT power line.
- Utmost care shall be taken to ensure over all cleanliness and proper upkeep of the working areas

11.6 WASTE MANAGEMENT

Take suitable measures for waste management and environment related laws/legislation as a part of normal construction activities. Compliance with the legal requirements on storage/ disposal of paint drums (including the empty ones), Lubricant containers, Chemical Containers, and transportation and storage of hazardous chemicals will be strictly maintained.

11.6.1 BINS AT WORK PLACE

- Sufficient rubbish bins shall be provided close to workplaces.
- Bins should be painted yellow and numbered.
- Sufficient nos. of drip trays shall be provided to collect oil and grease.
- Sufficient qty. of broomsticks with handle shall be provided.
- Adequate strength of employees should be deployed to ensure daily monitoring and service for waste management.

11.6.2 STORAGE AND COLLECTION

- Different types of rubbish/waste should be collected and stored separately.
- Paper, oily rags, smoking material, flammable, metal pieces should be collected in separate bins with close fitting lids.
- Rubbish should not be left or allowed to accumulate on construction and other work places.
- Do not burn construction rubbish near working site.

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11.6.3 SEGREGATION

- Earmark the scrap area for different types of waste.
- Store wastes away from building.
- Oil spill absorbed by non-combustible absorbent should be kept in separate bin.
- Clinical and first aid waste stored and incinerated separately.

11.6.4 DISPOSAL

- Sufficient containers and scrap disposal area should be allocated.
- All scrap bin and containers should be conveniently located.
- Provide self-closing containers for flammable/spontaneously combustible material.
- Keep drainage channels free from choking.
- Make schedule for collection and disposal of waste.

11.6.5 WARNING AND SIGNS

- Appropriate sign to be displayed at scrap storage area
- No toxic, corrosive or flammable substance to be discarded into public sewage system.
- Waste disposal shall be in accordance with best practice.
- Comply with all the requirements of Pollution Control Board (PCB) for storage and disposal of hazardous waste.

11.7 TRAFFIC MANAGEMENT SYSTEM

11.7.1 SAFE WORKPLACE TRANSPORT SYSTEM

- Traffic routes in a work place shall be suitable for the persons or vehicles using them. This shall be sufficient in number and of sufficient size. This shall reflect the suitability of traffic routes for vehicles and pedestrians.
- Where vehicles and pedestrians use the same traffic routes there shall be sufficient space between them. Where necessary all traffic routes must be suitably indicated. Pedestrians or vehicles must be able to use traffic routes without endangering those at work. There must be sufficient separation of traffic routes from doors, gates and pedestrian traffic routes.
- For internal traffic, lines marked on roads / access routes and between buildings shall clearly indicate where vehicles are to pass.
- Temporary obstacles shall be brought to the attention of drivers by warning signs or hazard cones.
- Speed limits shall be clearly displayed. Speed ramps preceded by a warning signs or marker are necessary.
- The traffic route should be wide enough to allow vehicles to pass and re-pass oncoming or parked traffic and it may be advisable to introduce on-way system or parking restrictions.
- Safest route shall be provided between places where vehicles have to call or deliver.
- Avoid vulnerable areas/items such as fuel or chemicals tanks or pipes, open or unprotected edges and structures likely to collapse



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- Safe areas shall be provided for loading and unloading.
- Avoid sharp or blind bends. If this is not possible hazards should be indicated e.g. blind corner.
- Ensure road crossings are minimum and clearly signed.
- Entrance and gateways shall be wide enough to accommodate a second vehicle without causing obstruction.
- Set sensible speed limits which are clearly sign posted.
- Where necessary ramps should be used to retard speed. This shall be preceded by a warning sign or mark on the road.
- Forklift trucks shall not pass over road hump unless of a type capable of doing so.
- Overhead electric cable, pipes containing flammable hazardous chemical shall be shielded by using goal posts height gauge posts or barriers.
- Road traffic signs shall be provided on prominent locations for prevention of incidents and hazards and for quick guidance and warning to employees and public. Safety signs shall be displayed as per the project working requirement and guideline of the state in which project is done. Vehicles hired or used shall not be parked within the 15m radius of any working area. Any vehicle, that is required to be at the immediate/near the vicinity, shall be approved by the person in-charge of the site.

11.7.2 TRAFFIC ROUTE FOR PEDESTRIANS

- Where traffic routes are used by both pedestrians and vehicles road shall be wide enough to allow vehicles and pedestrians safely.
- Separate routes shall be provided for pedestrians to keep them away from vehicles. Provide suitable barriers/guard at entrances/exit and the corners or buildings.
- Where pedestrian and vehicle routes cross, appropriate crossing shall be provided.
- Where crowd is likely to use roadway e.g. at the end of shift, stop vehicles from using them at such times.
- Provide high visibility clothing for people permitted in delivery area.

11.7.3 WORK VEHICLE

Work vehicle shall be as safe stable efficient and roadworthy as private vehicles on public roads. Site management shall ensure that drivers are suitably trained. All vehicle e.g. heavy motor vehicle forklift trucks dump trucks mobile cranes shall ensure that the work equipment conforms to the following:

- A high level of stability.
- A safe means of access/egress.
- Suitable and effective service and parking brakes.
- Windscreens with wipers and external mirrors giving optimum all round visibility.
- Provision of horn, vehicle lights, reflectors, reversing lights, reversing alarms.
- Provision of seat belts.
- Guards on dangerous parts.
- Driver protection - to prevent injury from overturning and from falling objects/materials.
- Driver protection from adverse weather.
- No vehicle shall be parked below HT/LT power lines.
- Valid Pollution Under Control certification for all vehicles

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11.7.4 DAILY CHECK BY DRIVER

- There should also be daily safety checks containing below mentioned points by the driver before the vehicle is used.
 - Brakes.
 - Tires.
 - Steering.
 - Mirrors.
 - Windscreen waters.
 - Wipers.
 - Warning signals.
 - Specific safety system i.e. control interlocks
- Management should ensure that drivers carry out these checks.

11.7.5 TRANSPORTATION OF PERSONNEL AND MATERIALS BY VEHICLES

- All drivers shall hold a valid driving License for the class of vehicle to be driven and be registered as an authorized BHEL driver with the Administration Department.
 - Securing of the load shall be by established and approved methods, i.e. chains with patented tightening equipment for steel/heavy loads. Sharp corners on loads shall be avoided when employing ropes for securing.
 - All overhangs shall be made clearly visible and restricted to acceptable limits
 - Load shall be checked before moving off and after traveling a suitable distance.
 - On no account is construction site to be blocked by parked vehicles Drivers of vehicles shall only stop or park in the areas designate by the stringing foreman.
 - Warning signs shall be displayed during transportation of material.
- All vehicles used by BHEL shall be in worthy condition and in conformance to the Land Transport requirement.

11.7.6 MAINTENANCE

All Vehicles used for transportation of man and material shall undergo scheduled inspections on frequent intervals to secure safe operation. Such inspections shall be conducted in particular for steering, brakes, lights, horn, doors etc. Site management shall ensure that work equipment is maintained in an efficient, working order and in good repair. Inspections and services carried out at regular intervals of time and or mileage. No maintenance shall be carried below HT/LT power lines.

11.8 EMERGENCY PREPAREDNESS AND RESPONSE

- Emergency preparedness and response capability of site shall be developed as per Emergency Preparedness and Response plan issued by Regional HQ
- Availability of adequate number of first aiders and fire warden shall be ensured with BHEL and its subcontractors
- All the subcontractor's supervisory personnel and sufficient number of workers shall be trained for fire protection systems. Enough number of such trained personnel must be available during the tenure of contract. Subcontractor should nominate his supervisor to coordinate and implement the safety measures.
- Assembly point shall be earmarked and access to the same from different location shall be shown
- Fire exit shall be identified and pathway shall be clear for emergency escape.



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- Appropriate type and number of fire extinguisher shall be deployed as per Fire extinguisher deployment plan and validity shall be ensured periodically through inspection
- Adequate number of first aid boxes shall be strategically placed at different work places to cater emergency need. Holder of the first aid box shall be identified on the box itself who will have the responsibility to maintain the same.
- First aid center shall be developed at site with trained medical personnel and ambulance
- Emergency contact numbers (format given in EPRP) of the site shall be displayed at prominent locations.
- Tie up with fire brigade shall be done in case customer is not having fire station.
- Tie up with hospital shall be done in case customer is not having hospital.
- Disaster Management group shall be formed at site
- Mock drill shall be arranged at regular intervals. Monthly report of the above to be given to BHEL safety Officer as per prescribed BHEL formats
- Mock drill shall be conducted on different emergencies periodically to find out gaps in emergency preparedness and taking necessary corrective action

12.0 HSE INSPECTION

Inspection on HSE for different activities being carried out at site shall be done to ensure compliance to HSEMS requirements. The subcontractor shall maintain and ensure necessary safety measures as required for inspection and tests HV test, Pneumatic test, Hydraulic test, Spring test, Bend test etc as applicable, to enable inspection agency for performing Inspection. If any test equipment is found not complying with proper safety requirements then the Inspection Agency may withhold inspection, till such time the desired safety requirements are met.

12.1 DAILY HSE CHECKS

Both the Site Supervisors and safety officer of Subcontractor are to conduct daily site Safety inspection around work activities and premises to ensure that work methods and the sites are maintained to an acceptable standard. The following are to form the common subjects of a daily safety inspection:

- Personal Safety wears & gear compliance.
- Complying with site safety rules and permit-to-work (PTW).
- Positions and postures of workers.
- Use of tools and equipment etc. by the workers.

The inspection should be carried out just when work starts in beginning of the day, during peak activities period of the day and just before the day's work ends.

12.2 INSPECTION OF PPE

- PPEs shall be inspected by HSE officer at random once in a week as per format no. HSEP:13-F06 for its compliance to standard and compliance to use and any adverse observation shall be recorded in the PPE register.
- The applicable PPEs for carrying out particular activities are listed below.

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12.3 INSPECTION OF T&Ps

- A master list of T&Ps shall be maintained by each subcontractor.
- All T&Ps being used at site shall be inspected by HSE officer once in a month as per format no. HSEP:13-F07 for its healthiness and maintenance.
- The T&Ps which require third party inspection shall be checked for its validity during inspection. The third party test certificate should be accompanied with a copy of the concerned competent person's valid qualification record.
- The validity of T&P shall be monitored as per "Status of T&Ps" format no. HSEP:13-F08

12.4 INSPECTION OF CRANES AND WINCHES

- Cranes and winches shall be inspected by the operator through a daily checklist for its safe condition (as provided by the equipment manufacturer) before first use of the day.
- Cranes and Winches shall be inspected by HSE officer once in a month as per format no. HSEP:13-F09 for healthiness, maintenance and validity of third party inspection.
- The date of third party inspection and next due date shall be painted on cranes and winches.
- The operators/drivers shall be authorized by sub-contractor based on their competency and experience and shall carry the I-card.
- The operator should be above 18 years of age and should be in possession of driving license of HMV man & goods), vision test certificate and should have minimum qualification so that he can read the instructions and check list.

12.5 INSPECTION ON HEIGHT WORKING

- Inspection on height working shall be conducted daily by supervisors before start of work to ensure safe working condition including provision of
 - Fall arrestor
 - Lifelines
 - Safety nets
 - Fencing and barricading
 - Warning signage
 - Covering of opening
 - Proper scaffolding with access and egress.
 - Illumination
- Inspection on height working shall be conducted once in a week by HSE officer as per format no. HSEP:14-F10.
- Medical fitness of height worker shall be ensured.
- Height working shall not be allowed during adverse weather.

12.6 INSPECTION ON WELDING AND GAS CUTTING OPERATION

- Supervisor shall ensure that no flammable items are available in near vicinity during welding and gas cutting activity.
- Gas cylinders shall be kept upright.
- Use of Flash back arrestor shall be ensured at both ends.



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- Inspection during welding and gas cutting operations shall be carried out by HSE officer once a month as per format no. HSEP:14-F11.
- Use of fire blanket to be ensured to avoid falling of splatters during welding or gas cutting operation at height.
- Availability of fire extinguisher at vicinity shall be ensured.

12.7 INSPECTION ON ELECTRICAL INSTALLATION / APPLIANCES

- Ensure proper earthing in electrical installation
- Use ELCB at electrical booth
- Electrical installation shall be properly covered at top where required
- Use appropriate PPEs while working
- Use portable electrical light < 24 V in confined space and potentially wet area.
- Monthly inspection shall be carried out as per format no. HSEP:14-F12.

12.8 INSPECTION OF ELEVATOR

- Elevators shall be inspected by concerned supervisors once in a week as per format no. HSEP:14-F13.
- All elevators shall be inspected by competent person and validity shall be ensured.
- The date of third party inspection and next due date shall be painted on elevator.

13.0 HSE PERFORMANCE

HSE performance of the subcontractor shall be monitored as per the following parameters:

Sl. No.	Parameters of measurement
1	Timely deployment of qualified safety officer and cumulative number of days in a month the required no. of qualified safety officer is available
2	Shortfall in number of meetings in the month conducted or attended by the safety officer
3	Level of compliance wrt decisions taken in previous meetings/audit/inspection/as reported.
4	Delay in submission of monthly report on safety in the prescribed format
5	Delay in reporting any incident including near-miss to BHEL /Customer/statutory authority(if required)
6	Degree of PPE non-compliance
7	Non- conducting of health check-up as per BOCW equirements
8	Non availability of proper first-aid facility , ambulance, adequate labour welfare initiatives
9	Non conductance of induction training and tool box meeting
10	Total number of instances in the month, House keeping NOT attended inspite of instructions by BHEL i.e. removal/disposal of surplus earth/ debris/scrap/unused/surplus cable drums/other electrical items/surplus steel items/packing material

- Suitable HSE reward system shall be developed at site level to promote HSE compliance amongst workmen.
- To decide HSE reward performance towards HSE shall be evaluated for workmen and it shall be awarded regularly in public gathering.
- If safety record of the subcontractor in execution of the awarded job is to the satisfaction of safety department of BHEL, issue of an appropriate certificate to recognize the safety performance of the subcontractor may be considered by BHEL after completion of the job.

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14.0 HSE PENALTIES

- As per contractual provision HSE penalties shall be imposed on subcontractors for non- compliance on HSE requirement as per format no. HSEP:14-F14. The list in the format is only indicative. For any other violation, not listed in the format, the minimum penalty amount is to be decided as per BOCW act.
- If principal customer/statutory and regulatory bodies impose some penalty on HSE due to the non-compliance of the subcontractor the same shall be passed on to them.
- The penalty amount shall be recovered by Site Finance department from subcontractors from the RA/Final bill.

15.0 OTHER REQUIREMENTS

- In case of any delay in completion of a job due to mishaps attributable to lapses by the subcontractor, BHEL shall have the right to recover cost of such delay from the payments due to the subcontractor, after notifying the subcontractor suitably.
- If the subcontractor fails to improve the standards of safety in its operation to the satisfaction of BHEL after being given reasonable opportunity to do so and/or if the subcontractor fails to take appropriate safety precautions or to provide necessary safety devices and equipment or to carry out instruction regarding safety issued by BHEL, BHEL shall have the right to take corrective steps at the risk and cost of the subcontractor after giving a notice of not less than 7 days indicating the steps that would be taken by BHEL.
- If the subcontractor succeeds in carrying out its job in time without any fatal or disabling injury incident and without any damage to property BHEL may, at its sole discretion, favorably consider to reward the subcontractor suitably for the performance.
- In case of any damage to property due to lapses by the subcontractor, BHEL shall have the right to recover the cost of such damages from the subcontractor after holding an appropriate enquiry.
- The subcontractor shall take all measures at the sites of the work to protect all persons from incidents and shall be bound to bear the expenses of defense of every suit, action or other proceeding of law that may be brought by any persons for injury sustained or death owing to neglect of the above precautions and to pay any such persons such compensation or which may with the consent of the subcontractor be paid to compromise any claim by any such person, should such claim proceeding be filed against BHEL, the subcontractor hereby agrees to indemnify BHEL against the same.
- The subcontractor shall not employ men below the age of 18 years and women on the work of painting with products containing lead in any form. Wherever men above the age of 18 are employed on the work of lead painting, overalls shall be supplied by the subcontractor to the workmen and adequate facilities shall be provided to enable the working painters to wash during the cessation of work.
- The subcontractor shall notify BHEL of his intention to bring to site any equipment or material which may create hazard.
- BHEL shall have the right to prescribe the conditions under which such equipment or materials may be handled and the subcontractor shall adhere to such instructions.



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- BHEL may prohibit the use of any construction machinery, which according to the organization is unsafe. No claim for compensation due to such prohibition will be entertained by BHEL.

16. NON COMPLIANCE

NONCONFORMITY OF SAFETY RULES AND SAFETY APPLIANCES WILL BE VIEWED SERIOUSLY AND BHEL HAS RIGHT TO IMPOSE FINES ON THE SUBCONTRACTOR AS UNDER FOR EVERY INSTANCE OF VIOLATION NOTICED:

SN	Violation of Safety Norms	Fine (in Rs)
01	Not Wearing Safety Helmet	200/- *
02.	Not wearing Safety Belt or not anchoring life line	500/-*
03	Not wearing safety shoe	200/-*
04	Not keeping gas cylinders vertically	200/-
05	Not using flash back arrestors	100/-
06	Not wearing gloves	50/- *
07.	Grinding Without Goggles	50/- *
08.	Not using 24 V Supply For Internal Work	500/-
09.	Electrical Plugs Not used for hand Machine	100/-
10.	Not Sliding properly	200/-
11.	Using Damaged Sling	200/-
12.	Lifting Cylinders Without Cage	500/-
13.	Not Using Proper Welding Cable With Lot of Joints And Not Insulated Property.	200/-
14.	Not Removing Small Scrap From Platforms	500/-
15.	Gas Cutting Without Taking Proper Precaution or Not Using Sheet Below Gas Cutting	500/-
16.	Not Maintaining Electric Winches Which are Operated Dangerously	500/-
17.	Improper Earthing Of Electrical T&P	500/-
18	No or improper barricading	500/-
19.	Activity carried out without Safety work permit (Height work, Lifting activity, Hot work-each person/case)	1000/-
20.	Incident Resulting in Partial Loss in Earning Capacity	25,000/- per victim
21.	Fatal Incident Resulting in total loss in Earning Capacity	1,00,000/- per victim for first instance #

- Legend:-

*: per head. For repeated violation by the same person, the penalty would be double of the previous penalty. Date of "Repeated violation" will be counted from subsequent days.

#: or as deducted by customer, whichever is higher. For repeated fatal incident in the same Unit incremental penalty to be imposed. The subcontractor will pay 2 times the penalty compared to previously paid in case there are repeated cases of fatal incidents under the same subcontractor for the same package in the same unit.

Any other non-conformity noticed not listed above will also be fined as deemed fit by BHEL. The decision of BHEL engineer is final on the above. The amount will be deducted from running bills of the subcontractor. The amount collected above will be utilized for giving award to the employees who could avoid incident by following safety rules. Also the amount will be spent for purchasing the safety appliances and supporting the safety activity at site.



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17.0 HSE AUDIT/INSPECTION

- Regular HSE Audit/inspection shall be carried out by Subcontractor as per Site HSE audit calendar.
- HSE checklist(**Annexure 02**) shall be used for carrying out audit/inspection and report shall be submitted to BHEL sitemanagement
- All non-conformities and observations on HSE identified during internal or external HSE audit shall be disposed off by site in a time bound manner and reported back the implementation status
- Corrective action and Preventive action on HSE issues raised by certification body issued by Regional HQs shall be implemented by site and reported to Site management.

18.0 MONTHLY HSE REVIEW MEETING

- Site shall hold HSE review meeting every month to discuss and resolve HSE issues of site and improve HSE performance. It will also discuss the incidents occurred since previous meeting, its root cause and Corrective action and Preventive action. The agenda is given below:
 - Implementation of earlier MOM
 - HSE performance
 - HSE inspection
 - HSE audit and CAPA
 - HSE training
 - Health check-up camp
 - HSE planning for the erection and commissioning and installation activities in the coming month
 - HSE reward and promotional activities
- The meeting shall be chaired by Construction Manager, convened by HSE coordinator and attended by all HOS, Site Incharge of Subcontractors and HSE officer of Subcontractors.
- MOM on the discussion will be circulated to the concerned for implementation.

19.0 FORMATS USED (Details available in Annexure-04)

SL. No.	Format Name	Format No.	Rev No.
01	Inspection of First Aid Box	HSEP:13-F01	00
02	Health Check Up	HSEP:13-F02	00
03	HSE Induction Training	HSEP:13-F03	00
04	Tool Box Talk	HSEP:13-F04	00
05	Monthly Site HSE Report	HSEP:13-F05	00
06	Inspection of PPE	HSEP:13-F06	00



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POWER SECTOR

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08	Status of T&Ps	HSEP:13-F08	00
09	Inspection of Cranes and Winches	HSEP:13-F09	00
10	Inspection on Height Working	HSEP:13-F10	00
11	Inspection on Welding & Gas Cutting	HSEP:13-F11	00
12	Inspection on Electrical Installation	HSEP:13-F12	00
13	Inspection on Elevator	HSEP:13-F13	00
14	HSE Penalty	HSEP:13-F14	00
15	Accident /incident / property damage /fire incident report	HSEP:13-F15	00

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20.0 ANNEXURES

ANNEXURE 01

As per Contract Labour (Regulation & Abolition Act), Central Rules, 1971,

- (1) The first-aid box shall be distinctively marked with a Red Cross on a white background and shall contain the following items, namely:

(a) For establishments in which the number of contract labour employed does not exceed fifty, each first aid box shall contain the following equipment:

(i)	6 small sterilized dressings
(ii)	3 medium size sterilized dressings
(iii)	3 large size sterilized dressings
(iv)	6 pieces of sterilized eye pads in separate sealed packets.
(v)	6 roller bandages 10 cm wide.
(vi)	6 roller bandages 5 cm wide.
(vii)	One tourniquet
(viii)	A supply of suitable splints
(ix)	Three packets of safety pins.
(x)	Kidney tray.
(xi)	3 large sterilized burn dressings.
(xii)	1 (30ml) bottle containing a two percent alcoholic solution of iodine
(xiii)	1 (30 ml) bottle containing Sal volatile having the dose and mode of administration indicated on the label
(xiv)	1 snake bite lancet
(xv)	1 (30gms) bottle of potassium permanganate crystals.
(xvi)	1 pair scissors
(xvii)	1 copy of the First-Aid leaflet issued by the Director General, Factory Advice Service and Labour Institutes, Government of India.
(xviii)	A bottle containing 100 tablets (each of 5 grains) of aspirin
(xix)	Ointment for burns
(xx)	A bottle of suitable surgical anti-septic solution

(b) For establishment in which the number of contract labour exceeds fifty each first-aid box shall contain the following equipment:

(i)	12 small sterilized dressings
(ii)	6 medium size sterilized dressings
(iii)	6 large size sterilized dressings.
(iv)	6 large size sterilized burn dressings
(v)	6 (15 grams) packets sterilized cotton wool
(vi)	12 pieces of sterilized eye pads in separate sealed packets.



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(vii)	12 roller bandages 10 cm wide.
(viii)	12 roller bandages 5 cm wide.
(ix)	One tourniquet.
(x)	A supply of suitable splints.
(xi)	Three packets of safety pins.
(xii)	Kidney tray.
(xiii)	Sufficient number of eye washes bottles filled with distilled water or suitable liquid clearly indicated by a distinctive sign which shall be visible at all times.
(xiv)	4 per cent Xylocaine eye drops, and boric acid eye drops and soda by carbonate eye drops.
(xv)	1 (60ml) bottle containing a two percent alcoholic solution of iodine
(xvi)	One (two hundred ml) bottle of mercurochrome (2 per cent) solution in water.
(xvii)	1 (120ml) bottle containing Sal volatile having the dose and mode of administration indicated on the label.
(xviii)	1 roll of adhesive plaster (6 cmX1 meter)
(xix)	2 rolls of adhesive plaster (2 cmX1 meter)
(xx)	A snake bite lancet.
(xxi)	1 (30 grams) bottle of potassium permanganate crystals.
(xxii)	1 pair scissors
(xxiii)	1 copy of the First-Aid leaflet issued by the Director-General, Factory Advice service and labour Institutes, Government of India.
(xxiv)	a bottle containing 100 tablets (each of 5 grains) of aspirin
(xxv)	Ointment for burns
(xxvi)	A bottle of a suitable surgical anti septic solution.

(2) Adequate arrangement shall be made for immediate recoupment of the equipment when necessary.



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ANNEXURE 02

HSE AUDIT/INSPECTION CHECKLIST CUM COMPLIANCE REPORT

PROJECT: _____

SUBCONTRACTOR: _____

DATE : _____

OWNER : _____

INSPECTION BY: _____

Note : write 'NA' wherever the items is not applicable

Item	Y e s	N o	Remarks	Action
HOUSEKEEPING				
Waste containers provided and used				
Passageways and walkways clear				
General neatness of working area				
Other				
PERSONNEL PROTECTIVE EQUIPMENTS				
Goggles; shields				
Face protection				
Hearing protection				
Respiratory masks etc.				
Safety belts				
Other				
EXCAVATIONS / OPENINGS				
Openings properly covered or barricaded				
Excavations shored				
Excavations barricaded				
Overnight lighting provided				
Other				
WELDING, CUTTING				
Gas cylinders chained upright				
Cable and hoses not obstructing				
Fire extinguisher (s) accessible				
Others				
SCAFFOLDING				
Fully decked platforms				
Guard and intermediate rails in place				
Toe boards in place				
Adequate shoring				
Adequate access				
Others				
LADDER				
Extension side rails 1 m above				
Top of landing				
Properly secured				



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POWER SECTOR

Angle $\pm 70^0$ from horizontal				
Other				
HOISTS, CRANES AND DERRICKS				
Condition of cables and sheaf OK				
Condition of slings, chains, hooks OK				
Inspection & maintenance log maintained				
Outriggers used				
Signals observed and understood				
Qualified operators				
Others				
MACHINERY, TOOLS & EQUIPMENT				
Proper instruction				
Safety devices				
Proper cords				
Inspection and maintenance				
Other				
VEHICLE AND TRAFFIC				
Rules and regulations observed				
Inspection and maintenance				
Licensed drivers				
Other				
TEMPORARY FACILITIES				
Emergency instructions posted				
Fire extinguishers provided				
Fire-aid equipment available				
General neatness				
Others				
FIRE PREVENTION				
Personnel instructed				
Fire extinguishers checked				
No smoking in prohibited areas.				
Hydrants				
Clearance				
Others				
ELECTRICAL				
Proper wiring				
ELCB's provided				
Ground fault circuit interrupters				
Protection against damage				
Prevention of tripping hazards				
Other				
HANDLING & STORAGE OF MATERIALS				
Properly stored or stacked				
Passageways clear				
Other				
FLAMMABLE GASES AND LIQUIDS				
Containers clearly identified				
Proper storage				
Fire extinguisher nearby				



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POWER SECTOR

Other				
WORKING AT HEIGHT				
Safety nets				
Safety belts				
Safety helmets				
Anchoring of safety belt to the life line rope				
ENVIRONMENT				
Lubricant waste/engine oils properly dispose.				
Waste from Canteen, offices, sanitation etc. disposed properly.				
Disposal of surplus earth, stripping materials, expired batteries, oily rags and combustible materials done properly.				
HEALTH CHECKS				
Hygienic conditions at labor camps O.K.				
Availability of first-aid facilities				
Proper sanitation at site, office & labor camps.				
Arrangement of medical facilities.				
Measures for dealing with illness.				
Availability of potable drinking water for workmen & staff.				
Provision of crèches for children.				



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ANNEXURE 03

REFERENCES

- Contract documents
- Relevant legislations
- HSEMSM
- Relevant Indian standards as listed below (illustrative only):

SL NO	CODE NAME	TITLE
(1)	IS : 818-1888 (Reaffirmed 2003)	Code of Practice for safety and health requirements in Electric and Gas Welding and Cutting operations.
(2)	IS: 1179-1967 (Reaffirmed 2003)	Specification for Equipment for Eye & Face protection during welding.
(3)	IS : 1989 (Part 2):1986 (Reaffirmed 1997)	Specification for Leather Safety Boots & Shoes
(4)	IS:2925 – 1984 (Reaffirmed 2010)	Specification for Industrial Safety Helmets
(5)	IS:3521 : 1999 (Reaffirmed 2002)	Industrial Safety Belts & Harnesses-Specification
(6)	IS:3646(Part II) – 1966 (Reaffirmed 2003)	Code of Practice for Interior Illumination
(7)	IS:3696 (Part I) – 1987 (Reaffirmed 2002)	Safety Code for Scaffolds and Ladders
(8)	IS: 3696(Part 2) : 1991 (Reaffirmed 2002)	Scaffolds and Ladders-Code of Safety
(9)	IS:3786 – 1983 (Reaffirmed 2002)	Method for Computation of Frequency and Severity Rates for Industrial Injuries and Classification of Industrial Incidents
(10)	IS:4770 : 1991 (Reaffirmed 2006)	Rubber Gloves – Electricals purposes-Specification
(11)	IS:4912 : 1978 (Reaffirmed 2002)	Safety Requirements for Floor and Wall Openings, Railings and Toe Boards
(12)	IS: 5983 – 1980 (Reaffirmed 2002)	Specification for Eye-Protectors
(13)	IS:6519 – 1971 (Reaffirmed 1997)	Code of Practice for Selection, Care and Repair of Safety Footwear
(14)	IS:9167:1979	Specification for Ear-Protectors
(15)	IS:6994(Part I)-1973 (Re affirmed 1996)	Specification for Industrial Safety Gloves Leather and Cotton Gloves
(16)	IS:8519 – 1977 (Reaffirmed 1983)	Guide for Selection of Industrial Safety Equipment for Body Protection.
(17)	IS 11006 : 2011	Flash Back(Flame Arrestor) Specification



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(18)	IS:8520 – 1977 (Reaffirmed 2002)	Guide for Selection of Industrial Safety Equipment for Eye, Face and Ear Protection.
(19)	IS:9473:2002	Respiratory Protective Devices-Filtering Half Masks to protect against Particles-Specification.
(20)	IS:9944:1992 (Reaffirmed 2003)	Natural and Man-made Fiber Rope Slings-Recommendations on Safe working loads.
(21)	IS:11057 – 1884 (Reaffirmed 2001)	Specification for Industrial Safety Nets
(22)	IS:12254:1993 (Reaffirmed 2002)	Polyvinyl Chloride (PVC) Industrial Boots-Specification
(23)	IS:13367(Part 1):1992 (Reaffirmed 2003)	Safe Use of Cranes-Code of Practice
(24)	IS:14166:1994 (Reaffirmed 2002)	Respiratory Protective Devices-Full Face Masks Specification
(25)	IS:14746 : 1999 (Reaffirmed 2003)	Respiratory Protective Devices-Half Masks and Quarter Masks - Specification
(26)	IS : 15397 :2003 (Reaffirmed 2008)	Portable Extinguisher Mechanical Foam Type(Stored Pressure)-Specification
(27)	IS: 19011:2002	Guidelines for Quality and/or Environmental Management Systems Auditing

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ANNEXURE 04 : SAFETY FORMATS
&
ANNEXURE 05 : WORK PERMIT FORMATS

**POWER SECTOR****INSPECTION OF FIRST AID BOX**

FORMAT NO: HSEP:13-F01

REV NO.: 00

PAGE NO. 01 OF 02

Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection :	

Number of employees on the site:- _____

Sl.No.	Item	No. Available	Remarks
1	No. of small sterilized dressings		
2	No of medium sized sterilized dressings		
3	No of large sized sterilized dressings.		
4	No of large sized sterilized burn dressings		
5	No of (15 grams) packets sterilized cotton wool		
6	No of pieces of sterilized eye pads in separate sealed packets.		
7	No of roller bandages 10 cm wide.		
8	No of roller bandages 5 cm wide.		
9	Whether tourniquet available		
10	Whether supply of suitable splints available.		
11	No of packets of safety pins.		
12	Whether kidney tray available		
13	Whether sufficient number of eye wash bottles, filled with distilled water or suitable liquid, clearly indicated by a distinctive sign which shall be visible at all times, available.		
14	Whether 4%-xylocaine eye drops, and boric acid eye drops and soda by carbonate eye drops available.		
15	Whether (60ml) bottle containing a two percent alcoholic solution of iodine available		
16	Whether (two hundred ml) bottle of mercurochrome (2 per cent) solution in water available.		



POWER SECTOR

INSPECTION OF FIRST AID BOX

FORMAT NO: HSEP:13-F01

REV NO.: 00

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Sl.No.	Item	No. Available	Remarks
17	Whether 120ml bottle containing Sal volatile having the dose and mode of administration indicated on the label, available.		
18	Whether roll of adhesive plaster (6 cmX1 meter) available		
19	No of rolls of adhesive plaster (2 cmX1 meter)		
20	Whether snake bite lancet available.		
21	Whether (30 grams) bottle of potassium permanganate crystals available.		
22	Whether a pair scissors available		
23	Whether copy of the First-Aid leaflet issued by the Director-General, Factory Advice service and labour Institutes, Government of India available.		
24	Whether bottle containing 100 tablets (each of 5 grains) of aspirin available		
25	Whether Ointment for burns available		
26	Whether bottle of a suitable surgical anti septic solution available		

Signature of Subcontractor's Site I/C::

**POWER SECTOR****HEALTH CHECK UP**

FORMAT NO: HSEP:13-F02

REV NO.: 00

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Name of Site :	
Name of Sub-Contractor :	
Name of Employee :	

NAME:

History Of Past Illness	H/O Epilepsy
	H/O Drug Allergy
	H/O Diabetics/ Hypertension
	H/O Unconsciousness

Personal History

EXAMINATION	OBSERVATION
<u>General Physical Examination</u>	
Height	:
Weight	:
BMI	:
Built And nourishment	:
Pallor	:
Temperature	:
Chest Expansion	: Inspiration Expansion
Lymph Node Enlargement	:
<u>Ear, Nose, Throat</u>	:
Ear	:
Nose	:
Throat	:

**POWER SECTOR****HEALTH CHECK UP**

FORMAT NO: HSEP:13-F02

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EXAMINATION	OBSERVATION
<u>Cardiovascular System Examination :</u>	
Inspection :	
Palpation :	Pulse BP
Auscultation (Heart Sounds) :	
<u>Respiratory System :</u>	
Inspection :	Respiratory Rate
Palpation:	
Percussion :	
Auscultation (Breath Sounds) :	
<u>Examination of Abdomen :</u>	
Inspection :	
Palpation :	
Auscultation (Bowel Sounds) :	
Any Other :	
Clinical Impression	

Signature of the examining doctor

**POWER SECTOR****HSE INDUCTION TRAINING**

FORMAT NO: HSEP:13-F03

REV NO.: 00

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Name of Site :	
Name of Sub-Contractor :	
Date :	
Name of Training Co-ordinator	

Sl No.	Name	Designation	Organisation	Signature

Signature of Training co-ordinator :

	POWER SECTOR	FORMAT NO: HSEP:13-F04 REV NO.: 00 PAGE NO. 01 OF 01
	TOOL-BOX TALK	

Name of Site :	
Sub-Contractors Name :	
Date :	

Topic	Name of person delivered Tool Box Talk	No. of Participants attended	Remarks

Signature of Site I/C of Subcontractor :

	POWER SECTOR	FORMAT NO: HSEP:13-F06 REV NO.: 00 PAGE NO. 01 OF 01
	PERSONAL PROTECTIVE EQUIPMENTS	

Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection :	

Item	Issued this Month	Nos. Issued up to the Month	Percentage of usage at site
Safety Helmet			
Safety Shoes			
Full Body Harness			
Fall Arrestor			
Safety Nets			
Other PPEs.			

Signature of Site I/C of Subcontractor :



POWER SECTOR

INSPECTION OF T&Ps

FORMAT NO: HSEP:13-F07

REV NO.: 00

PAGE NO. 01 OF 01

Name of Site :	
Name of Sub-Contractor :	
Date of Inspection :	

Sl.No.	Description	Remarks
1.0	Name of equipment	
2.0	Basic Information of equipment	
2.1	Specification	
2.2	Sr. No. of equipment	
2.3	Make	
2.4	Year of manufacture	
3.0	Major repairs / overhauls(Furnish details of work carried out)	Date(s) of major repair/overhaul
3.1		
3.2		
3.3	Repairs carried out at site	
4.0	Any performance test conducted	Yes/No
5.0	Document Submitted	Yes/No
6.0	Manufacturer's test / guarantee certificate	Available/ Not available
7.0	Performance test	Done/ Not Done
8.0	Acceptance Norms	
9.0	Committee Observations	
10.0	Date of next review (if accepted)	

Signature-Site Safety Officer (BHEL)

Signature-Subcontractor/ Subcontractor's
Safety Officer

	POWER SECTOR	FORMAT NO: HSEP:13-F08 REV NO.: 00 PAGE NO. 01 OF 01
	STATUS OF T&Ps	

Name of Site	
Name of Sub-Contractor	
Date of Inspection	

Item	Nos. Deployed	Identification No.	Nos. Tested by competent person	Validity of Test Certificate
Winches				
Chain Blocks				
Wire Rope Slings				
Man Cages				
D-Shackles				
Air Compressors				
Crawler Cranes				
Mobile Cranes				
Hydra Cranes				
Others				

Signature of Site I/C of subcontractor :

**POWER SECTOR****INSPECTION OF CRANES AND WINCHES**

FORMAT NO: HSEP:13-F09

REV NO.: 00

PAGE NO. 01 OF 03

Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection:	

Crane Reg. No (Make/Model) _____

Name of Driver/Operator _____

Sl.no.	Description	Observation	Measures
1	Valid Driving license		
2	Hook & Hook Latch		
3	Over Hoist limit switch		
4	Boom limit switch		
5	Boom Angle Indicator		
6	Boom limit cutoff switch		
7	Condition of Boom		
8	Condition of ropes		
9	Number of load lines		
10	Size and condition of the slings		
11	Stability of the cranes		
12	Soil Condition		
13	Swing Break And Lock		
14	Proper Break And Lock		
15	Hoist Break And Lock		
16	Boom Break And Lock		
17	Main Clutch		
18	Leakage in Hydraulic Cylinders		
19	Out riggers fully extendable		
20	Tyre pressure		
21	Condition of Battery And Lamps		



POWER SECTOR

INSPECTION OF CRANES AND WINCHES

FORMAT NO: HSEP:13-F09

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Sl.no.	Description	Observation	Measures
22	Guards of moving and rotating parts		
23	Load chart provided		
24	Number and position of pedant ropes		
25	Reverse Horn		
26	Load Test Details		
27	Operator's fitness		
28	Pollution under control certificate		
29	Fire extinguisher of appropriate type.		
30	Training of the operator		

WINCH

Sl. No.	Description	YES	NO	NA	Remarks
1	Has the copy of Third Party Inspection certificate been provided in winch machine shed?				
2	Is winch machine operator experienced enough to operate the winch machine?				
3	Is the winch machine operated by someone other than the winch machine operator?				
4	Is there guard provided in all moving parts like wheel and motor's shaft?				
5	Will it protect against unforeseen operational contingencies?				
6	Are brakes, clutch and locking arrangement working properly?				
7	Has it been ensured that the guard does not constitute a hazard by itself?				
8	Are the cranks and the connecting rods protected by guardrails?				
9	Is there provision for fully covered shed with wooden plank roof?				



POWER SECTOR

INSPECTION OF CRANES AND WINCHES

FORMAT NO: HSEP:13-F09

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PAGE NO. 03 OF 03

Sl. No.	Description	YES	NO	NA	Remarks
10	Is wire rope free from any kind of damage or wear and tear?				
11	Is split pin provided for the protection of clutch and brake locking arrangement?				
12	Is pulley inspected by competent person and certified before use?				
13	Is pulley free from any wear and tear visually?				
14	Is winch rope barricaded with clipsheet for the protection of rope and person?				
15	Is the wire rope lubricated by cardium oil?				
16	Is there any friction in wire rope which may damage the wire rope rather than the rolling parts?				
17	Is there any oil leakage in the hydraulic system of the winch machine?				
18	Has it been ensured that the guard will not cause discomfort or inconvenience to operator?				
	Total Number of NO:				
	Total Number of NA:				
	% Compliance :				

Signature of Site I/C of subcontractor :

	POWER SECTOR	FORMAT NO: HSEP:13-F10 REV NO.: 00 PAGE NO. 01 OF 02
	INSPECTION OF HEIGHT WORKING	

Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection:	

Sl. No.	Descriptions	Observation (Yes/No)	Remarks
1	All the workers have been explained safe work method?		
2	An established communication system has been established and explained to the workers.		
3	Adequate illumination has been ensured.		
4	Work area inspected prior to the start of the work.		
5	Area below the work place barricaded, particularly below hot work.		
6	Workers provided with bags /box to carry bolts, nuts and hand tools		
7	Arrangement for fastening hand tools made.		
8	All work platforms ensured to be of adequate strength and ergonomically suitable.		
9	Fabricated makeshift arrangements are checked for quality and type of material welding, anchoring etc.		
10.	Work at more than one elevation at the same segment is restricted.		
	ACCESS/EGRESS		
1	Walkways provided with handrail, mid-rail and toe guard?		
2	All checkered plates, gratings properly welded/ bolted?		
3	Are ladders inspected and they are in good condition?		
4	Are ladders spliced?		
5	Are ladders properly secured to prevent slipping, sliding or falling?		
6	Do side rails extend 36" above top landing?		
7	Are built up ladders constructed of sound materials?		



POWER SECTOR

INSPECTION OF HEIGHT WORKING

FORMAT NO: HSEP:13-F10

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Sl. No.	Descriptions	Observation (Yes/No)	Remarks
8	Are rugs and cleats not over 12" on center?		
9	Metal ladders not used around electrical hazards.		
10	Proper maintenance and storage.		
11	Ladders placed at right slope.		
12	Ladders / staircases welded/ bolted properly.		
13	Any obstruction in the stairs.		
14	Are landing provided with handrails, knee rails, toe boards etc.?		
15	Whether ramp is provided with proper slope.		
16	Proper hand rails / guards provided in ramps.		
	Housekeeping		
1	Walkways, aisles & all overhead workplaces cleared of loose material.		
2	Flammable materials, if any, are cleared.		
3	All the de shuttering materials are removed after de shuttering is done.		
4	Platforms and walkways free from oil/grease or other slippery material.		
5	Collected scrap are brought down or lowered down and not dropped from height.		
	PPE And Safety Devices		
1	Use of safety helmet, safety belts ensured for all workers		
2	Anchoring points provided at all places of work.		
3	Common lifeline provided wherever linear movement at height is required.		
4	Safety nets are use wherever required.		
5	Proper fall arrest system is deployed at critical workplaces.		
6	Crawler boards/Safety system or works on fragile roof are used.		

Signature of Site I/C of subcontractor :



POWER SECTOR

INSPECTION OF WELDING AND GAS CUTTING

FORMAT NO: HSEP:13-F11

REV NO.: 00

PAGE NO. 01 OF 02

Name of Site	
Name of Sub-Contractor	
Inspected by	
Date of Inspection	

Welding				
Sl.no.	Description	Y e s	N o	Remarks
1	Is electric connection given through 30 mA ELCB/RCCB to welding m/c?			
2	Is electric cable fitted properly in junction box on m/c?			
3	Is electrical cable free from joints?			
4	Are the joints attached firmly & insulated with tape?			
5	Is double earthing given to body of m/c?			
6	Is the physical condition of the m/c good?			
7	Is ON/OFF switch connected to the m/c is working and in good condition?			
8	Are indication lamps on m/c working?			
9	Is the electrode holder in good condition?			
10	Are the cables of the welding m/c lugged & tight properly?			
11	Are return lead connected properly (Rod, Angle, Channels shall not be used)			
	Total No of NO			
	Total No of YES			



POWER SECTOR

INSPECTION OF WELDING AND GAS CUTTING

FORMAT NO: HSEP:13-F11
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Gas Cutting				
Sl. no	Description	Yes	No	Remarks
1	Are Cylinders kept on trolleys?			
2	Physical condition of Gas cylinders Good?			
3	Is there Oil/Grease on valve of the cylinder?			
4	Are pressure regulators in good condition?			
5	Condition of hose pipe OK?			
6	Are hose pipe clamped with hose clip?			
7	Is flash back arrestor & NRV fitted on torch both for O2 and LPG cylinder?			
8	Is nozzle of the torch cleaned?			
	Total Number of NO			
	Total No of YES			
	% Compliance			

Signature of Site I/C of subcontractor :

	POWER SECTOR	FORMAT NO: HSEP:13-F12 REV NO.: 00 PAGE NO. 01 OF 02
	INSPECTION OF ELECTRICAL INSTALLATION	

Name of Site	
Name of Sub-Contractor	
Inspected by	
Date of Inspection:	

Sr. No.	Contents	Yes/No	Remarks
A	Cable		
1.	Whether the condition of cable is checked?		
2.	Are cables received from other sites checked for insulation resistance before putting them into use?		
3.	Are all main cables taken either underground / overhead?		
4.	Are welding cables routed properly above the ground?		
5.	Are welding and electrical cables overlapping?		
6.	Is any improper joining of cables/wires prevailing at site?		
B	DBs/SDBs		
1.	Is earth conductor continued upto DB / SDB?		
2.	Whether DBs and extension boards are protected from rain / water?		
3.	Is there any overloading of DBs / SDBs?		
4.	Are correct / proper fuses & CBs provided at main boards and sub-boards?		
5.	Is energized wiring in junction boxes, CB panels & similar places covered all times?		
C	ELCB		
1.	Whether the connections are routed through ELCB?		
2.	Is ELCB sensitivity maintained at 30 mA?		



POWER SECTOR

INSPECTION OF ELECTRICAL INSTALLATION

FORMAT NO: HSEP:13-F12

REV NO.: 00

PAGE NO. 02 OF 02

Sr. No.	Contents	Yes/No	Remarks
3.	Are the ELCB numbered and tested periodically & test results recorded in a logbook countersigned by a competent person?		
D	Grounding		
1.	Is natural earthing ensured at the source of power (main DB at Generator or Transformer)?		
2.	Whether the continuity and tightness of the earth conductor are checked?		
3.	Mention the gauge of the earth conductor used at the site.		
4.	Mention the value of Earth Resistance.		
E	Electrically operated Machines or Accessories.		
1.	Whether the plug top is provided everywhere.		
2.	Are all metal parts of electrical equipment and light fittings / accessories grounded?		
3.	Is there any shed or cover for welding machines?		
4.	Are halogen lamps fixed at proper places?		
5.	Are portable power tools maintained as per norms?		
6.	Any other information:		

Signature of Site I/C of subcontractor :

**POWER SECTOR****INSPECTION OF ELEVATOR**

FORMAT NO: HSEP:13-F13

REV NO.: 00

PAGE NO. 01 OF 01

Name of Site	
Name of Sub-Contractor	
Inspected by	
Date of Inspection	

Sr. No.	Description	Remarks
1.0	Name of equipment	
2.0	Basic Information of equipment	
2.1	Specification	
2.2	Sr. No. of equipment	
2.3	Make	
2.4	Year of manufacture	
3.0	Major repairs/overhauls(Furnish details of work carried out)	Date(s) of major repair/overhaul
3.1		
3.2		
3.3	Repairs carried out at site	
4.0	Any performance test conducted	Yes/No
5.0	Document Submitted	Yes/No
6.0	Manufacturer's test / guarantee certificate	Available/ Not available
7.0	Performance test	Done/ Not Done
8.0	Acceptance Norms	
9.0	Committee Observations	
10.0	Date of next review (if accepted)	

Signature-Subcontractor/ Subcontractor's
Safety Officer

Signature-Site Safety Officer (BHEL)

**POWER SECTOR****HSE PENALTY**

FORMAT NO: HSEP:13-F14

REV NO.: 00

PAGE NO. 01 OF 02

Sub: MEMO for Penalty for non compliances in Safety

Following lapse (tick marked) was observed and penalty is imposed as stated at the bottom of this memo. It is requested that such occurrences be please avoided in future.

Safety Area

SN	Violation of Safety Norms	Fine (in Rs)
01	Not Wearing Safety Helmet	200/- *
02.	Not wearing Safety Belt or not anchoring life line	500/-*
03	Not wearing safety shoe	200/-*
04	Not keeping gas cylinders vertically	200/-
05	Not using flash back arrestors	100/-
06	Not wearing gloves	50/- *
07.	Grinding Without Goggles	50/- *
08.	Not using 24 V Supply For Internal Work	500/-
09.	Electrical Plugs Not used for hand Machine	100/-
10.	Not Slings properly	200/-
11.	Using Damaged Sling	200/-
12.	Lifting Cylinders Without Cage	500/-
13.	Not Using Proper Welding Cable With Lot of Joints And Not Insulated Property.	200/-
14.	Not Removing Small Scrap From Platforms	500/-
15.	Gas Cutting Without Taking Proper Precaution or Not Using Sheet Below Gas Cutting	500/-
16.	Not Maintaining Electric Winches Which are Operated Dangerously	500/-
17.	Improper Earthing Of Electrical T&P	500/-
18.	No or improper barricading	500/-
19.	Activity carried out without Safety work permit (Height work, Lifting activity, Hot work-each person/case)	1000/-
20.	Incident Resulting in Partial Loss in Earning Capacity	25,000/- per victim
21.	Fatal Incident Resulting in total loss in Earning Capacity	1,00,000/- per victim for first instance #

Legend:-

*: per head. For repeated violation by the same person, the penalty would be double of the previous penalty. Date of "Repeated violation" will be counted from subsequent days.

#: or as deducted by customer, whichever is higher. For repeated fatal incident in the same Unit incremental penalty to be imposed. The subcontractor will pay 2 times the penalty compared to previously paid in case there are repeated cases of fatal incidents under the same subcontractor for the same package in the same unit.

	POWER SECTOR- HQ	FORMAT NO: HSEP:13-F15 REV NO.: 00 PAGE NO. 01 OF 01
	Incident Report (To be submitted within 24 hours of time of incident)	

Type of incident: Fatal/Major/ Minor/Fire/Property Damage/Near-miss

1	NAME OF SITE		3	ACTIVITY AREA	
2	SCOPE OF WORK		4	NAME OF CONTRACTOR	
			5	NAME & DESIGNATION OF BHEL ACTIVITY I/C	
6	DATE & TIME OF ACCIDENT		7	DATE RESUMED	
8	NO. OF WORK-DAYS LOST BY VICTIM (If duty not resumed, give estimated figure)				
9	NO. OF MANHOURS LOST BY OTHERS				
10	PERSONAL DETAILS OF INJURED AND / OR DETAILS OF MATERIALS / EQUIPMENT / PROPERTY DAMAGED				
NAME			NAME OF MATERIAL / EQUIPMENT / PROPERTY		
PERIOD OF EMPLOYMENT					
AGE	YRS	SEX	MALE/ FEMALE	ESTIMATED COST	ACTUAL COST
MARITAL STATUS		SINGLE / MARRIED			
OCCUPATION		NATURE OF DAMAGE			
PART OF BODY INJURED					
NATURE OF INJURY					
AGENCY (OBJECT / EQUIPMENT / SUBSTANCE) MOST RESPONSIBLE FOR CAUSING ACCIDENT / INJURY / DAMAGE					
12	PERSON (NAME & DESIGNATION) WITH MOST CONTROL OVER AGENCY (OBJECT / EQUIPMENT / SUBSTANCE) CAUSING ACCIDENT INJURY / DAMAGE				
13	DESCRIBE CLEARLY HOW THE ACCIDENT OCCURRED (USE ADDITIONAL SHEET, IF REQUIRED)				
ANALYSIS					
14	WHAT ACTS AND / OR CONDITIONS CONTRIBUTED MOST DIRECTLY TO THIS ACCIDENT				
15	WHAT ARE THE BASIC REASON FOR THE EXISTENCE OF THESE ACTS AND / OR CONDITION ?				
16	WHAT CORRECTIVE ACTIONS HAVE BEEN TAKEN TO PREVENT ACCIDENT RECURRENCE ?				
	DATE :		SIGNATURE OF SITE HSE COORDINATOR		
17	COMMENTS OF HEAD / SOX				
	DATE:		SIGNATURE OF HEAD/SOX		



SAFETY WORK CLEARANCE

Permit no. _____

Project: _____

Emergency Contact Nos: _____

Subcontractor: _____

BURNING/WELDING /HOT WORK PERMIT

Area : _____ Date: _____ Time: _____

Name of Site Engineer (Permit Requesting Authority): _____ Sign: _____

Name of Work Performing Contractor: _____

Name of Package In charge: _____ Sign: _____ Date: _____

Description of Work: _____

Work Execution Date: _____ Time Valid from: _____ to _____

The above signing person(s) will be responsible to ensure that the above described work will be done under all the safety precautions mentioned on the permit to work.

The following precautions are to be taken:

No.	Item	Yes	Not required
1.	Proper Access/Exit available		
2.	Proper ventilation and /or lighting provided.		
3.	Proper and safe scaffolding, platform, ladder provided.		
4.	Welding machine located in a clean and dry area.		
5.	Welding machine grounded at the equipment and proper leakage current protection device (ELCB) provided for welding machine.		
6.	Emergency STOP buttons are in working condition. Welder /Helper knows how to operate it.		
7.	Welding machine input/output cables, welding holder and weld return clamp (Holder) are insulated and in good condition.		
8.	Welder & Fitter trained to connect ground/work return clamps (Holder) to work place prior to energization of welding machine.		
9.	Gas cylinders are stacked vertically and not below the welding / cutting area. Regulator key is available with cylinder.		
10.	Pressure gauges/Flash back arrestor provided and in working condition.		
11.	Personal Protective equipment Minimum applicable: safety helmet, safety goggles, welding helmet, safety shoes, leather gloves, long sleeve and nose mask -provided		
12.	In case of pits, water removed from the pit and wood/rubber insulation provided.		
13.	Safety signboards are in place.		
14.	Adequate and Suitable nos. of fire fighting extinguisher provided.		
15.	Nearby combustible material removed. Housekeeping done.		
16.	Other		

Name of Contractor Safety Officer: _____ Sign: _____ Date: _____ Time: _____

Reviewed and approved by BHEL Site Engineer (Permit Issuing Authority):

Name: _____ Sign: _____ Date: _____ Time: _____

Name of BHEL Safety Representative: _____ Sign: _____

I understand the precaution to be taken as described above and as per project requirement and hereby confirm that work will be executed under my supervision by following all precaution and Safety Rules.

Name of Work Performing Authority: _____ **Sign:** _____ **Date:** _____ **Time:** _____**Permit Cancellation:**

I hereby declare that the work is complete, all workers under my control have been withdrawn and the site restored to safe tidy condition.

Name of Work performing Authority: _____ Sign: _____ Date: _____ Time: _____

Name of Site Engr. (Permit Requesting Authority): _____ Sign: _____ Date: _____ Time: _____

Name of BHEL Site Engr. (Permit Issuing Authority): _____ Sign: _____ Date: _____ Time: _____

(This permit is valid only for the date it is issued)

Original at BHEL site

Second Copy – BHEL SAFETY

Third Copy : Contractor



SAFETY WORK CLEARANCE

Permit no. _____

Project: _____

Emergency Contact Nos: _____

Subcontractor: _____

LIFTING ACTIVITY PERMIT

Area : _____ Date: _____ Time: _____

Name of Site Engineer (Permit Requesting Authority): _____ Sign: _____

Name of Work Performing Contractor: _____

Name of Package In charge: _____ Sign: _____ Date: _____

Description of Work: _____

Work Execution Date: _____ Time Valid from: _____ to _____

The above signing person(s) will be responsible to ensure that the above described work will be done under all the safety precautions mentioned on the permit to work.

The following precautions are to be taken:

No.	Item	Yes	Not required
1.	Crane used for lifting activity tested, certified and approved for rated lifting		
2.	All lifting tackles, gears/appliances are tested and certified for lifting works.		
3.	Crane operator is trained and competent for lifting operation.		
4.	Lifting sling/ belt is protected against sharp edge of the jobs to be lifted.		
5.	Access and exit marked and without obstruction.		
6.	Lifting arrangement adequate.		
7.	Unwanted rubbish material removed from work platform.		
8.	Minimum 2 guidelines have been provided for balancing and guiding jobs to be lifted.		
9.	Periphery area of crane booms as well as lifting job is barricaded and unauthorised/no-entry sign board posted.		
10.	Rigger and signal man is trained and competent for lifting work.		
11.	No lifting activity to be carried out during lightening, heavy wind/rain.		
12.	If scaffolding to be used during lift, scaffolding with valid tag available for use.		
13.	Double lanyards safety harness/belt checked and in working condition.		
14.	Safety shoes (non-slip), helmet with chin strap available with employees.		
15.	Others.		

Name of Contractor Safety Officer: _____ Sign: _____ Date: _____ Time: _____

Reviewed and approved by BHEL Site Engineer (Permit Issuing Authority):

Name: _____ Sign: _____ Date: _____ Time: _____

Name of BHEL Safety Representative: _____ Sign: _____

I understand the precaution to be taken as described above and as per project requirement and hereby confirm that work will be executed under my supervision by following all precaution and Safety Rules.

Name of Work Performing Authority: _____ **Sign:** _____ **Date:** _____ **Time:** _____**Permit Cancellation:**

I hereby declare that the work is complete, all workers under my control have been withdrawn and the site restored to safe tidy condition.

Name of Work performing Authority: _____ Sign: _____ Date: _____ Time: _____

Name of Site Engr. (Permit Requesting Authority): _____ Sign: _____ Date: _____ Time: _____

Name of BHEL Site Engr. (Permit Issuing Authority): _____ Sign: _____ Date: _____ Time: _____

(This permit is valid only for the date it is issued)

Original at BHEL site**Second Copy – BHEL SAFETY****Third Copy : Contractor**



SAFETY WORK CLEARANCE

Permit no. _____

Project: _____

Emergency Contact Nos: _____

Subcontractor: _____

WORKING AT HEIGHT PERMIT

Area : _____ Date: _____ Time: _____

Name of Site Engineer (Permit Requesting Authority): _____ Sign: _____

Name of Work Performing Contractor: _____

Name of Package In charge: _____ Sign: _____ Date: _____

Description of Work: _____

Work Execution Date: _____ Time Valid from: _____ to _____

The above signing person(s) will be responsible to ensure that the above described work will be done under all the safety precautions mentioned on the permit to work.

The following precautions are to be taken:

No.	Item	Yes	Not required
1.	All workers on job are medically fit for working at height (Person should not have vertigo)		
2.	Scaffolding with valid tag available for use		
3.	Safety harness with life line support/ fall arrester are checked and in working condition		
4.	Safety shoes (non-slip), Helmet with chin strip available with employees		
5.	Safety nets are provided as per design and provided 25 ft. below working area & extending 8 ft beyond.		
6.	Horizontal life lines are provided to cater to design specification of 2300kg per person.		
7.	Ladders have been inspected and provided as per BHEL standard/contract.		
8.	All lifting / tightening tools, hand tools/equipment checked and in good condition		
9.	Access and exit marked and without obstruction.		
10.	Lighting arrangement adequate.		
11.	Unwanted and rubbish material removed from working platform.		
12.	Electrical cable, welding Hose/Compressed air hose properly secured and lay down without obstruction.		
13.	Signboards provided on working platforms		
14.	Hazards in the vicinity are identified and communicated to the worker.		
15.	Other		

Name of Contractor Safety Officer: _____ Sign: _____ Date: _____ Time: _____

Reviewed and approved by BHEL Site Engineer (Permit Issuing Authority):

Name: _____ Sign: _____ Date: _____ Time: _____

Name of BHEL Safety Representative: _____ Sign: _____

I understand the precaution to be taken as described above and as per project requirement and hereby confirm that work will be executed under my supervision by following all precaution and Safety Rules.

Name of Work Performing Authority: _____ **Sign:** _____ **Date:** _____ **Time:** _____**Permit Cancellation:**

I hereby declare that the work is complete, all workers under my control have been withdrawn and the site restored to safe tidy condition.

Name of Work performing Authority: _____ Sign: _____ Date: _____ Time: _____

Name of Site Engr. (Permit Requesting Authority): _____ Sign: _____ Date: _____ Time: _____

Name of BHEL Site Engr. (Permit Issuing Authority): _____ Sign: _____ Date: _____ Time: _____

(This permit is valid only for the date it is issued)

Original at BHEL site**Second Copy – BHEL SAFETY****Third Copy : Contractor**



WBPDCL

**EPC Bid Document
Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase - III**

Annexure - 10

GENERAL TECHNICAL REQUIREMENTS



Development Consultants Pvt. Ltd.

**Volume : II-A
Section : V
General Technical Requirements**



WBPDCL

**EPC Bid Document
Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase - III**

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4.00.00	SAFETY AND SECURITY
5.00.00	GUARDS
6.00.00	LOCATION AND LAYOUT REQUIREMENTS
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ATTACHMENTS

ANNEXURE-I	LIST OF STANDARDS FOR REFERENCE
ANNEXURE-II	CRITERIA FOR LAYOUT



Development Consultants Pvt. Ltd.

**Volume : II-A
Section : V
General Technical Requirements**



GENERAL TECHNICAL REQUIREMENTS

1.00.00 CODES AND STANDARDS

1.01.00 Except where otherwise specified, the Plant shall comply with the appropriate Indian Standard or an agreed internationally accepted Standard Specification as listed in the annexure to this Section and mentioned in detailed specifications, each incorporating the latest revisions at the time of tendering. Where no internationally accepted standard is applicable, the Bidder shall give all particulars and details as necessary; to enable the Owner to identify all of the Plant in the same detail as would be possible had there been a Standard Specification.

1.02.00 Where the Bidder proposes alternative codes or standards he shall include in his tender one copy (in English) of each Standard Specification to which materials offered shall comply. In such case, the adopted alternative standard shall be equivalent or superior to the standards mentioned in the specification.

1.03.00 Wherever specified or required the Plant shall conform to various statutory regulations such as Indian Boiler Regulations, Indian Electricity Rules, Indian Explosives Act, Factories Act etc. Wherever required, approval for the plant supplied under the specification from statutory authorities shall be the responsibility of the Successful Bidder.

1.04.00 In the event of any conflict between the codes and standards referred above, and the requirements of this specification, the requirements, which are more stringent, shall govern.

1.05.00 In case of any change of code, standards and regulations between the date of purchase order and the date the Successful Bidder proceeds with manufacturing the Owner shall have the option to incorporate the changed requirements. It shall be the responsibility of the Successful Bidder to advise Owner of the resulting effect.

2.00.00 RESPONSIBILITY FOR DESIGN

2.01.00 The Bidder shall assume full responsibility for the design of the whole and every portion of the Plant, whether or not the design work was undertaken specifically in relation to the Contract and whether or not the Successful Bidder was directly involved in the design work.

2.02.00 Notwithstanding the Owner's wish to receive the benefits of new, advanced and improved technologies, a prime requirement is that all the systems and components proposed shall have been already adequately developed and shall have demonstrated good reliability under similar, or more arduous conditions elsewhere, at least for continuous 2 years in two different power station.

2.03.00 The Bidder shall carry out optimization studies for selection of pipe size and equipment wherever required. The result of such studies shall be included as part of bid proposal.





The successful Bidder shall have to carry out surge analysis and other transient condition studies as may be necessary and as required by the Owner as per proven engineering practice.

2.04.00 The Bid shall include a detailed discussion on the development status of and the reasons for any changes made in proposed systems or components for the Plant, as compared with similar items previously supplied in other installations cited by the bidder as reference plants.

2.05.00 The Bidder may also make alternate offers, provided such offers are superior in his opinion in which case adequate technical information, operating feedback, etc. are to be enclosed with the offer, to enable the Owner to assess the superiority and reliability of the alternatives offered. In case of each alternative offer, its implications on the performance, guaranteed efficiency, auxiliary power consumptions, etc. shall be clearly brought out to the Owner to make an overall assessment. In any case, the base offer shall necessarily be in line with the specifications i.e. Base offer shall be as per the technical specifications and the same will be considered for techno-commercial evaluation.

3.00.00 **NAME PLATES (RATING PLATES)**

3.01.00 Instruction plates, nameplates or labels shall be permanently attached to each main and auxiliary item of plant in a conspicuous position. These plates shall be engraved with the identifying name, type and manufacturers serial number, together with the loading conditions under which the item of plant has been designed to operate.

3.02.00 Items such as valves, etc. which are subject to hand operation, shall be provided with nameplates so constructed as to remain clearly legible throughout the life of the plant giving due consideration to the difficult climatic conditions to be encountered. Nameplates shall be securely mounted where they will not be obscured in service by insulation, cladding, actuators or other equipment. Direction of flow is also to be engraved.

3.03.00 All trade nameplates and labels shall be in English language. All measurements shall be in M.K.S. Units.

3.04.00 The size and location of nameplates shall be subject to Approval of the Owner/Owner's Engineer.

4.00.00 **SAFETY AND SECURITY**

4.01.00 The design shall incorporate every reasonable precaution and provision for the safety of all personnel and for the safety and security of all persons and property. The design shall comply with all appropriate statutory regulations relating to safety. All structures and equipment shall be designed and constructed to withstand every foreseeable static and dynamic loading condition, including loading under earthquake conditions, with an adequate margin of safety.

4.02.00 Ready and safe access with clear headroom shall be provided to all parts of the plant for operation, inspection, cleaning and maintenance.



4.03.00 Escape routes and clear ways shall be provided to allow speedy evacuation of the plant in the event of fire or explosion, and the plant layout shall allow for ease of access to all parts of the Works by rescue and fire fighting teams. The Plant layout shall be designed to localize and minimise the effects of any fire or explosion. The recommendations of NFPA, OSHA, and TAC etc. as necessary shall be followed in all respects.

4.04.00 The use of corrosive, explosive, toxic or otherwise hazardous materials shall be kept to a minimum during construction and the design of the plant shall minimise the requirement for such materials during operation and maintenance. Where such materials must be used, all necessary precautions shall be taken in the design, manufacture and layout of equipment to minimise the resulting hazard, and all equipment necessary for the protection and first-aid treatment of personnel in the event of accidents shall be provided. Particular attention is drawn to avoid the use of materials containing asbestos in any form.

5.00.00 **GUARDS**

5.01.00 Effective guards and fences must be provided to prevent injury to operators through accident or malpractice.

5.02.00 Mesh guards which allow visual inspection of equipment with the guard in place are generally preferable. The guards shall be constructed of mesh attached to a rigid framework of mild steel rod, tube, or angle and the whole galvanised to prevent loss of strength by rusting or corrosion. The guards shall be designed to facilitate removal and replacement during maintenance.

5.03.00 All drive belts, couplings, gears, sharp metallic edges and chains must be safely guarded. Any lubricating nipple requiring attention during normal running must be positioned where they can be reached without moving the guards.

5.04.00 Guards for couplings and rotating shafts shall be in accordance with BS 5304-1975 or similar approved standard. All rotating shafts and parts of shafts must be covered.

5.05.00 Suitable fencing shall be provided to enclose all openings or doorways used for the hoisting and lowering of machinery etc. This fencing must be securely fixed but quickly detachable when required. A secure handhold must be provided on each side of the opening or doorway.

6.00.00 **LOCATION AND LAYOUT REQUIREMENTS**

The majority of plant and equipment shall all be of indoor installation. A broad list of buildings housing such equipment is given In Vol-II-G2 Section I. Layout shall facilitate access for operation-maintenance and inspection of any one or more equipment/components at a time without disturbing the operation or installation of rest of the plant. Further, Bidder should comply with the criteria given under the various equipment and system specifications as well as those stipulated in Annexure-II attached to this section.

Enclosed General Layout and other tender layout drawings enclosed in Vol-II-L show the location of major installations and auxiliary buildings. The Bidder



shall try to retain these locations as far as practicable. The layout of equipment within the power house as shown in the tender drawings is indicative. The Bidder may, subject to Owner's acceptance alter the same to suit the space requirement of the equipment offered.

While developing the layout of buildings the following criteria shall be given effect:

- a) The minimum width of clear access corridors around equipment shall be 1.2 meters.
- b) Each building shall have an identified vacant space for equipment unloading and maintenance and preferably a separate bay altogether in buildings housing heavy equipment. Provision for handling equipment by monorail hoist and/or overhead crane shall be made as required.
- c) The plinth level with respect to the existing grade level shall be as indicated elsewhere in Vol-II-A Section-V/Annexure-II.
- d) The minimum clear height available between two consecutive floor slabs shall not be less than five (5) meters. A clear head room of 2.2 meters shall be maintained between the floor and any overhead piping/cables or other obstruction. Adequate provision for natural ventilation and illumination shall be made as per good engineering practices.
- e) There shall be at least two (2) nos. main access doors, one on either side of each building, of which one shall be minimum 3 meters wide with rolling shutters for equipment entry. For multistoried buildings, at least two (2) nos. regular staircases diagonally opposite to each other shall be provided connecting all the floors and roof. These minimum requirements shall be augmented as required depending on the floor area, statutory requirements and TAC recommendations.
- f) All buildings shall have provision for toilet and associated effluent discharge system together with facility for drinking water. The criteria for ventilation, fire protection and illumination of building spaces shall be as specified in Vol-II-A Section-V/Annexure-II.
- g) All rail/road crossings for pipe/cable racks shall be constructed with minimum 8 meters headroom from top of rail/road to bottom of rack. Similarly top cover over underground pipes/cables shall be minimum one (1) meter. For other detail refer to Annexure-II of this section.
- h) Cubicle for operating personnel shall be located at safe place near the equipment.
- i) Pipe rack, cable rack and Pipe cum Cable rack shall have hand railings (not less than 1200 mm high) in walkways (min. 800 mm wide) on both sides at appropriate heights.

**7.00.00 OPERATION AND MAINTENANCE CONSIDERATIONS**

7.01.00 Space for ease of operation and maintenance including equipment removal, tube bundle/cartridge/rotor pulling etc. shall be provided. All valves, gates, dampers and other devices shall be located and oriented in such a way that they are accessible from operating floor levels. Where this cannot be adhered to, platforms and walkways with access ladders shall be provided to facilitate operation and maintenance.

7.02.00 Lifting devices i.e. hoists, chain pulleys, jacks, etc. shall be provided for handling of any equipment and/or part having weight in excess of 100 Kg during erection and maintenance activities. Suitable beams, hooks etc. for this purpose shall be provided in the buildings and clear space provided below to a platform or floor which will allow normal risk free transport means to be used.

Lifting tackles, slings, etc. to be connected to hook of the hoist/crane shall also be provided by the Bidder for lifting the various equipments and accessories covered under this specification.

7.03.00 All similar parts of the equipment shall be made to gauge and shall be interchangeable with and shall be made of same material and workmanship as the corresponding parts of the equipment. Where feasible common components shall be employed in different pieces of equipment in order to optimize the spares inventory and utilization.

8.00.00 MATERIALS

8.01.00 In selecting materials of construction of equipment, the Bidder shall pay particular attention to the atmospheric conditions existing at the Site and the nature of material/fluid handled.

All materials shall be new and shall be of the quality most suited to the proposed application.

8.02.00 Materials used for various components shall be those which have already proven operating experience in similar type of applications.

8.03.00 All parts which could deteriorate or corrode under the influence of the atmospheric, meteorological or soil conditions at the Site, or under the influence of the working conditions shall be suitably and effectively protected so that such deterioration or corrosion is a minimum over the life of the plant.

8.04.00 Prohibited Materials

The use of the following materials is prohibited:

- a) High alumina cement in structural elements
- b) Wood wool slabs in permanent framework to concrete
- c) Calcium chloride in mixtures for use in concrete works



- d) Naturally occurring aggregate for use in reinforced concrete that does not comply with the applicable codes and standards.
- e) Cast iron for any oil service
- f) Carcinogenic material and suspected carcinogenic materials by World Health Organization.
- g) Asbestos or any other fibrous form of hydrated magnesium silicate
- h) Any other material generally known to be deleterious if used or incorporated in such project like the facility.

9.00.00 LUBRICATION

- 9.01.00 Provision shall be made for suitable efficient lubrication where necessary to ensure smooth operation free from undue wear.
- 9.02.00 Non ferrous capillary tubing shall be used throughout.
- 9.03.00 Gear boxes and oil baths shall be provided with filling and drain plugs, both of adequate size. An approved means of oil indication including level switches and temperature indication shall be provided.
- 9.04.00 All high speed gears shall be oil bath lubricated. Low speed gears shall be lubricated by means of soft grease. Removable and accessible drip pans shall be provided to collect lubricant, which may drop, from operating parts.
- 9.05.00 All lubrication points shall be conveniently situated for maintenance purposes. It must be possible to carry out lubrication from a gangway or landing and without the removal of guarding or having to insert the hand into it. Where accessibility to a bearing for oiling purposes would be difficult a method of remote lubrication shall be fitted.
- 9.06.00 The Bidder shall supply grease gun equipment suitable to service each type of nipple fitted.

10.00.00 LUBRICANTS, SERVO FLUIDS AND CHEMICALS

- 10.01.00 The Bidder shall provide a detailed and comprehensive specification for all lubricating oils, greases and control fluids required for the entire plant. A sufficient supply of these shall be provided by the Successful Bidder for initial commissioning, first fill and till completion of facilities and handing over of respective units.
- 10.02.00 The Bidder shall supply a detailed schedule giving the lubricant testing, cleaning and replacement procedures. All equipment and facilities necessary for the testing, cleaning and changing of lubricants and control fluids shall be provided. The Successful Bidder shall endeavor to reduce the varieties and grades of required lubricants and control fluids to a minimum, matching them where possible to those already in use in the generating station in order to simplify procurement and minimise storage requirements. All lubricants and control fluids shall be of internationally recognized standards and shall be easily



obtainable from a large number of Indian suppliers. Bidder shall also indicate the equivalent Indian Standard for the above for easy procurement in future.

10.03.00 No lubricant or control fluid shall have toxic or other harmful effects on personnel or on the environment.

11.00.00 **PLANT LIFE AND MODE OF OPERATION**

The complete plant including all the equipment and systems individually and collectively shall be designed for continuous operation for an economic service life of thirty (30) years under the prevailing site conditions and for the type of duty as specified in relevant sections of the specification.

The critical components of the Steam Generator, Turbine-Generator and Auxiliary equipment, the life of which is limited by time and temperature dependent mechanisms such as thermal stress, creep and low cycle fatigue, are to be designed considering expected (hot, warm and cold) start-up, shut-down and cyclic load variations. (Details are specified in the Volume IIB – Specification of Steam Generator and Auxiliaries and Volume IIC – Specification of Steam Turbine and Auxiliaries and)

The units would be operated on base load with cyclic load variation. The load variation is expected to be as per schedule depending on power demand.

12.00.00 **PACKAGING & MARKING**

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. While packing the materials, the limitations from the point of view of availability of railway wagon sizes in India should be taken account of. The details of various wagons normally available with Indian Railways for transportation of heavy equipment shall be considered by the Bidder. The Bidder shall be responsible for all loss or damage during transportation, handling and storage due to improper packing.

Bidder shall conduct his own route survey and transportation logistics for transportation of the equipments to project site by road/rail/sea and indicate the same in his proposal.

Each package shall have identification marking indicating the name and address of the consignee shall be clearly marked in indelible ink on two opposite sides and top of each of the packages. In addition the Bidder shall include in the marking gross and net weight, outer dimension and cubic measurement. Each package shall be accompanied by a packing note (in weather proof paper) quoting specifically the name of the Bidder, the number and date of contract and names of the office placing the contract, nomenclature of contents and Bill of Material.

13.00.00 **PROTECTION**

Equipment having antifriction or sleeve bearings shall be protected by weather-tight enclosures. Coated surfaces shall be protected against impact, abrasion, discoloration and other damages. Surfaces that are damaged shall be repainted.



Electrical equipment, controls and insulations shall be protected against moisture and water damages. All external gasket surfaces and flange faces, couplings, rotating equipment shafts, bearings and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other suitable covering to ensure their full protection. All exposed threaded parts shall be greased and protected with metallic or other suitable protectors.

All piping, tubing and conduit connections on equipment and other equipment openings shall be closed with rough usage covers or plugs shall be sealed and taped. Male threaded openings shall be closed with rough usage covers or plugs shall be sealed and taped. Female threaded openings shall be closed with forged steel plugs.

Returnable containers and special shipping devices shall be returned by the Bidder.

14.00.00 PAINTING**14.01.00 General**

All exposed metallic and wooden surfaces subject to corrosion shall be protected by shop application of suitable coatings. Surfaces not easily accessible after shop assembly shall be treated before-hand and protected for life of the equipment. Surfaces to be finish painted after installation shall be shop painted with at least two (2) coats of primer. Steel surfaces, which are not to be painted, shall be coated with suitable rust preventive compound subject to the acceptance of the Owner.

All paints shall be used in accordance with the manufacturer's instructions. No thinners or other substance shall be added to the coating material without the prior notification and specific acceptance of the Owner. The quality and vendor of the paints shall require acceptance of the Owner.

Procedure for painting of any item, if not indicated in the relevant specification, shall be developed by the Bidder. This procedure and quality of paint shall be subject to Owner's acceptance

All paints shall be applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.

All primers shall be properly applied on to the surface and the first priming coat shall be applied as soon as possible after cleaning, within four hours maximum. The paint shall be applied by brush, roller or airless spray, according to the manufacturer's instructions. Spray painting shall be carried out by operators trained and thoroughly experienced in the use of the spray painting equipment.

If the drying interval between successive coats of paint or primer exceeds the manufacturer's recommendations, the paint already applied shall be completely and uniformly abraded with fine abrasive paper before putting on the next coat.



Paint spraying on large surfaces shall not be done indoors, without the prior notification and specific acceptance of the Owner. Spray guns shall not be used outdoors in windy weather nor near unprotected surfaces of a contrasting colour and under no circumstances shall spray guns be used where spray may be carried into or onto exposed electrical equipment or unprotected humans.

The Bidder shall provide suitable protection for adjacent plants from air borne materials during cleaning and spraying to the satisfaction of Owner

Paint containers shall not be opened until required and the paint shall be mechanically mixed thoroughly before use, and agitated occasionally during use.

Electrical equipment shall be shop finished with one or more coats of primer and two coats of high-grade oil resistant enamel. The interior of all panels' cabinets and enclosures shall be finished with gloss white enamel. For detail please refer relevant electrical sub-section Volume II F1 & F2.

The Bidder shall furnish sufficient touch-up paint for one complete finish coat on all exterior factory surfaces of each item of equipment. The touch-up paint shall be of the same type and colour as the factory applied paint and shall be carefully packed to avoid damage during shipment. Complete painting instructions shall be furnished.

Shop primer for steel and iron surfaces which will have a continuous operating temperature below 35°C shall be selected by the Bidder, in accordance to the relevant standard. Special high temperature primer shall be used on surface exposed to operating temperature above 35°C.

The colour scheme shall be submitted during execution of contract for acceptance by the Owner.

14.02.00 Surface Preparation

The grade of surface preparation shall be classified as indicated in Annexure-I of this section.

Sl. No.	Type of Preparation	Reference Standards		
		SSPC	SIS	BS 4232
1.	Solvent cleaning	SP1	-	-
2.	Hand Tool Cleaning	SP2	St-2	-
3.	Power Tool Cleaning	SP3	St-3	-
4.	Flame cleaning of new steel	SP4	-	-
5.	White metal blast cleaning	SP5	Sa-3	First Quality
6.	Commercial blast cleaning	SP6	Sa-2	Third Quality
7.	Brush-off blast cleaning	SP7	Sa-1	-
8.	Pickling	SP8	-	-



9.	Weathering followed by blast cleaning	SP9	-	-
10.	Near white blast cleaning	SP10	Sa-2.5	Second Quality

Oil and grease shall be removed from the surface by washing with a suitable detergent, rinsing with clean water, and drying.

The abrasive to be used shall be metal grit.

The surface preparation of all steel surfaces to be coated shall be free from all mill scales, rust corrosion products, oxides, paints, oil or other foreign matter.

All welded areas and appurtenances shall be given special attention for removal of welding flux in crevices. Welding splatter, slivers, laminations and underlying mill scale exposed during shot blasting shall be removed or repaired.

No acid/solvents/other cleaning solutions shall be used on surfaces after they have been blasted.

14.03.00 **Application of Primer and Paint**

Primer shall be applied immediately after surface preparation has been completed.

Brushing, spraying, roller coating or other suitable method shall be adopted for application of primer and paint and the work shall be carried out strictly as per the recommendation given by the paint manufacturer.

Primerized surfaces shall be faultless and shall not have mudcracking, dripping over thickness and dry sprays.

Before application of paint/primer, the following shall be particularly checked for conformance to this specification and recommendation of the paint manufacturer:

- Surface preparation profile.
- Catalysis ratio for two component paints.
- Pot life.
- Minimum and maximum top coating times.
- Type and quantity of thinners (if required)
- Viscosity
- Soundness of previous coating.
- Ambient conditions (temperature, humidity, etc)



Depending on the degree of contamination by foreign matters, the surfaces primed at shop shall be washed as follows to the satisfaction of the Owner:

- a) With clean water under a pressure of a least 7 Kg/cm² (g) using suitable nozzles. During washing broom or corn brushes shall be used.
- b) With suitable solvents, (such as Carbon Tetrachloride, Trichloroethylene etc.) if necessary, to remove traces of grease, oil etc.

Coated parts shall be carefully handled using hemp ropes, cloth belts, pendulum conveyors or suitable means as instructed by the Owner.

Surfaces which cannot be painted after fabrication shall be primed and provided with suitable rust preventive oil before boxing up.

Paints shall be stored in well-ventilated rooms, far away from heat sources, open flames, sparks and protected from sun. Outdoor storage is not permitted. Storage life shall be clearly indicated on the container. Paints, which have thickened or gelled or contained in non-original containers or in unsealed containers shall not be used. Owner's decision in this regard shall be final and binding.

The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as per Table I & II of this section.

For detail painting on building & structural steel elements refer Section-II/G/1 & II/G/2 of this specification.

14.04.00 Damaged Paintwork

Any damaged paintwork shall be made good as follows:

- a) The damaged area, together with an area extending 25mm around its boundary, shall be cleaned down to bare metal.
- b) A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50mm around the perimeter of the original damage.
- c) The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming.

14.05.00 Surface preparation and painting work shall not be carried out under the following weather conditions:

- a) When the surface is wet or expected to become wet before the paint/primer has dried up due to impending rain, fog or mist.
- b) High winds.
- c) Ambient temperature below 5deg.C or surface temperature less than 3 deg.C above dew point.



- d) Relative Humidity is more than 85%.

14.06.00 Inspection and Testing of Painting

The following inspection and testing shall be performed during and on completion of paint systems.

- Shot blasting profile shall be checked using a suitable profile-meter. Acceptable profile shall be 25-30 microns.
- Check of time of top coating and drying, in accordance with the recommendation of paint manufacturer.
- Check of Dry Film thickness by suitable Non Destructive Equipment. The painting shall be rejected if any of the spot measurement shows thickness to be less than 80% of the specified thickness.
- Check of adhesion of Paint Material by "Chequering" or another suitable method.
- Check of porosity of coating for internals, by the use of a suitable instrument.
- Visual inspection of appearance and uniformity of the surfaces painted.

If during above inspection, painting defects are observed, the Bidder shall carry out rectification to bring the faulty surface to the acceptable degree.

The areas where defective or damaged coatings have been repaired or replaced shall be re-inspected to the original requirements.

Surface temperature and humidity readings shall be taken prior to application of each coat. The work shall not proceed if the ambient temperature parameters are outside the requirements of this specification. If more stringent, the coating manufacturer's requirement shall dictate.

The dry film thickness shall be tested with a micro test film gauge or an accepted equivalent. The testing method shall be in accordance with SSPC – PA 2.

15.00.00 COLOUR CO-ORDINATION & FINISH

15.01.00 Exterior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and with the surrounding landscape.

15.02.00 Interior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and which will be conducive to; the comfort, well-being and high productivity of the operators. Operating plant and services provided shall be colour coded for ease of identification.

15.03.00 All finishes shall be durable and as far as possible maintenance free. Finishes shall be easily cleaned.





15.04.00 Final colours and finishes shall be to the acceptance of the Owner.

16.00.00 ENVIRONMENT PROTECTION AND NOISE LEVEL REQUIREMENT

16.01.00 Environment Protection

The plant shall be designed for installation and operation in harmony with the surrounding environment and all measures of pollution control shall be ensured by the Bidder to restrict pollution from the liquid effluent and stack emission within the limits as given below with due consideration of Environment (Protection) Rules 1986 as amended till date.

The Plant shall be designed meeting the latest environmental requirement issued by MoEF, GOI. In the event of Ministry of Environment & Forest stipulate any other conditions not specified hereunder, the Bidder shall comply with those requirements.

16.01.01 Liquid Effluent Discharge

- a) Provision laid down in schedule-I for Thermal Power Plants and also in Schedule-VI. General Standards for discharge of Environmental pollutants Part-A: Effects of Environmental (protection) Rules 1986, as amended till date.
- b) Any specific requirement of State Pollution Authorities over and above the above stipulation.

16.01.02 Air Quality Emissions

- a) Suspended Particulate Matter at chimney outlet - Maximum 30 mg/Nm³
- b) Oxides of Nitrogen (NO_x) - 100 mg/Nm³ .
- c) Sulphur di-Oxide(SO₂) - 100 mg/Nm³
- d) Mercury (Hg) - 0.03 mg/Nm³
- e) The Efflux velocity from boiler stack(s) shall not be less than 25 m/sec.
- g) Outlet dust emission level of bag filter installed in AHP and CHP shall be restricted to 30 mg/NM³.
- h) For The Coal Handling Plant, areas covered under Dry Fog Dust Suppression (DFDS) shall be designed to control the dust emission level in the working area measured at distance of 2m from the dust generation sources, over and above the atmosphere background dust level to shall be within 5 mg/NM³

The Bidder shall include in his scope all necessary equipment and measuring instruments to comply with above requirements. Location and accessibility of the instruments shall be properly coordinated.



16.02.00

Noise Level Requirement

The plant shall be designed, constructed and provided with suitable acoustic measures to ensure the noise level criteria as per the following stipulations.

- a) Maximum noise level shall not exceed 85 dB (A) when measured at 1.0M away from the noise emission source.
- b) Maximum noise level from its source within the premises shall not exceed 70 dB (A) as per Environment (Protection) Rules 1986, Schedule-III, 'Ambient Air Quality Standards' in respect of noise.
- c) Any statutory changes in stipulations regarding noise limitation that may occur in future according to State Pollution Control Board or Central pollution Control Board or Ministry of Environment & Forest regulation during tenure of the contract, the Successful Bidder shall comply with the requirement.

17.00.00

INSPECTION AND TESTING

17.01.00

Inspection and Tests during Manufacture

17.01.01

The method and techniques to be used by the Successful Bidder for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner prior to the Award of Contract.

17.01.02

The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.

17.01.03

Before any item of plant or equipment leaves its place of manufacture the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.

17.01.04

Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Successful Bidder may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results.

The Successful Bidder shall forthwith forward to the Owner's Engineer duly certified copies of the Test Certificates in Three (3) copies for approval.

17.01.05

Under no circumstances any repair or welding of castings be carried out without the consent of the Engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Engineer.

17.01.06

All the individual and assembled rotating parts shall be statically and dynamically balanced in the works.



Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Successful Bidder shall allow for trial assembly prior to dispatch from place of manufacture.

- 17.01.07 All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the Purchaser. The certificates shall include tests for mechanical properties and chemical analysis of representative material.
- 17.01.08 All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than one hour.
- 17.01.09 All necessary non-destructive examinations shall be performed to meet the applicable code requirements.
- 17.01.10 All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination magnuflux and ultrasonic testing shall be employed wherever necessary/ recommended by the applicable code. At least 10% of all major butt welding joints shall be radiographed. Statutory payments in respect of IBR approvals including inspection shall be made by the Successful Bidder. Successful Bidder's scope and responsibility shall also include preparation of all necessary documents in the specific formats stipulated by the statutory bodies, coordination and follow up for above approvals.
- 17.02.00 **Performance Tests at Site**
- 17.02.01 The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected System shall be tested by the Successful Bidder on site under normal operating conditions. The Successful Bidder shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.
- 17.02.02 The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.
- 17.02.03 The Successful Bidder shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection, pre-commissioning to tests on completion and commissioning of the complete system/equipment.
- 17.03.00 For details of specific tests required on individual equipment refers to respective section of this specification.

**18.00.00****TRAINING OF OWNER'S PERSONNEL**

The Successful Bidder shall extend all possible assistance and co-operation to the Purchaser regarding the transfer of technology and developing expertise in the area of engineering operation and maintenance of the Plant.

Number of man-days of training as mentioned below shall be included in his Tender.

18.01.00**Training at Successful Bidder's Premises**

The Successful Bidder shall conduct training of Sixty Five (65) engineers of the Purchaser on engineering, operation and maintenance of the Plant at the Successful Bidder's or Associates or Sub Vendor's premises where adequate training facilities are available during the design and manufacturing stage of the successful Bidder.

The total man-months for training of engineers shall be maximum sixty (60), having following indicative break-up:



Discipline	No. of Engineers	No. of Man-month
Operation	25 heads	25
Maintenance Boiler, Turbine,	25 heads	25
Electrical Maintenance	5 heads	5
Control & Instrumentation	10 heads	5
	-----	-----
	65 heads	60
	-----	-----

However, the details of the training programme will be discussed and finalised with the successful Bidder.

The training may also be arranged by the Successful Bidder in any Plant where the equipment manufactured by the Successful Bidder or his Associates is under installation, operation or testing to enable the trainees to become familiar with the equipment being furnished by the Successful Bidder. All expenses inherently related to the training shall be borne by the Successful Bidder and shall include but not limited to travel expenses in case of off-shore training (international and inland fares), lodging and per diem charges as well as medical insurance, instructors fee, programme and miscellaneous cost to be incurred during the training.

The training programme shall be adequate for the trainees to acquire the necessary expertise and competence in the area of engineering, operation and maintenance and as trainers for in-house technology transfer programme of the Purchaser.

The Successful Bidder shall be responsible for the development of the Training Module and Programme Schedule, which shall be submitted to the Purchaser for approval.

The components of the training modules shall include but not be limited to the training procedures/methodology, instructional materials such as audio visual materials, CDs and slides and manuals for each trainee.

Three (3) sets of the materials included in the training modules shall be handed over to the Purchaser upon completion of the training. An evaluation shall be jointly undertaken by the Successful Bidder and the Purchaser's representative on the adequacy, appropriateness and relevance of the training and the programme effectiveness after the training. The training material shall be in English language only.

The content of the training programme shall include but not be limited to :

1. Coal fired thermal plant principles in management and practice for operators, technicians and maintenance personnel.



2. Plant operation and systems training for operators including simulator training as applicable.
3. Maintenance training programme covering electrical, mechanical and instrumentation and control.

Said training programme shall be submitted to the Purchaser for approval.

The timing of the training should be such that the participants will be conversant with sufficient know-how to participate in the pre-commissioning and commissioning tests of the Plant.

The Successful Bidder shall provide qualified English speaking instructors and training coordinator(s) during the tenure of the training programme.

18.02.00 Operation and Maintenance Training at Site

The Successful Bidder shall provide a comprehensive training programme related to design application, plant management, operation and maintenance, including trouble shooting, of the Successful Bidder's supplied system and equipment at the Site starting from Start of Commissioning and thereafter up to the Final hand over of the Unit..

The following instructors shall be at the Site continuously during the training :

- a) One (1) for Steam Generator and Auxiliaries
- b) One (1) for Turbine Generator and Auxiliaries
- c) One (1) for Electrical Works
- d) One (1) for Instrumentation and Control (Boiler and Auxiliaries)
- e) One (1) for Instrumentation and Control (Turbine and Auxiliaries)

18.03.00 On-the-Job Training

During the period of pre-commissioning, commissioning and trial operation, the Purchaser shall provide operation and maintenance personnel to assist the Successful Bidder in the operation and maintenance of his supply and work under the direction of the Successful Bidder for the purpose of on-the-job training.

The Purchaser shall have the right to send to the Site his employees later intended to operate and maintain the equipment supplied under this Contract. The successful Bidder shall, without additional cost, use his site staff to instruct these employees on the operation and maintenance of the equipment. All instructions shall be in the English language.



ANNEXURE-I

LIST OF STANDARDS FOR REFERENCE

- a) International Standards Organisation (ISO).
- b) International Electro-technical Commission (IEC).
- c) American Society of Mechanical Engineers (ASME).
- d) American National Standards Institute (ANSI).
- e) American Society for Testing and Materials (ASTM).
- f) American Institute of Steel Construction (AISC).
- g) American Welding Society (AWS).
- h) Architecture Institute of Japan (AIJ).
- i) National Fire Protection Association (NFPA).
- j) National Electrical Manufacturer's Association (NEMA).
- k) Japanese Electro-technical Committee (JEC).
- l) Institute of Electrical and Electronics Engineers (IEEE).
- m) Federal Occupational Safety and Health Regulations (OSHA).
- n) Instrument Society of America (ISA).
- o) National Electric Code (NEC).
- p) Heat Exchanger Institute (HEI).
- q) Tubular Exchanger Manufacturer's Association (TEMA).
- r) Hydraulic Institute (HIS).
- s) International Electro-Technical Commission Publications.
- t) Performance Test Code (PTC).
- u) Applicable German Standards (DIN).
- v) Applicable British Standards (BS).
- w) Applicable Japanese Standards (JIS).
- x) Electric Power Research Institute (EPRI).



- y) Standards of Manufacturer's Standardization Society (MSS).
- z) Bureau of Indian Standards Institution (BIS).
- aa) Indian Electricity Rules.
- bb) Indian Boiler Regulations (IBR).
- cc) Indian Explosives Act.
- dd) Indian Factories Act.
- ee) Tariff Advisory Committee (TAC) rules.
- ff) Emission regulation of Central Pollution Control Board (CPCB).
- gg) Pollution Control regulations of Ministry of Environment & Forests, Govt. of India.
- hh) Central Board of Irrigation and Power (CBIP) Publications.
- ii) National Building Code (NBC).
- jj) Indian Road Congress (IRC).
- kk) Latest guidelines of Railway Authority.



ANNEXURE-II

CRITERIA FOR LAYOUT

PLOT PLAN LAYOUT REQUIREMENTS

The guidelines shall be applied in general, unless otherwise stated in other technical Volumes. In addition to these guidelines, Bidder shall refer the attached Plot Plan, drawing no. **12A05-DWG-M-003A**, for tentative arrangement of the various facilities under this package.

ITEM	SPECIFICATION REQUIREMENT
A. Site conditions to be considered	
1. Prevalent wind direction during summer (for deciding Cooling Tower orientation)	Refer wind-rose in plot plan.
2. Prevalent wind direction(s) during dry seasons (for deciding the location of coal stock pile and ash dump/ unloading areas, minimising the pollution effect due to dust)	Refer wind-rose in plot plan
3. Location of:	
a) Water intake point.	Towards South.
b) Water discharge point.	-.
c) Plant drainage outfall point(s).	Towards East.
d) Railway entries & exits.	Towards South.
e) Road entries & exits.	Towards North & North-East.
f) Electrical power transmission grid system.	Towards East.
g) selected ash dump area.	Towards North.
h) Nearest residential area.	Towards South.



ITEM	SPECIFICATION REQUIREMENT
B. Layout Requirements	
1. Maximum permissible slope in	
a) Rail track	1 in 400
b) Road	1 in 30
c) Sides of unpaved embankment	1 in 2
2. Required road width	
a) Main roads	8.0 Metres with 2.5m wide shoulders on either side.
b) Auxiliary interconnections	4.0 Metres with 1.0m wide shoulders on either side.
c) Road to the power house unloading bay :	
• Only for entry to the unloading bay	Yes.
• To pass through the unloading bay	No.
3. Required minimum horizontal distance between the nearest points of	
a) Plant boundary and the boundary of residential area	(Local municipality/factory rule)
b) Electrical transformer and any other	As per the Tariff Advisory building/facility Committee Rules.
c) Fire water supply installation and any building/facility subject to fire risk.	As per the Tariff Advisory Committee Rules.
d) Inflammable liquid (fuel oil, etc.) storage & handling installation and their fencing and other buildings/facilities.	Rules of the Indian Explosive (Indian Explosives Act) and Indian Petroleum Code.
4. Required minimum vertical clearance	
a) Under pipes/cable racks at road crossings	8.0 Metres.
b) Soil coverage over underground pipes	1.0 Metre (minimum).
c) Pipe/Cable trench	No Trench. Pipe/Cable Racks shall be used exclusively.



ITEM	SPECIFICATION REQUIREMENT
5. Railway Wagon clearance	As per the rules of the Indian Railways.
6. Minimum Clearance between any road edge and building/structure/ any fixed installation.	3 Metres.
7. Required level, above the local developed grade level, of	
a) top of all roads	150 mm.
b) all outdoor paved areas	150 mm.
c) Temporary storage areas, workshops, offices, residence etc. required at the time of erection work.	Yes.

**BUILDING/ EQUIPMENT LAYOUT REQUIREMENTS**

ITEM	SPECIFICATION REQUIREMENT
A. Minimum clear space required at all working and walking areas for operating & maintenance personnel	
1. Horizontal, in all directions	
a) Adjacent to any electrical equipment, electrical cables, running (rotating/reciprocating) equipment, safety valve or vent/drain pipe outlet, pipe/ equipment of surface temperature exceeding 60°C.	1200 mm.
b) Adjacent to any other plant facilities (including walls/structures)	1000 mm.
2. Vertical (head-room clearance)	
a) Under any pipe/equipment surface of temperature exceeding 60°C and any electrical cables or other electrical items.	2.2 Meters.
b) Under any other plant facilities (including structures, pipes etc.)	2.2 Meters.
3. For all areas where any equipment (including trucks, trolleys and other material handling equipment) will move or maneuver.	Minimum 500 mm clear in all direction from the outer edges of the equipment.
4. Minimum clear hand space required for	
a) The application of thermal insulation	100 mm
b) Welding work	150 mm
c) Bolt tightening	150 mm

**B. Floors, platforms, staircase, ladders, walls, doors & windows****1. Statutory Requirement**

As per the regulations of OSHA, Tariff Advisory Committee, Indian National Building Code, Indian Factories Act, Local Municipal Rules, etc.

2. Operation & Maintenance Requirement

- a) Adequate floor space shall be kept to permit dismantling, temporary storing and in-situ maintenance of plant & equipment parts, satisfying the clear space requirements stated above. A separate unloading bay for such purpose is required.

Yes

- b) Floors or fixed/portable platforms with stairs/ ladders shall be provided for easy approach to any plant item, including valves, instruments, etc. to be operated, observed and/or to be frequently (more than once a month) maintained.

Yes

3. **Plinth level** of all buildings, above the Finished Ground Level (FGL)

300 mm. However, 500 mm for power house building.

4. **Minimum access** opening required (with rolling shutter)

3.5 m wide x 4 m high or, more wherever entry of loaded truck is envisaged, depending upon the equipment size to be handled.

C. Other Maintenance Requirement**C. Other Maintenance Requirement****1. Generator stator handling**

In case the Generator stator cannot be handled by the turbine house crane, all provisions for its overhauling, including the arrangement to slide the stator on the turbine house floor, the foundation work for stator jacking /lowering assembly, dismantling of building end walls/structures etc. shall be kept.

Yes





2. Maintenance of the internals/impellers of all important equipment, like boiler feed pumps, feed water heaters, Surface Condenser, fans of the boiler draft plant, Intake and circulating water pumps, cooling water pumps, coal mills, air compressors, blowers, heat exchangers, fuel oil pumps, filters etc. Shall be possible without disconnecting or dismantling any piping/ducting.
 3. Overhauling and handling of the casings for the above items Shall be possible without disturbing/dismantling any piping/ducting not directly connected to them.
 4. Crane Approach

Wherever required the unobstructed approach of the crane hook/other hoisting equipment hook to various plant & equipment shall be possible. Yes
- D. Central Control Room
- All electronic equipment other than those directly associated with control, operation or presentation of displays shall be mounted external to the control room in air conditioned control equipment room. Yes
- The bidder shall describe in his bid the proposed layout philosophy of the Central Control Room and Control Equipment Room and the arrangement of equipment best suited for the system offered by him and as per good ergonomically consideration.
- However, as a guide line, following features are given :
- a) False ceiling and false flooring shall be provided.
 - b) Uniform height, colouring schemes for cabinets etc. shall be available.
 - c) The total area of floor space covered by Control Consoles/Panels in the Control Room shall not exceed 15% of floor area.
 - d) No opening shall be provided from Boiler side.
 - e) Two double leaf doors, suitably located for entering the Control room shall be provided with opening towards the turbine floor.



- f) Cable entry for the panels/consols shall be from bottom and suitable openings shall be provided.
- g) The Control Room lighting shall be designed to provide a glare free uniform illumination. The level of illumination shall be minimum 400 LUX.
- h) Necessary Air Conditioning shall be provided for Central Control room, Control Equipment Room and SWAS room etc.
- i) Basic amenities like toilet, Tiffin rooms, wash basins, rest rooms etc. shall be provided near the Control Room.

D. Toilet and drinking water facility

Required in all buildings and on all floors wherever operating personnel are to be deployed.

Annexure - 11

ENGINEERING SERVICES

CONTENTS

CLAUSE NO.	DESCRIPTION
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3.00.00	CO-OPERATION WITH OTHER SUCCESSFUL BIDDERS AND CONSULTANTS
4.00.00	GUIDELINES FOR OWNER'S ENGINEERING SERVICES
5.00.00	INSTRUCTION MANUALS
6.00.00	PLANT HANDBOOK
7.00.00	TENDER STAGE DOCUMENT SUBMISSION
8.00.00	CONTRACT STAGE DOCUMENT SUBMISSION AND APPROVAL PROCEDURE

OWNER'S ENGINEERING SERVICES

1.00.00 GENERAL

- 1.01.0 As part of the overall project management activity, the Successful Bidder Shall be responsible for proper Owner's Engineering and co-ordination of activities during various phases of execution of the contract. The Successful Bidder shall identify a person, designated as Project Manager, with whom the Owner, the Consulting Owner's Engineer or the Review Consultant shall interact on matters related to Owner's Engineering as well as execution of the contract. The Project Manager shall be the single-point contact person on behalf of the Successful Bidder and shall be responsible for all Owner's Engineering co-ordination. The Owner /Consultant /Review Consultant shall interact with the Project Manager only on all matters of co-ordination between the Owner and the Successful Bidder or on matters involving the Successful Bidder, his manufacturing units and sub-vendors. For expediting, the Owner or his representative may sometimes interact with the manufacturing units or sub-vendors of the Successful Bidders. However such interaction will not, under any circumstance, dilute the responsibility of the Successful Bidder to provide a fully Owner's Engineered and coordinated package under this contract.
- 1.02.0 On finalization of the contract, a procedure for exchange of Owner's Engineering information will be mutually agreed and finalized between the Owner and the Successful Bidder.

2.00.0 DESIGN COORDINATION MEETING

The Successful Bidder and his sub-vendors will be called upon to attend design co-ordination meetings with the Owner's Engineer, other Successful Bidders and the Consultants of the Owner during the period of execution of contract. The Successful Bidder including his sub-vendors shall attend such meetings at their own cost at Owner's or Consultant's office in Kolkata/ or at mutually agreed venue as and when required and fully cooperate with such persons and agencies involved during those discussions.

3.00.00 CO-OPERATION WITH OTHER CONTRACTORS AND CONSULTING OWNER'S ENGINEERS

The Successful Bidder shall agree to cooperate with the Owner's other Contractors and Consulting Owner's Engineers and freely exchange with them such technical information as is necessary to obtain the most efficient and economical design and to avoid unnecessary duplication of efforts. The Owner's Engineer shall be provided with copies of all

correspondences addressed by the Successful Bidder to other Sub-Vendors and Consulting Owner's Engineers in respect of such exchange of technical information.

4.00.00 GUIDELINES FOR OWNER'S ENGINEERING SERVICES

- 4.01.00 Prior to commencement of the Owner's Engineering work as part of design submissions, all aspects of design viz., criteria for selection and sizing of all equipment and systems, design margins etc. including that for structural steel and civil work shall be outlined and these shall form the basis for the detailed Owner's Engineering work.
- 4.02.00 Owner's Engineering work shall be performed on modern and proven concepts and internationally accepted good Owner's Engineering practices but fully compatible with the Indian environments. Owner shall have the right to review and approve the Owner's Engineering work by themselves and/or through consultant and ask for any clarifications and changes/modifications to the work performed by Successful Bidder.
- 4.03.00 At any stage during the performance of assignment, the Successful Bidder may be required to make certain changes/modification/improvements in design/drawing/other documents, which in the opinion of the Owner could result in better improved design, layout, operability, plant availability, maintainability, reliability or economy of the plant and its systems/sub-systems in view of revised and more accurate information/data available at a later date(s) or feedback(s) received during execution/operation of similar units. Such changes/modifications/improvements required could be identified by Owner and/or Consultant and mutually discussed. Owner requires the Bidder to incorporate such action in the subject assignment appropriately without any additional cost liability and time implication to the Owner and same shall be within the responsibilities and Scope of the Successful Bidder.
- 4.04.00 During the course of review of detailed Owner's Engineering stages, it may be essential in the opinion of Owner to obtain certain classified data for review purposes only. In case Owner so desires, the Bidder shall submit such data to Owner.
- 4.05.00 During the course of review of detailed Owner's Engineering, it may be essential in Owner's opinion to obtain data and the Bidder engineers information on similar equipment and plants Owner. In case, Owner so desires the Bidder shall submit such data and information to the Owner.
- 4.06.00 It is not the intent to give details of every single task covered in the total Owner's Engineering work to be carried out by Successful Bidder, however, all Owner's Engineering work required for the satisfactory completion of the plant/systems as specified shall be carried out by the

Successful Bidder. Broadly, the following are the minimum requirements in respect of scope of major items of work.

- 4.06.01 Preparation, updating and finalisation of scheme drawings, control and interlock diagrams, detailed and fully dimensioned layout drawings (plant layout and equipment layout detailed plan, elevation and cross-sectional drawings at different elevations/ floor levels) covering all mechanical, electrical, C&I, civil and structural items, equipment, systems and facilities. Drawings and Schedules prepared by the Successful Bidder from time to time, as detailed designs are developed, shall be submitted for Owner's/ Consultant's approval before the work is taken up. Revisions, corrections, additions to drawings and schedules shall not be considered to change the scope of work.
- 4.06.02 Preparation of detailed technical specifications including data sheets, tender drawings and bill of material for all bought out items, as also finalisation of corresponding sub-Vendors.
- 4.06.03 Review of sub-Vendor's data, drawings, design calculations, schedules, bill of materials, instruction manuals etc. for all equipment, before forwarding them to Owner/Consultant for approval.
- 4.06.04 Preparation of civil construction drawings for all equipment showing foundation details and full details regarding equipment loads, floor openings, details of embedment, etc. required for preparation of civil construction drawings and also as referred at relevant sections of Scope & Exclusions. These documents shall be preceded by appropriate design calculations, static and dynamic analysis as necessary.
- 4.06.05 Preparation and finalisation of process piping and instrumentation diagrams and schematics, complete in all respects for all systems/packages of the power plant.
- 4.06.06 Preparation of consolidated schedules and bills of materials, including line numbers, tag numbers, source of supply, service conditions, specifications, materials, types and connections details, quantities for items of the plant including dampers, steam traps, strainers, instrumentations, ducting.
- 4.06.07 Sizing of all piping and equipment as per the stipulated design criteria; carrying out of flexibility analysis/dynamic analysis as necessary; hangers & support Owner's engineering.
- 4.06.08 Final revision of all documents including preparation and compilation of Instruction Manuals for installation, commissioning, operation and maintenance for all equipment and systems. Refer clause 5.00.00 for the specific requirement in this regard.

4.06.09 Certification and submission of final as-built drawings for all areas.

4.06.10 Preparation and compilation of all drawings, schedules and instructions, which may be required at site, whether separately, mentioned or not.

4.06.11 All erection and assembly drawings, which may be required at site.

5.00.00 INSTRUCTION MANUALS

5.01.00 The Bidder shall provide all necessary instruction manuals for the Owner's review, comment, and final acceptance as required in the contract. The instruction manual shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The instruction manual shall be submitted in the form of one (1) soft copy in CD and 15 hard copies.

5.02.00 Erection Manuals

The erection manuals shall be submitted at least three (3) months prior to commencement of erection activities of particular equipment/system. The manuals shall contain the following as a minimum:

- a) Erection strategy.
- b) Sequence of erection.
- c) List of tools, tackles, heavy equipment like cranes, dozers etc. Required for erection.
- d) Bill of Materials.
- e) Safety precautions to be followed during erection.
- f) Erection instructions.
- g) Critical checks and permissible deviation/tolerances.
- h) Check-list for pre-commissioning activities
- i) Checklist for commissioning of the system.
- j) Procedure for initial checking, testing and acceptance norms.

5.03.00 Operation & Maintenance Manuals

5.03.01 The operating and maintenance instructions together with drawings of the equipment, as completed, shall be in sufficient detail to enable the Owner to operate, maintain, dismantle, reassemble, and adjust all parts of the equipment. They shall outline a systematic procedure for all operations likely to be carried out during the life of the plant/ equipment. Each manual shall include a complete set of drawings together with performance/ rating curves of the equipment and test certificates wherever applicable.

5.03.02 If after commissioning and initial operation of the plant, the manuals require any modification/ additions in the view of the Owner or Bidder, the same shall be incorporated and the updated final manuals shall be submitted to the Owner.

5.03.03 The manuals shall include the following:

- a) List of spare parts along with their drawing, catalogue, and Performa for ordering spares.
- b) Location and identification guide for bearings of various equipment and lubrication schedule including charts showing lubrication checking, testing and replacement procedure.
- c) Wherever applicable, fault location charts shall be included to facilitate fault detection.
- d) Detailed specification for all consumables (including lubricating oils, greases, chemicals etc.) required for each equipment.

6.00.00 PLANT HANDBOOK

The Bidder shall provide the plant handbook to the Owner as per provision of the contract.

The Plant Handbook shall contain the following as a minimum:

- a) Design and performance data
- b) Process & instrumentation diagrams
- c) Single line diagrams
- d) Sequence & Protection interlock schemes
- e) Alarm and trip values
- f) Performance curves
- g) General layout plan and layout of Balance of Plant building and auxiliary buildings
- h) Important Do's and Don'ts.

7.00.00 TENDER STAGE DOCUMENT SUBMISSION

7.01.00 The Bidder shall submit along with his bid all documents/drawings as specified in RFP and respective sections of the Technical Specifications in Vol-II and Vol-III. The documents shall include but not be limited to the following:

- a) All Bid proposal sheets duly filled up.
- b) Detailed experience list and financial resources of the Prime Bidder his collaborators/associates in this bid as well as the sub-vendors proposed.
- c) Scheme drawings indicating scope of supply and service as offered by the Bidder indicating clearly exclusions, if any.
- d) List of terminal points of the package offered together with quality and quantity of various input (i.e. water, air, electricity etc.) as required from the Owner at such interfaces.

- e) Equipment GA, Layout, Design Calculations, interlock and other write-up, catalogues/literature etc. as required for clear understanding of the bid submitted.
- f) High level project schedule network indicating target dates for intermediate milestones and final commissioning of plant systems; This network shall be supplemented by a detailed write-up on proposed sequence and method of execution for project implementation, deployment schedule for Key personnel with their bio-data, schedule of construction machinery etc.

8.00.00 CONTRACT STAGE DOCUMENT SUBMISSION AND APPROVAL PROCEDURE

- 8.01.00 Owner's Engineering schedule shall be submitted by the Bidder as indicated in the RFP. Owner's Engineering schedule shall be developed in format as desired by the Owner/consultant.

The documents shall be divided into two categories: a) for approval and b) for information/further Owner's Engineering and co-ordination by the Consultant.

In preparing this schedule, the Bidder shall allow one (1) week from date of receipt for review and comments by the Consultant for each submission of a document.

This document submission schedule shall require acceptance by the Owner/Consultant.

Bidder shall also develop and submit a Master drawing list to the Owner/consultant.

- 8.02.00 All contract documents shall be marked with the name of the Owner, the Project, the specification title and number and the unit designation.

All dimensions shall be in metric units.

All notes, markings etc. shall be in English.

- 8.03.00 Documents/Drawings, submitted during tender stage, shall be revalidated or revised as required and submitted as certified contract document for approval/information of the Owner/Consultant.

- 8.04.00 Unless specified otherwise, the following categories of documents/drawings would require approval of the Owner/Consultant:

- a) System scheme and Process & instrumentation Diagrams (P & IDs).

- b) Design basis documents / memoranda / calculations justifying sizing and selection of equipment, vessels, tanks, piping, valves & specialties as well as the process parameters.
- c) Equipment data sheets and general arrangement drawings.
- d) Materials of construction.
- e) General Arrangement and Layout drawings.
- f) Typical control schemes, circuit diagrams, drive/ feeder-wise control scheme showing all external interfaces.
- g) Control System Configuration
- h) Shop Inspection and Testing Procedures, Test Set-up & Instrumentation, Acceptance Criteria and Codes / Standards followed, correction curves / charts, etc.
- i) Performance Test Procedures, Instrumentation, Acceptance Criteria and Codes / Standards followed, correction curves / charts, etc.
- j) Schedules covering equipment delivery schedules, erection, testing and commissioning schedules at L1 and L2 levels.

8.05.00 Unless specified otherwise, the following categories of documents / drawings would be treated for information/further Owner's Engineering by the Owner/Consultant. The Bidder shall, however, incorporate all additional information and clarifications in these documents/ drawings as and when desired by the Owner/ Consultant.

- a) Equipment foundation drawings.
- a) Equipment cross-section drawings, product literature etc. which are of proprietary nature.
- b) Predicted performance curves of equipment.
- c) Various bills of quantity, schedules etc.
- d) Piping fabrication drawings, isometrics etc.
- e) Panel wiring diagrams.
- f) Instruction/Operation manuals.

- g) Service manuals and trouble shooting guide for C & I system including field instruments.
- h) Operation logic diagrams.
- i) Cable schedule and interconnection chart.

In essence, the Bidder is solely responsible for corrections and adequacy of design & Owner's Engineering for documents under this category.

8.06.00 Upon review, the Consultant shall put his remarks and one of the following action stamps on the drawing / document:

- a) Approved.
- b) Approved except as noted, forward final drawing
- c) Approved except as noted, resubmission required.
- d) Disapproved.
- e) For information/reference only.

For action stamps in category (c) & (d), documents must be resubmitted for review by the Owner/Consultant. For action stamp in category (b), further review by Owner/Consultant would not be necessary provided the Bidder agrees & incorporates the minor comments made on the document.

Except for action stamp under category (c) & (d), the Bidder can proceed with manufacturing and other sequential activities for those areas of a drawing/document which do not have any review comment by the Owner/Consultant.

The Consultant may accord approval in category (c) or (d) in more than one submission of a document till he is satisfied that the intent of the specification has been fully complied with. The Bidder shall be responsible for delay in such cases and no extension of time shall ordinarily be allowed on such grounds.

The Bidder's work shall be in strict accordance with the finally approved drawings and no deviation shall be permitted without written approval of the Consultant.

8.07.00 Except key plan/general yard plan, any layout drawing requiring scrutiny shall not be drawn to a scale less than 1:50.

8.08.00 For review by the Consultant, the Bidder shall furnish three (3) prints of each drawing (only for first submission). There upon all transaction of drawings including reviewed comments and stamping shall be done

in soft. All transaction of drawings shall be accompanied by a reference letter mentioning the date, revision no. and document status. Only on receiving the Approval Stamping, bidder shall distribute 6 sets of drawings (2 at WBPDCCL corporate office and 4 sets at WBPDCCL site office).. The Bidder shall furnish three (3) CDs of all as built/final drawings for Owner/Consultant site.

- 8.09.00 In case of contradiction between the stipulations above and those stated elsewhere in the specification, the stipulations herein shall prevail.



WBPDCL

**EPC Bid Document
Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase – III**

Annexure - 12

SECTION-VI

PROJECT MANAGEMENT AND SITE SERVICES



Development Consultants Pvt. Ltd.

**Volume : II-A
Section : VI
Project Management and Site Services**



WBPDCL

**EPC Bid Document
Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase – III**

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	PROJECT MANAGEMENT SERVICES
2.00.00	SITE SERVICES
3.00.00	PROTECTION & CARE
ANNEXURE-I	LIST OF SUB-VENDORS



Development Consultants Pvt. Ltd.

**Volume : II-A
Section : VI
Project Management and Site Services**



PROJECT MANAGEMENT AND SITE SERVICES

1.00.00 PROJECT MANAGEMENT SERVICES

1.01.00 Responsibility

The Bidder shall identify a separate and independent project management team headed by a Project Manager for the execution of this project. Responsibilities of this project Management team shall cover the areas listed below :

- a) Planning and Monitoring
- b) Owner's Engineering Management
- c) Contracts Management
- d) Quality Assurance, Inspection & Expediting
- e) Construction Management
- f) Spares Management
- g) Commissioning Management

Detailed responsibilities in the above areas are discussed below :

1.02.00 Organisation

1.02.01 Headquarters

The project management team shall be stationed at the organizational headquarter and headed by a senior level executive designated as the Project Manager who shall be responsible to Owner for the execution of the project. . He should have adequate financial power and authority to give decision.

Separately, designated leaders shall be identified for each of the areas mentioned under 1.01.00, who, in turn, will report to the Project Manager for all matters related to this contract.

1.02.02 Central Co-ordination Cell

The central coordination/ cell shall be based in Kolkata and shall have sufficient technical personnel to coordinate technical matters and to quickly resolve day to day queries or references made by Owner and his Consultants without having the need to refer to his headquarters each time.

**1.02.03 Site Organisation**

The site should have a competent construction manager for all site operations with adequate financial power and sufficient level of authority to take site decisions. The organisation chart for site should indicate the various levels of experts to be posted for supervision in the various fields in civil construction, erection, commissioning etc.

1.02.04 Organisation Chart

The Bidder shall furnish a detailed organisation chart for the project management team, clearly identifying the key personnel in each of the areas mentioned at 1.01.00 above. The expected number of executives at different levels shall also be indicated, separately for headquarters, central coordination cell and site organisation.

1.03.00 Implementation Schedule

The following milestones shall be followed by the Contractor against each activity as detailed below:

1.	Letter of Award (LOA)	Zero Date
2.	Supply Completion	
3.	Synchronization	
4.	Completion of Trial Operation	
5.	System & Completion of all facilities as per contract and handing over	
6.	P. G. Test	To be completed within three (3) months after Completion of all facilities and handling over.
7.	Guarantee/Warranty Period	For a period of 18 months from the date of completion of the facilities or twelve (12) months from the date of operation acceptance (or any part thereof), whichever occurs first and any suitable extension of time for completion of rectified job granted by Employer
8.	Final Acceptance	After the expiry of defect liability period

**1.03.01 Owner's Engineering Schedules**

These schedules shall cover various design submissions indicating different Owner's Engineering activities to be performed. Such schedules shall be furnished by the Bidder for each and every plant/systems/ equipment/ item covered in the scope of this specification.

1.03.02 Manufacturing Schedule

The Contractor shall submit to the Owner's Engineer his manufacturing and delivery schedules for all equipment within thirty (30) days from the date of issue of the Letter of Award (LOA). Such schedules shall be in line with the detailed network for all phases of the work of the Contractor. Such schedules shall be reviewed, updated and submitted to the Owner's Engineer, once in every two months thereafter, by the Contractor. Schedules shall also include the materials and equipment purchased from outside suppliers.

1.03.03 Erection Schedules

In order to achieve the overall completion schedule, the Contractor shall provide the Owner all the information covering erection sequence, testing and commissioning activities. These schedules may be based on the recommended erection procedures and will be subject to discussions/agreements with the Owner subsequent to the award of contract.

1.03.04 The successful Bidder shall have to provide all the above schedules (i.e. 1.03.01, 1.03.02 & 1.03.03) in a tabular form in addition to that in the form of L2 & L3 networks and these shall necessarily include information not limited to the earliest and latest dates for various activities/submissions and also any related constraints. However, the Bidder shall include in his proposal a Level-1 (L-1) network showing the major activities and various milestones to achieve the above mentioned completion schedule.

1.03.05 The Contractor shall provide the Owner the original disc/software for all such schedules along with requisite no. of copies (as required by the Owner) within an agreed time schedule. This time schedule will be agreed between Owner/Bidder at the time of award of Contract. The Contractor's project management software shall be compatible with that of the Owner and the input data shall be furnished to the Owner in a manner compatible with Owner's project management software, Primavera.

1.04.00 Detailed Responsibilities**1.04.01 Planning & Monitoring****a) Planning**

The Bidder shall prepare a Master Network Schedule in the form of PERT network consisting of at least 500 activities.



The network shall be prepared on a Work Breakdown Structure for the project which sub-divides the project into a set of manageable systems/sub-systems. The master network will identify milestones of key events for each system/package in the areas of Owner's Engineering, procurement, manufacture and despatch and erection and commissioning. The master network shall represent the Level-I plan and will form the basis for development of detailed second and third tier execution plans. The master network shall conform to the overall schedule prescribed by Owner.

The master network should be submitted along with the bid, which would be mutually discussed and finalised before the Award of Contract. This master network would clearly indicate the responsibility of the Bidder and project management team. This master network would form a part of the contract. The master network shall also identify a complete list of inputs to be furnished by the Owner which may be required for proper interfacing and tie-up. Scheduled dates for providing such inputs shall also be indicated, which will be mutually discussed and finalised.

b) Monitoring & Progress Reporting

The progress reports would be emanated every month, one from the head office of the Contractor and another from the site office. The progress report emanating from the head office should necessarily include the following sections:

- i) Report on key milestones.
- ii) Management summary indicating critical areas with details of actions initiated and effect of any on the project.
- iii) Action needing attention of the Owner/Consultant.
- iv) Detailed package wise status of Owner's Engineering submissions, quality plan submissions and approval, procurement manufacture and despatch.

The monthly report generated from the site office should necessarily include:

- i) Report on key milestones.
- ii) Management summary indicating critical areas with details of actions initiated and effect if any on the project.
- iii) Action needing attention of the Owner/Consultant.



- iv) This report would also cover the areas pertaining to the receipt of the equipment at the port, port clearance, transport, receipt at site, erection and commissioning.

In addition to the above, as the project execution progresses, the Contractor shall also be responsible for generating more frequent reports in the form of fax/e-mail information on progress in critical areas so that actions can be expedited. The exact format of the progress report shall be finalised after award of Contract.

1.04.02 Owner's Engineering Management

Based on the master network for the project (L-1) the Contractor will prepare an exhaustive list of Owner's Engineering activities for the equipment/systems covered in his scope and a detailed programme of accomplishing the same within the time frame specified in the master network. This schedule will form the Level-2 (L-2) network for Owner's Engineering activities.

Based on (L-2) network, the Bidder shall further develop the Level-3 (L-3) network for Owner's Engineering activities which will indicate schedule for data availability, drawing release date and document submission dates.

Detailed (L-2) and (L-3) networks would be submitted sequentially by the Contractor within two months from the date of issue of Letter of Award and finalised within one (1) month thereafter.

All such networks shall be provided in MS PROJECT software.

The Owner's Engineering management team should also co-ordinate all interface Owner's Engineering activity between the Contractor and the equipment sub-vendors so as to ensure the correctness and completeness of related Owner's Engineering documentation before the same is submitted to the Owner.

1.04.03 Contracts Management

Based on the master network, the Contractor shall submit L-2 programmes of manufacture and despatch. In addition, the master network shall also include periods considered for site activities viz. erection, commissioning etc. These L-2 programmes would be submitted in 2 months time from the date of award of contract and finalised within one (1) month thereafter. The Contractor will also submit site mobilisation plan. This programme would be submitted at the time of finalisation of award of contract and agreed immediately thereafter so that immediate development of the various activities at site could take place.

The Contractor should also submit L-3 programmes for the manufacturing, despatch of the various items. These networks shall also show the customer hold points (CHP) which have to be cleared by Owner or their authorised representative(s) before further manufacturing can take place. These L-3 programmes for the manufacture and despatch would clearly identify responsibilities of the Contractor, sub-Contractor and Owner. These networks



shall be submitted within one (1) month of the date of finalisation of the various sub-contracts by the Contractor.

In case all the manufacture is being done by the Contractor then the L-2 programmes would be themselves amplified to cover details of the manufacture, inspection, clearance by Owner and despatch.

The Contractor shall also submit the programme for procurement of bought out items, detailed shipping schedule and cash flow statement for Owner's approval.

1.04.04 Quality Assurance, Inspection and Expediting

The Contractor shall submit the list of manufacturers/sub-vendors from whom the equipment are expected to be procured and the quality assurance plans thereof for the manufacture shall be approved by the QA group of Owner before the manufacturing is commenced. The list of major suppliers would be submitted along with the bid and this shall be mutually discussed and approval will be given by the Owner during contract negotiation meeting prior to placement of Letter of Award. This approved list will be binding to the bidder. In the said list, Owner reserves the right to include reputed/reliable vendors of his own choice. Regarding the various other sub-vendors, the list would be submitted within six (6) months of the award of the contract that shall be scrutinized by the Owner to accord approval. In such list Owner reserves the right to include vendors of his own choice. No further vendor approval will be given after six (6) months. On the quality plans, the customer hold points will also be identified based on which Owner would give clearance for the manufacture to proceed further.

Quality assurance/Inspection group of Owner or its representative would issue a material despatch clearance certificate (MDCC) after the inspection clearance which will enable the Contractor to despatch the equipment and claim the payment. In the despatch programme, the Contractor shall indicate a schedule of estimated programme, tonnages specifically identifying various oversize dimensioned consignments (ODC). Further the Contractor will also be required to ensure at all stages of shipment that packing of all shipments despatched are suitable for ocean freight to India, handling at the port of entry, inland transportation and preservation at site up to erection. All despatch details & item lists shall be made available to both Owner & site immediately after shipping.

The Contractor shall also expedite all despatches from their own works/works of their sub-vendors, so as to match with the various activities mentioned at 1.04.03 above.

1.04.05 Construction Management

Based on the L-1 Master Network Programme, within two (2) months of the issue of Letter of Award, the Contractor shall submit a programme of construction/erection/commissioning, either in continuation with the manufacture and despatch or separately for the implementation. These



programmes would be amplified showing when the civil drawings shall be released by him and construction of civil works shall be completed by him to facilitate start of erection and subsequent activities and shall form the basis for site execution and detailed monitoring. The three monthly rolling programme with the first month's programme being tentative based on the site conditions would be prepared based on these L-3 programmes. The Contractor shall also be involved along with the Owner to tie up detailed resource mobilisation plan over the period of time of the contract matching with the performance targets.

The L-3 programme would be jointly finalised by the site in-charge of the Contractor with the Owner's project coordinator as well as the site planning representative. The erection programme will also identify the sequential erectable tonnages that are required for various equipment which should be taken care of in the despatch programmes.

Erection and commissioning of the equipment shall also be done under the supervision of experts from the respective equipment/ system supplier.

1.04.06 Spares Management

Along with the proposal for the plant and equipment, the Contractor shall also submit proposals/schedule for the following:

- a) Mandatory spares
- b) Recommended spares

While the award for mandatory spares will be finalised at the time of the award of contract, recommended spares will be finalised within twelve (12) months thereafter.

1.05.00 Project Progress Review Meetings

Keeping in mind the overall responsibility of the Contractor it is intended that periodic progress reviews on the entire activities of execution in respect of Sagardighi Thermal Power Plant unit #5 will be held initially at least once in two (2) months at Kolkata/site. During peak period it may be held once in a month. These meetings will be attended by reasonably higher officials of the Contractor and their leading sub- contractors and will be used as a forum for discussing all areas where progress needs to be speeded up. Actions will be placed on the concerned agencies and decisions will be taken to expedite/speed up the progress. Minutes of such meetings will be issued reflecting the major discussions and decisions taken and circulated to all concerned for reference and action. The Contractor shall be further responsible for ensuring that suitable steps are taken to meet various targets decided upon such meetings.

In addition to the above, and to streamline the construction and erection at site, a suitable frequency and forum of periodic meetings between the Contractor and the Owner will be decided upon as part of erection coordination procedure. Site co-ordination meeting may be held on weekly basis.

**1.06.00 Owner's Consultant**

The Owner would appoint a consultant to assist him in some of the areas mentioned at 1.01.00 above. The details of interaction and procedures for coordination between Owner/Owner's Consultant and Contractor/Contractor's project management team shall be finalised during contract negotiations.

1.07.00 Commissioning Management

1.07.01 For commissioning of the various equipment/system covered under the scope of contract, Owner will form an organisation structure which may consist of the following committees. The Contractor shall nominate his representative on one or more of the committee as decided by the Owner:

- a) Commissioning Teams.
- b) Testing Teams.

1.07.02 Commissioning documents shall be prepared by the Contractor in the following manner and submitted for Owner's approval :

- a) Paper of Principle

This document shall be prepared for the various equipment/ systems under commissioning and shall have the following objectives to fulfill and shall be submitted for Owner's approval at least six (6) months before their actual commissioning :

- i) Establish design data against which Plant Performance will be compared.
- ii) Set-out the testing objectives and proposals.
- iii) Define the documentation required.

- b) **Testing/Commissioning Schedule**

These shall be prepared for the various equipment/systems under consideration and shall contain sections like detailed testing method, programme, safety, individual responsibility and results.

- c) **Standard Check Lists**

Standard checklists are intended for use at the completion of erection to ensure correct erection, testing and to a limited extent operation for repetitive items.

**1.07.03 Test Reports**

After the completion of commissioning activity of equipment/ systems, the Contractor shall prepare the test reports which shall include all the relevant information related to various commissioning checks, tests carried out, any deviations/commissions noticed with respect to the intended design requirements, sequence of various commissioning activities as actually adopted vis-à-vis as recommended in the procedures, programme schedules achieved and any other such information as required. These test reports shall be submitted in requisite number of copies to the Owner and this should be duly signed jointly by the Owner/Consultant and the Contractor/Equipment supplier, who are involved during the commissioning activities.

2.00.00 SITE SERVICES

These services shall be rendered by the Bidder as part of the overall project management service. The services shall broadly include but not be limited to the following :

- 2.01.00 Arranging material despatch from the shop by rail/road and/or sea as applicable.
- 2.02.00 Monitoring movement of materials & follow-up as necessary with Railways, road transport, port clearance etc. from the time of despatch F.O.R. works/F.O.B. port of shipment by Contractor till receipt of the same at site.
- 2.03.00 Unloading of materials at Railway Station/Railway Siding inside project area, transportation to site store, assessment of lost/damaged items in transit and arranging insurance claims and replacement of lost/damaged items. The Contractor shall submit to the Owner's Engineer a report detailing all the receipts during the week.
- 2.04.00 Issuing materials from site store/open yard from time to time for erection as per the construction programme. The Contractor shall be the custodian of all the materials issued till the plant is officially taken over by the Owner after complete erection and successful trial run & commissioning.
- 2.05.00 Transportation of materials to their respective places of erection and erection of the complete plant & equipment as supplied under this specification.
- 2.06.00 Trial run and commissioning of individual equipment/sub-systems and the plant as a whole to the satisfaction of the Owner, including supply of temporary equipment & services for chemical cleaning, steam blowing as well as performance guarantee tests.

For Coal Handling Plant, satisfactory operation of the system, amongst others, shall consist of operation without spillage or choking anywhere even during monsoon.



Provision for preservation of individual equipment after trial run and commissioning e.g. Nitrogen blanketing etc. as necessary shall also be in the scope of the Bidder.

- 2.07.00 Supply and application of the final paints lubricating oils and all consumable till completion of facilities and hand over..
- 2.08.00 For the purpose of erection and commissioning the Contractor's scope of work shall include but not be limited to the following :
- 2.08.01 Deployment of all skilled and unskilled manpower required for erection, supervision of erection, watch & ward, commissioning and other services to be rendered under this specification.
- 2.08.02 Deployment of all erection tools & tackle, construction machinery, transportation vehicles and all other implements in adequate number and size, appropriate for the erection work to be handled under the scope of this specification.
- Supply of commissioning spares.
- 2.08.03 Supply of all chemicals and consumables, e.g. Regeneration chemicals, alum, lime, polyelectrolyte, resin, welding electrodes, cleaning agents, diesel oil, grease, lubricant etc. as well as materials required for temporary supports, scaffolding etc. as necessary for such erection commissioning work till completion of facilities and hand over, except those listed under exclusion elsewhere in this specification.
- 2.08.04 Construction of all civil/structural/architectural works, including construction of foundation for all equipment supplied as required, grouting of equipment on foundation after alignment, and all other incidental civil activities as detailed elsewhere.
- 2.08.05 All structural steel fabrication and erection work as detailed elsewhere in the specification.
- 2.08.06 Providing support services for the Contractor's erection staff e.g. construction of site offices, temporary stores, residential accommodation and transport to work site for erection personnel, insurance cover, watch & ward for security and safety of the materials under the Contractor's custody etc. as required.
- 2.08.07 Maintaining proper documentation of all the site activities undertaken by the Contractor as per the proforma mutually agreed with the Owner; submitting monthly progress reports as also any such document as and when desired by the Owner; taking approval of all statutory authorities e.g. Boiler Inspector, Factory Inspector, Inspector of Explosives etc. for respective portions of work under the jurisdiction of such statutes or laws.
- 2.08.08 The Contractor shall provide 'Industrial Relations' unit and 'Medical' unit to take care of his erection staff and the Owner shall have no obligation in this regard.

**2.09.00 Site Organisation**

The Contractor shall maintain a site organisation of adequate strength in respect of manpower, construction machinery and other implements at all times for smooth execution of the contract. This organisation shall be reinforced from time to time, as required, to make up for slippages from the schedule without any commercial implication to the Owner. The site organisation shall be headed by a competent construction manager having sufficient authority to take decisions at site.

On award of contract, the Contractor shall submit to the Owner a site organisation chart indicating the various levels of experts to be deployed on the job. The Owner reserves the right to reject or approve the list of personnel proposed by the Contractor. The persons, whose bio-data have been approved by the Owner, will have to be posted at site and deviations in this regard will not generally be permitted.

The Contractor shall also submit to the Owner for approval a list of construction equipment, erection tools, tackle etc. prior to commencement of site activities. These tools & tackle shall not be removed from site without written permission of the Owner.

2.10.00 General Guidelines for Field Activities

2.10.01 The Contractor shall execute the works in a professional manner so as to achieve the target schedule without any sacrifice on quality and maintaining highest standards of safety and cleanliness.

2.10.02 The Contractor shall co-operate with the Owner and other Contractors working in site and arrange to perform his work in a manner so as to minimise interference with other Contractors' works. The Owner's Owner's Engineer shall be notified promptly of any defect in other Contractor's works that could affect the Contractor's work. If rescheduling of Contractor's work is requested by the Owner's Owner's Engineer in the interest of overall site activities, the same shall be complied with by the Contractor. In all cases of controversy, the decision of the Owner shall be final and binding on the Contractor without any commercial implication to owner.

2.10.03 The Owner's Engineer shall hold weekly meetings of all the Contractors working at Site at a time and a place to be designated by the Owner's Engineer. The Contractor shall attend such meetings and take notes of discussions during the meeting and the decisions of the Owner's Engineer and shall strictly adhere to those decisions in performing his Work. In addition to the above weekly meeting, Owner's Engineer may call for other meetings either with individual contractors or with selected number of contractors and in such a case the Contractor, if called will also attend such meetings.

2.10.04 Time is the essence of the Contract and the Contractor shall be responsible for performance of his Work in accordance with the specified construction schedule. If at any time the Contractor is falling behind the schedule, he shall



take necessary action to make good of such delays by increasing his work force or by working overtime or otherwise accelerate the progress of the work to comply with the schedule and shall communicate such action in writing to the Owner's Engineer, satisfying that his action will compensate for the delay. The Contractor shall not be allowed any extra compensation for such action.

- 2.10.05 The Owner's Engineer shall however not be responsible for provision of additional labour and or materials or supply or any other services to the Contractor except for the co-ordination work between various Contractors as set out earlier.
- 2.10.06 The works under execution shall be open to inspection & supervision by the Owner's Owner's Engineer at all times. The Contractor shall give reasonable notice to the Owner before covering up or otherwise placing beyond the reach of inspection any work in order that same may be verified, if so desired by the Owner.
- 2.10.07 Every effort shall be made to maintain the highest quality of workmanship by stringent supervision and inspection at every stage of execution. Manufacturer's instruction manual and guidelines on sequence of erection and precautions shall be strictly followed. Should any error or ambiguity be discovered in such documents, the same shall be brought to the notice of the Owner's Owner's Engineer. Manufacturer's interpretation in such cases shall be binding on the Contractor.
- 2.10.08 The Contractor shall comply with all the rules and regulations of the local authorities, all statutory laws including Minimum Wages, Workmen Compensation etc. The contractor shall engage maximum number of local unskilled and semi skilled labours for construction works. All registration and statutory inspection fees, if any, in respect of the work executed by the Contractor shall be to his account.
- 2.10.09 All the works such as cleaning, checking, leveling, blue matching, aligning, assembling, temporary erection for alignment, opening, dismantling of certain equipments for checking and cleaning, surface preparation, edge preparation, fabrication of tubes and pipes as per general Owner's Engineering practice at site, cutting grinding, straightening, chamfering, filling, chipping, drilling, reaming, scrapping, shaping, fitting-up bolting/welding, etc., as may be applicable in such erection and are necessary to complete the work satisfactorily, are to be treated as incidental and the same shall be carried out by the Contractor as part of the work.
- 2.10.10 In case of any class of work for which there is no such specification as laid down in the contract such as, blue matching, welding of stainless steel parts, etc., the work shall be carried out in accordance with the instructions and requirements of the Owner's Engineer.
- 2.10.11 It may sometimes be necessary to remove some of the erected structural members to facilitate erection of bigger/pre-assembled equipment. In such cases, the removal and re-erection of such members, which are essential, and if so agreed by the Owner's Engineer, will have to be done by the Contractor.



- 2.10.12 Attachment welding of necessary instrumentation tapping points, thermocouple pads, root valves, condensing vessels, flow nozzles and control valves etc., both for regular measurement and performance testing to be provided on equipment, its auxiliaries or pipelines covered within the scope of this tender, will also be the responsibility of the Contractor and the same will be done as per the instructions of Owner's Engineer. The erection and welding of all above items will be the Contractor's responsibility, even if :
- a) Product groups under which these items are re-leased are not covered in the scope of this tender.
 - b) Items are supplied by an agency other than the Contractor.
- 2.10.13 Preservation of all materials/equipment under custody of the Contractor during storage, pre-assembly & erection, commissioning etc., shall be the responsibility of the Contractor. All necessary preservatives and consumables like paints, etc., shall be arranged by the Contractor. Necessary touch up painting, periodic application of preservatives/paints on pressure parts/other equipment even after erection until completion of work shall be carried out by the Contractor. The Contractor shall fabricate piping, install lub oil systems and carry out the acid cleaning of fabricated piping. The Contractor shall also service the lub oil system, carryout the hydraulic test of oil coolers, etc.
- 2.10.14 It is responsibility of the Contractor to do the alignment etc. if necessary, repeatedly to satisfy Owner's Engineer, with all the necessary tools & tackles, manpower, etc. The alignment will be complete only when jointly certified so, by the Contractor's Owner's Engineer & Owner. Also the Contractor should ensure that the alignment is not disturbed afterwards.
- 2.10.15 Additional platforms for approaching different equipment as per site requirement, which may not be indicated in drawings, shall be fabricated and erected by the Contractor. The materials required for these works shall be supplied by the Contractor and he will have to fabricate them to suit the requirement.
- 2.10.16 Equipment and material, which are wrongly installed, shall be removed and reinstalled to comply with the design requirement at the Contractor's expense, to the satisfaction of the Owner/ Consultant.
- 2.10.17 Before erection of any equipment on a foundation, the Contractor shall check and undertake if necessary rectification of foundation bolts, reaming of holes, drilling of dowels, matching of bolts and nuts, making new dowel pin, etc.
- 2.10.18 Assistance for calibrating/testing the power cylinders, valves, gauges, instruments, etc., and setting of actuators coming under various groups shall be provided by Contractor.
- 2.10.19 It shall be the responsibility of the Contractor to provide ladders on columns for initial works till such time stairways are completed. For this, the ladder should not be welded on the column and should be prefabricated clamping type. No



temporary welding on any structural member is permitted except under special circumstances with the approval of Owner.

- 2.10.20 Structural materials required for the supporting/operating platforms required for the valves at various levels for the safe operation of valves will be arranged by the Contractor.
- 2.10.21 For civil, structural and architectural works, volume IIG/1 & IIG/2 may be referred. For Instrumentation and Electrical works Vol. IIE and Vol. IIF1 & F2 may be referred.
- 2.11.00 Safety
- 2.11.01 Safety and overall cleanliness of work site shall be given top priority. The Contractor shall ensure the safety of all workmen, materials and equipment either belonging to him or to others working at site. He shall observe safety rules & codes applied by the Owner at site without exception.
- 2.11.02 The Contractor shall notify the Owner of his intention to bring to site any equipment or material which may create hazard. The Owner shall have the right to prescribe the conditions under which such equipment or material may be handled and the Contractor shall adhere to such instructions. The Owner may prohibit the use of any construction machinery, which according to him is unsafe. No claim for compensation due to such prohibition will be entertained by the Owner.
- 2.11.03 Storage of petroleum products & explosives for construction work shall be as per rules and regulation laid down in Petroleum Act, Explosive Act and Petroleum and Carbide of Calcium Manual. Approvals as necessary from Chief Inspector of Explosives or other statutory authorities shall be the responsibility of the Contractor.
- 2.11.04 The Contractor shall be responsible for safe storage of his and his sub-contractor's radioactive sources.
- 2.11.05 All requisite tests & inspection of handling equipment, lifting tools & tackle shall be periodically done by the Contractor. Defective equipment shall be removed from service. Any equipment shall not be loaded in excess of its recommended safe working load.
- 2.11.06 All combustible waste and rubbish shall be collected and removed from the worksite at least once each day. Use of undercoated canvas paper, corrugated paper, fabricated carton, plastic or other flammable materials shall be restricted to the minimum and promptly removed.
- 2.11.07 The Contractor shall provide adequate number of fire protection equipment of the required types for his stores, office, temporary structures, labour colony etc. Personnel trained for fire-fighting shall be made available by the Contractor at site during the entire period of the Contract.



- 2.11.08 All electrical appliances used in the work shall be in good working condition and shall be properly earthed. No maintenance work shall be carried out on live equipment. The Contractor shall maintain adequate number of qualified electricians to maintain his temporary electrical installation.
- 2.11.09 All workmen of the Contractor working in construction site shall wear safety helmets, safety boots and safety belts. The Contractor shall take appropriate insurance cover against accidents for his workmen as well as third party.
- 2.11.10 All the worksites shall be provided with adequate lighting facilities e.g. flood lighting, hand lamps, area lighting etc. by the Contractor for proper working environment during night times.
- 2.11.11 Adequate number of temporary toilets/urinals (men & women separate) shall be provided at work places with soak pits. Adequate drinking water facilities and rest rooms shall be provided for workers to take food and rest.
- 2.11.12 All safety precautions shall be taken for welding and cutting operations as per IS-818.
- 2.11.13 All safety precautions shall be taken for foundation and other excavation marks as per IS-3764.
- 2.12.00 Taking Delivery & Storage
- 2.12.01 The Contractor shall arrange issue of all equipment and materials to be erected under the contract from the stores/open yard at site by signing on standard indent forms. After completion of work, detailed auditing of the materials so issued shall be submitted to the Owner.
- 2.12.02 The Contractor shall arrange for proper and safe storage of materials till the same are taken over by the Owner as per terms of the contract. Manufacturer's instructions for preservation shall be strictly followed.
- 2.12.03 All empty containers, packing materials, gunny bags, transport frames and also surplus and unused materials reconciliation prior to completion of contract shall be the property of the Owner and returned to the Owner by the Contractor.
- 2.13.00 Site Welding & Heat Treatment
- 2.13.01 Welding shall be done in accordance with IS-813, IS-816, IS-9595 & other relevant IS/International standards and as per instructions of Contractor. Only those welders, who are qualified as per IS-817 for ordinary welds and as per IBR/ASME Section-IX for high pressure welds, shall be employed in the job.
- 2.13.02 All welders shall be tested and approved by Owner's Engineer before they are actually engaged on the work even though they may possess the requisite certificates. The Owner reserves the right to reject any welder without assigning any reason. The welder identification code as approved by the Owner's Engineer shall be stamped by the welder on each joint done by them. The



Contractor will be responsible for the periodic renewal, re-testing of the welders as demanded by Owner.

- 2.13.03 The Owner's Engineer is entitled to stop Contractor's any welder from his work if his work is unsatisfactory for any technical reason or there is a high percentage of the rejection of joints welded by him, which in the opinion of Owner's Engineer will adversely affect the quality of welding even though the welder has earlier passed the tests. The welders having passed the tests do not relieve the Contractor from his contractual obligations, to check the performance of the welders.
- 2.13.04 All charges for testing of welders including destructive and non- destructive tests if conducted by Owner or by the inspection authority at site shall have to be borne by the Contractor. The necessary test materials and consumables will have to be arranged by the Contractor and all testing facility made available, as required.
- 2.13.05 All welded joints shall be subject to acceptance by Owner's Engineer. Inspection of welds shall be in accordance with IS-822 or equivalent code.
- 2.13.06 Preheating/post-heating and stress relieving after welding are part of fabrication and erection work and shall be performed by the Contractor in accordance with the instruction of Owner's Engineer. Contractor shall arrange to supply heating equipment with automatic recording devices. Also the Contractor shall have to arrange for the labour, heating elements, thermocouples, compensating cables, insulation materials like mineral wools, asbestos cloth, ceramic beads, asbestos rope, etc. required for the heat-treatment and stress relieving works. During pre- heat/stress relieving operations, the temperature shall be measured at one or more points as required by attaching thermocouples and recorded on a continuous printing type recorder. All the record graphs for the heat treatment works carried out shall be got signed by the Owner's Engineer prior to the commencement of each cycle and handed over to Owner's Engineer on completion. The graphs will be the property of Owner. The Contractor has to provide thermo-chalks temperature recorders, thermocouple attachments, units, graph sheets, etc. required for the job and maintain them in good condition.
- 2.13.07 All electrodes shall be baked and dried in the electric/electrode drying oven to the required temperature and for the period specified by the Owner's Engineer before they are used in erection work. The electrodes used shall be as per IS-814, IS-815, IS-1442, IS-7280 and other codes as applicable, and shall be of approved reputed manufacture. The electrodes shall meet the requirement of the pipe material. No electrode manufactured more than 12 months ago and the type covered under certificate issued after conducting tests more than 6 months ago shall be used. All electrodes shall be preserved at works and at site as per manufacturer's recommendations.
- 2.13.08 Oxy-acetylene flame or Exothermic chemical heating for stress relieving is not permitted. Heating shall be by means, of electric induction coil or electric resistance coil.



- 2.13.09 It may become necessary to adopt inter layer radiography/MPT/UT depending upon the site/technical requirement necessitating interruptions in continuation of the work and making necessary arrangement for carrying out the above work.
- 2.13.10 Gas tungsten arc welding process (TIG) shall be adopted for all root pass welds except for structural works until 4.75 mm thickness is deposited. Subsequent welding after root pass can be carried out by manual metal arc welding with coated electrodes. For pipes of thickness less than 6 mm the entire welding has to be carried out by TIG welding.
- Fillet weld shall be made by shielded metal arc process as per applicable codes.
- However, the Owner's Engineer will have the option of changing the method of welding as per site requirement. The method adopted for manual arc welding shall be weaving technique and the width of weaving shall not exceed 1.5 times of the dia. of the electrode.
- In case of deviation from welding process and electrodes, the Contractor shall take approval of the Owner prior to adoption of same.
- 2.13.11 The root pass for butt joints shall be such as to achieve full penetration with complete fusion of root edges.
- 2.13.12 Each pass shall be cleared and freed of slag before the next pass is deposited.
- 2.13.13 On completion of each run, craters, weld irregularities, slag etc. shall be removed by grinding or chipping.
- 2.13.14 Each layer of welding shall have an even and smooth appearance.
- 2.13.15 Welding sequence shall be adjusted in such a way that distortion due to welding shrinkage is minimised. Further any movement, shock or vibration during welding shall be avoided to prevent weld cracks.
- 2.13.16 Proper protection of welders and the work shall be taken during periods of rain. No welding shall be carried out when surfaced to be welded are wet from any cause.
- 2.13.17 Following will be stages of inspection during welding:
- a) Two pieces to be joined shall be individually checked for the weld edge preparation and profile dimensionally and to the template. Dye penetrant check shall be carried out on edge prepared surfaces at random. The percentage will depend upon on criticality as specified by Owner's Engineer.
 - b) Joint fit up will be a stage of inspection. Misalignment after fit up may vary from 0.3 mm to 1.6 mm depending on outside diameter and thickness.



- c) All joints shall be offered for visual inspection after root run. Subsequent welding should be made only after the approval of root run.

2.13.18 All welded joints shall be painted with anti-corrosive paint immediately on completion of radiography and stress-relieving.

2.14.00 For further details on procedures of work at site on civil, architectural, electrical and instrumentation & control services, refer Volume: II-E, II-F1 & F2 and II-G/1 G/2 & G/3 of this specification.

3.00.00 **PROTECTION AND CARE**

3.01.00 All construction and erection activities for this project are to be carried out in the plant premises.

3.02.00 Generator Stator Lifting may be considered by either of the two options as mentioned below:

- a) With the help of two (2) nos. turbine room cranes.
- b) With the help of separate lifting arrangement to be provided by the Bidder from outside the TG building A-row column before the construction of A-row building wall.

**REQUIREMENTS OF SPARES, TOOLS & TACKLE,
LUBRICANTS/OIL/CONSUMABLES**

1.00.00 TOOLS & TACKLE

The Contractor shall supply with the equipment one complete set of special tools and tackle as required for the erection, assembly, dismantling & maintenance of the equipment. These special tools will also include special material handling equipment, jigs & fixtures for maintenance and calibration/readjustment, checking & measurement aids etc. A list of such tools & tackle shall be submitted by the Bidder along with the offer. Detailed description of each tools/tackle, its function along with the equipment/part for which it is meant for and the price of each tools/tackle shall also be indicated in the offer. These tools & tackle shall be separately packed and sent to site before the first unit commissioning. The Bidder shall also ensure that these tools are not used for erection purpose.

2.00.00 SPARES

2.01.00 General

The Bidder shall indicate and include in his scope of supply all the necessary start-up, commissioning and recommended spares in addition to mandatory spares as specified elsewhere in the specification. The Owner reserves the right to buy any or all mandatory and recommended spares. The Contractor shall also state for each item of spares both mandatory and recommended, the normal expected service life.

2.01.01 All spares supplied under this contract shall be strictly interchangeable with the parts for which they are intended to replace. The spares shall be treated and packed for long storage under the climatic conditions prevailing at the site, e.g. small items shall be packed in sealed transparent plastic bags with dessicator packs as necessary.

2.01.02 Each spare part shall be clearly marked or labelled on the outside of the packing with the description. When more than one spare part is packed in a single case, a general description of the contents shall be shown on the outside and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purposes of identification.

2.01.03 All cases, containers or other packages are liable to be opened for examination as may be considered necessary by the Engineer.

2.01.04 All mandatory spares shall be delivered to site within one to three months prior to the scheduled date of the trial operation of the plant. However, they shall not be despatched before the despatch of the associated main equipment.

SPARES, TOOLS, TACKLES, CONSUMABLES

- 2.01.05 The Bidder shall also guarantee supply of spare parts, which will be made, based on manufacturer's drawings on special order from the Purchaser for 30 years after commissioning of the plant.
- 2.01.06 Warranty period for all kinds of spares shall be six thousand (6000) hours of operation, except normal wear or eighteen (18) months from the date of receipt at site, whichever is earlier. In case of failure or non-conformance to specifications, the Contractor shall replace them free of cost.
- 2.02.00 **Recommended Spares**
- 2.02.01 The Contractor shall provide a list of recommended spares giving unit prices and total prices for 2 years of normal operation of the plant for spares of indigenous origin, and for 5 years of normal operation for spares of non-indigenous origin. This list shall take into consideration the mandatory spares specified elsewhere in the specification and should be a separate list.
- 2.02.02 The price of recommended spares will not be used for the evaluation of bids. The price of these spares shall remain valid for a period as specified elsewhere in the specification from the date of Award of the Contract. Where the recommended spares are the same as mandatory spares, the prices shall be the same. The prices of any recommended spares, which are not common with mandatory spares, shall be subject to review by the Owner, and shall be finalised after mutual discussion.
- 2.03.00 **Start-up Commissioning Spares**
- 2.03.01 Start-up commissioning spares are those spares which may be required during the start-up and commissioning of the equipment/system. All spares used until the plant is handed over to the Owner shall come under this category. Said spares, properly marked, shall be supplied together with the main equipment and shall be used by the Contractor, if needed, during erection & commissioning stage. All such spares which remain unused till issuance of Taking Over Certificate by the Owner, along with an equipment-wise quantitative consumption report shall be returned to the Owner during time of handover. The list of commissioning spares to be brought by the Contractor to ensure smooth commissioning of the plant shall be subject to the Engineer's approval.
- 2.03.02 The Contractor shall submit a complete BBU list inclusive of recommended, mandatory, initial start-up and commissioning spares. Costs of the above spares, which are consumed before the handing-over of the plant, shall be deemed to have been included in the lump sum proposal price of the package, and the Contractor shall have no claim on this account to the Owner.

TECHNICAL DEVIATIONS

<i>Sl. No</i>	<i>Section no.</i>	<i>Clause No.</i>	<i>Page / No.</i>	<i>Specification</i>	<i>Statement of Deviations/variations</i>	<i>Reason for Deviation</i>	<i>cost of withdrawal</i>

COMPLIANCE CUM CONFIRMATION SCHEDULE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate and furnishing same with the offer:

- 1) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions/ deviations with regard to same.
- 2) QP/ test procedures shall be submitted in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL/ Customer approval in the event of order & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. The charges for 3rd party inspection (Lloyds, TUV or equivalent) for imported components shall be included in the base price of the equipment by the bidder.
- 3) All drawings/ data – sheets etc. to be submitted during contract shall be subject to BHEL/Customer review/ approval. GA drawings, as submitted with offer at tender stage are for reference purpose only and shall be subject to approval during contract stage.
- 4) There are no other deviations with respect to specification other than those furnished in the 'Schedule of Deviations'.
- 5) The offered materials shall be either equivalent or superior to those specified. Also for components where material is not specified it shall be suitable for intended duty, materials shall be subject to approval in the event of order.
- 6) The commissioning spares (if any) are supplied on 'As Required Basis' & prices for same included in the base price (If bidders reply to this is "No commissioning spares are required" and if some spares are actually required during commissioning same shall be supplied by bidder without any cost to BHEL).
- 7) All sub vendors shall be subject to BHEL/ CUSTOMER approval.
- 8) Any special tools & tackles, if required, shall be in bidder's scope.
- 9) Demonstration parameters shall stand valid till the satisfactory completion of demonstration test and its acceptance by BHEL/Customer.

DECLARATIONS

I certify that all the technical data and information pertaining to this specification are correct and are true representation of the equipment/system covered by our format proposal number Dated and there is no deviation to the specification.

I hereby certify that I am duly authorized representative of the Bidder's company whose name appears above my signature.

Bidders Company Name

Authorized representative's
Signature

Name

Bidder's Name	The bidder hereby agrees to fully comply with the requirements and intent of this specification for the price indicated