

**THE WEST BENGAL POWER DEVELOPMENT CORPORATION
LIMITED**

1 X 660 MW SAGARDIGHI TPS UNIT NO. 5 PHASE -III

TECHNICAL SPECIFICATION

FOR

VENTILATION SYSTEM

**SPECIFICATION NO.: - PE-TS-445-554-A002 (REV00)
(MARCH-2022)**



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
POWER PROJECTS ENGINEERING INSTITUTE BUILDING
SECTOR-16A, PLOT NO.-25, NOIDA, INDIA**



TITLE:
1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
TECHNICAL SPECIFICATION FOR
VENTILATION SYSTEM

SPECIFICATION No: PE-TS-445-554-A002

SECTION

REV. 00

MARCH 2022

SHEET : 1 OF 2

CONTENTS

This Technical specification consists of two sections:

SECTION - I

| SUB-SECTIONS | TITLE | Page No |
|-----------------------|---|----------------|
| Sub-Section-A | INTENT OF SPECIFICATION | 2 - 4 |
| Sub-Section-B | PROJECT INFORMATION WITH WIND & SEISMIC DESIGN CRITERIA AND WATER ANALYSIS | 5 - 24 |
| Sub-Section-C | TECHNICAL SPECIFICATIONS | 25 |
| Sub Section-C1 | SPECIFIC TECHNICAL REQUIREMENT | 26 - 48 |
| Sub Section-C2 | CUSTOMER SPECIFICATION | 49 |
| | C2 - A TECHNICAL REQUIREMENT | 50 - 175 |
| | C2 - B PROJECT SPECIFIC GENERAL REQUIREMENTS INCLUDING: GENERAL TECHNICAL REQUIREMENT FUNCTIONAL / PERFORMANCE / DEMONSTRATION / GUARANTEE TESTS QUALITY ASSURANCE DRAWINGS / DOCUMENTS SUBMISSION PROCEDURE PACKING PROCEDURE PROJECT MANAGEMENT AND SITE SERVICES PAINTING SPECIFICATIONS | 176 - 321 |
| Sub Section-C3 | TECHNICAL SPECIFICATION (ELECTRICAL PORTION) | 322 - 365 |
| Sub Section-C4 | TECHNICAL SPECIFICATION (C&I PORTION) | 366 -564 |
| Sub Section-C5 | TECHNICAL SPECIFICATION (HANDLING ARRANGEMENT) | 565 -586 |
| Sub Section-D | STANDARD TECHNICAL SPECIFICATIONS | 587 - 636 |
| Sub Section-E | ANNEXURE-I LIST OF MAKES OF SUB-VENDOR ITEMS | 638 - 640 |
| | ANNEXURE-II MANDATORY SPARE LIST | 641 |
| | ANNEXURE-III LIST OF TOOLS & TACKLES AND LIST OF COMMISSIONING SPARES. | 642 - 643 |
| | ANNEXURE-IV DRAWINGS / DOCUMENTS SUBMISSION PROCEDURE | 644 - 645 |
| | ANNEXURE-V MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION | 646 - 650 |
| | ANNEXURE-VI FORMAT FOR OPERATION AND MAINTENANCE MANUAL | 651 - 654 |
| | ANNEXURE-VII SITE STORAGE AND PRESERVATION | 655 - 670 |
| | ANNEXURE-VIII PAINTING SPECIFICATION & COLOUR SCHEME | 671 |
| | ANNEXURE-IX PACKING PROCEDURE | 672 |

SECTION - II



TITLE:
1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
TECHNICAL SPECIFICATION FOR
VENTILATION SYSTEM

SPECIFICATION No: PE-TS-445-554-A002

SECTION

REV. 00

MARCH 2022

SHEET : 2 OF 2

| SUB SECTIONS | TITLE | Page No |
|----------------------|--|----------------|
| Sub Section-1 | INSPECTION AND TESTING WITH STANDARD QUALITY PLAN | 674-667 |
| Sub Section-2 | LIST OF DOCUMENTS TO BE SUBMITTED WITH BID | 678-679 |
| Sub Section-3 | COMPLIANCE CUM CONFIRMATION CERTIFICATE | 680 -682 |
| Sub Section-4 | PRE BID CLARIFICATION SCHEDULE | 683-684 |
| Sub Section-5 | NO DEVIATION CERTIFICATE | 685-687 |
| Sub Section-6 | GUARANTEED POWER CONSUMPTION (GPC) | 688-689 |
| Sub Section-7 | TENDER DRAWINGS (PID/ MECHANICAL LAYOUT DRAWINGS SHOWING LOCATION OF EQUIPMENT/PLOT PLAN) | 690-702 |



**1 X 660 MW SAGARDIGHI TPS UNIT
NO. 5 PHASE III
VENTILATION SYSTEM**

SPECIFICATION No: PE-TS-445-554-A002

SECTION: I

REV. 00

DATE: MARCH 2022

SECTION - I



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
INTENT OF SPECIFICATION**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

Sub Section: A

REV. 00

DATE: MARCH 2022

SHEET 1 OF 3

**SECTION-I
SUB-SECTION-A
INTENT OF SPECIFICATION**



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
INTENT OF SPECIFICATION**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

Sub Section: A

REV. 00

DATE: MARCH 2022

SHEET 1 OF 3

1.0 INTENT OF SPECIFICATION

1.1 The specification covers design (i.e. Preparation and submission of drawing /documents including "As Built" drawings and O&M manuals), engineering, manufacture, supply / procurement, inspection and testing at vendor's / sub vendor's / manufacturer's works, painting, maintenance tools & tackles (as applicable), fill of lubricants & consumables till handing over, mandatory spares along with spares for erection, start-up and commissioning as required, forwarding, proper packing and shipment till site, unloading, handling & on-site transportation, storage, preservation , security / safety at site , Erection & Commissioning, final painting at site, minor civil & structural works (as applicable) as required, trial run at site and carrying out Performance guarantee / Functional / Demonstration tests at site (As applicable), training of customer/client O&M staff and handover in flawless condition of the package to the end customer complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification as specified above, amendment & agreements till placement of order for **1X660 MW SAGARDIGHI TPS.**

1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil 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 the contractor of the responsibility of providing such facilities to complete the supply, erection and commissioning, performance and guarantee/demonstration testing of **VENTILATION SYSTEM.**

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 highest 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 judgement is not in full accordance herewith.

1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from 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 may have been omitted in the drawing. Similarly, the extent of supply also includes all items required for completion of the system and not withstanding that they may have been omitted in drawings / specifications or schedules.

1.5 The general term and conditions, instructions to tenderers and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is 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 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
INTENT OF SPECIFICATION**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

Sub Section: A

REV. 00

DATE: MARCH 2022

SHEET 1 OF 3

- 1.6 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 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 under Vol-III of the specification **within 10 days of receipt of tender documents**. In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser / 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 Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.
- 1.7 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.
- 1.8 Deviations, if any, should be very clearly brought out clause by clause along with cost of withdrawal in the enclosed schedule (in Vol – III); otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification. If no cost of withdrawal is given against the deviation, it will be presumed that deviation can be withdrawn without any cost to BHEL/its customer.
- 1.9 In the event of any conflict between the requirements of two clauses of this specification documents or requirements of different codes and standards specified, Section – C1 shall prevail over section – D, however more stringent requirement as per the interpretation of the owner shall apply.
- Further, in case of any discrepancy in section 'C1' and section 'C2', Section-C2 shall prevail (customer specification). however more stringent requirement as per the interpretation of the owner shall apply.
- 1.10 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.
- 1.11 For definition of word like Contractor, bidder, supplier, vendor, Customer/ Purchaser Employer, consultant, please refer relevant clause of NIT.



**1 X 660 MW SAGARDIGHI TPS UNIT
NO. 5 PHASE III
VENTILATION SYSTEM
PROJECT INFORMATION WITH WIND AND
SEISMIC DESIGN CRITERIA**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

Sub Section : B

REV. 00

DATE: MARCH 2022

SHEET:

SECTION: I

SUB-SECTION: B

**PROJECT INFORMATION WITH WIND & SEISMIC DESIGN CRITERIA
AND WATER ANALYSIS**



WBPDC

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

SECTION-III

PROJECT SYNOPSIS AND GENERAL INFORMATION



Development Consultants Pvt. Ltd.

**Volume : II-A
Section : III
Project Synopsis and General
Information**



WBPDCL

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

CONTENTS

| CLAUSE NO. | DESCRIPTION | PAGE NO. |
|-------------------|---|-----------------|
| 1.00.00 | INTRODUCTION | 1 |
| 2.00.00 | APPROACH TO SITE | 1 |
| 3.00.00 | LAND | 1 |
| 4.00.00 | SOURCE OF COAL | 2 |
| 5.00.00 | SOURCE OF WATER | 2 |
| 6.00.00 | ASH DISPOSAL AREA | 2 |
| 7.00.00 | DETAILS OF EXISTING FACILITIES OF PHASE-II | 3 |
| 8.00.00 | SALIENT DESIGN DATA | 16 |



Development Consultants Pvt. Ltd.

**Volume : II-A
Section : III
Project Synopsis and General
Information**

**SECTION-III****PROJECT SYNOPSIS AND GENERAL INFORMATION****1.00.00 INTRODUCTION**

The West Bengal Power Development Corporation Limited (WBPDC) proposes to extend their on-going Phase-II extension project of 2x500 MW at Sagardighi by adding one super critical unit of 660 MW as Phase-III extension unit. Sagardighi TPS is located in the village Manigram in Murshidabad district of West Bengal, India. The West Bengal Power Development Corporation Limited, a Company fully owned by the Government of West Bengal formed in the year 1985, have commissioned 2x300 MW Thermal Power Plant together with all other infrastructure at Sagardighi Thermal Power Project. Presently WBPDC is also working on their under-construction Phase- II extension project of 2x500 MW at Sagardighi.

The Bidder shall acquaint himself, by visiting the site, with the conditions prevailing at site. The information given here in under is for general guidance only.

2.00.00 APPROACH TO SITE

Sagardighi Super 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. From Sagardighi railway station a railway line will branch off to the site for material unloading and coal marshalling. The equipment will be normally transported by rail only and under exceptional cases by road. The material consignments shall be as per the restrictions of rail and road transportation prevailing in the country.

Nearest Airport – Kolkata.

Nearest Seaport –Haldia.

3.00.00 LAND

The total land available for the Power Station and Plant auxiliaries will be generally as per the Site Location Plan (12A05-DWG-M-002) enclosed and flexibility will remain to make the final equipment layout based on equipment sizes.

All construction material, heavy equipment, over dimensioned consignments (ODC) for the station during construction may be transported through road/rail access. During operation stage, coal would be transported through rail access.





The total land, approximately 706 hectares, has already been acquired for the present and proposed extension. The locations of various facilities and plant auxiliaries for Unit 1 & 2 under Phase-I and Units 3 & 4 in Phase-II and the space provision for extension unit no. 5 (660 MW) will be as per the General Layout enclosed. About 456 acre of land has been kept for disposal of ash. The Bidder shall accommodate equipment offered under this specification generally within the spaces allocated for such equipment in the General Layout. Specific approval from Owner/Consultant shall be taken by the contractor prior to any revision or relocation.

Except where stated otherwise, the plinth levels of all buildings shall be 300 mm above the corresponding developed grade level and the road level shall be 150 mm above the developed grade.

4.00.00 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. The coal would be carried in rake loads of BOBR/BOX-N wagons.

It is considered that coal would be received from the same source as the plant under Phase-I and Phase-II station with similar characteristics and a new mine at Pachwara (north) in Jharkhand being developed by WBPDC. These sources being connected by B.G. rail track, coal would be transported by rail only. For coal unloading, crushing and storage facility it is proposed that a new Wagon tippler along with crusher houses, conveyors will be installed in addition to existing coal handling plant of Phase-II station with suitable extension from the end of Transfer Point (TP-19).

5.00.00 SOURCE OF WATER

The source of water for this project is the River Bhagirathi (5 km) through the proposed intake pump house under implementation for Phase-II station. 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 for phase - II for meeting the requirement of Phase-III Sagardighi TPS.

The Power station will operate on semi open recirculating condenser cooling system using cooling towers. In addition all water conservation and recycling measures will be adopted to minimize requirement of make up water. The proposed project will adopt zero effluent discharge philosophy.

6.00.00 ASH DISPOSAL AREA

Bottom Ash (BA) shall be extraction in wet form and conveyed to the disposal area in lean slurry form. Whereas Fly Ash (FA) shall be extracted in dry form and stored in dry form for onward usage. However, arrangement shall be also





made to dispose fly ash in lean slurry form to ash dump yard located within 1 km from Plant boundary under exigency..

7.00.00 DETAILS OF EXISTING FACILITIES OF PHASE-II**INTRODUCTION**

The proposed phase-III, Unit No. 5 is an extension project with many auxiliary systems being common and shared with the Phase-II units (Unit Nos. 3 & 4). It is not the intent to describe all systems in details. Facilities being shared by both Phase-II & Phase-III units and which have a common terminating and control philosophy are outlined below:

MAIN & AUXILIARY COOLING WATER SYSTEMS & ACCESSORIES

Condenser cooling water and auxiliary cooling water system of Phase-III will be independent of Phase-II. Separate pump house and pumping system shall be installed for Phase-III. Only CT make-up system of Phase-II will be shared for Phase-III. However, DMCW system of boiler of Phase-II has excess capacity, which can be utilized for phase-III. The detail of excess cooling water capacity is furnished below:

Provision kept of miscellaneous BOP coolers in DMCW (SG) pump capacity of Phase-II:

- i) AHP compressor coolers – $2 \times 300 = 600 \text{ m}^3/\text{hr}$ (for 2X500 MW units)
- ii) MRS compressor coolers - $2 \times 30 = 60 \text{ m}^3/\text{hr}$ (for 2X500 MW units)
- iii) Plant air compressor coolers - $2 \times 175 = 350 \text{ m}^3/\text{hr}$ (for 2X500 MW units)

Cooling water consumption for miscellaneous BOP coolers (both working and standby) of Phase-II:

- i) AHP compressor coolers $158 \text{ m}^3/\text{hr}$ (for 2X500 MW units)
- ii) Fluid Coupling of Ash slurry pumps = $40 \text{ m}^3/\text{hr}$ (for 2X500 MW units)
- iii) BA overflow pumps = $30 \text{ m}^3/\text{hr}$ (for 2X500 MW units)
- iv) MRS compressor coolers - $30 \text{ m}^3/\text{hr}$ (for 2X500 MW units)
- v) Plant air compressor coolers - = $185 \text{ m}^3/\text{hr}$ (for 2X500 MW units)

The following excess capacity of DMCW(SG) system of Phase-II is available, which can be shared by miscellaneous BOP coolers of Phase-III (except BAOF pump and vacuum pumps), by suitable extension of existing supply and return header of Phase-II :

- i) AHP system coolers- $372 \text{ m}^3/\text{hr}$
- ii) MRS compressor coolers - $30 \text{ m}^3/\text{hr}$
- iii) Plant air compressor coolers - = $165 \text{ m}^3/\text{hr}$

Bidder to check and confirm that excess available capacity of DMCW (SG) system of Phase-II would be adequate for satisfactory operation of the above mentioned BOP systems of Phase-III. With this consideration, the capacity of DMCW (SG) can be optimized for Phase-III.



**Condensate Storage Tanks & Transfer System:**

In addition to two (2) nos. installed Condensate storage tanks of Phase-II, One (1) no. similar capacity Condensate storage tank (CST) of capacity 750 m³ shall be installed for Phase-III.

Inside CST pumps, the following horizontal centrifugal pumps are installed for Phase-II:

- a) Three (3) nos. (2W+1S) cycle make-up (DMSW)pumps of capacity 120 m³/hr and TDH 50.0 MWC at rated capacity
- b) Two (2) nos. (1W+1S) boiler fill(SG Fill) pumps of capacity 190 m³/hr and TDH 140.0 MWC at rated capacity
- c) Two (2) nos. (1W+1S) CPU Regeneration pumps

In addition to these, installed pumps, the CST pump house have the provision for the following pumps of Phase-III:

- a) One (1) no cycle make-up pump
- b) One (1) no boiler fill pump (though no additional pump is considered for Phase-II, as the capacity of boiler fill pumps of Phase-II is envisaged to be sufficient for requirement of Phase-III).
- c) Two (2) nos. (1W+1S) CPU Regeneration pumps

The proposed pumps of Phase-III shall be selected and interconnected such that the aggregate pumping capacity of Phase-II & III can be shared by all the units of both Phase-II & III.

WATER & WASTEWATER TREATMENT SYSTEMS**Pre-Treatment System-**

A Pre-Treatment Plant for Phase-II (Unit Nos. 3 & 4) have been envisaged which shall cater the requirement for Phase-III (Unit 5). As per the WBD developed for 3,4 & 5 the total clarified water requirement works out as 4789 m³/hr. therefore the requirement of construction of additional PT Plant is not called for. However the detail of the Pre-Treatment System is given below.

Raw water will be taken through a flow control station to Aerator where raw water will be aerated and then led to Stilling Chamber where its turbulence will be broken.

To inhibit incidental growth of organic matters in raw water, pre chlorination of raw water in Stilling Chamber shall be carried out by use of gaseous chlorine.





Water will then flow to three (3) nos. Distribution Chambers through three (3) nos. Parshall Flumes. From Distribution Chambers, water would be directed to three (3) nos. proposed High Rate Solids Contact Clarifiers. Chemicals such as Ferric Chloride, Lime solution & Polyelectrolyte will be added at the inlet of each of the High Rate Solids Contact Clarifiers.

Clarified water from Clarifiers will flow through channel and be stored in a Clarified Water Reservoir for further use.

The sludge generated from Clarifiers as addressed above will be collected in a common Sludge Sump. Sludge will be pumped from Sludge Sump by means of three (3) nos. Sludge transfer Pumps to the Effluent Treatment Plant. An arrangement for sludge recirculation to Clarifiers shall be provided to aid flocculation in case of low turbidity in raw water.

All chemicals required for the entire plant will be stored in the ground floor of a two-storied Chemical House. Chemicals will be unloaded from the trucks and thereafter be stacked in the respective storage space at ground floor by means of an Electrically Operated Monorail Hoist. However, preparation of chemical solution of Ferric Chloride, lime and polyelectrolyte for injection to raw water shall be carried out in the first floor of the Chemical House. Chemicals will be lifted from ground floor to first floor by means of another Electrically Operated Monorail Hoist. The water required for preparation of solutions is supplied from Overhead Clarified Water Tank to be located above Chemical House or directly from the Service Water Line.

The Chlorination System will be complete with Electrically Operated Monorail Hoist, Chlorine Ton Containers, Booster Pumps, Strainers, Pipe Works and Diffuser Systems up to points of injection, Emergency Chlorine Leak Absorption System and all other necessary accessories and auxiliaries.

The Chlorinators will be connected with Chlorine Ton Containers. The water to the Booster Pumps will be supplied from Overhead Clarified Water Tank located above Chemical House. All the necessary equipment (Chlorinators, Chlorine Ton Containers, etc.) will be located indoor at ground floor of the Chemical House as addressed above.

The water to the booster pumps will be supplied from Overhead Clarified Water Tank.

De-mineralization System

A De-mineralization Plant for Phase-II (Unit Nos. 3 & 4) have been envisaged which shall cater the requirement for Phase-III (Unit 5), considering 500 MW sub-critical unit. In view that Unit #5 is now rated to 660 MW super-critical technology, the requirement of DM water has been reduced as evident from attached WBD. Therefore the requirement of construction of additional DM Plant is not called for. However the detail of the De-mineralization System is given below.





Clarified Water will be pumped from Clarified Water Reservoir (located in Raw Water Treatment Plant area) by three (3) nos. DMF Feed Pumps to UF-RO-MB Exchanger Plant.

Clarified Water will enter the Dual Media Filters and suspended solids present in it will be removed.

From the Dual Media Filters, water shall flow to UF Modules through Pre-Filter. The UF Modules shall be backwashed automatically as per the requirement. Permeate from UF Modules shall be stored in 'UF Permeate Water Storage Tank' for further treatment by Reverse Osmosis. Reject from UF Modules shall be collected to Backwash Collection Pit and feed to the Waste Water Treatment System.

Ultrafiltered water from UF Permeate Storage Tank shall be pumped to Cartridge Filter for further filtration, prior to RO Modules.

Required quantity of antiscalant shall be dosed before Cartridge Filters in order to reduce scale formation tendency of feed water on the surface of the RO Membranes. Sodium Bi Sulphite shall be dosed to de-chlorinate the water and acid shall be dosed to maintain the pH.

After Dosing, filtered Water from Cartridge Filter shall be passed through RO High Pressure Pump to deliver water at desired pressure to the inlet on RO Modules.

The entire RO System shall be designed to achieve minimum 85% recovery. Permeate shall be passed through Degasser Tower to reduce the dissolved CO₂ content in the water. Water from Degasser Towers shall be collected to the Degassed Water Storage Tank.

Degassified RO Permeate, finally be pumped to MB Exchanger for further reduction of TDS, to get desired quality of Water.

For chemical cleaning of UF System, One (1) no..UF Cleaning Solution tank, two (2) nos. UF Cleaning Chemical Pumps and one (1) no. 5 micron cartridge filter along with necessary piping and instrumentation as addressed in the P&I Diagram shall be provided.

A full-fledged chemical cleaning system comprising One (1) no. chemical cleaning tank, one (1) no. chemical solution circulating pumps and one (1) no. 5 micron cartridge filter along with necessary piping and instrumentation as addressed in the P&I Diagram shall be provided for RO Skid.

The entire UF-RO-MB Exchanger System along with Chemical Dosing / Cleaning Systems shall be located indoor within DM Plant Building.

**EFFLUENT TREATMENT SYSTEM**

An Effluent Treatment Plant is already under construction for the Treatment of liquid waste to be generated from Unit# 3, 4 & 5. The wastewater streams from different sources of the Power Plant will be collected, treated and then reused to the maximum extent possible within the Plant. Various waste waters are to be handled and treated for reuse.

However few items have been envisaged for Phase-III (Unit 5) which is described below.

One (1) no. Retention pit and two (2) nos. transfer pumps for service oily waste from Power House Area which will pump the effluent from Power House Area to the existing Waste water Treatment Plant.

One (1) no. Retention pit and two (2) nos. transfer pumps oily effluent from Transformer Yard area which will pump the effluent from Transformer Yard area to the existing Waste water Treatment Plant.

COAL HANDLING SYSTEM

The Existing Coal Handling Plant has been designed to cater the requirement for Phase-II & III stations together. One (1) track hopper for Phase-I, one (1) additional track hopper (Capacity: 5100T) and one (1) wagon tippler (Rated capacity 20 Tips/Hour and Design capacity 25 tips/Hour) along with one (1) side arm charger (Rated / Design capacity 29 Loaded wagons of 140 T) in Phase-II are provided. These are adequate for Phase-III extension unit#5 also. Further two (2) nos. of stacker-cum-reclaimers having 2000 / 2200 TPH rated / design capacity for Phase-II station are adequate for both Phase- II & III units. In the existing crushers, coal would be sized to (-) 20 mm. Crushed coal would thereafter be led either to the boiler bunkers or to the stack yard. In the main route, coal will be directly taken to the powerhouse via TP # 19. Existing four (4) nos. in-line magnetic separators, two (2) nos. metal detectors, two (2) nos. suspended magnets, four (4) nos. belt weighers, two (2) nos. coal sampling units will be commonly used for phase-II & phase-III units.

New set of 2000 / 2200 TPH rated / designed capacity twin stream conveyors as per the same for existing CHP would be installed under Phase-III beyond Transfer Point 19 of unit #4 upto unit #5 bunkers.

New set of 1650 / 1500 TPH, 1200 / 1320 TPH (rated / designed) capacity twin stream conveyors considered from New Wagon Tippler to TP-20. This conveyor stream will also feed to conveyor 22A & 22B for Stacking on the Existing Stock Pile.

Existing system facilities to be commonly used for Phase-II & III and new dedicated system facilities for Phase-III





The major equipment for the coal handling plant installed for Phase-II & shall serve Phase III also is listed below :-

1. a) Track Hopper : 5100T with paddle feeders to twin stream conveyors
- b) Wagon Tippler : One (1) no (Rated capacity 20 Tips/ Hr and Design capacity 25 ips / hr.).
- c) Side Arm Charger : One (1) no
2. Conveyors : Twin stream conveyor line of 2000 / 2200 TPH rated / design capacity.
3. Crushers : **Type:** Ring granulator.
Number: Four (4) (2 working + 2 standby)
Capacity: 1200 TPH (Rated) / 1320 TPH (Design)
Input coal size: (-) 300 mm
Output coal size: (-) 20 mm
4. Vibrating Screen : **Type:** Roller screen type.
Number: Four (4) (2 working + 2 standby)
Capacity: 1200 TPH (Rated) / 1320 TPH (Design)
5. Paddle Feeder : Capacity 1200 TPH rated / 1320 TPH design x 2 in each stream of conveyors.
6. Stacker-cum-reclaimer : **Type:** Hydraulic motor-driven rail-mounted unidirectional having slewing and adequate lifting arrangement.

Stacking Capacity: 2000 TPH (Rated) / 2200 TPH (Design)
Reclaiming Capacity: 2000 TPH (Avg.) / 2200 TPH (Peak)



**Quantity:** Two (2)**Coal size:** (-) 20 mm

7. Apron feeder : 2000 / 2200 TPH rated / design capacity

ASH HANDLING SYSTEM

BAHP Water System

Six (6) nos. (4W+2S) BAHP water pumps (Make- Flowmore& Model - 5822 (HS) / 350 X 300) with drive, each of capacity 1000 CMH and discharge pressure of 70 MWC, are already installed in existing ash water sump & pump house (common for Phase-II & III). Space for two (2) nos. BAHP water pumps (one shall cater the HP water requirement of bottom ash system and the other for wet fly ash system) with drive for Unit#5, had been kept in the existing ash water sump & pump house.

For details and disposition of existing equipments of Phase-II and space provision for proposed equipment of phase-III, please refer layout of ash water sump & pump house (Dwg. No I-5034-M-GA-002).

BALP Water System

Three (3) nos. (2W+1S) BALP water pumps (Make – Flowmore & Model - 5821A / 300 X 250) with drive, each of capacity 757 CMH and discharge pressure of 25 MWC, are already installed in existing ash water sump & pump house. Space for one (1) no BALP water pump with drive for Unit#5, had been kept in the existing ash water sump & pump house.

For details and disposition of existing equipments of Phase-II and space provision for proposed equipment of phase-III, please refer layout of ash water sump & pump house (Dwg No I-5034-M-GA-002).

Eco Water System

Three (3) nos. (2W+1S) Eco water pumps (Make – Flowmore & Model - F5824A / 100 X 75) with drive, each of capacity 48 CMH and discharge pressure of 45 MWC, are already installed in existing Boiler area for Phase-II i.e. Unit #3 & #4. Space for one (1) no eco water pump for Unit # 5, had been kept in the existing Boiler area (Phase-II).

Ash Conditioning Water System

Two (2) nos. (1W+1S) ash conditioning water pumps (Make – Flowmore & Model - F5824 / 100 X 75) with drive, each of capacity 106 CMH and discharge pressure of 50 MWC, are already installed in existing silo utility building. Space for one (1) no ash conditioning water pump for the proposed silo of Unit#5, had been kept in the existing silo utility building.





For details and disposition of existing equipment of Phase-II and space provision for proposed equipment of phase-III, please refer layout of silo utility building (Dwg No I-5034-M-BE-016).

Seal Water System

Two (2) nos. (1W+1S) seal water pumps (Make – Flowmore & Model - M5972 / 150 X 100) with drive, are already installed in existing ash slurry pump house for Phase-II i.e. Unit #3 & #4. Space for Two (2) nos. (1W+1S) seal water pumps for Unit # 5, had been kept in the existing ash slurry pump house.

Civil foundations for the proposed pumps have already been constructed in the existing slurry pump house. The base plate of the proposed pumps shall be matched with the foundation.

For details and disposition of existing equipment of Phase-II and space provision for proposed equipment of phase-III, please refer layout of ash slurry sump & pump house (Dwg No I-5034-M-GA-001).

Ash Slurry Disposal System

Four (4) nos. (2W+2S) ash slurry pump (Make – Indure & Model - A-918-401) chain (each slurry pump chain consists of 2 nos. pumps in series and there is space provision for future series pump also) with drive, each of capacity 1270 CMH, are already installed in existing ash slurry sump & pump house for Phase-II i.e. Unit #3 & #4. Space for one (1) no ash slurry pump chain for Unit # 5, had been kept in the existing ash slurry sump & pump house.

Civil foundations for the proposed pumps have already been constructed in the existing slurry pump house. The base plate of the proposed pumps shall be matched with the foundation.

For details and disposition of existing equipments of Phase-II and space provision for proposed equipment of phase-III, please refer layout of ash slurry sump & pump house (Dwg No I-5034-M-GA-001).

Silo

Three (3) nos silos, each of capacity 2400 Tons, are already installed in existing silo area for Phase-II i.e. Unit #3 & #4. Space for one (1) no silo for Unit # 5, had been kept in the existing silo area.

For details and disposition of existing silos of Phase-II and space provision for proposed silo of phase-III, please refer layout of ash compressor house (Dwg No I-5034-M-GA-015).



**Silo Fluidizing Air System**

Five (5) nos. (3W+2S) water cooled silo aeration blowers (Make - Swam & Model - RH-250 WC) with drive and heater, each of capacity 1860 CMH and discharge pressure of 10 MWC, are already installed in existing silo utility building for Phase-II i.e. Unit #3 & #4. Space for one (1) no silo aeration blower and heater for Unit # 5, had been kept in the existing silo utility building.

For details and disposition of existing equipment of Phase-II and space provision for proposed equipment of phase-III, please refer layout of silo utility building (Dwg No I-5034-M-BE-016).

Instrument Air System

Four (4) nos. (2W+2S) oil free, water cooled screw compressor (Make - Atlas Copco & Model ZR 110) with drive and heat of compression (HOC) dryer (Make - Atlas Copco), each of capacity 900 CMH (FAD) and discharge pressure of 8 Kg/cm² (g), are already installed in existing ash compressor house for Phase-II i.e. Unit #3 & #4. Space for one (1) no instrument air compressor & HOC dryer for Unit # 5, had been kept in the existing ash compressor building.

For details and disposition of existing equipment of Phase-II and space provision for proposed equipment of phase-III, please refer layout of ash compressor house (Dwg No I-5034-M-GA-018).

Recycle Water System

Space for two (2) nos. (1W+1S) recycle water pump with drive for phase-III, had been kept in the existing ash clarifier area.

Space for one (1) no ash slurry disposal pipe (450 NB x 9.52 MM Thk.) for Unit # 5, had been kept in the existing slurry piping corridor of Phase-II. Please refer Dwg No I-5034-M-BE-015 & I-5034-M-BE-025 for layout of existing ash slurry disposal piping & ash dyke.

MILL REJECT SYSTEM (COMPRESSED AIR SYSTEM)

Two (2) nos. (1W+1S) oil free, water cooled screw compressor (Make - ELGI and Model No. - EG110 - 5.5 WC) with drive, each of capacity 20 m³/min (FAD) and discharge pressure of 5.0 Bar (g), are already installed in existing Plant Compressor House (Common for Phase-II & III) for Phase-II i.e. Unit #3 & #4. Space for one (1) no conveying air compressor for Unit # 5, had been kept in the existing plant compressor building.

Civil foundation for the proposed MRS Compressor has already been constructed in the existing plant compressor house. The base plate of the proposed compressor shall be matched with the foundation.





For details and disposition of existing equipments of Phase-II and space provision for proposed equipment of phase-III, please refer layout compressor house (Dwg. No. PE-V0-373-160-505).

Cooling water requirements for conveying air compressor shall be met from existing DMCCW system. The supply and return lines shall be connected at the tie in points from the existing DMCCW system.

PLANT COMPRESSED AIR SYSTEM

Plant air compressor house will be common for Phase-II & III. Instrument air and service air compressors, dryer, receivers and interconnecting piping system for phase-II are installed in the compressor house. Provision of one (1) no. Instrument air Compressor and one (1) no. Service air Compressor, with dryer, receivers and interconnecting piping system are kept in the compressor house for Phase-III. The brief details of existing facilities of Phase-II are indicated below:

- a) Instrument Air Compressors- Three (3) nos. (2W+1S) Motor driven oil free screw compressors with air dryer, each of capacity 36 Nm³/min (FAD-46.53 m³/min) and discharge pressure of 8.0 kg/cm²(g)at after cooler outlet at rated capacity.
- b) Service Air Compressors- Two (2) nos. (2W+0S) Motor driven oil free screw compressors with air dryer, each of capacity 36 Nm³/min (FAD-46.53 m³/min) and discharge pressure of 8.0 kg/cm²(g)at after cooler outlet at rated capacity.
- c) Air Receivers- Five (5) nos., each of capacity 10m³.

For details and disposition of existing equipment of Phase-II and space provision for proposed equipment of phase-III, please refer P&ID & layout Compressor house of Phase-II (Dwg. no. PE-V0-373-555-A002 & PE-V0-373-555-A001 respectively).

The proposed compressors of Phase-III shall be selected and interconnected such that the aggregate compressed air capacity of Phase-II & III can be shared by all the units of both Phase-II & III.

FIRE PROTECTION SYSTEM

Two (02) nos. inter-connections with isolation valves for hydrant system and Two (02) nos. inter-connections with isolation valves for spray system shall be considered at site for proposed integration with the hydrant and spray network of Phase-III with Phase – II. Please refer Composite piping layout of hydrant and spray network of Phase-II (Dwg. no. PE-V0-373-522-A0013) for locations of inter connection points.

LP PIPING (PIPE RACK)

Existing pipe rack of Phase-II shall be utilized to carry pipe lines from new pumps/ compressors of Phase-III to be installed in existing pump/compressors





houses of Phase-II. Suitable augmentation/ modification/strengthening of existing pipe racks of Phase-II shall be carried out by the bidder.

FUEL OIL HANDLING SYSTEM

No further extension of unloading and storage capacity is envisaged for installed fuel oil handling system, which is sufficient for requirement of Phase-I, II & III units.

Pressurizing pumps will supply oil from the HFO/LDO storage tanks to the burner. Three (3) nos. HFO (2 W+ 1S) & two (2) nos. LDO (1W +1S) pressurizing pumps (each having capacity equivalent of 2X500 MW units) are installed under Phase-II system.

There is provision for one additional HFO pressurizing pump along with HFO Heater to be installed in pressurizing pump house to cater the requirement of Phase-III. Installed LDO forwarding pumps of Phase-II can also cater requirement of Phase-III. HFO & LDO Pressurizing pump discharge lines, which has been extended up to Unit #4 of Phase-II, shall be further extended by bidder to feed Phase-III.

HFO supply and return lines to and from boiler of phase-III to be extended from existing HFO supply and return header respectively (terminated with isolation valve) of Phase-II. Similarly, LDO supply line to boiler of phase-III to be extended from existing LDO supply header (terminated with isolation valve) of phase-II.

The proposed HFO pressurizing pump with heater of Phase-III shall be of identical capacity with the existing equipment to utilize existing equipment foundations at site.

ELECTRICAL EQUIPMENT & ACCESSORIES

Necessary power supply for Phase-III Fuel oil pump will be arranged from existing FO Switchboard. Accordingly existing FO switchboard shall be modified as specified elsewhere.

If the new equipment of Phase-III 400kV air insulated switchyard can be accommodated in the existing switchyard control building, same needs to be modified if required.

For further details regarding the existing facilities of Phase – II, please refer Volume – II F1 and F2: Technical Specifications for Electrical Equipment and accessories.

CONTROL & INSTRUMENTATION

The following are the existing Stage-II facilities which shall be used for Unit #5 C&I works.





- | | System | Existing Facilities to be used |
|----|--|---|
| a) | Fuel Oil Pressurizing & Heating System | Existing spare I/O cards and spare I/O slots of Unit #3 & Unit #4 DCS [Stage-II] shall be used for augmentation of the new Fuel Oil Pressurizing & Heating System of Unit#5 of Stage-III. Relevant control shall be implemented in the existing DCS processors. |
| b) | Compressed Air System | <p>New Instrument Air Compressor and Service Air Compressor shall share the existing serial network of Compressors of Unit#3 & Unit#4 DCS [Stage-II] for DCS soft communication.</p> <p>The new Instrument Air Compressor shall also be interfaced with the existing electronic sequencer module (ES-6) provided for the existing Instrument Air compressors of Unit#3 & Unit#4 DCS [Stage-II] for group interlocks.</p> |
| c) | Mill Reject Handling System | <p>The control shall be implemented in the existing MRHS PLC of Unit#3 & Unit#4 [Stage-II], located in the existing CPU regeneration Area control room. The new MRH System shall use the existing processor of the PLC. New IO panel for additional IO cards for the new system shall be installed in the assigned location of the existing control room for Future IO Panel.</p> <p>The UPS for the new MRH system PLC IO Panel shall be derived from the existing UPS ACDB located in the existing CPU Regeneration Building Control Room (Stage-II).</p> |
| d) | Ash Handling System | <p>The operation and control of new Unit#5 AHP facilities shall be through the existing PLC of Stage-II (located in the Compressor House Control room).</p> <p>Existing PLC processor (PLC-1), shall cater to the control of the common systems including Ash Water & Ash Slurry System, Fly Ash Unloading System, Instrument Air System & various sump draining systems.</p> <p>Additional IO panels shall be installed in the locations assigned for future IO panels in the Compressor House Control Room, Ash Water Pump House RIO Room and Silo Utility Building RIO Room of Stage-II units.</p> |





One new redundant processor shall be installed in the existing Processor Panel located in the Compressor House Control room to cater the new Unit#5 Bottom Ash & Fly Ash Evacuation System. Extended RIO of the new processor shall be procured for the Unit#5 systems.

For new PLC CPU/ IO at existing (Stage-II) Compressor House Control Room, existing UPS system in the Existing [Stage-II] Compressor House Control Room shall be considered.

New Energy Meter, Numerical Relays, Air Compressor etc. shall share the existing serial network for interface with existing PLC for Unit#3 & Unit#4 [Stage-II].

- e) Coal Handling System

Spare IOs cards at Remote IO Unit of existing Stage-II CHP PLC near TP-17 of Stage-II shall be used for the augmentation of new CHP system of Unit#5 (Stage-III). The control shall be implemented in the existing PLC processor.

However, for Wagon Tippler & Crusher separate new PLC based system with connectivity with existing PLC at HMI network level shall be envisaged.

Existing “3D Level Mapping Software” loaded in the CHP PLC for Unit#3 & #4 of Stage-II shall be used for the new Unit#5 Bunker Level indication System. The existing Fiber Optic network for CHP PLC interface with Bunker Level indication System of Stage-II shall also be used by the new Bunker Level indication System for CHP PLC interface.

- f) GPS Master Clock System

All the microprocessor based control systems like DCS, PLC based systems, CCTV, TSI & Rotating machine condition monitoring system etc of unit#5 shall be time synchronized with the Existing GPS Master clock of Phase-II.

- g) Fire Alarm System

Existing Fire Alarm Panel at Fire Station of phase II shall be used to display parameters / Alarms of new Fire Alarm System of unit#5. Main FAP of unit#5 shall be connected to the phase II FAP located at existing fire station.



**CIVIL, STRUCTURAL AND ARCHITECTURAL WORK (BUILDINGS CONSTRUCTED WITH SPACE FOR PHASE III)**

Necessary Walkway connection between operating floors of Power House of Phase – II (Existing) and Phase – III shall be considered by Bidder.

Few civil foundations have already been constructed for future equipment. Such existing foundation details including bolts, inserts etc. to be studied in detail before procurement of specific equipment for respective purposes so that the same can safely be placed over the existing foundations complying all technical compatibility. In case this is not at all possible, new foundations need to be constructed after complete demolition of existing foundations.

For further details regarding the existing facilities of Phase – II, please refer Volume – II G1, G2 and G2: Technical Specifications for Civil, Structural and Architectural..

8.00.00 SALIENT DESIGN DATA

8.01.00 For implementation of the project, the Bidder shall consider the following Site and Meteorological data:-

- a) Location : Manigram village, Sagardighi, Raghunathganj sub-division, Murshidabad District, West Bengal.
- b) Latitude and Longitude : 24⁰ 22' 13.7" N, 88⁰ 6' 15.8" E (Topo sheet No.78/D/3)
- c) Nearest Towns : Ajimganj, Jangipur, Raghunathganj.
- d) District Head Quarters : Berhampore - 40 km.
- e) Approach Road : 20 km from National Highway (NH-34)
- f) Nearest Railhead : Manigram railway station on Bandel-Barhawara branch line 1 km from site.
- g) Source of Water : Bhagirathi River - 5 km
- h) Source of Coal : Pachwara (North) mine block in Jharkhand.
- i) Fuel Transportation : By rail in rake loads of BOBR/BOX-N wagons.
- j) Surrounding Habitations : Villages - Manigram, Chhamugram, Karaia, Thakurpara on the south; Bhumhar, Khasittor, Ekrakhi on the west;





WBPDC

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

Dhalo, Bagpara, Santoshpur on the north and Harirampur, Chandparam, Dogachhi on the east.

- k) Level : Within 34.5 m contour. Land is above HFL (highest flood level) of the area.
- l) Soil : Less fertile alluvial soil.
- m) Land Use : Within existing plant boundary of WBPDC.

Meteorological data of site is given below:

- a) Design ambient dry bulb temperature : 50 °C maximum
5 °C minimum
- b) Highest wet bulb temp : 26.9 °C
- c) Maximum relative humidity : 84%
- d) Average relative humidity : 73%
- e) Average annual Rainfall : 1389 mm
- f) Wind load : In accordance with IS-875 for a basic wind speed of 47 m/sec, up to a height of 10 metres above mean ground level.
- g) Seismic Zone : Zone III as per IS: 1893 latest edition.
- h) Altitude : 34M above MSL





**1 X 660 MW SAGARDIGHI TPS UNIT
NO. 5 PHASE III
VENTILATION SYSTEM
TECHNICAL SPECIFICATION**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

Sub Section : C

REV. 00

DATE: MARCH 2022

SECTION: I

SUB SECTION: C

TECHNICAL SPECIFICATION



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
SPECIAL TECHNICAL REQUIREMENT**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

Sub Section : C 1

REV. 00

DATE: MARCH 2022

Page 1 of 23

SECTION: I

SUB-SECTION: C 1

SPECIAL TECHNICAL REQUIREMENT



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
SPECIAL TECHNICAL REQUIREMENT**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

Sub Section : C 1

REV. 00

DATE: MARCH 2022

Page 2 of 23

1. FUNCTION

The purpose of the system is to provide Ventilation System for different areas of **1x660 MW, SAGARDIGHI TPS UNIT NO. 5, PHASE-III** under the scope of this tender.

2. SYSTEM DESCRIPTION

2.1. POWER HOUSE

2.1.1 The Ventilation System is provided in the following locations within the Power House by Air washers. Coursing of air in desired direction / areas shall be made by using roof extractors.

2.1.2 TG bay (ground, mezzanine and operating floor), HP/LP heater area, condenser area, Boiler feed pump area Oil cooler area

2.1.3 MCC Rooms.

2.1.4 Cable Spreader Rooms

2.1.5 Switchgear Rooms

2.1.6 Cooled and filtered air from Air Washer Unit shall be distributed by means of ducting to the TG building near various heat sources like turbo-generator, condenser, Boiler feed pump HP & LP heaters etc. The hot air from the hall shall be exhausted by means of roof extractors. The quantity of air exhausted shall be kept lower than the quantity of air supplied in such a way that a little overpressure is maintained inside the hall. This will reduce infiltration of outside hot and dusty air.

2.1.7 The supply air quantity is supplied from four (4) nos. containerized type air washers for Unit 5- two (2) nos. being located outside A-Row of TG building at roof of DG room and two (2) nos. being placed on B-C bay at 24.0M floor level. Such division and location area has been decided to achieve effective air distribution with less amount of ductwork and less pressure drop in fans. These air washers shall be placed outside, open to atmospheric condition.

2.1.8 The Air Washer Units will primarily serve TG hall and the electrical areas like MCC Room, Switchgear Room, and Cable Spreader Room. The washed air supplied to MCC / Switchgear/Cable Spreader Rooms shall be exhausted outside through Back Draft Dampers. Fire dampers are provided in the supply air ducting leading to all electrical rooms (MCC, Switchgear etc.)

2.1.9 The supplied air in the lower level of TG hall after taking the heat load of TG bay rises through different openings to the upper floors and is then finally exhausted (**60%** of total supplied by Air washers) by means of roof exhausters placed over the roof of TG Hall. Some quantity of air leaks out through various leakage areas thus maintaining slight positive pressure inside w.r.t. outside.

2.1.10 These being containerized type of air washers placed, outside, exposed to ambient condition.

2.1.11 The location of air washers as described above, may change during detail engineering.



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
SPECIAL TECHNICAL REQUIREMENT**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

Sub Section : C 1

REV. 00

DATE: MARCH 2022

Page 3 of 23

2.2 ESP CUM FGD CONTROL ROOM

- a) Minimum Two (2) no. of Unitary air filtration unit (UAF) of minimum capacity 1,50,000 m³/hr each, with all accessories etc. as detailed out in technical specification shall be provided for non-AC area of ESP cum FGD control room.

2.3. Miscellaneous areas:

All other areas like pump house, MCC rooms and switchgear rooms, battery rooms covered under bidder's scope and shall be ventilated by a combination of supply air fans and roof exhauster fans or supply air fans & exhaust fans or supply air fans and back draft dampers or fresh air in-take louvers & exhaust air fans. For ventilation of battery rooms and oil rooms, flame proof motor shall be used. Further, toilets shall be provided with propeller type exhaust air fans.

2.4. The ventilation philosophy in various areas shall be as under:

| S. No. | Area | Type of Ventilation | ACPH |
|--------|--|---|------|
| 1. | TG Hall | Ventilation with Air washer & mechanical exhaust from roof extractor units. | 6 |
| 2. | Cable Spreader room in TG Building. | Ventilation with Air washer & exhaust through gravity damper. Motorized Fire dampers will be provided in the supply air ducting. | 5 |
| 3. | Electrical Rooms (M.C.C. room, Switchgear room in TG Building) | Ventilation with Air washer & exhaust through gravity damper. Motorized Fire dampers will be provided in the supply air ducting. | 15 |
| 4. | Toilets, pantries. | Mechanical ventilation with propeller type exhaust fan. Supply through undercut / opening below door. | 20 |
| 5. | Battery and battery charger room (Lead Acid & VRLA battery room) | Negative pressurization means of axial flow exhaust having spark proof construction fans with flameproof motors. Supply of washed air to battery room shall be through intake louvers provided in wall adjacent to the exhaust fan. | 20 |
| 6. | Non AC areas of ESP cum FGD control building (MCC / switch gear room) | Ventilation with UAF & exhaust through gravity damper. Motorized Fire dampers will be provided in the supply air ducting. | 15 |
| 7. | Non AC areas of ESP cum FGD control building (cable spreader room) | Ventilation with UAF & exhaust through gravity damper. Motorized Fire dampers will be provided in the supply air ducting. | 5 |



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
SPECIAL TECHNICAL REQUIREMENT**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

Sub Section : C 1

REV. 00

DATE: MARCH 2022

Page 4 of 23

| | | | |
|-----|--|---|----|
| 8. | CW Pumps House cum Fire Water Pump House | Supply air by wall-mounted axial flow fans (without filter) and exhaust through Exhaust louver. Note: If air volume is too high, RE Unit shall be provided in place of axial fan along-with intake louvers. | 10 |
| 9. | CW Treatment cum chlorination building | Wall mounted exhaust fans for the Chlorination area. Fresh air will enter the Building through intake louvers. For the associated Electrical MCC Room, Pressurised ventilation with wall mounted fan filter units and air exhaust through Back Draft Dampers. | 20 |
| 10. | CW Dosing Pump House Area | Supply air by wall-mounted axial flow fans (without filter) and exhaust through Exhaust louver. | 10 |
| 11. | Extension of CST Pump House Area | Supply air by wall-mounted axial flow fans (without filter) and exhaust through Exhaust louver. | 10 |
| 12. | CPU Regeneration Building | Fresh air entry through Inlet Louvers and hot air exhaust through Wall Mounted Exhaust Fans. | 10 |
| 13. | RC Pump + Oxidation Blower House for FGD Package | Supply air by wall-mounted axial flow fans (without filter) and exhaust through Exhaust louver. | 10 |
| 14. | SO ₂ analyzer room for FGD Package (Non-AC area) | Supply air by wall-mounted axial flow fans (with filter) and exhaust through gravity damper. | 10 |
| 15. | Elevator Machine room | Supply air by wall-mounted axial flow fans (with filter) and exhaust through gravity damper. | 15 |
| 16. | AC Plant Equipment Areas | Mechanical Exhaust by means of axial flow exhaust fans and air entry through intake louvers. | 10 |
| 17. | SWAS Room (Non AC Area) | Supply air by wall-mounted axial flow fans (with filter) and exhaust through gravity damper. | 10 |
| 18. | Oil rooms | Negative pressurization by means of axial flow exhaust fan having spark proof construction fans with flameproof motors. air entry through intake louvers. | 20 |
| 19. | MCC / Switchgear room and cable spreader room of associated buildings. | Supply air by wall-mounted axial flow fans (with filter) and exhaust through gravity damper. | 15 |



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
SPECIAL TECHNICAL REQUIREMENT**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

Sub Section : C 1

REV. 00

DATE: MARCH 2022

Page 5 of 23

| | | | |
|-----|-------------------------------|--|----|
| 20. | Gas Rooms | Wall mounted exhaust fans and air entry through intake louvers. | 10 |
| 21. | MRS Compressor house | Pressurized ventilation with wall mounted fan filter units and air exhaust through Back Draft Dampers. | 10 |
| 22. | ACW & Central Lube oil room | Supply air by wall-mounted axial flow fans (without filter) and exhaust through Exhaust louver. | 10 |
| 23. | Bunker Bay tripper floor. | Mechanical exhaust by Roof Extractor units and air entry through intake louvers. | 30 |
| 24. | DG Room | Wall mounted exhaust fans and air entry through intake louvers (provided shutter with grills). | 15 |
| 25. | Fire Water Booster Pump House | Supply air by wall-mounted axial flow fans (without filter) and exhaust through Exhaust louver. | 10 |
| 26. | Stores | Mechanical exhaust by means of axial flow exhaust fans. | 10 |
| 27. | Chemical House | Mechanical exhaust by means of axial flow exhaust fans and air entry through intake louvers. | 15 |

2.5 Ventilation will be provided in any room / building / extension / augmentation in phase-II area building for locating / installing stage-III equipment.

3. DESIGN CRITERIA

System Design Criteria:

3.1. The outdoor design conditions: -

| | Summer | Monsoon | Winter |
|-------------------|---------------|----------------|---------------|
| DBT(deg C) | 41.5 | 34.45 | 13.05 |
| WBT(deg C) | 32.5 | 31.0 | 10.5 |

3.2. The inside design conditions:

3.2.1 In the areas ventilated by evaporative cooling units (TG & ESP), the inside dry bulb temperature will be 3°C lower than the summer ambient temperature (DB).



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
SPECIAL TECHNICAL REQUIREMENT**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

Sub Section : C 1

REV. 00

DATE: MARCH 2022

Page 6 of 23

- 3.2.2** In dry type forced (mechanical) type ventilation system, the inside temperature shall be restricted about 3°C higher than the summer ambient temperature.
- 3.2.3** For other details please refer to clauses no 4.00.00 and other relevant clauses of Customer technical specification section C2-A.
- 4. LAYOUT CONSIDERATIONS**
- 4.1.1** A total of 4 No Air washers shall be provided for unit 5. Each air washer with 2x50% duty DIDW Centrifugal Fans. The tentative location of these air washers shall be as under.
- 4.1.1.1.** 2 Nos. Air Washers shall be located outside the TG Hall A- row on roof of DG room at transformer yard. 2 No Air Washer shall be located in BC Bay at 24.0 between column No. 13-14.
- 4.1.1.2.** These air washers shall be placed in open, exposed to ambient conditions and no masonry room shall be provided.
- 4.1.2** Two (2) nos. UAF shall be provided for ESP cum FGD Building. Each UAF with 1x100% duty DIDW Centrifugal Fans. These UAF shall be placed in open at Roof level.
- 5. EQUIPMENT AND SERVICES TO BE PROVIDED FOR VENTILATION SYSTEM:**
- 5.1 Air-WASHERS**
- 2.1.12** Four (4) Nos. containerized type Air washer units (AWU) each having a capacity of 2,80,000 M3/Hr with 85 mm wc static pressure for TG building Unit 5.
- 2.1.13** Each air washer comprises of:
- 5.1.1** Two (2) no. (2x50% duty) Centrifugal fan backward inclined, DIDW Type, complete with electric drive motor, drive Pulleys, V-belt, belt guards, slide rails and other accessories etc. Both inside & outside surfaces of all parts of the fan shall be spray galvanized whereas the shaft shall be only epoxy painted.
- 5.1.2** Two (2) nos. (2x100 % duty) Back pull out / Horizontal Split Casing type centrifugal pumps for circulation of water shall be considered. Pump suction shall be provided with pot strainer with by-pass valves, inlet and outlet pressure gauge and filter back wash arrangement.
- 5.1.3** Moisture eliminator of die-extruded PVC construction with flooding nozzles of Brass / SS construction.
- 5.1.4** Air washer chamber of sheet metal construction with black MS sheet (thickness of MS sheet shall be min. 4mm). Air washer chamber covering all components of the Air Washer Unit including the Centrifugal Blowers but excluding the water circulating pump sets. Air washer chamber shall be provided with adequate



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
SPECIAL TECHNICAL REQUIREMENT**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

Sub Section : C 1

REV. 00

DATE: MARCH 2022

Page 7 of 23

stiffness, bracings etc. (duly painted with epoxy resin based paint from inside and outside).

- 5.1.5 Top Surface of the AWU (for Sheet Metal Construction unit) shall be thermally insulated with 13 mm thick thermal insulation made of Aluminium foil faced closed cell elastomeric Nitrile Rubber (of density min. 40 Kg / Cu. M) / XLPE (of density min. 33 Kg / Cu. M) or equal having a thermal conductivity not exceeding 0.035W/MK. The insulation shall have self-extinguishing & non-dripping properties against fire attack.
- 5.1.6 Air Intake Louvre with Bird screen of GI Construction.
- 5.1.7 All valves, pipes, nuts & bolts, pipe hangers, supports, internal fittings and supports including ball float valves for make-up water connection.
- 5.1.8 Individual inspection door with ladder and cat walk is to be provided for different section of the air washer unit.
- 5.1.9 Drain pipe with valve and overflow connection with siphon, marine light (1 Nos.) in each section.
- 5.1.10 Automatically cleanable type Stainless Steel Mesh Filters complete with SS frame continuously flooded with water with the help of stainless steel water spray nozzles spraying over the filters in the direction of air flow.
- 5.1.11 Fill deck made of cellulose paper in cross fluted configuration duly impregnated with insoluble anti-rot salts, rigidifying saturates and wetting agents and assembled in self-supporting pads. Flute angle shall be of 45 Deg.
- 5.1.12 02 nos. (2 x 100% duty) mono-block pumps for circulation of water through the fill deck. Pump suction shall be provided with pot strainer with by-pass valve, inlet and outlet pressure gauge and filter back wash arrangement.
- 5.1.13 Low Level switch for Air washer sump.
- 5.1.14 Air Washer Sump / tank of minimum 5mm thick MS Construction duly painted with epoxy resin based paint both from inside and outside
- 5.1.15 Inter connecting GI piping between centrifugal pump sets (both HSC and Mono-block) and air washer unit spray headers/ sump, with necessary supports and supporting structure.
- 5.1.16 No masonry Room shall be provided for the Air washer units including its accessories. All accessories including centrifugal Fans shall be placed inside the sheet metal casing. However, the water circulating pump sets shall be located outside this AWU casing.
- 5.1.17 For other details please refer to clauses no 2.05.00, 5.07.00 and other relevant clauses of Customer technical specification section C2-A.



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
SPECIAL TECHNICAL REQUIREMENT**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

Sub Section : C 1

REV. 00

DATE: MARCH 2022

Page 8 of 23

5.2 UAF

2.1.14 Two (2) Nos. Sheet metal containerized type Unitary Air Filtration system (UAF) each having a capacity of 1,50,000 M3/Hr with 60 mm wc static pressure for ESP cum FGD building and shall be placed at roof of ESP cum FGD bldg.

2.1.15 Each UAF comprises of:

5.2.1 One (1) No. (100% duty) Centrifugal fan backward inclined, DIDW type, complete with electric drive motor, drive Pulleys, V-belt, belt guards, cushy foot mounting slide rails and other accessories etc. Both inside & outside surfaces of all parts of the fan shall be spray galvanized whereas the shaft shall be only epoxy painted.

5.2.2 Two (2) Nos. (2 x100 % duty) Centrifugal mono-bloc / Back pull out / Horizontal Split Casing type centrifugal pumps for circulation of water. Pump system shall be provided with pot strainer with by-pass valves, inlet and outlet pressure gauge and filter back wash arrangement.

5.2.3 A spray nozzle system consisting of single bank spray system connected to header, flow regulating valves for controlling flow to spray header. Nozzles shall be of Brass / SS.

5.2.4 Moisture eliminator of die-extruded PVC construction with flooding nozzles of SS construction.

5.2.5 UAF Chamber shall be of sheet metal (2mm thick) MS construction with 3 mm thick MS tank. Both the casing and the water tank shall be duly painted with epoxy resin based paint both from inside and outside.

5.2.6 Intake louver with frame & bird screen of GI construction.

5.2.7 All valves, pipes, nuts & bolts, pipe hangers, supports, internal fittings and supports including ball float valves for make-up water connection. Suction pipe connection with coarse strainer, overflow connection with siphon and quick-fill connection with valve.

5.2.8 Inspection door with ladder and cat walk in the spray chamber

5.2.9 Drain pipe with siphon, marine light (1 No.) in each section.

5.2.10 Automatic cleanable SS mesh filters with SS / Aluminium frames shall be provided, which shall be continuously flooded with water by one bank of spray header with stainless steel water spray nozzles spraying water over the filters in the direction of air flow.

5.2.11 GI connection piece between the centrifugal fan & UAF casing.

5.2.12 Interconnecting GI piping between Pump and UAF Unit Spray Header/Sump, with necessary supports and supporting structures.



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
SPECIAL TECHNICAL REQUIREMENT**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

Sub Section : C 1

REV. 00

DATE: MARCH 2022

Page 9 of 23

5.2.13 No masonry Room shall be provided for the UAF units including its accessories. All accessories including centrifugal Fans shall be placed inside the sheet metal casing. However, the water circulating pump sets shall be located outside this UAF casing.

5.2.14 For other details please refer to clauses no 2.06.00, 5.08.00 and other relevant clauses of Customer technical specification section C2-A.

5.3 Centrifugal fan units

Each centrifugal fan shall be complete with

5.3.1 Fan impeller (backward curved) with casing, required steel frame and support structure.

5.3.2 Electric drive motor.

5.3.3 Drive Pulleys, V-belt, belt guards, slide rails etc.

5.3.4 Dampers and flexible connection with matching flanges. Flexible connection shall be Rubberized canvas

5.3.5 Vibration isolators, Cushy foot type mountings, foundation bolts and nuts.

5.3.6 Removable drain plug with fan casing.

5.3.7 For other details please refer to clauses no 2.02.00, 5.02.00, 5.05.00, 5.06.00 and other relevant clauses of Customer technical specification section C2-A.

5.4 Wall mounted axial flow fan

Each wall mounted axial flow fan shall be complete with

5.4.1 Fan impeller with aerofoil section of cast aluminium alloy & casing / short duct as required and with inspection cover near motor terminal box and greasing arrangement for motor bearings from outside the fan casing.

5.4.2 The speed of fans shall not exceed 960 rpm for fan with impeller diameter above 450 mm and 1400 rpm for fan with impeller diameter 450 mm or less. However, for fans having static pressure of 30 mm WC or above the speed of the fan shall not exceed 1500 rpm for fan with impeller diameter of above 450mm and 2800 rpm for with impeller diameter of 450 mm or less. The first critical speed of rotating assembly shall be at least 25% above the operating speed.

5.4.3 Electric drive motor with coupling if any, including motor brackets.

5.4.4 Inlet cone and grouting framework, if any.

5.4.5 Rain protection cowl (G.I / Aluminium) with bird-screen adjustable damper, vibration isolators, nuts and bolts, back draft dampers etc. Shall be provided.

5.4.6 Filters wherever required/ specified in the tender.

5.4.7 For other details please refer to clauses no 2.03.00, 5.02.00, 5.05.00, 5.06.00 and other relevant clauses of Customer technical specification section C2-A.



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
SPECIAL TECHNICAL REQUIREMENT**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

Sub Section : C 1

REV. 00

DATE: MARCH 2022

Page 10 of 23

5.5 Roof Extractor unit

Each wall roof extractor unit shall be complete with

- 5.5.1 Fan wheel, electric drive motor with motor coupling if any and motor bracket.
- 5.5.2 The speed of the roof ventilators shall not exceed 960 rpm for impeller diameters larger than 450 mm and 1440 rpm for impeller diameters 450 mm and less.
- 5.5.3 Short duct mounting / axial fan casing having inspection door and base with proper sealing arrangement, greasing arrangement of motor bearings from outside the fan casing.
- 5.5.4 Grouting framework & foundation bolts including screen at bottom.
- 5.5.5 Rain protection cowl with bird-screen (provided with roof – hood) and Vibration Isolators.
- 5.5.6 Casing/cowl/hood: M.S. Sheet to IS: 2062 (Short duct casing).
- 5.5.7 Impeller: Cast Aluminium alloy to A-6M, IS-617.
- 5.5.8 Support frame and structure: M.S of adequate thickness (IS-2062).
- 5.5.9 For other details please refer to clauses no 2.04.00, 5.03.00, 5.05.00, 5.06.00 and other relevant clauses of Customer technical specification section C2-A.

5.6 Ductwork

- 5.6.1 GSS supply air ducting (as per IS 655) fabricated with GSS sheet (as per IS 277) having zinc coating of 180 g/sqm. The ducting shall be complete with vanes, splitters, dampers, hangers, supports, anchor bolts, sealing components, gaskets etc.
- 5.6.2 All duct (G.I./M.S.) for ventilation supply or exhaust shall be manufactured of at least 1 mm thick (20G) sheet upto 2250 mm (duct largest side) and 1.25 mm thick (18G) above 2250 mm duct largest side. GI ducting grade shall be 180GSM.
- 5.6.3 For Battery room areas, where exhaust ducting is required for ventilation, MS ducting having epoxy coating shall be provided.
- 5.6.4 The diffuser / grills shall be of powder coated MS sheet (20 SWG) for ventilation system.
- 5.6.5 Manually adjustable / back draft type / Gravity type exhaust air dampers, Volume control dampers, guide vane, splitter dampers.
- 5.6.6 Supports and hangers including anchor bolts as required.
- 5.6.7 Fire Dampers (Motorised type Electrically operated) shall be provided with open and close status limit switches). Fire Damper shall have fire rating minimum 90 minutes.



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
SPECIAL TECHNICAL REQUIREMENT**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

Sub Section : C 1

REV. 00

DATE: MARCH 2022

Page 11 of 23

- 5.6.8 For other details please refer to clauses no 2.08.00, 5.13.00 and other relevant clauses of Customer technical specification section C2-A.
- 5.7 Thermal Insulation**
- 5.7.1 Thermal insulation shall be provided for the duct exposed to sun / rain only.
- 5.7.2 25 mm thick grade of Expanded Polystyrene insulation conforming to IS – 4671. Such Insulation shall be covered with 500Gauge Polythene sheet, chicken wire mesh, 12mm thick sand cement plaster and an overall cladding of 28G GI sheet.
- 5.8 Water Pump Sets**
- Each circulating water pump set for air washer and UAF shall comprise of the following
- 5.8.1 Back pull out / Horizontal Split Casing centrifugal pump of adequate capacity to match the system requirement for air washer spraying arrangement and mono-block type pump sets for circulation of water through fill deck arrangement & Back pull out / Split Casing Centrifugal Pump of adequate capacity to match the system requirement for UAF.
- 5.8.2 One no. adequately sized TEFC sq. cage induction motor suitable for 415V, 3 phase, 50 Hz AC supply.
- 5.8.3 One no. Pot type strainer at inlet complete with screen, drain arrangement etc.
- 5.8.4 150 mm dia. Dial Type pressure gauges one each at suction & discharge side of the pump set.
- 5.8.5 Gate valve, one each at suction and Globe valve, one each at discharge side of the pump set.
- 5.8.6 One no. non-return (check) valve at discharge side of pump set.
- 5.8.7 One set of base plate, coupling, coupling guard, anti-vibration mountings, foundation bolts etc.
- 5.8.8 Rain protection canopy for the pumps and motors, if located at outdoor shall be provided.
- 5.8.9 For other details please refer to clauses no 2.07.00, 5.12.00 and other relevant clauses of Customer technical specification section C2-A.
- 6.0 SPECIFIC FEATURES: -**
- 6.1 The system shall be design to maintain specified inside design conditions during peak summer under design outdoor condition.
- 6.2 All ventilation system shall operate on 100% fresh air.
- 6.3 The air washer shall have minimum **90%** saturation efficiency and UAF shall have minimum **70%** saturation efficiency.



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
SPECIAL TECHNICAL REQUIREMENT**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

Sub Section : C 1

REV. 00

DATE: MARCH 2022

Page 12 of 23

- 6.4 Ventilation ducts shall be provided with motorized type fire dampers at the supply duct in electrical area like MCC / Switch gear room/ cable spreader room in power house building, as well as Electrical areas of ESP/VFD Building which will close in case of fire. Fire Damper shall have fire rating minimum 90 minutes.
- 6.5 Velocity of air in duct shall not normally exceed 12 m/sec.
- 6.6 Air Velocity through different system equipment should be maintained as follows:
- Intake Louvers for AWU/UAF Units: 2m/s through face area (Max.)
 - Fill deck Section AWU: 2.25m/s through face area (Max.)
 - Moisture eliminators AWU/UAF Units: 2.5m/s through face area (Max.)
 - Intake Louvers (except AWU/UAF): 3.5 m/s through face area (Max.)
 - Exhaust Louver: 6m/s through face area (Max.)
 - Volume Control dampers: 10m/s through face area (Max.)
 - Back Draft dampers: 7m/s through face area (Max.)
 - Supply Air Grills/Diffusers: 6m/s through face area (Max.)
 - Filters: 2.5m/s through face area (Max.)
- 6.7 Motors for Roof Exhausters and wall mounted Exhaust Fans shall be designed for a minimum 55-degree C ambient while the motors for supply air fans shall be designed for a min. 50-degree C ambient condition.
- 6.8 RE / wall mounted fans shall be selected so as to have motor rating and wall / slab opening as under. Feeder suitable for following ratings only shall be provided by BHEL.

| | | | |
|----|--|--------------|---------------------|
| 1. | Roof extractor units with 15 mmwc static pressure. | | |
| | Capacity | Motor rating | Roof / Slab opening |
| a. | 50,000 CMH | 5.5 KW | 1320mm |
| b. | 40,000 CMH | 5.5 KW | 1320mm |
| c. | 20,000 CMH | 2.2 KW | 1000mm |
| 2 | Axial flow supply fans with 30 mmwc static pressure. | | |
| | Capacity | Motor rating | Wall opening |
| a. | 10,000 CMH | 2.2 KW | 1000mmx1000mm |
| b. | 7,500 CMH | 1.5 KW | 1000mmx1000mm |



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
SPECIAL TECHNICAL REQUIREMENT**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

Sub Section : C 1

REV. 00

DATE: MARCH 2022

Page 13 of 23

| | | | |
|----|---|--------------|---------------|
| c. | 6,000 CMH | 1.1 KW | 600mmx600mm |
| d. | 4,000 CMH | 0.75 KW | 500mmx500mm |
| 3 | Axial flow supply fans with 20 mmwc static pressure. | | |
| | Capacity | Motor rating | Wall opening |
| a. | 10,000 CMH | 1.5 KW | 1000mmx1000mm |
| b. | 7,500 CMH | 1.1 KW | 1000mmx1000mm |
| c. | 6,000 CMH | 1.1 KW | 1000mmx1000mm |
| d. | 4,000 CMH | 0.75 KW | 1000mmx1000mm |
| 4 | Axial flow exhaust fans (Bifurcated type) with 15 mmwc static pressure. | | |
| | Capacity | Motor rating | Wall opening |
| a. | 15,000 CMH | 2.2 KW | 1000mmx1000mm |
| b. | 10,000 CMH | 1.5 KW | 1000mmx1000mm |
| c. | 7,500 CMH | 1.1 KW | 1000mmx1000mm |
| d. | 4,000 CMH | 0.75 KW | 700mmx700mm |
| E. | 2,000 CMH | 0.55 KW | 700mmx700mm |
| 5 | Axial flow exhaust fans with 10 mmwc static pressure. | | |
| | Capacity | Motor rating | Wall opening |
| a. | 15,000 CMH | 1.1 KW | 900mmx900mm |
| b. | 10,000 CMH | 0.75 KW | 900mmx900mm |
| c. | 7,500 CMH | 0.55 KW | 700mmx700mm |
| d. | 6,000 CMH | 0.55 KW | 700mmx700mm |
| e. | 4,000 CMH | 0.55 KW | 600mmx600mm |
| e. | 2,000 CMH | 0.37 KW | 500mmx500mm |
| 6 | Exhaust fan (propeller type) with 5 mmwc static pressure. | | |
| | Capacity | Motor rating | Wall opening |



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
SPECIAL TECHNICAL REQUIREMENT**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

Sub Section : C 1

REV. 00

DATE: MARCH 2022

Page 14 of 23

| | | | |
|----|----------|-------|--------------|
| a. | 1200 CMH | 100 W | 300 circular |
|----|----------|-------|--------------|

7.0 MATERIALS OF CONSTRUCTION

7.1 CENTRIFUGAL FAN

- 7.1.1 Fan Scroll: Heavy Gauge MS (IS-2062 Gr.B) with Galvanized.
- 7.1.2 Fan Casing (side plates & stiffeners): Mild Steel Sheets/plate to IS: 2062 Gr.B / IS: 1079 /Eq. The minimum thickness of casing shall be 3.15 mm.
- 7.1.3 Impeller: M.S. sheet/plate (IS-2062 Gr.B)
- 7.1.4 Impeller hub: Mild Steel
- 7.1.5 Impeller back plate blade & shroud: Mild Steel to IS: 2062 Gr.B.
- 7.1.6 Shaft: EN - 8 or eqv.
- 7.1.7 Shaft sleeve: EN - 8 or eqv.
- 7.1.8 Fan Supports, frames and structure: Mild Steel (IS-2062 Gr.B)
- 7.1.9 Flexible connection at outlet/inlet: Fire resistant type plastic impregnated canvas with M.S. flange and cleats (3 mm thick).
- 7.1.10 V Belt (matched sets): ISI marked (Reinforced rubber section to (IS: 4776)
- 7.1.11 V Pulley: Cast Iron multi-groove to Gr-20 as per IS: 210.
- 7.1.12 Slide rails: M.S./C.I.
- 7.1.13 Connection pieces: G.I. according to supplier's design.
- 7.1.14 Bolts & nuts: Galvanized / MS (Epoxy painted).
- 7.1.15 Vibration isolating cushy foot mountings, foundation bolts and nuts etc.
- 7.1.16 Dampers: Heavy Gauge MS (IS-2062 Gr.B).
- 7.1.17 For other details please refer to clauses no 2.02.00, 5.02.00, 5.05.00, 5.06.00 and other relevant clauses of Customer technical specification section C2-A.

7.2 AXIAL FAN

- 7.2.1 Casing: M.S. sheet – 3 mm thk for fan dia upto 750 mm, 5mm thick for fan dia of 750 mm and above as per IS:1079 / IS:2062 Gr.B
- 7.2.2 Impeller: Cast Aluminium. (Alloy A-6M, IS-617)
- 7.2.3 Hub: As per manufacturer std. (AL- LM6)



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
SPECIAL TECHNICAL REQUIREMENT**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

Sub Section : C 1

REV. 00

DATE: MARCH 2022

Page 15 of 23

- 7.2.4 Support frame and structure: M.S. of adequate thickness (Galvanized / painted) IS-2062 Gr.B.
- 7.2.5 Neoprene rubber pads: As required.
- 7.2.6 Coned inlet for wall exhausters / supply fans: MS (IS-2062 Gr.B)
- 7.2.7 Supporting frame for mounting: Required.
- 7.2.8 Protective screen at inlet: Yes (Min 14 SWG Galvanized wire knitted in 1" square mesh).
- 7.2.9 Rain Protection Cowl: Aluminium or hot dip galvanised after fabrication from MS.
- 7.2.10 Mounting flange on casing: At inlet and outlet.
- 7.2.11 Painting / protecting coating – All the MS parts shall be galvanised or protected with three coats of epoxy paint.
- 7.2.12 For other details please refer to clauses no 2.03.00, 5.02.00, 5.05.00, 5.06.00 and other relevant clauses of Customer technical specification section C2-A.

7.3 ROOF EXTRACTOR UNIT

- 7.3.1 Casing/cowl/hood: (Spray / hot galvanised M.S. Sheet to IS: 2062 Gr.B (Short duct casing).
- 7.3.2 Impeller: Cast Aluminum alloy to A-6M, IS-617.
- 7.3.3 Support frame and structure: M.S of adequate thickness (IS-2062 Gr.B).
- 7.3.4 For other details please refer to clauses no 2.04.00, 5.03.00, 5.05.00, 5.06.00 and other relevant clauses of Customer technical specification section C2-A.

7.4 AIR WASHER

- 7.4.1 Moisture Eliminators plates: 100% virgin PVC die-extruded construction of minimum finished thickness of 2 mm.
- 7.4.2 Moisture Eliminator Frame: 22 SWG GI sheets and GI angle of adequate strength. ft sleeve: EN - 8 or eqv.
- 7.4.3 Fill deck: - cellulose paper in cross fluted configuration duly impregnated anti rat salts, rigidify saturates and wetting agents and assembled in self-supporting pads.
- 7.4.4 Tank: Black MS for sheet metal Air washer (5mm) thk (Epoxy paint both inside and outside of tank). Min depth -800mm
- 7.4.5 Casing: Black M.S. 4mm thick (Spay galvanisation or two coat of epoxy paint).
- 7.4.6 Piping: MS Heavy class (Galvanized) to IS: 1239 Part I or IS: 3589 depending on size.



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
SPECIAL TECHNICAL REQUIREMENT**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

Sub Section : C 1

REV. 00

DATE: MARCH 2022

Page 16 of 23

- 7.4.7 Suction Screen for Water: Brass (40 mesh size 2 nos for each air washer)
- 7.4.8 Spray and flooding nozzles: Brass / SS
- 7.4.9 For other details please refer to clauses no 2.05.00, 5.07.00 and other relevant clauses of Customer technical specification section C2-A.

7.5 UNITARY AIR FILTERATION

- 7.5.1 Eliminators plates: 100% virgin PVC die-extruded construction of minimum finished thickness of 2 mm.
- 7.5.2 Tank: M.S. 3mm thick (Epoxy Paint) both inside and outside of tank.
- 7.5.3 Casing: M.S. 2mm thick (Spray galvanised or two coats of epoxy paint).
- 7.5.4 Piping: MS Heavy class Galvanised to IS: 1239 Part I / IS 3589 depending on size.
- 7.5.5 Suction Screen Water: Brass.
- 7.5.6 Spray and flooding nozzles: Brass / SS.
- 7.5.7 Banks: Single bank type (along the air flow), spraying water over the filters.
- 7.5.8 For other details please refer to clauses no 2.06.00, 5.08.00 and other relevant clauses of Customer technical specification section C2-A.

7.6 AIR FILTERS

7.6.1 PRE FILTER

- 7.6.1.1 Filter Media: Fibrous material (extruded polyethylene) or felt filter: Dry types with element of 5 ply construction for fabric type.
- 7.6.1.2 Efficiency: shall be 90% down to 10 microns.
- 7.6.1.3 Allowable pressure drop: Initial pressure drop – Not to exceed 5.0 mm WC at rated flow. Final pressure drops- Up to 7.5 mm WC.
- 7.6.1.4 Frame Work 18 G GSS. Filter mounting frame shall be GI angle iron frame of adequate thickness.
- 7.6.1.5 Size – 610 x 610 mm (Approx.)
- 7.6.1.6 For other details please refer to clauses no 5.16.00 and other relevant clauses of Customer technical specification section C2-A.

7.6.2 FINE FILTER

- 7.6.2.1 Filter Media: Synthetic non-woven for fresh air pressurization (MCC).



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
SPECIAL TECHNICAL REQUIREMENT**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

Sub Section : C 1

REV. 00

DATE: MARCH 2022

Page 17 of 23

- 7.6.2.2 Allowable pressure drop: For HDPE (SNW) -6 mm WG during clean condition & 12 mm WG during dirty condition.
- 7.6.2.3 Frame Work: 18 G GSS.
- 7.6.2.4 Size -610 x 610 mm (Approx.)
- 7.6.2.5 The filter media shall be of High Density Polyethylene (HDPE) or equivalent and shall have efficiency not less than **95%** down to particle size of **5 microns**.
- 7.6.2.6 The filter media shall be sandwiched in between two galvanized wire netting arrangement in a uniformly corrugated form to increase the surface area.
- 7.6.2.7 The filter shall be fixed in GI angle iron frames of adequate thickness suitable for long use in an industrial plant.

7.6.3 FILTER FOR AWU / UAF

- 7.6.3.1 SS FILTER (for Air washer / UAF units) The filters shall be washable/cleanable type construction of SS 316 wire netting with three or more layers of wire mesh of different mesh sizes stitched together and held in a SS / Al frame of adequate thickness but not less than 18 SWG for Al and 20 SWG for SS suitable for long use in an industrial plant. The filter when flooded shall have a filtration efficiency of 90% down to 10 microns. The filter mat shall be weaved with SS wire of 0.16mm diameter providing an aperture of max 0.025mm

7.7 VALVES:

- 7.7.1 Valves shall have full sizes port and suitable for horizontal and as well as vertical installation.
- 7.7.2 Valves for regulating duty shall be of globe type suitable for controlling throughout its lift.
- 7.7.3 Gate, Globe and stop check valves shall have bonnet back seat to facilitate easy replacement of packing with the valves in service.
- 7.7.4 All safety / relief valves shall be so constructed that the failure of any part does not obstruct the free discharge.
- 7.7.5 Manual gear operators be provided for valves of size 250 NB and above.
- 7.7.6 All valves shall be provided with locking arrangement.
- 7.7.7 All water line valves shall be of cast iron body for sizes 65 NB and above conforming to IS: 780 and Gun metal construction for sizes less than 65 NB conforming to IS: 778. Cast iron parts shall conform to IS: 210 Gr. FG 220.



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
SPECIAL TECHNICAL REQUIREMENT**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

Sub Section : C 1

REV. 00

DATE: MARCH 2022

Page 18 of 23

7.8 CENTRIFUGAL PUMP

- 7.8.1 Impeller: Bronze as per Grade IS: 318 Grade 2
- 7.8.2 Pump shaft: SS 316
- 7.8.3 Casing: 2% Ni Cast iron to IS: 210 GR. FG-260.
- 7.8.4 Wearing ring: Bronze Grade IS: 318 GR-2.
- 7.8.5 Shaft Sleeve: SS 316.
- 7.8.6 Base plate: Carbon steel as per the IS-2062 Gr.B.
- 7.8.7 Bolt and nuts: M.S. (Epoxy painted / Galvanised).
- 7.8.8 Type of seal: Mechanical
- 7.8.9 Pump motor coupling: Pin & bush type.
- 7.8.10 Shaft seal: Mechanical seal
- 7.8.11 For other details please refer to clauses no 2.07.00, 5.12.00 and other relevant clauses of Customer technical specification section C2-A.

8.0 CONTROL PHILOSOPHY

- 8.1 DDCIMS based control has been envisaged for Ventilation System. DDCIMS based controls in the ventilation system is provided only for the air washers of the powerhouse building and UAF for ESP cum FGD control building.
- 8.1.1 Following indications shall be provided for Air Washers / UAF
 - a. FAN RUNNING
 - b. FAN STOP
 - c. PUMP - 1 RUNNING
 - d. PUMP - 1 STOP
 - e. PUMP - 2 RUNNING
 - f. PUMP - 2 STOP
 - g. FAN MOTOR OVERLOAD.
 - h. PUMP - 1 MOTOR OVERLOAD.
 - i. PUMP - 2 MOTOR OVERLOADS.
 - j. 'RH' HIGH.
 - k. 'RH' LOW.
- 8.1.2 Following drives pertaining to Ventilation system shall be controlled from the above said panel.
 - a. Air Washer Unit Fan / UAF unit Fan
 - b. Air Washer Unit Pump / UAF unit Pump
 - c. Field instrument for Air washer / UAF as per P&ID attached.



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
SPECIAL TECHNICAL REQUIREMENT**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

Sub Section : C 1

REV. 00

DATE: MARCH 2022

Page 19 of 23

8.1.3 The water sump of each Air Washer / Unitary Air Filtration Units shall be provided with a low level switch which will initiate an alarm and will trip the pump sets, in case the water level falls below the predetermined level.

8.1.4 At the delivery pipe of each pump, a pressure indicator will be provided.

8.1.5 HUMIDITY CONTROL

8.1.5.1 FOR AIR WASHER UNIT AND UAF UNIT

To protect the equipment located in the ventilated space from effects of high humidity, control device using Humidistat interlocked with the Pump Motor of the Fill Section of air washer and Pump Motor of UAF shall be used in the electrical areas. Humidity beyond 60% RH in these ventilated space shall automatically trip the respective AWU pump for fill section only and UAF pump. The pump may be restarted automatically at about 50% RH. Selection and starting of stand-by pump shall be manual.

At least two (2) nos. Humidistat (RH High and Low) shall be provided for each Air Washer Unit and UAF Unit. However, manual over riding facility shall be provided for humidistat controlled Pump sets of the Air Washer Unit and UAF Unit.

8.1.6 FIRE DAMPER

Motorized type electrically operated fire dampers shall be provided in the ventilation supply air ducting/ fans leading to electrical rooms like various MCC rooms, switchgear rooms, cable spreader rooms and in the exhaust path of oil room and oil tank area. These dampers shall be operated with the help of signal from smoke detectors/ thermal sensors. Motors shall remain energized in the normal condition to effect opening of dampers. In the event of fire, the motors shall be de-energized and the damper shall close due to spring action. Fire Damper shall have fire rating minimum 90 minutes.

8.2 Supply air fans, exhaust air fans / roof extractor units of each area shall be provided with their local starter panel.

8.3 For other details please refer to clauses no 3.00.00 and other relevant clauses of Customer technical specification section C2-A.



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
SPECIAL TECHNICAL REQUIREMENT**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

Sub Section : C 1

REV. 00

DATE: MARCH 2022

Page 20 of 23

9. GENERAL

- 9.1** Basis of design, all calculations including heat load calculations for summer seasons, equipment selection criterion, layout drawings/ schemes/G.A. drawings and documents like data sheet/ technical particulars etc. are subject to Customer approval during detail engineering stage.
- 9.2** Vendor to furnish characteristic curves for all major equipment offered indicating duty point during detailed engineering.
- 9.3** Vendor to include the Back wash arrangement of pot strainer with gate valve, piping etc for the Air Washer.
- 9.4** Vendor to include Level transmitters & gauge for each Air-washer tank for alarm & trip of the pumps. Also include Pressure transmitters for each air washer pump along with pressure gauge.
- 9.5** All drawings and documents shall be computer based.
- 9.6** All commissioning spares & consumables for trouble free operation shall be provided.
- 9.7** Quality Requirements in the Technical Specification are indicating minimum requirements for inspection and testing. Vendor shall note that quality plan is subject to Customer & BHEL approval during detail engineering stage. Standard QP format is enclosed in the technical specification.
- 9.8** Indicative list of makes is enclosed as per Annexure-I however these equipments / items shall be subject to Customer & BHEL approval during detail engineering Stage.
- 9.9** Minor civil works like making openings to suit/finishing of opening, sealing of duct opening, grouting of foundation/foundation bolts etc. including special type of grouting like GPX2 etc. are in the scope of Ventilation system vendor.
- 9.10** Inserts or any support arrangement for fixing fans, piping etc. shall not be provided by BHEL. Necessary supports may be taken from nearest structure / walls / roofs / floors etc. by Vendor.
- 9.11** Fixing frame works for diffusers and grilles in the scope of Vendor.
- 9.12** Anchor fastener shall be used by vendor for fixing duct pipes etc. wherever applicable.
- 9.13** Necessary beam from main column in TG building shall be provided by BHEL. Vendor shall take secondary support (in form of angle/channel/beam/bracket etc.) from main column / beam provided by BHEL as required for supporting the duct / piping / equipments. Supporting structure shall be in vendor scope on lump sum basis and no unit rate shall be applicable.
- 9.14** Drain piping within room up to the drain point to be provided by the Vendor.



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
SPECIAL TECHNICAL REQUIREMENT**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

Sub Section : C 1

REV. 00

DATE: MARCH 2022

Page 21 of 23

- 9.15** Vendor to furnish schedule of power and control cables. Vendor to furnish cable termination details interconnection drawings etc. during detail engineering stage.
- 9.16** The tools and machine required for erection of equipment shall be arranged by Vendor.
- 9.17** Tools & tackles as required for regular maintenance shall be supplied by Vendor.
- 9.18** Instruments required for performance testing of various equipments / system of the package shall be arranged by Vendor at site.
- 9.19** Instrument for testing shall be calibrated by Ventilation plant supplier before taking up testing.
- 9.20** Temperature transmitter shall be provided with thermo wells and fixing arrangement.
- 9.21** Pressure gauges shall have provision for air venting. Three way valves shall be used which shall have air venting provision.
- 9.22** Matching sockets / stubs (weld type) for flow switches and other instruments shall be supplied.
- 9.23** Bidders shall guarantee to maintain specified inside design conditions during summer, monsoon and winter and also even if the internal equipment load varies from 100% to 25%.
- 9.24** Besides the system performance as above, bidder shall guarantee major technical parameters of various equipments as per design basis / details furnished. Motorized fire damper will be installed at supply air duct in electrical areas like MCC / Switchgear room / cable spreader room etc. in power house building. Fire damper will close on receiving fire signal from fire protection system and shall also be possible manually from remote control panel. Also respective Air washers shall trip on receiving fire signal from fire protection system.
- 9.25** Any Electrical/C&I items and accessories like junction box, glands etc. shall be included by vendor in his scope. Only those items shall be provided free of cost by BHEL which are categorically listed in the Electrical scope sheet of technical specification.
- 9.26** Vendor to furnish drawings / documents as per the drawings/documents submission schedule given in the contract.



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
SPECIAL TECHNICAL REQUIREMENT**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

Sub Section : C 1

REV. 00

DATE: MARCH 2022

Page 22 of 23

- 9.27** All electrical equipment shall be suitable for the power supply fault levels and other climatic conditions indicated in project information / synopsis enclosed.
- 9.28** Tender drawings enclosed form the part of specification and the bidder shall check the space requirements.
- 9.29** Feeder for a combination of fire dampers / valves etc. shall be derived from respective control panel by bidder. Distribution through junction box / distribution board shall be in bidders' scope and shall have provision for isolation of individual fire damper / valves. Suitable transformer shall be provided by bidder (if required) to derive the power input.
- 9.30** In the event of any conflict between the requirements of two clauses of this specification documents or requirements of different codes and standards specified, the more stringent requirement as per the interpretation of the owner shall apply.
- 9.31** Bidder to note that BHEL reserves the right for drawings/documents submission through web based Document Management System. Bidder would be provided access to the DMS for drawings/documents approval and adequate training for the same. Bidder to ensure proper net connectivity at their end.
- 9.32** The drawings/ documents submitted by vendor shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non- submission with delays attributable to vendor's account. For any clarification/discussion required to complete the drawings, the bidder shall himself depute his personnel to BHEL / Customer's place any number of time as per the requirement for across the table discussions/ finalizations/ submissions of drawings.
- 9.33** All openings required in brick wall for installing the axial supply and exhaust fans, propeller fans, duct opening, louvers and damper openings etc shall be done by BHEL. Grouting of fans along with anchor fasteners shall also be done by vendor. The openings shall be finished properly. In case openings are done once the walls have been painted, repainting, to match with the existing wall paint shall also be done by the vendor. Sealing of duct opening, grouting of foundation / foundation bolts etc. including special type of grouting like GPX2 etc. are in the scope of Ventilation system vendor.
- 9.34** Flat, platform type RCC / PCC foundation shall be provided for installing Air washer / pumps etc. Vendor shall fix the equipment using proper anchor fasteners to secure the equipment and obtain parameter related to vibration and noise.
- 9.35** Bidder to note that the P&ID shows only the bare minimum requirement of valves and instruments. Any instrumentation & valves as required for the completion of the system in line with technical specification shall be provided by bidder during detailed engineering without any commercial implication.
- 9.36** All codes and standards shall be as per contract specifications.



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
SPECIAL TECHNICAL REQUIREMENT**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

Sub Section : C 1

REV. 00

DATE: MARCH 2022

Page 23 of 23

10. EXCLUSIONS

Items of works listed below are excluded from scope of the Ventilation plant supplier.

- 10.1 Construction of Air washer plant foundations for Ventilation equipments (air washer, centrifugal fan only).
- 10.2 Slab cut out for running ducts, pipes, cables, grilles/dampers. Underground masonry trenches and masonry risers. However minor civil work like making opening to suit / finishing of opening, sealing of duct opening, grouting of foundation bolts including special type of grouting like GPX2 etc. are in the scope of bidder.
- 10.3 Provision of drain traps / points, however, vendor to connect the drain to nearest available drain point.
- 10.4 For Electrical scope, refer Electrical scope matrix sheet.
- 10.5 Structure (i.e. box girder/ beam between columns) for running the ventilation ducting header; however, required inputs shall be provided by the vendor. Further, any secondary support (i.e. angles/ channels/ beam etc.) to be drawn from column/ interconnecting beam along with tie rods, nuts, bolts etc. for supporting the duct shall be in bidder's scope.



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
CUSTOMER SPECIFICATIONS**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

SUB-SECTION : C 2

REV. 00

DATE: MARCH 2022

**SECTION: I
SUB-SECTION: C 2
CUSTOMER SPECIFICATIONS**



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
CUSTOMER SPECIFICATIONS
TECHNICAL REQUIREMENT**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

SUB-SECTION : C 2A

REV. 00

DATE: MARCH 2022

SECTION: I

SUB-SECTION: C 2A

**CUSTOMER SPECIFICATIONS
TECHNICAL REQUIREMENT**



WBPDCL

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

**SECTION-II
TECHNICAL SPECIFICATION
VENTILATION SYSTEM**



Development Consultants Pvt. Ltd.

**Volume: II-J2
Section: II
Ventilation System**



CONTENT

| CLAUSE NO. | DESCRIPTION | PAGE NO. |
|-------------------|---------------------------------------|-----------------|
| 1.00.00 | SYSTEM DESCRIPTION | 1 |
| 2.00.00 | SCOPE OF SUPPLY | 7 |
| 3.00.00 | CONTROL PHILOSOPHY | 14 |
| 4.00.00 | DESIGN CRITERIA | 15 |
| 5.00.00 | DESIGN AND CONSTRUCTIONAL REQUIREMENT | 18 |
| 6.00.00 | TESTING AND INSPECTION | 34 |
| 7.00.00 | DOCUMENTS, DATA TO BE FURNISHED | 35 |
| ATTACHMENT | | |
| 8.00.00 | LIST OF DRAWINGS | 38 |





SECTION-II

VENTILATION SYSTEM

1.00.00 SYSTEM DESCRIPTION

This Specification covers the Ventilation Systems required for One (1) unit of 660 MW, Phase – III Extn. Unit # 5 at Sagardighi Thermal Power Station located in Manigram, Murshidabad, West Bengal, India.

1.01.00 The Ventilation System shall be provided in the following locations within the Power House by Cell deck type Air Washers. Coursing of air in desired direction / areas will be done using Roof Extractors and Wall mounted Supply / Exhaust Fans.

- a) TG bay (Ground, Mezzanine and Operating floor), HP / LP heater area, Condenser area, Boiler Feed Pump area and Oil Cooler area.
- b) Deaerator Floor (if enclosed by walls and roof)
- c) Oil Room / Oil Lubrication Room
- d) 24V Battery Room & 220V DC Battery Room
- e) MCC Rooms
- f) Cable Spreader Floors
- g) Switchgear Rooms
- h) Toilet Areas
- i) SWAS Room (Wet Panel area)

Coursing of air to the desired direction / areas in the Turbine Building will be done using Roof Extractors.

1.02.00 Coal Conveyor Floor and Coal Terminal Room shall be ventilated by means of Roof Exhausters. Air Intake Louvers should be provided at lower level on Coal Conveyor Floor and opening with / without grating.

1.03.00 Ventilation provision for Auxiliary Buildings in various locations shall be done as per the following :

| | | |
|----|---|--|
| a) | Electrical & Cable Spreader rooms of ESP Control Building | Washed and filtered air supply from Unitary Air Filtration Unit (UAF) and air exhaust through Back Draft Dampers. |
| b) | Electrical & Cable Spreader rooms of Coal handling Plant | Washed and filtered air supply from Unitary Air Filtration Unit (UAF) and air exhaust through Back Draft Dampers. |





| | | |
|---------------|--|--|
| c) | Vacuum Pump House Area | Pump House-Supply air by wall mounted Axial Flow fans (without filter) and exhaust through louvers. Electrical Area-Pressurized Ventilation with washed and filtered air supply from Unitary Air Filtration Unit (UAF) and air exhaust through Back Draft Dampers. Cable Spreader Room - Pressurized Ventilation with washed and filtered air supply from Unitary Air Filtration Unit (UAF) and air exhaust through Back Draft Dampers. |
| d) | CW Pump House cum Fire Water Pump House | Supply air by wall mounted Axial Flow fans (without filter) and exhaust through louvers. |
| e) | CW Treatment cum Chlorination Building | Wall mounted Exhaust Fans and blowers (for leak absorption system) for CW Chlorination area and Wall mounted type Supply Fans (without Filter) for CW Dosing Pump House area |
| f) | Extension of CST Pump House | Supply air by wall mounted Axial Flow fans (without filter) and exhaust through louvers. |
| g) | CPU Regeneration Building | Fresh air entry through Inlet Louvers and hot air exhaust through Wall Mounted Exhaust Fans. |
| h) | Sub-station building of New Wagon Tippler complex | MCC/Switchgear room and cable spreader room, if any - Washed and filtered air supply from Unitary Air Filtration Unit (UAF) and air exhaust through Back Draft Dampers. |
| i) | Sub-station building of New Crusher house | MCC/Switchgear room and cable spreader room, if any - Washed and filtered air supply from Unitary Air Filtration Unit (UAF) and air exhaust through Back Draft Dampers. |



| | | |
|----|--|---|
| j) | GHP Utility Building | Pump House- Supply air by wall mounted Axial Flow fans (without filter) and exhaust through louvers. (Without filter) and exhaust through louvers. |
| k) | Following buildings under FGD package I. Ball mill building II. Gypsum Dewatering Building III. RC Pump + Oxidation Blower House IV. SO2 analyser room V. Any other buildings as applicable | Pump House- Supply air by wall mounted Axial Flow fans (without filter) and exhaust through louvers. (Without filter) and exhaust through louvers. MCC/Switchgear room and cable spreader room, if any - Washed and filtered air supply from Unitary Air Filtration Unit (UAF) and air exhaust through Back Draft Dampers. |
| l) | LV Switchgear room (PH-II) and Battery Room located adjacent to the LV Switchgear room (PH-II) | MCC/Switchgear room- Pressurized Ventilation Systems by means of Wall Mounted Fan-Filter Units and exhaust through Back Draft Dampers 1 Battery Room-Exhaust (pull type) ventilation to be adopted for the battery rooms by providing 2 x 100% bifurcated type axial flow exhaust fans with the motor outside the air stream. One of these fans will act as stand-by |

Amendment-1:
Ball mill and Gypsum dewatering Bldg deleted from the scope

Refer Clarifications-1.

If Ventilation requirement arises during detailed engineering for Unit #5, bidder shall provide the following ventilation system for the existing buildings of Phase-II indicated below:, under Ash Handling System Package, which shall house equipment of Phase-III unit:

- ~~a) Ash Water Pump House & MCC Room~~
- ~~b) Ash Slurry Pump House & MCC Room~~
- ~~c) AHP Compressor House & MCC Room~~
- ~~d) Silo Utility Building & MCC Room~~





| | | |
|----|------------------------|--|
| a) | Ash Slurry Pump House. | <p>Pump House-Supply air by wall mounted Axial Flow fans (without filter) and exhaust through louvers.</p> <p>Electrical Area-Pressurized Ventilation with washed and filtered air supply from Unitary Air Filtration Unit (UAF) and air exhaust through Back Draft Dampers.</p> <p>Cable Spreader Room - Pressurized Ventilation with washed and filtered air supply from Unitary Air Filtration Unit (UAF) and air exhaust through Back Draft Dampers.</p> |
| b) | Ash Water Pump House. | <p>Pump House-Supply air by wall mounted Axial Flow fans (without filter) and exhaust through louvers.</p> <p>Electrical Area-Pressurized Ventilation with washed and filtered air supply from Unitary Air Filtration Unit (UAF) and air exhaust through Back Draft Dampers.</p> <p>Cable Spreader Room - Pressurized Ventilation with washed and filtered air supply from Unitary Air Filtration Unit (UAF) and air exhaust through Back Draft Dampers.</p> |
| c) | Silo Utility Building | <p>Pump House-Supply air by wall mounted Axial Flow fans (without filter) and exhaust through louvers.</p> <p>Electrical Area-Pressurized Ventilation with washed and filtered air supply from Unitary Air Filtration Unit (UAF) and air exhaust through Back Draft Dampers.</p> <p>Cable Spreader Room - Pressurized Ventilation with washed and filtered air supply from Unitary Air Filtration Unit (UAF) and air exhaust through Back Draft Dampers.</p> |
| d) | Compressor House area | <p>Compressor area -Pressurized Ventilation with washed and filtered air supply from Unitary Air Filtration Unit (UAF) and air exhaust through Back Draft Dampers.</p> <p>MCC room-Pressurized Ventilation with washed and filtered air supply from Unitary Air Filtration Unit (UAF) and air exhaust through Back Draft Dampers.</p> |





| | | |
|----|--------------------------|--|
| e) | Chemical House | Exhaust ventilation system by providing wall mounted exhaust fans with rain protection cowl and bird screen. Fresh air entry through wall mounted air inlet louver. All parts of the exhaust system for Chemical House shall be epoxy painted. |
| f) | Toilets of all buildings | Exhaust ventilation system by providing wall mounted exhaust fans with rain protection cowl and bird screen. Fresh air entry through door grilles. |

1.03.01 Any other area within the battery limits where ventilation is required but not covered above shall also have to be provided.

1.03.02 For any existing building, if augmentation of ventilation system is required due to the increase in equipment load/room areas, the same is also to be included

1.04.00 All Electrical Rooms associated with the Auxiliary Buildings, if any, shall be provided with the Pressurized Ventilation Systems by means of Wall Mounted Fan-Filter Units and exhaust through Back Draft Dampers.

1.05.00 Evaporative cooling system by adopting Air Washer Unit (AWU) is to be provided for the ventilation of Turbine Building. Cooled and filtered air from Air Washer Unit should be distributed by means of ducting to the TG building near various heat sources like Turbo-Generator, Condenser, Boiler Feed Pump, HP & LP heaters, Oil coolers and Deareator area (if enclosed by walls and roof) etc. The hot air from the hall and the Deareator area should then be exhausted by means of Roof Exhausters. The quantity of air exhausted should be kept lower than the quantity of air supplied (usually 60-65% of the supply air is exhausted) in such a way that a little overpressure is maintained inside the hall. This will reduce infiltration of outside hot and dusty air.

1.06.00 On the basis of net heat gain and assumed temperature rise as explained in the Design Criteria (4.00.00), the supply air quantity for TG hall is to be worked out for the unit. These air quantities are to be supplied from four (4) number of Air Washer Units, two(2) of which will be placed towards B-C bay at suitable locations while the balance two(2) units will be located on 'A' Row side of TG building. Such division and location area is decided to achieve effective air distribution with lesser amount of duct work and lesser pressure drop in fans with no cross-over of ducting across A-B bay.

Refer Clarifications-1.

1.07.00 The Air Washer Units will primarily serve TG Hall and the electrical areas like MCC Room, Switchgear Room, and Cable Spreader Room etc. The washed air supplied to MCC / Switchgear / Cable Spreader Rooms will be allowed to return to TG bay through gravity dampers. Fire dampers (motorized) should be provided in the supply air ducting / fans leading to all electrical rooms (MCC, Switchgear etc.) and oil rooms (if any).

The supplied air in the lower level of TG hall after taking the heat load of TG bay rises through different openings to the upper floors and is then finally





exhausted by means of Roof Exhausters placed over the roof of TG Hall. Some quantity of air leaks out through various leakage areas but still some amount of over pressure shall be maintained.

All these Air Washer Units should be of package type construction enclosed in sheet metal casing / Masonry construction, as the case may be to avoid the problem of water seepage and also to reduce load on building structure.

1.08.00 Deareator floor (if enclosed by walls and roof) shall be ventilated with the ambient air by using some Roof Exhausters. Deareator floor may be supplied with some amount of washed air near operating platform.

1.09.00 Exhaust (pull type) ventilation to be adopted for the battery rooms by providing 2 x 100% bifurcated type axial flow exhaust fans with the motor outside the air stream. One of these fans will act as stand-by. The air from the Battery Rooms contains acid fumes and therefore it should be discharged outside the TG Hall at a place away from the steel piping or structures nearby.

Refer
Clarifications-1.

All parts of such exhaust system coming in contact with the corrosive acid fumes shall be epoxy painted. The exhaust fans for the system will be of spark-proof construction. The fan motor shall have flameproof construction.

220V DC Battery Room shall be provided with Corrosion Proof Exhaust Fan with Corrosion Proof Wiring

1.10.00 Washed air from TG Hall will be supplied in the Battery Charger Rooms by means of air conveyance ducting. The air from the Battery Charger Room should then flow into the Battery Room through a manually operated Louver Shutter before being discharged out of the TG Building by the fan. These louvers shall be suitable for closing manually to prevent infiltration of the acid fumes into Battery Charger Room in case of failure of the Exhaust Fans. The air flow is only allowed to flow from Battery Charger Room to Battery Room and not in the reversed direction.

1.11.00 Ventilation of oil room is to be effected by supplying washed air. The air is to be exhausted out of the TG building through oil room by using exhaust fans (having Spark-proof construction) provided with fusible link type fire dampers. The supply air duct with motorized fire damper should also be provided in the oil room. The motor of the exhaust fans shall be of flameproof type.

1.12.00 Exhaust Ventilation System will also be adopted for CO₂ Room (if any) by providing wall mounted type Axial Flow Fans.

1.13.00 Various auxiliary buildings such as CW Pump House, CW Chlorination area, etc., are to be provided with mechanical ventilation by using either Supply Fans or Exhaust Fans or both. Details of Auxiliary Building ventilation requirement is given in 2.03.00. Any area not covered in this clause but requiring ventilation shall also be ventilated by using suitable fans (supply or Exhaust). Filters shall be used wherever required.





Chlorination Room will be ventilated by continuously running ventilation fans. When blowers of absorption system would come into operation through detection of dangerous level of chlorination leakage the normal ventilation fans should stop and the same will again restart when blowers of absorption system will stop.

2.00.00 SCOPE OF SUPPLY

2.01.00 Equipment

Equipment sizing is to be done on the basis of heat load and number of air changes. The higher of the sizes arising out of these requirements should be considered. Selection of fan duty conditions is to be supported by back-up calculations, to be enclosed with bid.

2.02.00 Centrifugal Fan unit each complete with:

- a) Fan impeller (backward curved) with casing & supports and required steel frame / supporting structure, if any.
- b) Electric drive motor of suitable rating.
- c) Drive Pulleys, V-belt, belt guards, slide rails etc.
- d) Dampers at fan outlet and flexible connection (Rubberized Canvas) with matching flanges.
- e) Vibration isolators (rubber in shear type / neoprene rubber pad), foundation bolts and nuts.
- f) Removable drain plug with the fan casing.
- g) Local Starter Panels for Fans except those covered under Air Washer Units and UAF Units.

NB. These Centrifugal fans also cover those required for Air Washer Units and UAF Units.

2.03.00 Wall mounted axial flow fans each complete with:

- a) Fan impeller of cast alloy aluminium construction (LM-6 Grade) with blades of aerofoil design.
- b) Electric drive motor including motor brackets.
- c) Vibration Isolators
- d) Short duct (wherever required)
- e) Coned inlet and grouting framework, if any.





- f) Rain protection cowl with bird-screen made of GI, Foundation Bolts etc.
- g) Dry filters including fixing framework (wherever required for Supply Air System).
- h) Back draft damper at fan outlet, wherever specified.
- i) Protective wire netting inside the room, wherever required.
- j) Local Starter Panels for Axial Flow Fans.

2.04.00 Roof mounted axial flow fans each complete with:

- a) Fan impeller of cast alloy aluminium construction (LM-6 Grade) with blades of aerofoil design
- b) Electric drive motor including motor brackets.
- c) Vibration Isolators
- d) Short duct piece having inspection door and base with proper water sealing arrangement
- e) Grouting Frame
- f) Fan casing of heavy gauge sheet steel construction
- g) Rain protection hood / cowl with bird screen and disconnection switch, foundation bolts etc.
- h) Local Starter Panels for Roof Extractors.

2.05.00 Air Washer Units (AWU)

2.05.01 Air Washer Units (AWU) shall be either of Sheet metal package type construction or shall be of masonry construction depending on the site requirement.

2.05.02 Each Air washer Units (AWU) shall be complete with the following :

- a) Air Intake Louver with bird screen of GI construction (Face velocity through Louver shall not exceed 2M/Sec.).
- b) Automatically cleanable type Stainless Steel mesh Filters complete with SS / Aluminium frame continuously flooded with water by one bank of spray header with Stainless Steel water spray nozzles spraying water over the filters in the direction of airflow.





- c) Two numbers Horizontally Split casing / back pull out type Centrifugal pump sets (one running and one standby) complete with drive motor for circulation of water through the above spray header bank and provided with pot type suction strainer with bypass valves, inlet and outlet pressure gauges and filter back wash arrangement.
- d) Fill deck made of impregnated and corrugated cellulose paper sheets bonded together with insoluble anti-rot salts, rigidifying saturants and wetting agents and assembled in self-supporting pads of cross fluted configuration with flute angle 45°/45°.
- e) Two numbers Centrifugal Monobloc pump sets (one running and one standby) for circulation of water through the above fill deck and provided with pot type suction strainer with bypass valves, inlet and outlet pressure gauges and filter back wash arrangement.
- f) Moisture eliminator sets of die-extruded PVC construction.
- g) Inspection doors and marine lights for different sections and cat walks as required.
- h) All valves, pipes with fittings, nuts and bolts, internal fittings and supports, including ball float valves for make-up water connection, quick-fill connection with valve, drain piping with valves up to the nearest drain point, and overflow connection with siphon.
- i) Double inlet double width Centrifugal fan units (2 X 50% capacity) with electric drive motor, drive pulleys, v-belt, belt guards, cushy foot mountings, removable drain plug and other accessories as required. Both inside and outside surfaces of all parts of the fans shall be spray galvanized. (Both the fans shall be placed inside the Air Washer casing).
- j) In case of sheet metal type construction, Air Washer chamber shall be fabricated out of 4mm thick sheet steel with adequate stiffeners, bracings etc. (duly painted with epoxy resin based paint from inside and outside) covering all components of the Air Washer Unit including Centrifugal Blowers, but excluding the water circulating pump sets.
- k) Top Surface of the AWU (for Sheet Metal Construction unit) shall be thermally insulated with 13 mm thick thermal insulation made of Aluminium foil faced closed cell elastomeric Nitrile Rubber (of density min. 40 Kg / Cu. M) / XLPE (of density min. 33 Kg / Cu. M) or equal having a thermal conductivity not exceeding 0.035W/MK. The insulation shall have self extinguishing & non-dripping properties against fire attack.
- l) Interconnecting G.I. piping between pump and AWU Spray Header / Sump complete with necessary supports and supporting structures etc.



- m) Air Washer Sump (for sheet metal construction) shall be of minimum 5mm thick MS construction duly painted with epoxy resin based paint both from inside and outside.
- n) One (1) no. Relay based Local Starter-cum-Control Panel for each Air Washer Unit.

2.06.00 Unitary Air Filtration (UAF) Units

2.06.01 Unitary Air Filtration Units, each consisting of:

- a) Air Intake Louver with bird screen of GI construction.
- b) A spray nozzle system consisting of single bank spray system connected to Header, flow regulating valves for controlling flow to spray header.
- c) Two (2) nos. (one no. working and one no. stand-by) Centrifugal Monobloc Pumps for circulation of water. Pump system shall be provided with pot strainer with by-pass valves, inlet and outlet pressure gauges and filter back wash arrangement.
- d) Automatically cleanable type Stainless Steel mesh Filters complete with SS / Al. frame continuously flooded with water by one bank of spray header with stainless steel water spray nozzles spraying water over the filter in the direction of air flow.
- e) Moisture eliminator sets of die-extruded PVC construction.
- f) UAF chamber shall be of sheet metal (2mm MS) construction with 3mm thick MS tank etc(the unit shall be self-enclosed by 2 mm thick sheet steel fabricated casing duly epoxy painted). Both the casing and the water tank shall be of epoxy painted from inside and outside and shall be complete with all valves, pipes, nuts and bolts, pipe hangers, supports, internal fittings and supports, suction pipe connection with coarse strainer, make-up water connection with ball float valve, overflow connection with siphon, drain connection with valve, quick fill connection with valve etc.
- g) Interconnecting G.I. piping between pump and Spray Header / Sump complete with necessary supports and supporting structures etc.
- h) Inspection door with ladder, Marine Lights and Cat Walk in the Spray Chamber.
- i) Single inlet single width Centrifugal fan (1 X 100%) complete with electric drive motor, drive pulleys, V-belt, belt guards, slide rails and other accessories etc. Both inside and outside surfaces of all parts of the fans shall be spray galvanized.



- j) GI connection piece between the centrifugal fan and UAF casing.
- k) Interconnecting G.I. piping between pump and UAF unit spray header / sump, with necessary supports and supporting structures etc.
- l) One (1) no. Relay based Local Starter cum Control Panel for each Unitary Air Filtration Unit.

2.07.00 Water Pumps

2.07.01 Each pump shall preferably be of centrifugal Horizontal Split Casing / Back Pull Out type directly coupled to electric drive motor and mounted on a common base plate and located by dowel pins after proper alignment. However, Mono bloc type may be acceptable below a certain motor rating, which is to be decided during detailed engineering.

2.07.02 The pumps will operate under flooded suction and shall have axial suction and radial discharge.

2.07.03 Pump head-capacity characteristics shall be gradually rising from operating to shut-off point without any zone of instability. The pump BHP flow characteristics shall preferably be non-over loading type beyond rated capacity point.

Pump shall be rated for continuous operation.

2.07.04 Pump head-capacity characteristics shall be gradually rising from operating to shut-off point without any zone of instability. The pump BHP flow characteristics shall preferably be non-over loading type beyond rated capacity point.

Pump shall be rated for continuous operation.

2.07.05 Operating speed of the pump shall not preferably be more than 1500 RPM. However, for Monobloc Pump sets, operating speed up to 2800 RPM shall be acceptable.

2.07.06 The pump bearings and the shaft shall be sized adequately to take the maximum possible unbalance and hydraulic loads. Pump bearings shall have adequate life and in no case it shall be less than 40,000 hours.

2.07.07 Pump and drives (for HSC / Back Pull Out type Centrifugal Pump Sets) shall be directly coupled through a flexible coupling. Suitable coupling guard shall be provided for each pump.

2.07.08 The design of the pumps shall conform to the relevant IS Code or equivalent.





- 2.07.09 Each Pump Sets shall be complete with the following :
- a) Pot type suction strainer having easily removable top cover for access to the filter cartridge. The filters shall be fitted with fine mesh copper or brass wire strip.
 - b) 150mm dia. Dial Type pressure gauges one each at suction & discharge side of the pump set.
 - c) Gate valve, one each at suction side and Globe valve, one each at discharge side of pump set.
 - d) One (1) no. non-return (check) valve at discharge side of pump set.
 - e) One set of base plate (common for pump and motor), mechanical seal, coupling, coupling guard, anti-vibration mountings, foundation bolts etc.
 - f) One (1) no. Flow measuring device at the common discharge header.
- 2.07.10 Material of the pump shall preferably as follows:
- | | | |
|----------------------|---|--|
| Casing | : | Cast iron, grade 20 as per IS-210 |
| Impeller & Wear Ring | : | Bronze |
| Shaft | : | Carbon steel C-45, IS 1570 or Class-IV, IS1875 |
| Shaft sleeve | : | Bronze / SS |
- 2.07.11 The pump motor should be so selected that it is not overloaded at 50% of the flow.
- 2.08.00 GI sheet steel fabricated ducting including the following:
- a) GI sheet metal (180 Grade) duct as per IS 655.
 - b) Branch Duct Damper with control arrangement at each branch off and whatever necessary.
 - c) All supply air grilles and diffusers made of powder coated MS sheet (20 SWG) with volume control dampers and supporting frames as required at site.
 - d) Supports and hangers including anchor bolts as required.
 - e) Sealing compound and jointing gasket for ducts.
 - f) Flexible connections of rubberized canvas.



- g) Motorized Fire damper with supply as well as with exhaust air duct (wherever applicable).

Motorized fire dampers will be provided in the supply air ducts and supply air openings leading to all the electrical areas (MCC and Switchgear Rooms, cable spreader rooms of Power House, ESP and other Auxiliary Buildings with ducted ventilation system). Similar fire dampers will also be provided with the exhaust fans provided for the Oil rooms and Gas Rooms of Power House Building.

The signal from smoke detectors / thermal sensors (to be provided by purchaser including potential free contact at the fire panel) shall be sent to operate the supply air fire damper. In case of fire / power failure, the damper actuator shall be de-energized to close the damper and respective fan motor shall be tripped in case of fire.

Power supply for the motorized dampers shall be arranged from Bidder's respective Local Starter cum Control Panel (LSCP) for AWU / UAF unit. The fire dampers shall be electrically operated motorized type (rated 240V \pm 10% volt, 50 \pm 5% HZ AC). The damper shall be suitable for electrical opening and closing for their automatic operation and manual testing purpose with the help of by-pass Push Buttons.

The damper actuators shall be spring return type. The damper shall be interlocked with respective motors of ventilation system.

- i) Back draft dampers will be provided at the air outlet areas where pressurized ventilation has been envisaged and as mentioned in fan schedule.

- 2.09.00 Local push button stations, wherever required.
- 2.10.00 Thermal insulation will be provided for the exposed portion of Supply Air ducting.
- 2.11.00 Smoke detector / thermal sensor for operation of fire dampers for the buildings not having fire-fighting arrangement.
- 2.12.00 Installation of all equipment supplied by bidder.
- 2.13.00 Anchor bolts, nuts and bolts and loose fitting as would be necessary for erection and commissioning.
- 2.14.00 One complete set of tools and tackles.
- 2.15.00 One set of recommended spare parts for trouble free operation of the system together with mandatory spare parts as specified.





- 2.16.00 Erection, testing and commissioning of electrical drive motors and equipment shall be as per VOLUME : II-F1 & F/2 of specification.
- 2.17.00 Cleaning protection and painting as specified herein.
- 2.18.00 The above clauses specify the equipment for general guidance only. Any other equipment and / or material necessary to ensure safe and satisfactory erection, commissioning, operation and maintenance plant shall also be included in the scope of the specification.
- 2.19.00 Provision for Fan / Pump running indication in unit Control Room for Air-Washers located in Power House shall be made available.
- 2.20.00 Power and control cabling for all ventilation equipment
- 2.21.00 Grounding of all drives and equipment required for Power House Ventilation system as per Main Plant Package, Technical Specifications, Volume: II-F/1, Electrical works.

3.00.00 CONTROL PHILOSOPHY

3.01.01 Humidity Control (Air Washer System)

To protect the equipment located in the ventilated space from effects of high humidity, control device using humidistat inter- locked with pump motor of the air washer unit shall be used in electrical areas. Humidity beyond 60% RH in these ventilated spaces shall automatically trip the respective AWU pump. The pump may be restarted automatically at about 50% RH. At least, Two (2) nos. humidistat (RH High and Low) shall be provided per pump of each Air Washer Unit. However, manual overriding facility shall be provided for humidistat controlled pumps for the Air Washer Unit. Selection and starting of stand by pump shall be manual. In any case the Pump sets for spraying water over the filters in Air Washer Unit will not be stopped.

Relative Humidity & Temperature to be displayed at least 3 locations of Switchgear Rooms.

3.01.02 Operation of Motorized Type Fire Damper

Motorized type electrically operated fire dampers shall be provided in the ventilation supply air ducting leading to Electrical Rooms like various MCC rooms, Switchgear rooms, cable spreader rooms and in the exhaust path of oil room. These dampers shall be operated with the help of signal from smoke detectors / thermal sensors. Motors shall remain energized in normal condition to effect opening of dampers. In the event of fire, the motors will be de-energized and the damper will close due to spring action. Smoke detector / thermal sensors will be supplied by the Bidder.





4.00.00 DESIGN CRITERIA

4.01.00 The weather report of Sagardighi Weather Station has been considered to arrive at the outdoor design conditions which shall be as follows :

- Summer : 41.5 °C. Dry Bulb (DB), 32.5°C. Wet Bulb (WB)
- Monsoon : 34.45 °C. DB, 31.0°C. WB
- Winter : 13.05°C. DB, 10.5°C. WB

4.02.00 Inside Design Conditions

The following desired inside conditions for all the ventilated spaces shall be maintained by selecting proper type of Ventilation System.

4.02.01 In dry type forced (mechanical) type ventilation system where the ambient air is drawn and distributed inside the building / room and then exhausted, the temperature inside the ventilated space will be restricted within 3°C higher than the ambient dry-bulb temperature. Relative humidity will depend upon moisture content of the ambient air.

4.02.02 In the areas ventilated by evaporative cooling units, the inside dry bulb temperature will be 3°C lower than the outside ambient temperature. This temperature will prevail near the roof level of the ventilated space. The hot air from the department will be exhausted out by roof exhausters / wall exhaust fans / louvers / back draft dampers.

In Powerhouse building, where this type of ventilation system shall be used, actual temperature at the Ground floor, Mezzanine Floor and Operating Floor shall be less. The relative humidity should be kept within 50%-60% through proper control of Air Washer Cell Deck Pump operation.

4.02.03 Inside condition of TG hall and other electrical areas like Switchgear Room, MCC room of Power House building will be made reasonably dust free by adopting flooded type filter in the Air Washer Units. Moreover some amount of over pressure will be maintained inside the TG hall and electrical areas, and dust infiltration will be prevented thereby. For this system to work effectively, the rolling shutters should be kept closed. In some dry type mechanical ventilation, dry type washable metallic filter shall be adopted where cleanliness requirement is of importance. Here also some amount of over pressure will be maintained by using back draft damper to prevent the ingress of dust.

4.02.04 Auxiliary buildings should be ventilated generally in line with Clause No. 2.03.00. Areas not covered in these places but require ventilation should also be ventilated.





4.02.05 The following minimum air change rates are to be maintained for the areas indicated below.

Refer Clarifications-1.

- | | | |
|-------|--|--------------------|
| i) | T.G. Hall (considering full height of the TG Building) | 6 Air Change / Hr |
| ii) | Cable Spreader Floor | 5 Air Change / Hr |
| iii) | Electrical Room like M.C.C. Room, Switchgear room in T.G. Building | 15 Air Change / Hr |
| iv) | Battery Room | 20 Air Change / Hr |
| v) | Toilet | 20 Air Change / Hr |
| vi) | Coal conveyor floor and coal terminal floor | 30 Air Change / Hr |
| vii) | Pump Houses | 10 Air Change / Hr |
| viii) | CW Chlorination Building | 20 Air Change / Hr |
| ix) | Electrical Rooms for all Auxiliary Buildings | 15 Air Change / Hr |
| x) | Non AC areas of ESP control Building | 15 Air Change / Hr |
| xi) | CPU Regeneration area | 10 Air Change / Hr |

NB : The fan capacities shall be decided on the basis of the actual heat load or specified minimum air change rate, whichever is higher. Selection of fan duty conditions will be supported by back-up calculations,

4.02.06 All drive motors for exhaust fans shall be suitable for 55⁰C ambient condition whereas drive motors for supply fans shall be suitable for 50⁰C ambient condition.

4.02.07 Saturation Efficiency of the AWU shall not be less than 90% while the same for the Unitary Air Filtration Units shall be not be less than ~~60%~~ 70%

4.02.08 All equipment shall be suitable for continuous operation.

4.02.09 All motors shall have margins as follows:

- a) At least 10% margin on BHP for HSC pumps. However margin on Monobloc Pumps shall be as per Manufacturer's standard.
- b) At least 15% margin on BHP for various Axial Flow / Centrifugal Fans.





4.03.00 Codes and Standards

4.03.01 Design, manufacture, inspection and testing of the equipment covered by the specification shall unless otherwise specified conform to the latest edition of the standards and code including all addenda mentioned below:

- IS: 325 -1978 - Three Phase Induction Motors
- IS: 4029 -1967 - Guide for Testing Three Phase Induction Motors.
- IS: 210 – 1978 - Grey Iron Casting
- IS: 2062 -1992 - Structural Steel (standard quality)
- IS: 277 - 1992 - Galvanized Steel Sheets
- IS: 2676 -1981 - Dimensions for Wrought Aluminium and Aluminium Alloys, Sheet and Strip
- IS: 617 – 1975 - Cast Aluminium Alloys
Reaffirmed 1991
- IS: 655 – 1963 - Metal Air Ducts
Reaffirmed 1991
- Standard Code for Testing Centrifugal & Axial Flow Fans AMCA: Bulletin No. 210.
- IS : 4894 – 1987 - Centrifugal Fans
- IS : 3588 – 1987 - Electric Axial Flow Fans
- IS : 3963 – 1987 - Roof Extractor Units
- IS: 5120 – 1977 - Technical Requirements for Roto dynamic Reaffirmed 1991 Special purpose Pumps
- IS: 1239 - 1992 - Mild Steel Tubes & Fittings
(Part - I & II)
- IS: 780 - 1984 - Gate Valves
Reaffirmed 1990
- IS: 5312 – 1984 - Check Valves
(Part-I) Reaffirmed 1990





| | | |
|---|---|--|
| BS: 6540 Part-I: 1985 | - | Methods for Test Air Filter used in Air conditioning and General Ventilations. |
| BS: 848 Part-1: 1980, Part-2: 1985 Part-5: 1986, Part-6: 1989 | - | Method of Performance Test for Fans |
| AMCA Publication 99 | - | Standard Hand Book |
| IS: 737 - 1986 Reaffirmed 1991 | - | Wrought Aluminium & Aluminium Alloys, Sheet and Strip |

4.03.02 The Bidder shall follow this specification for requirements of materials of construction.

5.00.00 DESIGN AND CONSTRUCTIONAL REQUIREMENT

5.01.00 General

5.01.01 All equipment shall be heavy-duty type suitable for installation in heavy industries and long period of uninterrupted service.

5.01.02 The equipment shall be designed to permit interchangeability of parts and ease of access during inspection, maintenance and repair.

5.01.03 All parts subject to substantial temperature changes shall be designed and supported to permit free expansion or contraction without resulting in leakage, harmful distortion or misalignment.

5.01.04 All electrical and mechanical equipment shall be designed and manufactured so that no damage will result from transportation, storage, installation and operation of the equipment with the climatic conditions to which it will be subjected.

5.01.05 All materials used shall conform to the specification and shall be new and first class in all respects.

5.01.06 Anchor bolts, nuts and seating steel work shall be supplied with the equipment. Only hexagonal nuts shall be used for holding down the equipment, with proper lock nuts. All bolt holes shall be spot faced for nuts. In specific cases where not necessary, spot facing may be omitted.

5.01.07 Casting and welding shall conform to their respective specifications and shall be free from flaws and objectionable imperfections, machined true and in a work-man like manner.

5.01.08 Proposal for repair or any similar operations involving the plugging, welding, boring or addition of metal to the original castings, shall be submitted to the Purchaser/Consulting Engineer and approval shall be received before any





such work is carried out. Drawings showing details and locations of such modifications shall be submitted to the Purchaser/Consulting Engineer for his records.

- 5.01.09 The separate pieces of equipment shall be marked with unit number. The assembly drawing shall indicate part number of each equipment and unit number for easy correlation.
- 5.02.00 Centrifugal and Axial Flow Fans
- 5.02.01 Centrifugal fans shall be SISW/DIDW as mentioned in the Specification. The designs shall be in general end suction and upward/downward/inclined/horizontal discharge type as demanded by the system/installation need. All centrifugal fans are coupled to the drive motors with V-belts. Puller holes should be provided on fan impellers and pulleys for ease of extraction from fan/motor shaft. Fan/motor shafts should have threaded centre holes for fixing pushers and locking the impeller/pulley axially on fan/motor shaft.
- 5.02.02 All roof exhausters/supply fans and wall exhausters/supply fans are of direct drive axial flow type. Roof exhausters/supply fans shall have multi-bladed impeller with a short duct casing while wall exhausters/supply fans shall have coned inlet suitable for free discharge of air.
- 5.02.03 The centrifugal fans and axial flow fans shall be capable of withstanding the stresses which may be experienced during normal operation under the condition which it is required for and during over speed test.
- 5.02.04 It is desirable that all centrifugal fans shall be designed to operate within 9% and 25% of system throttling line.
- 5.02.05 All the fan units shall be reasonably noise and vibration free in operation and therefore of reasonably low speed. RPM of axial flow fans shall be restricted within 1000 to reduce their noise level excepting roof extractors for which RPM shall be restricted to 1500. Outlet air velocity of all fans shall be restricted within 12 m/s.
- 5.02.06 Casing for centrifugal and axial flow fans shall be reasonably leak proof.
- 5.02.07 The first critical speed of the rotating assembly shall be at least 25% above the operating speed.
- 5.02.08 Fan wheels shall be statically and dynamically balanced according to ISO 1940 Grade 6.3.
- 5.02.09 Impeller
- a) The blades of the centrifugal fan impeller for all units shall be backward curved unless otherwise specifically mentioned. The blades of the impeller shall be die formed aerofoil or laminar type. They shall have self-cleaning and non-overloading characteristics, and shall be



welded to the back plate and shroud, if any. The fan wheel shall be statically and dynamically balanced.

- b) The axial flow fan impeller shall be cast in one piece, finished all over and are fully balanced both statically and dynamically. Finally the assembled rotor shall be dynamically balanced. All axial flow fan impeller shall consist of high efficiency aerofoil section blades. Puller holes should be provided on fan impellers and pulleys for ease of extraction from fan/motor shaft. Fan/motor shafts should have threaded centre hole for fixing pushers and locking the impeller/pulley axially on fan/motor shaft.

5.02.10 Casing

- a) Centrifugal fan casing shall be of welded construction and provided with flanges on inlet and outlet sides for duct connection. Mounting legs welded to the casing shall be provided. Plummer blocks should preferably be not supported on the bracings/stiffeners of casing sidewalls.
- b) Axial flow fan casing for roof exhausters / supply fans and their components shall be suitable for outdoor installation. The casings will be provided with flanges at inlet and outlet. All nuts & bolts associated with it shall be of zinc or cadmium plated with proper baking to remove hydrogen.

Easily removable inspection cover having galvanized fly nut shall be provided. The inspection covers shall be located such that the grease nipple for all bearings, and also motor terminals are easily accessible through the cover. It is however, preferred that provisions will be there for greasing the fan bearings from outside the fan casing.

Suitable motor brackets as per manufacturer's standard for both roof and wall exhausters/supply fans shall be fitted. The brackets shall be designed to provide rigid mounting for motors.

5.02.11 Bearing

Centrifugal fan shaft shall be mounted on self-aligning, heavy duty spherical roller bearing of adequate capacity and life. In no case the life of the bearings shall be less than 40,000 hours. Centrifugal fans for air washers installed in the T.G. Building, should have minimum bearing life of 100,000 hours. Bearings shall be grease lubricated and provided with fittings for lubrication from outside. The bearings shall be located in an easily accessible location to facilitate maintenance.

5.03.00 Roof Exhauster / Wall Mounted Fans

- a) Roof exhausters/wall mounted fans (if located on the exposed wall) shall be provided with hood for protection against rain and other





contingencies. It must ensure no dripping of rainwater under any circumstances and will have low pressure drop of air. The hoods shall be provided with a heavy gauge expanded metal bird screen. Axial flow fans should be fitted with protective screens from inside of room.

- b) Rain protection cowls will be designed to suit wall exhausters/supply fans for protecting fans from rain. The cowls will be provided with bird screen of heavy gauge expanded metal netting.
- c) A typical sketch enclosed herewith shows arrangements for both roof exhausters and rain protection cowl. Any other approved design for the hoods and cowls can be considered. Grouting frames for the cowls if required, shall be included in the supply along with nuts and bolts.

5.03.01 Coned Inlet

Wall exhausters shall be provided with coned inlet made of M.S.

5.03.02 Inlet Screen

Inlet screen shall be manufactured of min. 14 SWG galvanized wire knitted in 1" square mesh. Suitable flanges to protect the edges of the screen shall be provided.

5.03.03 Vibration Isolator

Double deflection rubber in shear or rubber in compression type vibration isolators shall be provided with each centrifugal fan. Rubber bushes, washers, wherever needed for the vibration isolators shall be included in the supply. Sufficient number of such isolators shall be provided to ensure isolation of foundation from vibration of the equipment.

5.04.00 Fans for Special Application

Fans for battery room, oil rooms and fuel stores shall be of spark proof and corrosion proof construction. These axial flow type fans, shall be bifurcated type construction with motor away from air stream. Motors for these fans shall be of flameproof construction.

All fans for special application shall have all accessories as mentioned in the Specification.

5.05.00 Fan Drive

- a) Centrifugal fans shall be provided with V-belts and sheaves. All belts shall be sized with minimum 1.5 service factor. All V-belt drives shall be equipped with removable guards that do not impede the air flow to the fan inlet. There shall be a minimum of two belts per drive. All pulleys should have threaded puller holes for the ease of their extraction.





- b) All direct drive axial flow fan impellers shall be directly mounted on extended motor shaft.

5.06.00 Materials of Construction

The following materials shall be used for the construction of various parts:

- | | | | |
|----|--|---|--|
| a) | Centrifugal fan impeller | : | M.S. sheet/Plate (IS: 2062) |
| b) | Axial flow fan impeller | : | Cast Aluminium Alloy A-6M. IS-617 |
| c) | Fan sheet | : | C-45, IS-1570 or Class-IV IS-1875 or its equivalent. |
| d) | Fan Scrawl | : | Heavy gauge M.S. (IS-2062) |
| e) | Fan supports, frames and Structure. | : | M.S. of adequate thickness (IS-2062) |
| f) | Coned inlet for wall Exhausters / Supply fans | : | M.S. (IS-2062) |
| g) | Dampers | : | M.S. of heavy gauge)(IS-2062) |
| h) | Flexible connections for fan: | : | Fire resistant type plastic inlet and outlet impregnated canvas with M.S. flange & cleats. |
| i) | “V” pulleys | : | G.I.multigrooves(IS-210, Gr.20) |
| j) | “V” belts (Matched sets) | : | Reinforced rubber of appropriate section. |
| k) | Slide rails | : | C.I. or M.S. |
| l) | Connection pieces | : | GI according to supplier's design. |
| m) | Bolts and Nuts | : | M.S. unless otherwise specified. |
| n) | Rain protection cowls hoods and casing for roof Exhausters / wall exhausters / Supply fans | : | Aluminium or hot dipped galvanized after fabrication from M.S. |
| o) | Vibration isolating pad washers and bushes, if any. | : | Hard synthetic rubber of hardness 40° shore. |

**5.07.00 Air Washer Units**

5.07.01 The air washer unit shall be designed as fill deck type units. Air is sucked by the centrifugal fan unit / units successively through the Air Intake Louver of GI louver with frame and GI Screen, Stainless Steel Filters continuously flooded with water through spray nozzles, Fill deck made of impregnated and corrugated cellulose paper sheets bonded together with insoluble anti-rot salts, rigidifying saturates and wetting agents and assembled in self-supporting pads of cross fluted configuration with flute angle 45°/45°, Die-extruded PVC eliminators and delivered to the duct system with Supply air Grilles for distribution.

5.07.02 The fill section consists of a perforated Fiberglass Reinforced Plastic (FRP) trough over the fill deck covering the top surface of the fill section (Maximum allowable height of each Fill section will be 2000 mm) for proper distribution of water through cellulose fills. In case the height of the Fill Section exceeds 2000 mm, double deck arrangement with a separate water trough shall have to be provided. The required quantum of water will be taken to the trough with the help of a Monobloc Centrifugal Pump set and medium class internal GI piping. The air velocity through the Fill Section will be limited to of 2.25 M / Sec (maximum).

5.07.03 The Filter section consists of a set of Stainless Steel (SS-316) mesh filter modules mounted on a ladder type GI framework and quick release mechanism for easy dislodgement of the filter modules. The filter mat shall be weaved with SS wire of 0.16 mm dia. providing an aperture of max. 0.025 mm. Such filters are continuously flooded with water spray from a spray header bank. The water spray is in the direction of airflow. The Spray nozzles shall be made of brass / stainless steel and shall be of hollow-cone type with an orifice dia. of 6 mm.

The filter module size shall not be more than 610 mm x 610 mm. The water spray will be generated with the help of a Horizontal Split Casing / back pull type Centrifugal Pump-Motor set and associated Medium Class GI piping with all fittings and supports. The water will be collected in a sheet metal tank and will be re-circulated by means of the said pump. This tank shall be common for both the Filter section and Fill section and shall be complete with make-up connection with float valve, quick fill connection, drain connection with valve and overflow connection with siphon. The tank shall be made of sheet metal of min. 5 mm thickness.

5.07.04 To protect the equipment located in the ventilated space from effects of high humidity, control device using Humidistat interlocked with the Pump Motor of the Fill Section shall be used in the electrical areas. Humidity beyond 60% RH in these ventilated spaces shall automatically trip the respective Pump set. The pump may be restarted automatically at about 50% RH. At least, Two (2) nos. Humidistat (RH High and Low) shall be provided for each Air Washer Unit. However, manual over riding facility shall be provided for humidistat controlled Pump sets of the Air Washer Unit.





- 5.07.05 The equipment shall be within the sheet metal casing. The overflow pipe connected with the water tank must be terminated with a siphon, to avoid leakage of air into the air washer chamber. All air washer internals coming in contact with moist air shall be duly painted with epoxy resin based paint. All in side and out side parts of the fans shall be spray galvanized whereas the shaft shall be only epoxy painted. Provision of Marine lights shall be kept in both the Filter and Fill section.
- 5.07.06 The Air Washer Units shall be suitable for running with clarified water. Bidder shall refer to the water analysis sheet enclosed with this specification for necessary confirmation.
- 5.07.07 The air washer units shall be designed for a saturation efficiency of 90% of the spray system with an inlet air condition as mentioned under Clause No. 4.00.00 "DESIGN CRITERIA" of the specification.
- 5.07.08 The outside dimensions are unavoidable restraints and cannot be altered. But within the space allotted the equipment design and location may be modified to suit the supplier's standard equipment.
- 5.07.09 All drain pipes will use "Tee" fitting instead of elbows or bends. "Tee" fittings should be installed such that the plugs can be removed and any section of the pipe can be cleaned. Drain valve will be located at the lowest point of the pipelines. If necessary, more than one drain valve will be installed to facilitate complete drainage from pipe. The make-up piping including all valves, bends, fittings, supports etc. shall be supplied by the Tenderer.
- 5.07.10 Properly hinged air tight epoxy painted inspection doors of suitable sizes with ladder and catwalk shall have to be provided in each sheet metal Air Washer Unit.
- 5.07.11 Sheet Metal Air Washer Chamber

Air washer chamber housing filter, (SS mesh in SS / Al frame), water headers, supports, Fill deck arrangement, moisture eliminators, water tanks etc. shall be manufactured of sheet steel in sections to facilitate easy dismantling and erection. The unit shall be fabricated from minimum 4mm thick black M.S. sheet with adequate stiffeners, bracings etc. The water sump shall be fabricated from minimum 5 mm thick black M.S. sheet with adequate stiffeners, bracings etc and shall be complete with suction pipe connection with coarse strainer, make-up water connection with float valve, overflow connection with siphon and drain connection with valve, quick fill connection with valve etc.

The various sections of the unit shall be bolted with suitable gasket to avoid leakage of water. All the sections of the units shall be duly epoxy painted to prevent corrosion. The nuts and bolts used for jointing the sections shall also be epoxy painted. The connection pieces shall have at least 2 coats of rust inhibiting paint. All inside and outside parts of the fan shall be spray galvanized except the shaft which shall only be of epoxy painted. The casing





front shall be provided with an air inlet louver.

5.08.00 Unitary Air Filtration Unit

5.08.01 Unitary Air Filtration Unit shall have in general one set of air intake GI louver with frame and GI Screen, one set of SS filter in SS / AL frame with continuous water spraying arrangement (through SS Spray Nozzles) over the surface of it for continuous cleaning of the filters and one set of Moisture Eliminators of PVC die extruded construction after the above water flooded filters to eliminate the carry over of moisture. Suitable Galvanized Iron grid shall be used inside both the filters and eliminators for reinforcement. One (1) no. Backward Curved SISW Centrifugal Blower shall be used for conveying the air. The unit shall be self-enclosed by 2 mm thick sheet steel fabricated casing duly epoxy painted. The casing front shall be provided with the air intake louvers of GI construction. The saturation efficiency of the spray system shall be ~~60%~~ for the Unitary Air Filtration Unit.

70%

5.08.02 Water with the dirt will be collected in the sump made from minimum 3 mm thick MS construction duly epoxy painted and bled off to the drain in small quantity. Water will be re-circulated by means of one set of Centrifugal Monobloc Pump sets. The drain pan shall be provided with overflow pipe terminating to the nearest drain point (provided by the Purchaser). The unit may be installed indoor or outdoor as per site requirement. Suitable rain protection sheds of sheet metal construction shall be provided for the motors installed outdoors. All parts including fan of this system coming in contact with moist air shall be spray galvanized except the fan shaft, which shall be of epoxy painted.

5.08.03 Properly hinged air tight epoxy painted doors of suitable sizes with ladder and catwalk shall have to be provided in each sheet metal Unitary Air Filtration Unit.

5.08.04 All drain pipes will use "Tee" fitting instead of elbows or bends. "Tee" fittings should be installed such that the plugs can be removed and any section of the pipe can be cleaned. Drain valve will be located at the lowest point of the pipelines. If necessary, more than one drain valve will be installed to facilitate complete drainage from pipe. The make-up piping including all valves, bends, fittings, supports etc. shall also be supplied by the Tenderer.

5.09.00 Moisture Eliminator Sets

5.09.01 Moisture eliminator sets used for the Air Washer / UAF units shall be vertical and die-extruded PVC construction.

5.09.02 Face velocity of air for the PVC Eliminator sets shall not exceed 2.5 m / sec.

5.09.03 Eliminators shall be manufactured in suitable sizes for easy handling, erection and replacement whenever necessary.

5.09.04 Moisture Eliminator shall have bends at 30° with the direction of airflow and





shall have 2 effectively hooked edges for trapping the carry over of water. The catcher should face the direction of airflow.

- 5.09.05 The Moisture Eliminators shall be fixed rigidly in their proper position and spacer shall be provided to maintain the proper gap.
- 5.09.06 Holding frame for the PVC Eliminators shall be of G.I. angles of adequate strength for support.
- 5.10.00 Spray Arrangement
- 5.10.01 The arrangement of spray nozzles for all Air Washer and UAF Units shall be of single bank with direct spray on the flooded type Stainless Steel Filters in the direction of airflow. The Spray nozzles shall be made of stainless steel and shall be of hollow-cone type with an orifice dia. of 6 mm. Supplier shall confirm the layout of the nozzles on the vertical face. The nozzle arrangement shall ensure good spray distribution and fine break-up of water across the air stream.
- 5.10.02 For Air Washer Units, the supplier shall include water spray headers and piping connected to both the pumps, out of which one will act for spraying arrangement on Stainless Steel Filters and the other for feeding water to the trough over the fill section. The water header and piping shall be of G.I. One pot strainer with very fine mesh brass screen shall be fitted preferably in the suction line of all the pump sets. The strainer should have a by-pass line.
- Water from the washer chamber tank shall be taken through a primary screen type water filter fitted in an accessible position in the tank. The filter screen shall be manufactured of S.S netting in a S.S. Frame.
- 5.10.03 Similarly for Unitary Air Filtration Units, the supplier shall include water spray headers and piping connected to the Pump sets. The water header and piping shall be of G.I. One pot strainer with very fine mesh brass screen shall be fitted preferably in the suction line of all the pump sets. The strainer should have a by-pass line.
- Water from the UAF Unit Sump shall be taken through a primary screen type water filter fitted in an accessible position in the tank. The filter screen shall be manufactured of S.S netting in a S.S. Frame.
- 5.10.04 All accessories like valves, drain valves, fittings, pipe support, hangers, etc. shall be included in the supply. These will be manufactured according to the supplier's standard.
- 5.10.05 The Bidder shall use the regular type fittings / bends for piping as per IS-1239, Part - II. Spacing and location of hangers shall conform to the preferred engineering practice. All materials for anchoring the hangers with reinforced concrete work or building structural beams and columns shall be furnished by the Tenderer. Bidder



- 5.11.00 Washable Metallic Filter
- 5.11.01 The filter media shall be designed to hold dust, sand and prevent it from being dislodged by vibration or other cause and passing through filter.
- 5.11.02 The filters shall be washable/cleanable type construction of SS wire netting with three or more layers of wire mesh of different mesh sizes stitched together and held in a SS / Al frame of adequate thickness but not less than 18 SWG for Al and 20 SWG for SS suitable for long use in an industrial plant. The filter when flooded shall have a filtration efficiency of 90% down to 10 microns.

The filters may be in panels of size about 610 x 610 for easy handling of the same.

The face velocity of air across the filters shall not exceed 2.5 m/sec.
- 5.12.00 Water Pumps
- 5.12.01 Each pump shall preferably be of centrifugal horizontally split casing / back pull out type directly coupled to electric drive motor and mounted on a common base plate and located by dowel pins after proper alignment. However, Mono bloc type may be acceptable below a certain motor rating which is to be decided during detailed engineering..
- 5.12.02 The pumps will operate under flooded suction and shall have axial suction and radial discharge.
- 5.12.03 Pump head-capacity characteristics shall be gradually rising from operating to shut-off point without any zone of instability. The pump BHP flow characteristics shall preferably be non-over loading type beyond rated capacity point.

Pump shall be rated for continuous operation.
- 5.12.04 Operating speed of the pump shall not preferably be more than 1500 RPM.
- 5.12.05 Material of the pump shall preferably be as follows (all material shall be of tested quality)
 - a) Casing : Cast iron, Grade-20, IS-210
 - b) Impeller and wearing rings : Bronze
 - c) Shaft : EN-8
 - d) Shaft sleeve : Bronze / SS



- 5.12.06 The pump bearings and the shaft shall be sized adequately to take the maximum possible unbalance and hydraulic loads. Pump bearings shall have adequate life and in no case it shall be less than 40,000 hours.
- 5.12.07 Pump and drives shall be directly coupled through a flexible coupling. Suitable coupling guard shall be provided for each pump.
- 5.12.08 Each pump shall be complete with pressure gauge at the suction and delivery, isolating valves, all integral piping required for sealing, cooling, etc.
- 5.12.09 The design of the pumps shall conform to the relevant IS Code or equivalent.
- 5.12.10 The pump suction strainer shall be of pot type having easily removable top cover for access to the filter cartridge. The filters shall be fitted with fine mesh copper or brass wire strip.
- 5.12.11 The pump motor should be so selected that it is not overloaded at 50% of the flow.
- 5.13.00 Ducting
- 5.13.01 General
- a) Velocity of air in any section of duct shall not normally exceed 12 m/sec.
 - b) All duct work for supply for air shall be fabricated from G.I. sheet and all duct work for exhaust system shall be fabricated of black M.S. sheet or whatever mentioned in the drawing. The duct work shall be properly reinforced to prevent sagging, buckling or vibration. Interior of all ducts shall be smooth and free from obstruction. This specification is applicable for all duct work except otherwise mentioned in the drawing.
 - c) All duct for ventilation supply or exhaust shall be manufactured of at least 1 mm thick G.I./M.S. sheet. up to duct largest size 2250mm and at least 1.25mm thick GI/MS sheet duct largest size more than 2250mm. (Amendment-1)
 - d) The duct conveying the battery room exhaust or any other corrosive fume shall be made of M.S. with epoxy painting on both sides.
- 5.13.02 Joints
- a) All longitudinal joints for ventilation duct shall be Pittsburgh Lock seam type.
 - b) Transverse joints of the low pressure ducting shall be continuous around the four sides. Corner closures are required. The type of transverse joints shall be as follows .



| Larger side (mm) | : | Type of transverse Joints |
|-------------------------|----------|---|
| Up to 600 | : | 25 mm wide pocket, drive or S-slip |
| 601 - 1500 | : | 75 mm wide, bar-S-slip or pocket slip |
| 1501 - 2250 | : | 40 mm x 40 mm x 60 mm M.S. Angle connection |

c) Low pressure ventilation ducts shall be provided with intermediate transverse bracings continuous around the four sides between the joints according to the following sizes:

| Larger Side (mm) | : | Bracing |
|-------------------------|----------|---|
| 0 – 450 | : | None |
| 451 – 1500 | : | 40 mm x 40 mm x 6 mm angle, 1200 mm from joints |
| 1501 and above | : | 40 mm x 40 mm x 6 mm angle, 600 mm from joints |

All flat surface between bracing or joints shall be reinforced 900 mm crosswise of the duct and by a longitudinal internal standing seam located in the center third of the duct width. All flat surfaces over 1500 mm widths shall be reinforced by the longitudinal internal standing seams located approximately on the third points of the width.

d) Riveting and Sealing

All joints, slips and seams shall be made secure by riveting on centers not exceeding 150 mm. All transverse stiffeners and all reinforced bar slip joints shall cross at corners and be riveted. All bar slip joints and angle iron bracings shall be riveted on centers not exceeding 75 mm.

All construction joints and seams shall be reasonably sealed with suitable sealing compounds.

e) Access Doors

All main duct work shall be accessible throughout using fitted hinged access doors. Doors shall have to be cemented on sponge rubber gaskets. Angle joints shall be provided with felt or rubber gaskets for leak-tightness of the joints.





- f) Suitable drain point with water trap shall be provided for all washed air duct routing at suitable places, preferably just after air washing unit.
- g) All duct sections shall be cross broken.
- h) Canvas or equal flexible connection shall be provided at each connection between duct work and fan units to isolate vibration.

5.13.03 Hangers and Supports

- a) All duct work shall be provided with adequate hangers to ensure rigid support and to prevent vibration.
- b) Hangers shall be suspended from the ceiling by cinch anchor/expansion bolts.
- c) Hangers for all ducts shall be trapeze type with the shelf constructed from 35 mm x 35 mm x 5 mm angle iron and hung from two steel rods each of 10 mm dia at least.
- d) All hangers and supports shall be approved by the Engineer. When vertical ducts pass through floor slab, they shall be supported by means of collars constructed of steel structural angles securely fastened about the girth of the duct and resting on the floor slab. The supporting angle shall be fastened to the floor slab with a filter or bitumastic compound between the horizontal leg of the supporting angle and the floor.
- e) All ducts running on the floor/roof shall be adequately fixed in position by angles. The supporting and fixing arrangement shall be approved by the Engineer. The fixing and supports interval shall not exceed 3 meters.

5.14.00 Grilles / Diffusers

- a) All supply air grilles shall have two sets of adjustable louvers for desired spread and throw requirement. All supply air grilles shall have one set of opposed multiple louver damper at the inlet. The damper shall be gang operated and will have a device to keep the dampers fixed in one position.

The grills frame and louvers shall be manufactured of at least 20 SWG powder coated MS sheet.

All exhaust air grilles shall have one set of louvers in the front of thick rat-proof wire net guards. All grilles shall be fitted with adjustable gaskets to prevent air leakage.

No grille should by any chance make any rattling sound during continuous operation. All grilles shall match the decor of the space.





- b) Design of grilles/nozzles shall be such as to create desired throw and spread and shall be approved by the Purchaser/ Engineer.

5.15.00 Dampers

5.15.01 Splitter Damper

Splitter dampers in branch take off wherever needed shall be provided. Damper blades shall be minimum 16 SWG thick.

5.15.02 Gravity Operated Damper

Gravity operated back draft dampers are needed to ensure pressurization of rooms where specified. These dampers shall be designed such as not to allow infiltration of air from outside while forced ex-filtration by the fan will be achieved through the above dampers. The louvers of the dampers shall be freely mounted on spindles to allow the damper to open with the pressure developed by the fan. The dampers shall be provided with flanges at inlet.

5.15.03 Fire Damper

Fire dampers shall be provided at the supply / exhaust fan / duct in all electrical areas and oil rooms. The fire dampers shall be of electrical type with damper actuated by motors and smoke detectors / heat sensors.

5.15.04 Opposed Multiple Louver Damper

Opposed multiple louver dampers shall be provided at the fan outlet as and where required by the system. Each blade of the damper shall be provided with bronze, gun-metal or nylon bearing at each end of its spindle. The spindle bearings shall be mounted in a strong structural frame work Operating lever with fixing device for keeping the damper at the desired position shall be fitted for the manually operated dampers. Operating lever will be fixed on an indicator to show the percentage of opening of the damper in all cases except for the application with grilles and nozzles. Velocity across the dampers shall not exceed 10 m/sec.

5.16.00 Dry Filter

5.16.01 The filter media shall be of high density Polyethylene or equivalent and shall have efficiency not less than 90% down to particle size of 10 microns.

5.16.02 The filter media shall be sandwiched in between two galvanized wire netting arrangement in a uniformly corrugated form to increase the surface area.

5.16.03 The filter shall have G.I. frames of adequate thickness suitable for long use in an industrial plant.





- 5.16.04 The filters may be in panels of size about 600 x 600 for easy handling. The filter panels shall be mounted on angle iron holding frames.
- 5.16.05 The frames shall be designed strong enough to take the load of double the pressure drop in dirty condition of the filters.
- 5.16.06 The face velocity across the filter media shall not exceed 2.5 m/sec. Pressure drop across the filter shall be limited to 6 mm WG during clean and 12 mm WG during dirty condition.
- 5.17.00 Drive Motor
- 5.17.01 All motors of all equipment shall be squirrel cage induction type of required BHP rating. The BHP rating of the motor for backward bladed centrifugal fans and also for axial flow fans shall provide at least 15% margin over their limit load power.
- 5.17.02 Motor Powers for other equipment shall have at least 15% margin over their driven equipment rated BHP including drive loss
- 5.17.03 All motors shall be suitable for direct-on-line starting. The motors shall be rated to suit the following :
- ❖ Supply voltage of 415 V $\pm 10\%$, 3 ϕ , 50 $\pm 5\%$ Hz with a combined voltage and frequency variation of $\pm 10\%$.
 - ❖ Ambient temperature 50 $^{\circ}$ C for all supply fans and 55 $^{\circ}$ C for exhaust fans .
 - ❖ Class-F insulation with Class-B temperature rise.
 - ❖ Enclosure TEFC, IP-55
 - ❖ All motors rated 250 W and below shall be suitable for single phase 240V $\pm 10\%$, 50 $\pm 5\%$ Hz. Motor rated above 250W shall be 3 phase and suitable for 415 V $\pm 10\%$, 50 $\pm 5\%$ Hz.
- 5.17.04 Each motor terminal box shall be provided with cable gland and lugs suitable for the size and type of cable of the respective motor as specified.
- 5.17.05 All electric drive motors including flame proof motors shall be as specified in Main Plant Package, Technical specification, Volume: II-F/1 & Volume II-F/2, Electrical Work.
- 5.17.06 Starting time for large fan motors shall be mentioned.
- 5.17.07 All motor should have threaded centre holes in their shafts.

**5.18.00 Electrical Panels****5.18.01 415 V LOCAL STARTER PANEL**

415V, 3 phase, 4 wire, 50Hz Local Starter Panel shall be provided for feeding motors (above 0.25 KW motor rating) of different Ventilation Fan motors. Local Starter Panel shall be provided for each 3 Phase Ventilation fan. Local Starter Panel will depend on the number of ventilation fans, their motor ratings and locations.

Local Starter Panel shall house incoming MCB/MCCB for incoming power supply, AI Bus Bars , outgoing MCB with power contactors, auxiliary contactors, thermal overload relays, Start-Stop push buttons, and indication lamps for incoming power supply, ON/OFF/TRIP indication lamps, terminal block, wiring for fan motors, with etc.

Emergency Stop P.B. shall be pressed to latch and turn to release type and provided near each fan.

The supply / exhaust fan-motors unit of ventilation system will be interlocked with the zone fire panel in such a way that in case of fire in any zone as detected by the zone fire / smoke detectors, the fan motor will be automatically stopped.

LSP shall be indoor type, air insulated, natural air cooled , self-supported , floor mounting, fully compartmentalized construction, multi-tiered , Non Draw out type , metal clad factory assembled , fully wired type tested assemblies.

The LSPs shall be front wired and front connected and their enclosure shall be dust and splash proof, conforming to degree of protection of IP-54.

All other constructional details shall be as per Main Plant Package, Technical Specifications, Relevant volume of Electrical Work.

5.18.02 Local Starter Cum Control Panel (LSCP) For Air Washer System And Unitary Air Filtration Unit System

Each Air Washer system/ UAF system will have One (1) no LSCP located near each Air Washer / UAF Unit. These LSCPs shall house all electrical devices for power and control purposes of Air Washer / UAF Unit loads like Fan Motors, Pump Motors etc. and other controls.

This LSCP shall house incoming MCB/MCCB for incoming power supply, AI Bus bars, outgoing MCCB with DOL starter, power contactors, auxiliary contactors, thermal overload relays, Start-Stop push buttons, and indication lamps for incoming power supply, ON/OFF/TRIP indication lamps, terminal block, wiring for fan and pump motors etc.





Stop P.B. shall be pressed to latch and turn to release type. Emergency Stop push buttons are provided near each Air Washer / UAF fans and pumps and these are wired directly to the LSCP.

Degree of Protection shall be IP-54.

General construction and other details of LCP shall be as per Main Plant Package, Technical Specifications - Relevant portion of Electrical Work.

5.18.03 Local Push Button Station

Stop Push buttons (lockable at stop position) shall be provided for each fan. Local Push Button Stations shall be as per Main Plant Package, Technical Specifications - Relevant portion of Electrical Work. Total number of Local Push Button Stations shall be as required as per specification and as required for satisfactory operation of the plant.

5.18.04 Local Push Button Stations

Local Push Button Stations shall be provided for the drive motors of Cooling Tower Fans, FCUs and Make-up Water Booster Pumps etc.), suitably located near the said drives.

Local Push Button Stations shall be as per the relevant Volume of the electrical specification.

5.18.05 Local Distribution Board (240v)

Electrical Requirements for Local Control Boards shall be as per Electrical Specification Volume IIF1 & IIF2.

NB : The detailed Specification for the above Electrical Equipments will be as per 12A05-EPC-V-II-F1- & F2 all Sections(Approved Electrical NIT)

5.19.00 Spare Parts

Refer Volume: II-A of Main Plant Package

6.00.00 TESTING AND INSPECTION

6.01.00 Testing and inspection both at manufacturer's works and at site after erection shall be conducted on all equipment.

6.02.00 Dynamic balancing of rotating parts shall be conducted for all centrifugal fans and for all axial flow fans.

6.03.00 Performance testing of fans is an essential requirement. Routine test certificates in case of all equipment except big size fan units (consuming more than 15 HP for centrifugal fans and consuming more than 5 HP for axial





flow fans) may be acceptable. For big size fan units, performance testing of at least one fan of each type is to be shown in presence of Purchaser's representative. This testing may be carried out at reduced speed for minimizing power consumption during testing. All instruments used shall be supplied by the Bidder and those shall be calibrated by an acceptable authority.

Performance testing of pumps of each type is to be carried out at manufacturer's works and the test certificates shall be made available to the purchaser for approval.

6.04.00 Field test shall also indicate freedom from vibration, unbalance, leakage, etc. and establish the design performance of the equipment. The Bidder shall also carry out the balancing of air flow in all duct branches to obtain the desired air quantities at all the points as mentioned in various tender drawings. All instruments used for the field test shall be supplied by the Bidder. Manufacturer shall submit the procedure of field test for Purchaser's approval. Within six (6) months from the date of equipment is placed in service, it shall be tested by the Purchaser.

7.00.00 DOCUMENTS, DATA TO BE FURNISHED

7.01.00 Drawings, Data to be Furnished with Tender Proposal

The proposal must accompany the bid proposal sheets duly filled in. Besides submitting these sheets after filling in, the proposal shall also include the following:

- a) Design Calculations supporting sizing of Ventilation equipment.
- b) Characteristic curves of each type of fans centrifugal and axial flow type.
- c) Characteristic curve of each pump.
- d) Characteristic curve of each motor.
- e) Descriptive and illustrative literature/catalogues/leaflets on each of the equipment and components offered.
- f) All experience list of supply of similar plant and equipment. The list shall indicate the size of installation in each case, the status of execution and the scope of approx. value of the work undertaken by the tenderer.
- g) All drawings and data as asked in tender specification.





- 7.02.00 Drawings, Data to Be Submitted After Award of Contract
- 7.02.01 Final Plant Sizing Calculations.
- 7.02.02 Equipment layout and sectional drawings of
 - a. Air Washer Unit.
 - b. Unitary Air Filtration Unit
- 7.02.03 Schematic flow and instrumentation diagram of the complete system indicating the limits of supply and erection.
- 7.02.04 Ducting layout drawing including sectional views indicating the details of duct sizes, duct joints, duct insulation, duct supports, diffusers, grilles, dampers etc for various floors of Turbine Building, ESP Control Building and other auxiliary buildings, as applicable.
- 7.02.05 Layout drawings showing the routes of water pipe line with details of hangers, supports etc.
- 7.02.06 Outline drawings incorporating all principal dimensions, civil foundation drawings and weight etc. and also sectional drawings incorporating data of material of construction wherever applicable for following equipment:
 - a. Air Washer Units
 - b. Unitary Air Filtration Units
 - c. Centrifugal Air Blower with the Drive Motors
 - d. Centrifugal Pump sets with Drive Motors for circulation of water
 - e. Fan Filter Units, Supply Fans and Exhaust Fans with drive Motors
 - f. Roof Extractor fans with Drive Motors
 - g. Supply Air Grilles / Diffusers
 - h. Fire Dampers
 - i. Back Draft Dampers
- 7.02.07 Technical Catalogues and data sheet for each Equipment and instrument.
- 7.02.08 Drawings and data sheets for Dry Panel Type Filters.
- 7.02.09 Location details of all wall mounted type Axial Flow Fans.
- 7.02.10 Write up on system interlock and / or interlock block diagram.
- 7.02.11 Electrical schematic and wiring diagram for Electrical Panels (LSCP / LSP) and the system as applicable with back-up write-up.





- 7.02.12 LSCP / LSP GA drawings, Bill of instruments and drawings showing construction of Electrical panels.
- 7.02.13 Material Test Certificates.
- 7.02.14 Layout drawing showing route of cables and trays.
- 7.02.15 Cable schedule.
- 7.02.16 Manufacturer's Quality Assurance Plan for various equipment.
- 7.02.17 Shop test reports and certificates.
- 7.02.18 Operation, maintenance and overhauling manuals as per specification.





ATTACHMENT

8.00.00 LIST OF DRAWINGS

| SL. NO. | DRAWING | DESCRIPTION |
|---------|----------------------|---|
| 1 | 12A05-002-DWG-VA-001 | TYPICAL SCHEME FOR SHEET METAL TYPE AIR WASHER UNIT |
| 2 | 12A05-002-DWG-VA-002 | TYPICAL SCHEME FOR UNITARY AIR FILTRATION UNIT |
| 3 | 12A05-002-DWG-VA-003 | SCHEME OF VENTILATION SYSTEM FOR DIFFERENT AUXILIARY BUILDINGS |
| 4 | 12A05-002-DWG-VA-004 | TYPICAL DETAIL OF ROOF EXHAUSTER, SUPPLY FAN UNITS (WITHOUT FILTER) AND EXHAUST FAN |

Amendments / Addenda

AMENDMENT/ADDENDA ON TENDER DOCUMENTS OF MAIN PLANT SAGARDIGHI EXTN UNIT-5(1X660 MW)

| Sl. No. | Vol. No. /Page no./ Sec. no. /Clause | Original Text | Amended Text /Addenda/Deletion |
|---------|---|---|---|
| 01 | Volume: II-J2/ Page 3 of 62 SEC- I/ 1.03.00 | 3 X 75% capacity Water cooled Semi-hermetic Screw Chiller | 3 X 50% capacity Water cooled Semi-hermetic Screw Chiller |
| 02 | Volume: II-J2/ Page 5 of 62 SEC- I/ 2.01.00.i | 3 X 75% capacity Water cooled Semi-hermetic Screw Chiller | 3 X 50% capacity Water cooled Semi-hermetic Screw Chiller |
| 03 | Volume: II-J2/ Page 19 of 62 SEC- I/ 3.01.00 | The chilled water plant shall operate with, 3 x 75% capacity Packaged Screw Chiller unit (Two (2) nos. working and One (1) no. Standby), 3x50..... | The chilled water plant shall operate with, 3 x 50% capacity Packaged Screw Chiller unit (Two (2) nos. working and One (1) no. Standby), 3x50..... |
| 04 | Volume: II-J2/ Page 3 of 38 SEC- I/ 1.03.00.k | Following buildings under FGD package i. Ball mill building ii. Gypsum Dewatering Building | Delete |
| 05 | Volume: II-J2/ Page 28 of 38 SEC- II/ 5.13.01.c | All duct for ventilation supply or exhaust shall be manufactured of at least 1 mm thick G.I./M.S. sheet. | All duct for ventilation supply or exhaust shall be manufactured of at least 1 mm thick G.I./M.S. sheet(Up to Duct Largest Side 2250 mm) and at least 1.25mm thick G.I./M.S. sheet(Duct Largest Side more than 2250 mm) |

Clarifications / Confirmations

QUERIES/CLARIFICATIONS ON TECHNICAL SPECIFICATIONS FOR 1X660 MW SAGARDIGHI EXTENSION PROJECT (SGPRJ03)

| Sl. No. | VOL. No. | Sec.: Page no./ Clause No. | As specified | Clarification Required | Reply of WBPDC |
|---------|--------------|---|---|--|--|
| | | | 7.01.09 Heat load calculation, calculation for plant sizing and requirement of water, power and compressed air. | | |
| 30 | Volume II-J2 | Section I/ Page 62 of 62/ 8.00.00 | 12A05-DWG-003-VA-002 - SCHEMATIC DIAGRAM OF WATER COOLED PRECISION AIR-CONDITIONER. 12A05-DWG-003-VA-004 - SCHEMATIC DIAGRAM OF AIR COOLED SPLIT AC UNIT. | Water cooled Precision AC are the standard manufacturing product and instrument provided inside the skid shall be as per manufacturer's standard practice. Please confirm. Air cooled split AC are the manufacturer's standard product. Kindly allow scheme of air cooled Split AC as per manufacturer's standard practice. Please confirm. | Bidder to specifically mention about the deviations, if there be any, Otherwise NIT specification prevails |
| 31 | Volume II-J2 | Section II/ Page 1 of 38/ 1.02.00 | Coal Conveyor Floor and Coal Terminal Room shall be ventilated by means of Roof Exhausters. Air Intake Louvers should be provided at lower level on Coal Conveyor Floor and opening with / without grating. | Roof extractor shall be provided only at bunker floor. No ventilation is envisaged at JNTs & Gallery. Please confirm. | NIT specification prevails |
| 32. | Volume II-J2 | Section II/ Page 2 of 38/ 1.03.00 (d) | CW Pump House cum Fire Water Pump House, Supply air by wall mounted Axial Flow fans (without filter) and exhaust through louvers. | As the high air volume is required for ventilation of CW pump house, kindly allow ventilation of CW pump house through RE unit with intake louver also. Please confirm. | NIT specification prevails. |
| 33 | Volume II-J2 | Section II/ Page 3 of 38/ | Ventilation provision for Auxiliary Buildings in various locations shall | We understand that LV switchgear room and battery room of PH II is | Ventilation as may be required in any room/building/ |

QUERIES/CLARIFICATIONS ON TECHNICAL SPECIFICATIONS FOR 1X660 MW SAGARDIGHI EXTENSION PROJECT (SGPRJ03)

| Sl. No. | VOL. No. | Sec.: Page no./ Clause No. | As specified | Clarification Required | Reply of WBPDCCL |
|---------|--------------|--|---|--|---|
| | | 1.03.00.L | <p>be done as per the following :</p> <p>(L) - LV Switchgear room (PH-II) and Battery Room located adjacent to the LV Switchgear room (PH-II)</p> | <p>already having a suitable ventilation system, Hence ventilation of these building is not in scope of bidder. Please confirm</p> | <p>extension/augmentation in phase-II area buildings for locating /installing stage III equipments shall be in Bidders scope.</p> |
| 34 | Volume II-J2 | <p>Section II/ Page 3 of 38/ 1.03.00</p> <p>Section II/Page 5 of 38 /1.03.02</p> | <p>If Ventilation requirement arises during detailed engineering for Unit #5, bidder shall provide the following ventilation system for the existing buildings of Phase-II indicated below:, under Ash Handling System Package, which shall house equipment of Phase-III unit:</p> <p>a) Ash Water Pump House & MCC Room b) Ash Slurry Pump House & MCC Room c) AHP Compressor House & MCC Room d) Silo Utility Building & MCC Room e)chemical house f) toilets of each building</p> <p>For any existing building, if augmentation of ventilation system is required due to the increase in equipment load/room areas, the same is also to be included</p> | <p>Owner is requested to provide existing building heat load data, existing building drawing and existing building equipment capacities to enable bidder to quantify requirement of ventilation system for said buildings.</p> <p>Also, bidder will consider the augmentation of ventilation capacity of said building considering additional equipment heat load provided by bidder for phase-III only.</p> <p>Owner is requested to confirm.</p> | <p>The Heat load calculation shall be shared with the contractor, bidder to consider additional equipment heat load provided by bidder for phase-III only</p> |

QUERIES/CLARIFICATIONS ON TECHNICAL SPECIFICATIONS FOR 1X660 MW SAGARDIGHI EXTENSION PROJECT (SGPRJ03)

| Sl. No. | VOL. No. | Sec.: Page no./ Clause No. | As specified | Clarification Required | Reply of WBPDC |
|---------|--------------|---|--|---|--|
| 35 | Volume II-J2 | Section II/ Page 4 of 38/ 1.03.00 (d) | Compressor House area Ventilation through UAF. | Bidder understand that this is AHP compressor house. Please confirm. | Confirmed. |
| 36 | Volume II-J2 | Section II/ Page 5 of 38 / 1.06.00 | ...These air quantities are to be supplied from four (4) number of Air Washer Units, two(2) of which will be placed towards B-C bay at suitable locations while the balance two(2) units will be located on 'A' Row side of TG building. Such division and location area is decided to achieve effective air distribution with lesser amount of duct work.... | Please confirm if other alternate arrangement can also be used for Air washer arrangement (i.e. modular type air washers which can be placed inside TG hall itself. These air washers may have smaller individual capacity. Total nos. of modular air washers shall be decided to meet the required ventilation capacity of complete TG hall) | No deviation from specification is accepted regarding location/placement of the same. However Air Washer Units (AWU) shall be either of Sheet metal package type construction or shall be of masonry construction depending on the site requirement, as per Clause 2.05.01 of specification. |
| 37 | Volume II-J2 | Section II/ Page 6 of 38/ 1.09.00 | Exhaust (pull type) ventilation to be adopted for the battery rooms by providing 2 x 100% bifurcated type axial flow exhaust fans with the motor outside the air stream. One of these fans will act as stand-by. The air from the Battery Rooms contains acid fumes and therefore it should be discharged outside the TG Hall at a place away from the steel piping or structures nearby. 220V DC Battery Room shall be provided with Corrosion Proof Exhaust Fan with Corrosion Proof Wiring | kindly clarify whether AC or ventilation is to be provided for 220V DC battery room. If ventilation is to be provided in 220V DC battery room, then inside room temperature shall be maintained 3 deg C above outside temp. This is inline with clause no. 4.02.01 of ventilation design criteria. | Any Battery Room having Ni-cd Battery is to be in AC Environment (including their Battery Charger) For other battery room (s) (Lead Acid, VRLA etc.), ventilation is to be provided. Washed air from TG Hall will be supplied in the Battery Charger Rooms by means of air conveyance ducting. The air from the Battery Charger Room should then flow into the Battery Room through a manually operated Louver Shutter before being discharged out of the TG Building by the fan. So air |

QUERIES/CLARIFICATIONS ON TECHNICAL SPECIFICATIONS FOR 1X660 MW SAGARDIGHI EXTENSION PROJECT (SGPRJ03)

| Sl. No. | VOL. No. | Sec.: Page no./ Clause No. | As specified | Clarification Required | Reply of WBPDC |
|---------|--------------|---|---|--|--|
| | | | | | <p>introduced in the Battery Room & Charger Room is wet air and not dry. Follow Clause No 1.10.00 of the relevant section.</p> <p>As per clause No 4.02.02, In the areas ventilated by evaporative cooling units, the inside dry bulb temperature will be 3 DegC lower than the outside ambient temperature.</p> |
| 38 | Volume II-J2 | Section II/ Page 9 of 38/ 2.05.02 (c) & (e) | <p>Two numbers Horizontally Split casing / back pull out type Centrifugal pump sets (one running and one standby) complete with drive motor for circulation of water through the above spray header bank</p> <p>Two numbers Centrifugal Monobloc pump sets (one running and one standby) for circulation of water through the above fill deck</p> | <p>Instead of using two different pumps, OEM practice shall be offered for numbers & types of Pumps, (however 100% standby shall be insured). Please confirm</p> | NIT specification prevails. |
| 39 | Volume II-J2 | Section II/ Page 14 of 38/ 3.00.00 | CONTROL PHILOSOPHY | <p>We understand that all air washer and UAF shall have only Local Starter cum control panel. There shall be no Central controlling / monitoring for air washers and UAFs. Please confirm.</p> | Noted and confirmed. |

QUERIES/CLARIFICATIONS ON TECHNICAL SPECIFICATIONS FOR 1X660 MW SAGARDIGHI EXTENSION PROJECT (SGPRJ03)

| Sl. No. | VOL. No. | Sec.: Page no./ Clause No. | As specified | Clarification Required | Reply of WBPDC |
|----------------|-----------------|--|---|---|-----------------------------|
| 40 | Volume II-J2 | Section II/ Page 14 of 38/ 3.01.00 | Relative Humidity & Temperature to be displayed at least 3 locations of Switchgear Rooms. | Bidder wants to clarify that Only one display (at main door location) is sufficient enough. Please confirm | NIT specification prevails |
| 41 | Volume II-J2 | Section II/ Page 15 of 38/ 4.02.01 | In dry type forced (mechanical) type ventilation system where the ambient air is drawn and distributed inside the building / room and then exhausted, the temperature inside the ventilated space will be restricted within 3°C higher than the ambient dry-bulb temperature. | The temperature inside the ventilated space will be maintained max.6°C above design ambient temperature in line with ASHRAE recommended standard for all mechanical ventilated space. Please confirm. | NIT specification prevails. |
| 42 | Volume II-J2 | Section II/ Page 16 of 38 Section II/4.02.05 (i) | T.G. Hall (considering full height of the TG Building) - 6 Air Change / Hr | As per good engineering practice, space for air change shall include from ground floor to 3 meter above operating floor . Reason for the same is that human activities shall be limited to this height only. Further, Considering full height of TG building will cause oversized ventilation system and in turn high operating power cost. Please confirm our consideration TG building shall be provided with wet ventilation system. Purpose of Ventilation system is to have better working environment for people and better ambient for equipment. After 5 M from TG deck to turbine building roof there is no equipment or working place shall be provided. Also, EOT crane cabin have its own ventilation | NIT specification prevails |

QUERIES/CLARIFICATIONS ON TECHNICAL SPECIFICATIONS FOR 1X660 MW SAGARDIGHI EXTENSION PROJECT (SGPRJ03)

| Sl. No. | VOL. No. | Sec.: Page no./ Clause No. | As specified | Clarification Required | Reply of WBPDCCL |
|---------|--------------|--|---|---|----------------------------|
| | | | | <p>system. Hence, bidder proposes to consider height upto 5 M from TG Deck floor level only to arrive at ventilation system capacity instead of entire height of TG building.</p> <p>Owner is requested to accept.</p> | |
| 43 | Volume II-J2 | Section II/ Page 16 of 38/ 4.02.05 (i) | <p>The following minimum air change rates are to be maintained for the areas indicated below.</p> <p>(i) T.G. Hall (considering full height of the TG Building)</p> | <p>For calculation purpose for deriving capacity of air washers, effective height 3M above operating floor shall be considered, as no equipment is coming above this area and no air is required to be supplied in this area. Please confirm.</p> | NIT specification prevails |
| 44 | Volume II-J2 | Section II/ Page 16 of 38/ 4.02.05 (iii) Section II/ Page 16 of 38/ 4.02.05 (X) | <p>Electrical Room like M.C.C. Room, Switchgear room in T.G. Building 15 Air Change / Hr.</p> <p>Non AC areas of ESP control Building 15 Air Change / Hr</p> | <p>Since Switchgear room and cable spreader room of TG building and ESP control building has been provided with Wet ventilation system bidder proposes to provide 6 to 8 air changes per hour instead of 15 air changes / hour as considered for dry ventilation system.</p> <p>Owner is requested to accept.</p> | NIT specification prevails |
| 45 | Volume II-J2 | Section II/ Page 16 of 38 Section II/ Page 16 of 38/ 4.02.05 (iv) | Battery Room 20 Air Change / Hr | <p>Ventilation is required in battery room to keep the hydrogen concentration below 1%, for this purpose 20 Air change /Hr ventilation rate is very high.</p> <p>We suggest to use ventilation rate as</p> | NIT specification prevails |

QUERIES/CLARIFICATIONS ON TECHNICAL SPECIFICATIONS FOR 1X660 MW SAGARDIGHI EXTENSION PROJECT (SGPRJ03)

| Sl. No. | VOL. No. | Sec.: Page no./ Clause No. | As specified | Clarification Required | Reply of WBPDCCL |
|---------|--------------|---|---|--|---|
| | | | | per battery supplier's recommendation. Please confirm | |
| 46 | Volume II-J2 | Section II/ Page 16 of 38/ 4.02.05 | The following minimum air change rates are to be maintained for the areas indicated below. iv) Battery Room 20 Air Change / Hr vi) Coal conveyor floor and coal terminal floor 30 Air Change / Hr | In case of battery room ventilation, air volume will be calculated with the larger value of the two; - Minimum ventilation for Max 1% hydrogen concentration in Battery room - Minimum ventilation for heat loss in Battery room The bidder would like to suggest air change per hour for coal conveyor floor and coal terminal floor will be 15 air change/hr(for supply) and 7 air changes/hr(for exhaust) Please confirm. | NIT specification prevails |
| 47 | Volume II-J2 | Section II/ Page 16 of 38/ 4.02.05 (iv) | The following minimum air change rates are to be maintained for the areas indicated below. (iv) Battery Room: 20 Air Change / Hr. | kindly clarify whether AC or ventilation is to be provided for battery room located inside TG hall (24V DC battery room, UPS battery room, 220V DC battery room). Further also clarify that other battery room associated with auxiliary building shall be air conditioned or ventilation. If ventilation is to be provided in 220V DC battery room, then inside room temperature shall be maintained 3 deg C above outside temp. This is inline with clause no. 4.02.01 of ventilation design criteria. | Any Battery Room having Ni-cd Battery is to be in AC Environment (including their Battery Charger) For other battery room (s) (Lead Acid, VRLA etc.), ventilation is to be provided. NIT specification prevails |
| 48 | Volume II-J2 | Section II/ Page 19 of 38 | RPM of axial flow fans shall be restricted within 1000 to reduce | For market availability reasons, in below cases RPM needs to be | NIT specification prevails |

QUERIES/CLARIFICATIONS ON TECHNICAL SPECIFICATIONS FOR 1X660 MW SAGARDIGHI EXTENSION PROJECT (SGPRJ03)

| Sl. No. | VOL. No. | Sec.: Page no./ Clause No. | As specified | Clarification Required | Reply of WBPDC |
|---------|---------------|--|---|---|---|
| | | Section II/ 5.02.05 (iv) | their noise level excepting roof extractors for which RPM shall be restricted to 1500. | increased (up to 3000 rpm) - for axial flow fans 1. for static head above 30 mm 2. For fans less than 450 mm diameter 3. For propeller fans Please confirm | |
| 49 | Volume: II-J2 | Section II/ Page 28 of 38/ 5.13.01 | c) All duct for ventilation supply or exhaust shall be manufactured of at least 1 mm thick G.I./M.S. sheet. | All duct for ventilation supply or exhaust shall be manufactured based on the SMACNA code of G.I./M.S. sheet. In case of duct thickness it is recommended that the thickness of duct will be finalized/decided based on the pressure, velocity, air volume of SMACNA code, Therefore the bidder would like to provide the duct thickness as 0.6, 0.8, 1.0mm in accordance with SMACNA code. | NIT specification prevails. 1mm thick sheet should be considered up to 2250 mm. Above 2250mm, 1.25 mm thick sheet is to be considered. Refer amendment in regard to the subject clause. |
| 50 | Volume II-L | 12A05-DWG-M-001Q | HVAC make up - from service water AC Plant make up - From UF permeate storage tank | For HVAC & AC plant makeup, water shall be taken from service water only. Water From UF permeate storage tank is not needed. Please confirm. | Clarified water is required for HVAC & AC Plant Make up. |
| 51 | Volume II-L | 12A05-DWG-M-004C | Air washers location | Refer drawing no. - 12A05-DWG-M-004C, Toward BC bay side, a room for Air washer is shown. We understand that masonry type air washer needed in this side. Please confirm our understanding | Please refer Clause 1.06.00, Section-II, Vol.-IIJ2 of the tender specification. |

QUERIES/CLARIFICATIONS ON TECHNICAL SPECIFICATIONS FOR 1X660 MW SAGARDIGHI EXTENSION PROJECT (SGPRJ03)

| Sl. No. | VOL. No. | Sec.: Page no./ Clause No. | As specified | Clarification Required | Reply of WBPDCCL |
|---------|-------------|-----------------------------|-------------------------------|--|--|
| 52 | Volume II-L | 12A05-DWG-M-001P 2SHEETS | Interconnection with Phase-II | Please indicate the terminal point location in the Plot Plan for Hydrant and Spray system interface from Phase-II along with Pipe size, Flow and Pressure details. | Stage II Composite Piping Layout of Hydrant System and Spray system is uploaded(.PE-VO-373-522-A0013, Rev.2) |

AMENDMENTS FOR 1X660 MW SAGARDIGHI EXTENSION PROJECT (SGPRJ03)

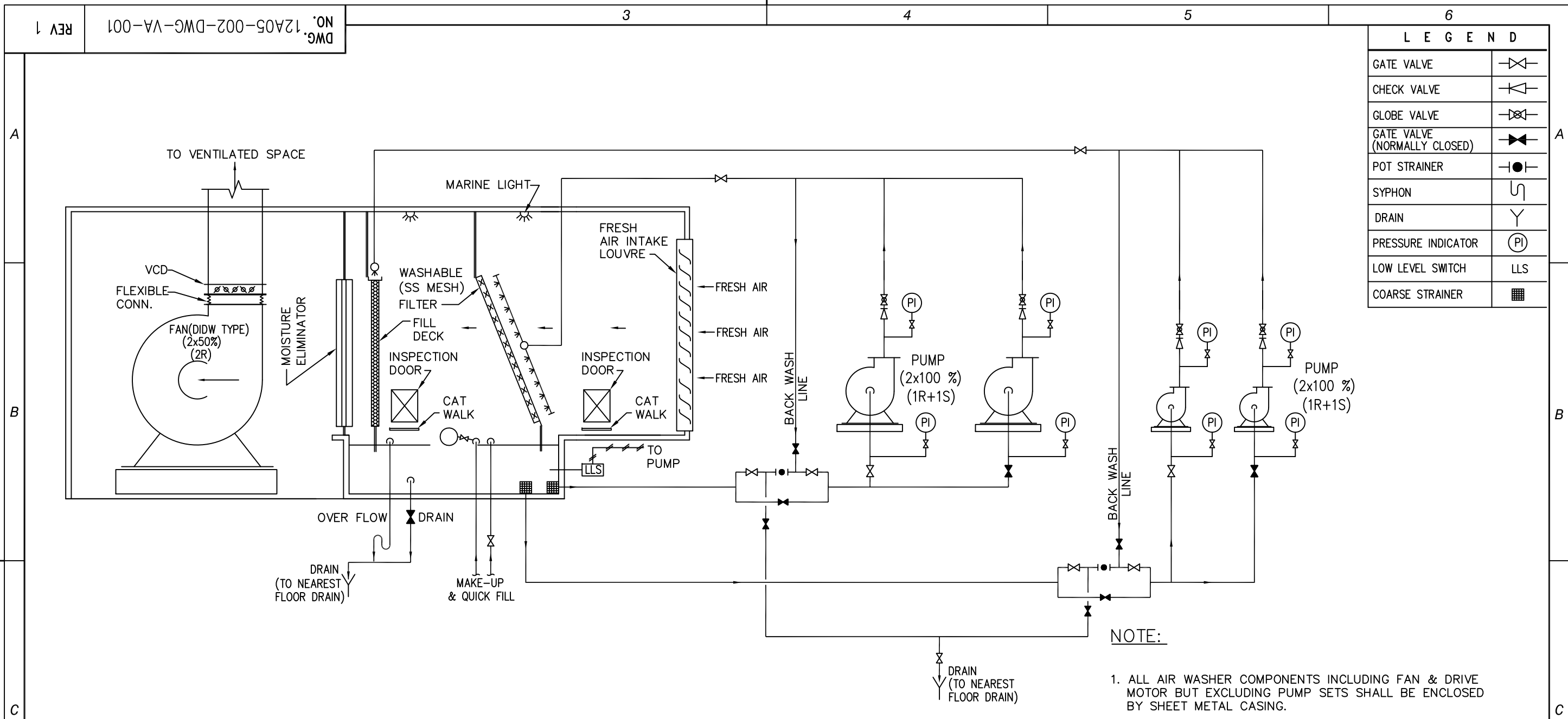
| Sl. No. | Vol. No. /Page no./ Sec. no. /Clause | Original Text/ Text of Amendment -1 | Amended Text /Addenda/Deletion |
|---------------|---|---|--|
| 1. | Volume III2/ Page 1 of 1/ Serial No 04 of Amendment -1 | | Amendment -1/Volume III2/ Section I /Serial No 4 shall be read as Volume III2(Ventilation System)/Section-II |
| 2. | Volume:II-J2/ Page 2 of 62 /Section-I Clause no. 1.01.00.B | For any existing building, if augmentation of AC system is required due to the increase in equipment load/room areas, the same is also to be included. | Bidder to provide Split AC units (with 100% Redundancy) for increase in equipment heat load (due to additional equipment/panel) for all areas. wherever existing facility to be augmented. Further, Bidder will provide AC capacity to the extent change in room dimensions /equipment heat load due to Phase III only. Capacity to be decided during detailed Engineering. |
| 3. | Volume:II-J2/ Page 2 of 62 /Section-I Clause no. 1.02.00 | 2 x100% capacity Air Handling Units (AHU) shall be provided for Workstation between Unit #4 & Proposed Unit #5 and C&I Lab | If these Two (2) numbers, 6Mx6M sound proof cubical with air-conditioning system (for operation personnel with work station and C&I Lab are located on same floor Common 2 X 100% AHUs may be provided. Otherwise If these two areas are in separate floor then, 2X100% Separate AHUs to be provided. |
| 4. | Volume:II-J2/ Pages 4,5,10,16 & 32 of 62 /Section-I Clause no. 1.03.00, 2.01.01-vi, 2.01.02, 2.01.14 and 5.07.00 | One no. Non chemical water treatment equipment at the common header of CW pumps. | Non-chemical type Water Treatment Device at the common header of CW Pump is not required separately. Common Water Softening Plant shall have to be considered before the Make-up Water Tank for the AC Plant. Service water shall be provided for water softening plant and tapping for the same shall be from service water distribution Network of unit V(Bidder's scope) |
| 5. | Volume:II-J2/ Page 10 of 62 /Section-I Clause no. 2.01.01-X | Central Programmable Logic Control system (PLC) with Supervisory controller and workstation PC. | A separate Standalone DCS for Air Conditioning System & Ventilation System having hardware in line with main plant DDCMIS family shall be provided. A separate Standalone UPS shall be provided for back-up. However PLC as per NIT is also acceptable. |

AMENDMENTS FOR 1X660 MW SAGARDIGHI EXTENSION PROJECT (SGPRJ03)

| Sl. No. | Vol. No. /Page no./ Sec. no. /Clause | Original Text/ Text of Amendment -1 | Amended Text /Addenda/Deletion |
|----------------|---|---|---|
| 6. | Volume:II-J2/ Page 5 of 40 /Section-II Clause no. 1.03.02 | For any existing building, if augmentation of ventilation system is required due to the increase in equipment load/room areas, the same is also to be included. | In Ventilation Modular type separate UAF Units shall be provided for augmentation required in ventilation system to the extent change in room dimensions /equipment heat load due to Phase III only, wherever UAF is already provided in stage-II.. |

FILE LOCATION: D:\Sagardighi Thermal Power Project\Phase-III\Specification\NEW FDRMAT\Formatted Specification\Final Specification\11-J2\12A05-002-DWG-VA-001-R-1.dwg
 PLOT DATE: 22-Jun-17 10:39 AM

A3 [420x297]



| LEGEND | |
|------------------------------|--|
| GATE VALVE | |
| CHECK VALVE | |
| GLOBE VALVE | |
| GATE VALVE (NORMALLY CLOSED) | |
| POT STRAINER | |
| SYPHON | |
| DRAIN | |
| PRESSURE INDICATOR | |
| LOW LEVEL SWITCH | |
| COARSE STRAINER | |

TYPICAL SCHEME FOR SHEET METAL TYPE AIR WASHER UNIT

FOR TENDER PURPOSE ONLY

THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
 KOLKATA, INDIA

SAGARDIGHI THERMAL POWER STATION
 1 x 660 MW, PHASE-III, EXTN. UNITS # 5

TYPICAL SCHEME FOR SHEET METAL TYPE AIR WASHER UNIT

DEVELOPMENT CONSULTANTS PVT LTD.
 CONSULTING ENGINEERS
 KOLKATA · MUMBAI · CHENNAI · NEW DELHI

| | | | |
|----------|-------|---------|------------|
| PREPARED | UN | JOB NO. | 12A05 |
| CHECKED | SC/DM | SCALE | NTS |
| APPROVED | DKR | DATE | 07.12.2016 |

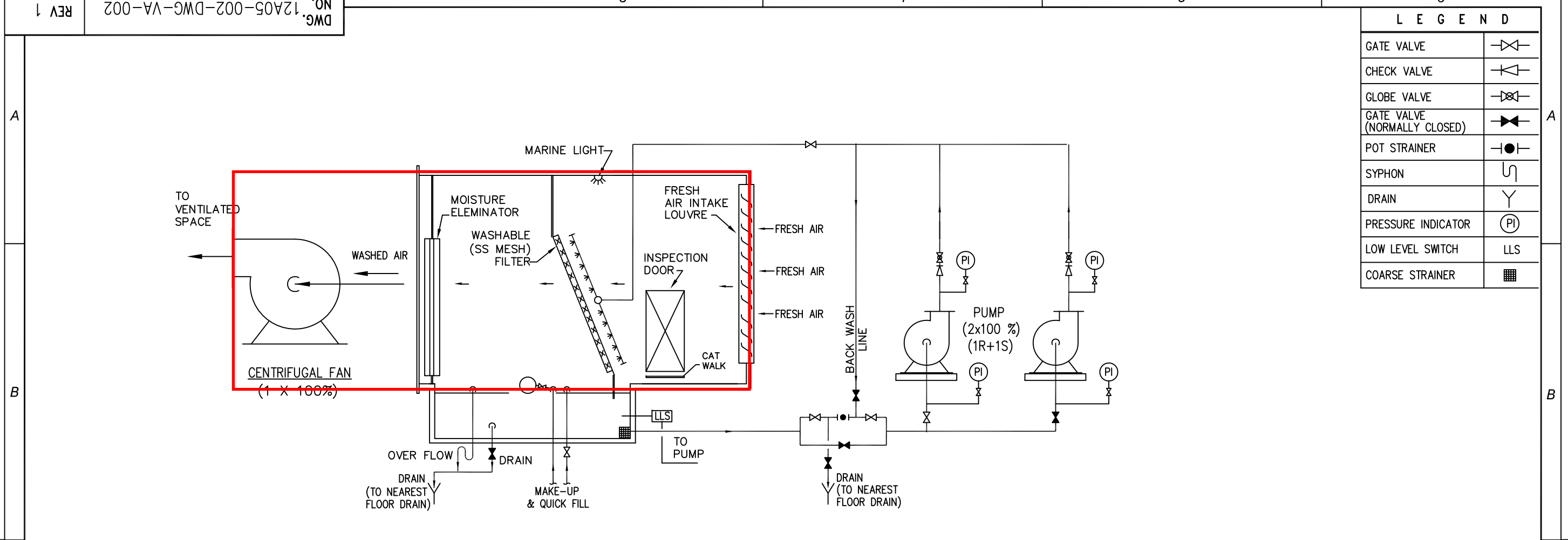
DWG. NO. 12A05-002-DWG-VA-001

REV 1
 SHEET 1 OF 1

| NO. | DATE | BY | CHKD | REVISION |
|-----|----------|----|------|-------------------|
| 1 | 23.05.17 | UN | DM | FOR SPECIFICATION |
| 0 | 07.12.16 | UN | SC | FOR SPECIFICATION |

| REVIEWED | DATE | PREP | CHKD | REVISION |
|----------|----------|------|------|-------------------|
| DKR | 23.05.17 | UN | DM | FOR SPECIFICATION |
| DKR | 07.12.16 | UN | SC | FOR SPECIFICATION |

| NO. | DATE | BY | CHKD | REVISION |
|-----|----------|----|------|-------------------|
| 1 | 23.05.17 | UN | DM | FOR SPECIFICATION |
| 0 | 07.12.16 | UN | SC | FOR SPECIFICATION |



| L E G E N D | |
|------------------------------|-----|
| GATE VALVE | |
| CHECK VALVE | |
| GLOBE VALVE | |
| GATE VALVE (NORMALLY CLOSED) | |
| POT STRAINER | |
| SYPHON | |
| DRAIN | |
| PRESSURE INDICATOR | |
| LOW LEVEL SWITCH | LLS |
| COARSE STRAINER | |

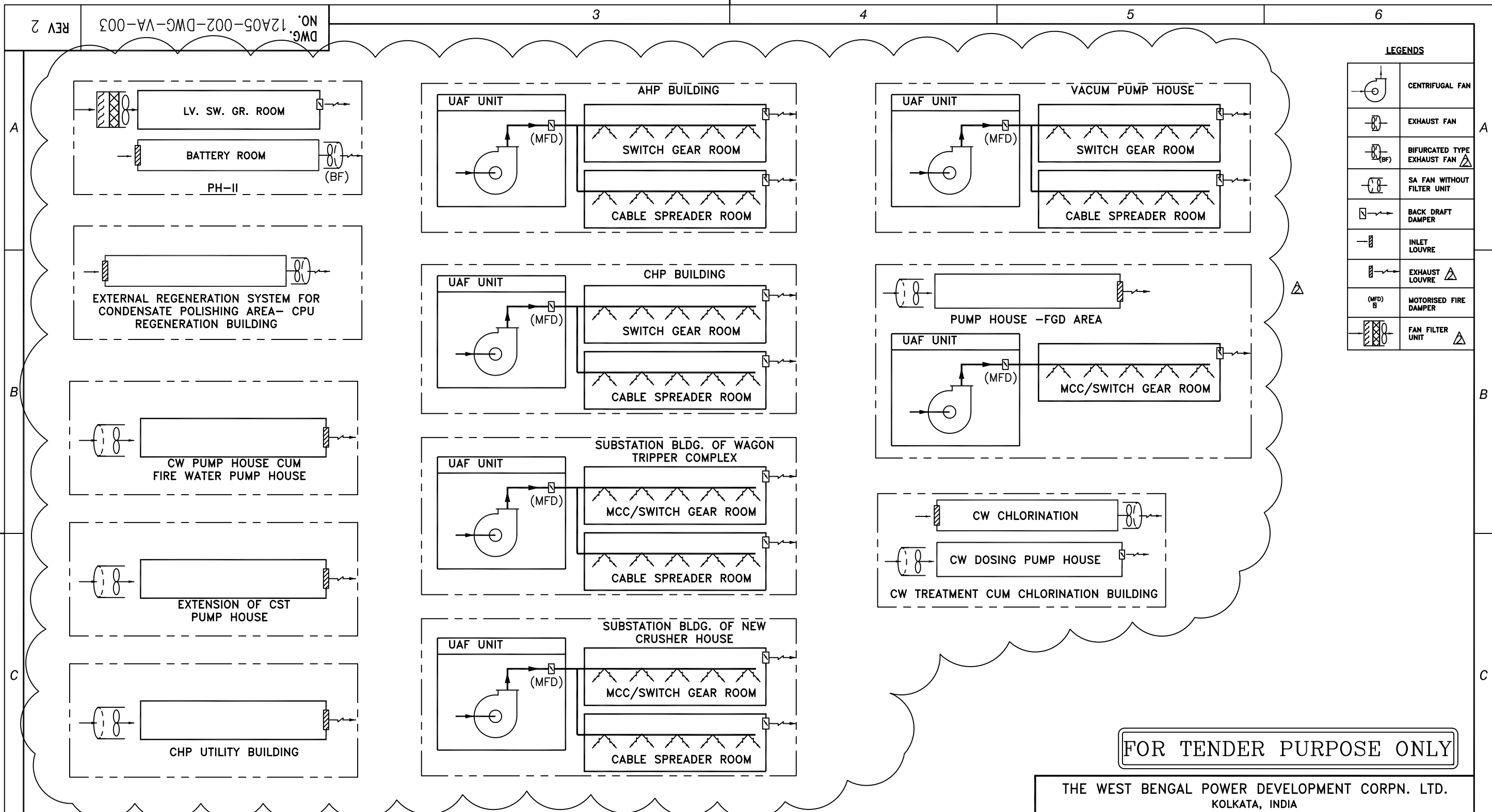
TYPICAL SCHEME FOR UNITARY AIR FILTRATION UNIT

FOR TENDER PURPOSE ONLY

| THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD. KOLKATA, INDIA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|------|---------|----------------------|------|--------------|-----------------|-------|----------------------------------|-----|----------|--------------------|------|---------------------|------|-----------|------|--------|-------|----------------------------------|-----|------|-------|------|----------------|------|-----------|--|--|--|--|--|--|--|-----|-------------------|---|----------|----|----|-------------|--|--|--|--|--|--|--|--|--|-----|-------------------|---|----------|----|----|---------------------|--|--|----------|--|--|--|--|--|--|--|--|--|--|--------------|--|--|--|----------|--|--|--|--|--|--|--|--|--|--|------------------|--|--|--|----------|--|--|--|--|--|--|--|--|--|--|---------|--|--|--|----------|--|--|--|--|--|--|--|--|--|--|------------|--|--|--|----------|--|--|--|--|--|--|--|--|--|--|--------------------|--|--|--|----------|--|--|--|--|--|--|--|--|--|--|---------------|--|--|--|----------|--|--|--|--|--|--|--|--|--|--|-----------------|--|--|--|----------|--|--|--|--|--|--|--|--|--|--|------------|--|--|--|----------|--|--|--|--|--|--|--|--|--|--|--------|--|--|--|
| SAGARDIGHI THERMAL POWER STATION 1 x 660 MW, PHASE-III, EXTN. UNITS # 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TYPICAL SCHEME FOR UNITARY FILTRATION UNIT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DEVELOPMENT CONSULTANTS PVT LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PREPARED | UN | JOB NO. | 12A05 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CHECKED | SC | SCALE | NTS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| APPROVED | DKR | DATE | 07.12.2016 | | REV 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DWG. NO. | | | 12A05-002-DWG-VA-002 | | | SHEET 1 OF 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <table border="1" style="width: 100%;"> <thead> <tr> <th>PROCESS</th> <th>MECH</th> <th>C&S</th> <th>ARCH</th> <th>ELEC</th> <th>INST</th> <th>OTHERS</th> <th>APPVD</th> <th>NATURE OF REVISION & DESCRIPTION</th> <th>REV</th> <th>DATE</th> <th>PREPD</th> <th>CHKD</th> <th>RELEASE STATUS</th> <th>DATE</th> <th>SIGNATURE</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>AKD</td> <td>FOR SPECIFICATION</td> <td>1</td> <td>23.05.17</td> <td>UN</td> <td>DM</td> <td>PRELIMINARY</td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>AKD</td> <td>FOR SPECIFICATION</td> <td>0</td> <td>07.12.16</td> <td>UN</td> <td>SC</td> <td>TENDER PURPOSE ONLY</td> <td></td> <td></td> </tr> <tr> <td colspan="11">REVIEWED</td> <td>FOR APPROVAL</td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="11">REVIEWED</td> <td>FOR CONSTRUCTION</td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="11">REVIEWED</td> <td>PROCESS</td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="11">REVIEWED</td> <td>MECHANICAL</td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="11">REVIEWED</td> <td>CIVIL & STRUCTURAL</td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="11">REVIEWED</td> <td>ARCHITECTURAL</td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="11">REVIEWED</td> <td>INSTRUMENTATION</td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="11">REVIEWED</td> <td>ELECTRICAL</td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="11">REVIEWED</td> <td>OTHERS</td> <td></td> <td></td> <td></td> </tr> </tbody> </table> | | | | | | | | | | | PROCESS | MECH | C&S | ARCH | ELEC | INST | OTHERS | APPVD | NATURE OF REVISION & DESCRIPTION | REV | DATE | PREPD | CHKD | RELEASE STATUS | DATE | SIGNATURE | | | | | | | | AKD | FOR SPECIFICATION | 1 | 23.05.17 | UN | DM | PRELIMINARY | | | | | | | | | | AKD | FOR SPECIFICATION | 0 | 07.12.16 | UN | SC | TENDER PURPOSE ONLY | | | REVIEWED | | | | | | | | | | | FOR APPROVAL | | | | REVIEWED | | | | | | | | | | | FOR CONSTRUCTION | | | | REVIEWED | | | | | | | | | | | PROCESS | | | | REVIEWED | | | | | | | | | | | MECHANICAL | | | | REVIEWED | | | | | | | | | | | CIVIL & STRUCTURAL | | | | REVIEWED | | | | | | | | | | | ARCHITECTURAL | | | | REVIEWED | | | | | | | | | | | INSTRUMENTATION | | | | REVIEWED | | | | | | | | | | | ELECTRICAL | | | | REVIEWED | | | | | | | | | | | OTHERS | | | |
| PROCESS | MECH | C&S | ARCH | ELEC | INST | OTHERS | APPVD | NATURE OF REVISION & DESCRIPTION | REV | DATE | PREPD | CHKD | RELEASE STATUS | DATE | SIGNATURE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | AKD | FOR SPECIFICATION | 1 | 23.05.17 | UN | DM | PRELIMINARY | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | AKD | FOR SPECIFICATION | 0 | 07.12.16 | UN | SC | TENDER PURPOSE ONLY | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| REVIEWED | | | | | | | | | | | FOR APPROVAL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| REVIEWED | | | | | | | | | | | FOR CONSTRUCTION | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| REVIEWED | | | | | | | | | | | PROCESS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| REVIEWED | | | | | | | | | | | MECHANICAL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| REVIEWED | | | | | | | | | | | CIVIL & STRUCTURAL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| REVIEWED | | | | | | | | | | | ARCHITECTURAL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| REVIEWED | | | | | | | | | | | INSTRUMENTATION | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| REVIEWED | | | | | | | | | | | ELECTRICAL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| REVIEWED | | | | | | | | | | | OTHERS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

FILE LOCATION: D:\Sagardighi Thermal Power Project\Phase-III\Specification\NEW FORMAT\Formatted Specification\Final Specification\11-J2\12A05-002-DWG-VA-003-R2.dwg
 PLOT DATE: 22-Jun-17 10:43 AM

A3 [420x297]



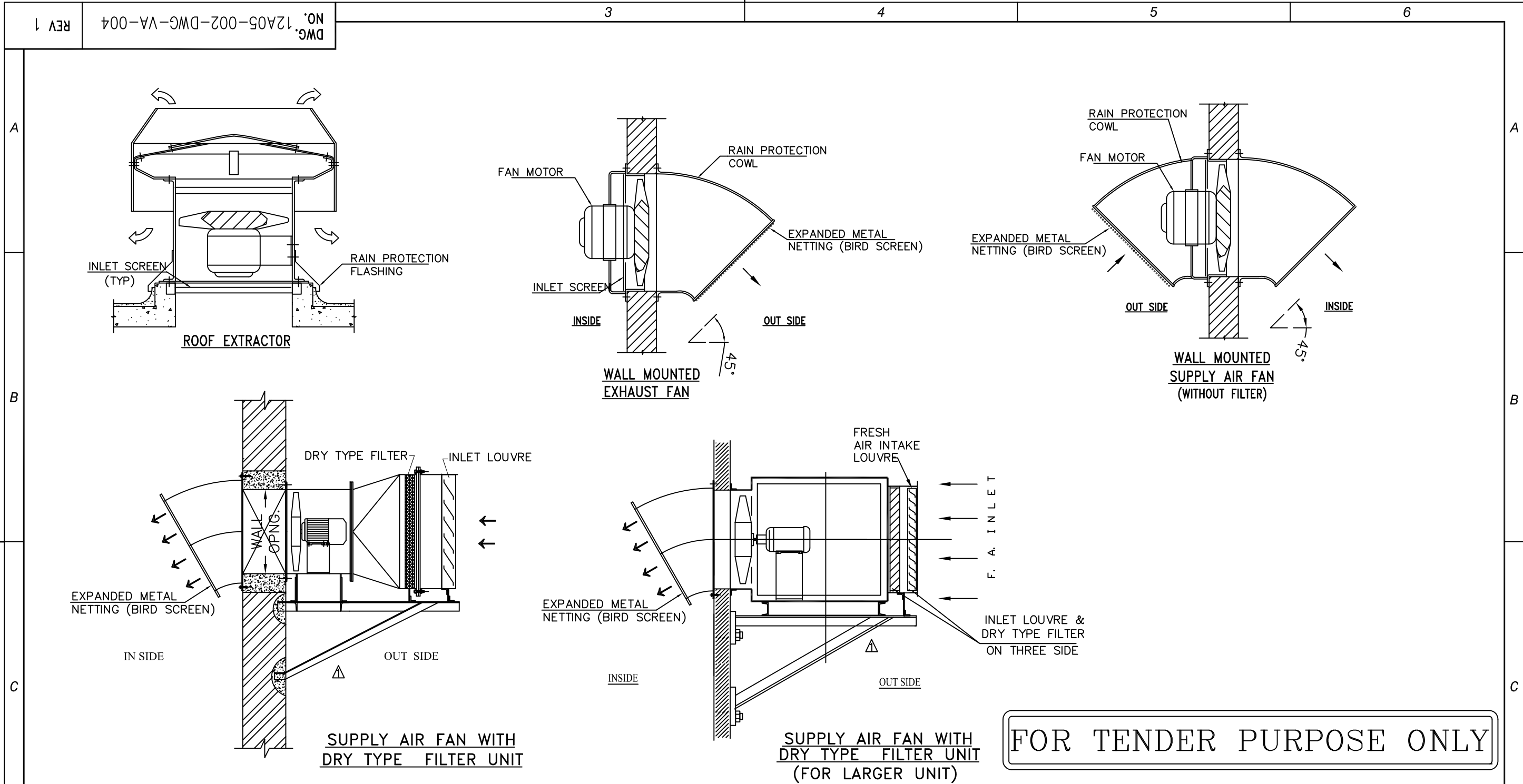
FOR TENDER PURPOSE ONLY

| | | | |
|--|-------|----------------------|------------|
| THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD. KOLKATA, INDIA | | | |
| SAGARDIGHI THERMAL POWER STATION 1 x 660 MW, PHASE-III, EXTN. UNITS # 5 | | | |
| SCHEME OF VENTILATION SYSTEM FOR DIFFERENT AUXILLARY BUILDING. | | | |
| DEVELOPMENT CONSULTANTS PVT LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI | | | |
| PREPARED | UN | JOB NO. | 12A05 |
| CHECKED | SC/DM | SCALE | NTS |
| APPROVED | DKR | DATE | 07.12.2016 |
| DWG. NO. | | 12A05-002-DWG-VA-003 | |
| REVISED | | REV 2 | |
| SHEET | | 1 OF 1 | |

| PROCESS | MECH | C&S | ARCH | ELEC | INST | OTHERS | APPVD | NATURE OF REVISION & DESCRIPTION | REV | DATE | PREPD | CHKD |
|---------|------|-----|------|------|------|--------|-------|----------------------------------|-----|----------|-------|------|
| | | | | | | | AKD | FOR SPECIFICATION | 2 | 19.06.17 | SD | DM |
| | | | | | | | AKD | FOR SPECIFICATION | 1 | 23.05.17 | UN | DM |
| | | | | | | | AKD | FOR SPECIFICATION | 0 | 07.12.16 | UN | SC |

| | | |
|---------------------|------|-----------|
| RELEASE STATUS | DATE | SIGNATURE |
| PRELIMINARY | | |
| TENDER PURPOSE ONLY | | |
| FOR APPROVAL | | |
| FOR CONSTRUCTION | | |
| PROCESS | | |
| MECHANICAL | | |
| CIVIL & STRUCTURAL | | |
| ARCHITECTURAL | | |
| INSTRUMENTATION | | |
| ELECTRICAL | | |
| OTHERS | | |

FILE LOCATION: D:\Sagardighi Thermal Power Project\Phase-III\Specification\NEW FORMAT\Formatted Specification\Final Specification\11-J2\12A05-002-DWG-VA-004-R-1.dwg
 PLOT DATE: 22-Jun-17 10:43 AM



FOR TENDER PURPOSE ONLY

| | | | |
|---|-------|----------------------|------------|
| THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD. KOLKATA, INDIA | | | |
| SAGARDIGHI THERMAL POWER STATION 1 x 660 MW, PHASE-III, EXTN. UNITS # 5 | | | |
| TYPICAL DETAILS OF ROOF EXHAUSTER, SUPPLY FAN UNITS (WITHOUT FILTER AND EXHAUST FAN) | | | |
| DEVELOPMENT CONSULTANTS PVT LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI | | | |
| PREPARED | UN | JOB NO. | 12A05 |
| CHECKED | SC/DM | SCALE | NTS |
| APPROVED | DKR | DATE | 07.12.2016 |
| DWG. NO. | | 12A05-002-DWG-VA-004 | |
| | | REV 1 | |
| | | SHEET 1 OF 1 | |

| REVIEWED | | PROCESS | MECH | C&S | ARCH | ELEC | INST | OTHERS | APPVD | NATURE OF REVISION & DESCRIPTION | REV | DATE | PREPD | CHKD | RELEASE STATUS | DATE | SIGNATURE |
|----------|--|---------|------|-----|------|------|------|--------|-------|----------------------------------|-----|----------|-------|--------------------|---------------------|------|-----------|
| | | | | | | | | | AKD | FOR SPECIFICATION | 1 | 23.05.17 | UN | DM | PRELIMINARY | | |
| | | | | | | | | | AKD | FOR SPECIFICATION | 0 | 07.12.16 | UN | SC | TENDER PURPOSE ONLY | | |
| | | | | | | | | | | | | | | FOR APPROVAL | | | |
| | | | | | | | | | | | | | | FOR CONSTRUCTION | | | |
| | | | | | | | | | | | | | | PROCESS | | | |
| | | | | | | | | | | | | | | MECHANICAL | | | |
| | | | | | | | | | | | | | | CIVIL & STRUCTURAL | | | |
| | | | | | | | | | | | | | | ARCHITECTURAL | | | |
| | | | | | | | | | | | | | | INSTRUMENTATION | | | |
| | | | | | | | | | | | | | | ELECTRICAL | | | |
| | | | | | | | | | | | | | | OTHERS | | | |

A3 [420x297]



WBPDCL

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

SECTION: VIII

**TECHNICAL SPECIFICATION
FOR
PIPING, FITTINGS AND VALVES**



Development Consultants Pvt. Ltd.

**Volume: II-12
Section: VIII
Piping, Fittings and Valves**



WBPDC

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

CONTENTS

| CLAUSE NO. | DESCRIPTION | PAGE NO. |
|-------------------|---|-----------------|
| 1.00.00 | INTENT OF SPECIFICATION | 1 |
| 2.00.00 | SCOPE | 1 |
| 3.00.00 | CODE & STANDARDS | 2 |
| 4.00.00 | DESIGN, MANUFACTURE, FABRICATION AND ERECTION | 5 |
| 5.00.00 | TESTS & INSPECTION | 35 |



Development Consultants Pvt. Ltd.

**Volume: II-12
Section: VIII
Piping, Fittings and Valves**



SECTION - VIII

PIPING, FITTINGS & VALVES

1.00.00 INTENT OF SPECIFICATION

This specification covers the design, manufacturing, inspection, shop testing, erection, testing and commissioning at site of all the piping, fittings, valves and all other accessories as specified and as further required.

2. 00.00 SCOPE

The items & materials to be supplied shall include but not be limited to the following:

- 2. 01.00 Pipes, bends, elbows, tees, branches laterals, crosses, reducing unions, couplings, cap, expansion joints, flanges, blank flanges, saddles, shoes, sampling connections etc. necessary for making a reliable piping system.
- 2. 02.00 Gaskets, ring joint, backing rings, jointing material etc. as required.
- 2. 03.00 Instrument tapping connection, stub and thermowells.
- 2. 04.00 Supply and machining work of flanges, pipe spools and matching pipes to connect flow measuring orifice nozzles etc., pressure accumulators as necessary.
- 2. 05.00 Valves and Isolation Gates, to start/stop and control / regulate flow.
- 2. 06.00 Strainers.
- 2. 07.00 Anchor blocks (for buried / over ground piping), support brackets, clamps, support trestles, hangers, vibration dampener etc. for the piping under the scope of contract.
- 2. 08.00 Bolts, nuts, fasteners as required for interconnecting piping, valves and fitting as well as for terminal points.
- 2. 09.00 Steel for pipe supports and embedded steel. Also pipe supports and necessary embedment required to be embedded in concrete for underground / above ground pipes.
- 2. 10.00 Painting, anti-corrosive coatings, etc. inside and outside of pipes as necessary and as specified.
- 2. 11.00 All embedded parts required for all tanks/water retaining structures made of RCC including puddle pipes shall be supplied by the Bidder.

**3. 00.00 CODE & STANDARDS**

The design, manufacture, fabrication shop testing & inspection, erection, testing and commissioning of piping fittings and valves shall conform to the latest revisions of the following Indian / International codes / standards and other applicable statutory codes / ordinances, rules, regulations as well as safety codes, in addition to other codes / standards if any as addressed elsewhere in the Tender Specification.

Other National / International Standards may also be considered acceptable (subject to specific approval by Purchaser) with reference to any specific situation / requirement provided they are recognized to be equivalent or superior to the Standards as stipulated in the Tender Specification.

| | | |
|------|------------------------|--|
| ANSI | - B 16.5 | : Steel pipe flanges and flanged fittings. |
| ANSI | - B 16.9 | : Wrought steel Butt welding fittings |
| ANSI | - B 16.11 | : Forged steel socket welding and screwed fittings |
| ANSI | - B 16.21 | : Non Metallic Gaskets for Pipe Flanges |
| ANSI | - B 16.25 | : Butt welding ends |
| ANSI | - B 16.28 | : Wrought Steel Butt Welding short radius elbows and returns |
| ANSI | - B 31.1 | : Power Piping code. |
| ANSI | - B 36.10 | : Welded & seamless wrought steel pipe |
| ANSI | - B 36.19 | : Stainless steel pipe |
| API | - 5L | : Specification for Line Pipe |
| ASME | - Section II | : Ferrous Materials Specification |
| ASTM | - A 53 | : Seamless carbon steel. |
| ASTM | - A 106 | : Grade C Seamless carbon steel pipe. |
| ASTM | - F441 / F441M - 09 | : Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80 |
| ASTM | - F439 - 11 | : Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80 |
| AWWA | - C-203 | : Coal tar protective coatings and linings for steel water pipe lines - Enamel and Tape - Hot Applied |



| | | | | |
|--------------|---|-------|---|--|
| AWWA | - | C-208 | : | Dimensions for Steel Water pipe fittings |
| AWWA | - | C-504 | : | Standard for butterfly valve. |
| BS | - | 1868 | : | Specification for steel check valves (flanged and butt-welding ends) for the petroleum, petrochemical and allied industries |
| BS | - | 5158 | : | Specification for cast iron plug valves |
| BS | - | 5353 | : | Specification for steel plug valves |
| BS EN | - | 593 | : | Industrial valves. Metallic butterfly valves |
| BS EN | - | 1796 | : | Plastics piping systems for water supply with or without pressure. Glass-reinforced thermosetting plastics (GRP) based on unsaturated polyester resin (UP) |
| BS EN | - | 13397 | : | Industrial valves. Diaphragm valves made of metallic materials |
| BS EN | - | 13789 | : | Industrial valves. Cast iron globe valves |
| BS EN | - | 14364 | : | Plastics piping systems for drainage and sewerage with or without pressure. Glass-reinforced thermosetting plastics (GRP) based on unsaturated polyester resin (UP). Specifications for pipes, fittings and joints |
| BS EN ISO | - | 16138 | : | Industrial valves. Diaphragm valves of thermoplastics materials |
| DIN | - | 16966 | : | Glass fibre reinforced polyester resin (UP-GRP) pipe fittings and joint assemblies - Requirements for and testing of bushes, flanges, and flanged and laminated joints |
| IS | - | 210 | : | Grey Iron Castings |
| IS | - | 318 | : | Leaded Tin Bronze Ingots and Castings |
| IS | - | 458 | : | Precast Concrete Pipes (with and without reinforcement). |
| IS | - | 554 | : | Pipe Threads where Pressure Tight-Joints are made on the Threads – Dimensions, Tolerances and Designation. |
| IS | - | 778 | : | Copper Alloy Gate, Globe and Check Valves for Waterworks Purposes. |
| IS | - | 783 | : | Code of Practice for Laying of Concrete Pipes. |



| | | |
|----|------------------|--|
| IS | - 1239 Part 1 | : Steel Tubes, Tubulars and other Wrought Steel Fittings - Specification Part 1 Steel Tubes |
| IS | - 1239 Part 2 | : Specification Steel Tubes, Tubulars and other Steel Fittings Part 2 Steel Sockets Tubular and other Steel Pipe Fittings |
| IS | - 1363 | : Hexagon Head Bolts, Screws and Nuts of Product Grade C. |
| IS | - 1364 | : Hexagon Head Bolts, Screws and Nuts of Product Grades A and B. |
| IS | - 1367 | : Technical Supply Conditions for Threaded Steel Fasteners. |
| IS | - 1536 | : Indian Standard for Centrifugally Cast (Spun) Iron Pressure Pipes for Water, Gas and Sewage. |
| IS | - 1537 | : Vertically Cast Iron Pressure Pipes for Water Gas and Sewage. |
| IS | - 1538 | : Cast Iron Fittings for Pressure Pipes for Water, Gas and Sewage. |
| IS | - 1703 | : Water Fittings - Copper Alloy Float Valves (Horizontal Plunger type) |
| IS | - 1879 | : Malleable Cast Iron Fittings |
| IS | - 2016 | : Plain washers |
| IS | - 2062 | : Hot Rolled Low, Medium and High Tensile Structural Steel. |
| IS | - 2629 | : Recommended practice for Hot dip galvanising of iron and steel |
| IS | - 2633 | : Method for testing uniformity of coating on zinc coated articles. |
| IS | - 2379 | : Colour Code for Identification of Pipe Lines. |
| IS | - 2685 | : Code of Practice for Selection, Installation and Maintenance of Sluice Valves. |
| IS | - 2712 | : Gaskets and Packings- Compressed Asbestos Fibre Jointing. |



| | | |
|----|--------------------|--|
| IS | - 2825 | : Code for Unfired Pressure Vessels. |
| IS | - 3006 | : Chemically Resistant Glazed Stoneware Pipes and Fittings. |
| IS | - 3042 | : Single Faced Sluice Gates (200 to 1200 mm size). |
| IS | - 3114 | : Code of Practice for Laying of Cast Iron Pipes. |
| IS | - 3589 | : Steel Pipes for Water and Sewage (168.3 to 2540 mm Outside Diameter). |
| IS | - 4038 | : Foot Valves for Waterworks Purposes. |
| IS | - 4682 (Part I) | : Code of practice for lining of vessels and equipment for chemical - rubber lining. |
| IS | - 4736 | : Hot-dip Zinc Coatings on Mild Steel Tubes. |
| IS | - 4984 | : High Density Polyethylene Pipes for Potable Water Supplies. |
| IS | - 4985 | : Unplasticized PVC Pipes for Potable Water Supplies. |
| IS | - 5312 | : Swing Check Type Reflux (non-return) Valves for Water Works Purpose. |
| IS | - 5822 | : Code of practice for laying of electrically welded steel pipes for Water supply. |
| IS | - 8062 | : Code of practice for cathodic protection (Part-II) of steel structure |
| IS | - 10221 | : Code of practice for coating and wrapping of underground mild steel pipes |
| IS | - 14846 | : Sluice Valve for Water Works Purposes (50 to 1200 mm Size). |

4. 00.00 DESIGN, MANUFACTURE, FABRICATION AND ERECTION

4.01.00 The piping system, fittings and accessories supplied shall conform to high standards of engineering, design, workmanship and be capable of performing in continuous commercial operation in a manner acceptable to Purchaser.

4.02.00 All the piping systems, fittings and accessories supplied under this package shall be designed to operate without replacement and with normal maintenance for a plant service life of 25 years and shall withstand the operating parameter fluctuations and cycle variations which can be normally expected during this period.





4.03.00 Material of construction for pipes under different services shall be as below:

| Service | Recommended Material of Construction |
|---------------------------------------|---|
| River Water | Carbon Steel |
| Clarified Water | Carbon Steel |
| Filtered Water | Carbon Steel (inside rubber lined) |
| Degassed Water | Carbon Steel (inside rubber lined) |
| Demineralised Water | Carbon Steel (inside rubber lined) |
| Service Air | Galvanized Steel |
| Instrument Air | Stainless Steel (schedule 40) |
| Potable Water | Galvanized Steel |
| Chlorine (liquid under pressure) | Seamless Carbon Steel (schedule 80) |
| Chlorine (dry gaseous under pressure) | Seamless Carbon Steel (schedule 80) |
| Chlorine under vacuum | CPVC (schedule 80) |
| Chlorine in water | CPVC (schedule 80) / Carbon Steel (inside rubber lined) |
| Sodium Hydroxide Solution | CPVC (schedule 80) / Carbon Steel (inside rubber lined) |
| Alum Solution | CPVC (schedule 80) / Carbon Steel (inside rubber lined) |
| Lime Solution | Galvanized Steel |
| Polyelectrolyte Solution | CPVC (schedule 80) / Carbon Steel (inside rubber lined) |
| Hydrochloric Acid (concentrated) | Carbon Steel (inside rubber lined) |
| Hydrochloric Acid (dilute) | Carbon Steel (inside rubber lined) |
| Sodium Hydroxide (concentrated) | Carbon Steel (inside rubber lined) |
| Sodium Hydroxide (dilute) | Carbon Steel (inside rubber lined) |
| Sulfuric Acid Solution (concentrated) | Carbon Steel |
| Sulfuric Acid Solution (dilute) | Carbon Steel (inside rubber lined) |



| Service | Recommended Material of Construction |
|---|--|
| Scale Inhibitor Solution | Stainless Steel (schedule 40) / CPVC (schedule 80) |
| Corrosion Inhibitor Solution | Stainless Steel (schedule 40) / CPVC (schedule 80) |
| Biocide Solution | Stainless Steel (schedule 40) / CPVC (schedule 80) |
| Filter Backwash Wastewater | Carbon Steel |
| Ammonia Solution | Seamless Stainless Steel (304 grade) |
| Hydrazine Solution | Seamless Stainless Steel (304 grade) |
| Oxygen Line | Aluminum |
| Crude Condensate | Carbon Steel (inside rubber lined) |
| Treated Condensate | Carbon Steel (inside rubber lined) |
| Demineralized Water with ion exchange resins | Stainless Steel (304 grade) |
| Non Oily Sludge | Cast Iron (underground) Carbon Steel (overground) |
| Neutralized Wastewater | Carbon Steel (inside rubber lined) |
| Cooling Tower Blowdown | Carbon Steel |
| Boiler Blowdown | Carbon Steel |
| Crude Oily Wastewater | Seamless Carbon Steel |
| Treated Oily Wastewater | Seamless Carbon Steel |
| Rainfall Runoff | Carbon Steel |
| Equalized Wastewater | Carbon Steel |
| Oily Sludge | Seamless Carbon Steel |

The portion of pipe lines at the downstream of isolation valves, conveying flushing water shall be of the material & type same as those of the pipelines which are being flushed.

**4.04.00 Material & Dimensional Standards for Piping and Fittings****4.04.01 The welded Carbon Steel Pipes shall conform to the following codes / standards:**

| Pipes | Material Code / Standard | Dimension Code / Standard |
|-------------------------|---|---|
| 50 mm NB and below | Mild Steel, ERW, IS-1239 Part-1 / ASTM-A 53 Grade B (Welded), Type-E, Schedule 80. | IS-1239 Part-1. Plain ends for Socket Welding. |
| 65 mm to 150 mm NB | Mild Steel, ERW, IS-1239 Part-1 / ASTM-A 53 Grade B (Welded), Type-E, Schedule 40. | IS-1239 Part-1. Bevelled ends for Butt Welding. |
| 200 mm to 450 mm NB | Mild Steel, ERW, IS-3589 Grade Fe 410 / ASTM-A 53 Grade B (Welded), Type-E, Schedule 40. | IS-3589. Bevelled ends for Butt Welding. |
| 500 mm NB and above | Rolled and Butt Welded from IS-2062 Grade A plates or SA-285 Grade C or Equivalent (subject to approval by Purchaser). / Spiral Welded pipes. | IS-3589. Bevelled ends for Butt Welding. |
| Elbows (R=1.5 D) | Material Code / Standard | Dimension Code / Standard |
| 50 mm NB and below | Forged carbon steel from ASME-SA 105 / Carbon Steel to IS-1239 Part-2 (Heavy grade). | SW ends to ANSI-B 16.11 (3000#) / IS-1239 Part-2. |
| 65 mm to 150 mm NB | ASME-SA 234 Grade WPB / Carbon Steel to IS-1239 Part-2 (Heavy grade). | BW ends to ANSI-B 16.9 / IS-1239 Part-2. |
| 200 mm to 350 mm NB | ASME SA-234 Grade WPB | BW ends to ANSI-B 16.9 / IS-1239 Part-2. |



| Mitre Bends (R=1.5 D) | Material Code / Standard | Dimension Code / Standard |
|----------------------------------|--|---|
| 400 mm NB and above | Fabricated from parent pipe. | ANSI-B 31.1 / AWWA-C 208. 90° - 3 cut, 4 piece constructions. 45° - 2 cut, 3 piece constructions. |
| Tees | Material Code / Standard | Dimension Code / Standard |
| 50 mm NB & below | Forged Carbon Steel to ASME-SA 105 / ASME-SA 234 Grade WPB / Carbon Steel to IS-1239 Part-2 (Heavy grade). | SW ends to ANSI-B 16.11 (3000#) / IS-1239 Part-2. |
| 65 mm to 150 mm NB | ASME-SA 234 Grade WPB / Carbon Steel IS-1239 Part-2 (Heavy grade). | BW ends to ANSI-B 16.9 / IS-1239 Part-2. |
| 200 mm NB and above | ASME-SA 234 Grade WPB / Fabricated from parent pipe.(set in / set on type). | ANSI-B 16.9 |
| Reducers | Material Code / Standard | Dimension Code / Standard |
| 50 mm NB & below | Forged carbon steel to ASME-SA 105 / ASME-SA 234 Grade WPB / Carbon Steel to IS-1239 Part-2 (Heavy grade). | SW ends to ANSI-B 16.11 (3000#) / IS-1239 Part-2. |
| 65 mm to 150 mm NB | ASME-SA 234 Grade WPB / Carbon Steel to IS-1239 Part-2 (Heavy grade). | BW ends to ANSI-B 16.9 / IS-1239 Part-2. |
| 200 mm NB and above | ASME-SA 234 Grade WPB / Fabricated from parent pipe.(set in / set on type) | ANSI-B 16.9 |



| Slip On Flanges / Blind Flanges | Material Code / Standard | Dimension Code / Standard |
|---------------------------------|--|--|
| All sizes | IS-226 / IS-2062 Grade A / ASME-SA 105 / ASTM-A 216 Grade WCB. Flanges shall be either machined or forged from plate / casting. | Dimensions / Drilling as per ANSI-B 16.5, Pressure rating 150# / 300# or otherwise as applicable, generally Flat face. |
| Bolts & Nuts | Material Code / Standard | Dimension Code / Standard |
| All sizes | IS -1367 CI 4.6 for bolts IS-1367 CI 4 for nuts | IS -1367 |
| Gaskets | Material Code / Standard | Dimension Code / Standard |
| All sizes | 3 mm thick wire reinforced rubber. Material shall contain no asbestos. | ANSI-B 16.21. |

- 4.04.02 Seamless Carbon Steel Pipe shall conform to ASTM-A 106 Grade C (Schedule 80) / ASTM-A 53 / API 5L. Fittings shall conform to applicable codes / standards and be in conformity with the code / standard for the parent pipe.
- 4.04.03 Galvanized Steel Pipes and Fittings shall conform to the clause 4.02.01 above and be galvanized to IS-4736. Ends of all fittings will however be screwed as per IS-554. Mitre Bends shall not be used. Pipe joints shall be screwed for lower size and flanged for higher size. No hot work on G.I. pipes shall be done. Flanges shall be screwed and hot dipped galvanized.
- 4.04.04 Pipes and Fittings which shall be rubber lined, need to conform the clause 4.02.01 above. The inside surfaces of the items shall be completely debeaded and made suitable for lining. The items will be inside rubber lined with 3 mm thick (minimum) natural rubber in two layers as per IS-4682. Flanges shall be flat face as per ANSI-B 16.5 and full face rubber lined. Pipe to Pipe joint will be flanged only. For small size fittings, SS-316 fittings shall be used if rubber lined carbon steel fittings are not available.





- 4.04.05 Stainless Steel Pipe shall conform to ASTM-A 312 of specified grade (Schedule 40) with dimensions as per ANSI-B 16.39. Fittings shall conform to applicable codes / standards and be in conformity with the code / standard for the parent pipe. Mitre Bends shall not be used. Elbows / Tees / Reducers shall be of Forged Stainless Steel (ASME-SA 182) with SW ends to ANSI-B 16.11 (3000#).

- 4.04.06 Cast Iron pipes shall conform to IS-1536. Fittings shall conform to applicable codes / standards and be in conformity with the code / standard for the parent pipe.

- 4.04.07 PVC Pipes shall conform to IS-4984 Class 4. Fittings shall conform to applicable codes / standards and be in conformity with the code / standard for the parent pipe.

- 4.04.08 High density Polyethylene Pipes shall conform to IS-4984 Class 5. Fittings shall conform to applicable codes / standards and be in conformity with the code / standard for the parent pipe.

- 4.04.09 CPVC pipe (Schedule 80) shall be produced from compounds which conform to and are specified in ASTM-D 1784. CPVC Pipe shall be manufactured in strict compliance with ASTM-F 441. Pressure-Rated CPVC Pipe shall be manufactured in strict compliance with ASTM-F 442. All CPVC piping shall be manufactured from NSF approved compounds and NSF Listed for potable water use. CPVC Fittings (Schedule 80) shall be as per ASTM-F 437 and F 439.

- 4.04.10 Pipe lines carrying water, chemicals, air etc. shall be sized generally based on the following ranges of velocities. However pipe size if any for any particular service is addressed in the Tender Drawings / Data Sheets, the selected size for the applicable service shall not be less than the specified size.

| Pipe Size | Velocity in m/sec | | |
|--|-------------------|----------------|----------------|
| | Below 50 mm | 50 mm - 150 mm | 200 mm & above |
| Pump Suction for Water | | 1.2 - 1.5 | 1.2 - 1.8 |
| Pump Discharge for Water | 1.2 - 1.8 | 1.8 - 2.4 | 2.1 - 2.5 |
| Header | | 1.5 - 2.4 | 2.1 - 2.4 |
| Compressed air below 2 Kg/cm ² (g) | 15 - 20 | 20 - 30 | 25 - 35 |



| Pipe Size | Velocity in m/sec | | |
|--|-------------------|----------------|----------------|
| | Below 50 mm | 50 mm - 150 mm | 200 mm & above |
| Compressed air 2 Kg/cm ² & above | 20 - 30 | 25 - 40 | 35 - 45 |
| Suction to compressor/ Blowers | | 7 - 8 | |
| Pump Suction for Chemical Solution | 1.0 - 1.2 | 1.1 - 1.3 | |
| Pump Discharge for Chemical Solution | 1.2 - 1.4 | 1.3 - 1.5 | |

4.05.00 Pipe line under gravity flow shall be restricted to a flow velocity of 1 m/sec generally. Channels under gravity flow shall be sized for a maximum flow velocity of 0.6 m/sec.

4.06.00 The following " C" Value shall be used in WILLIAM & HAZEN formula for calculating the friction loss in piping and fittings.

| | | | |
|------|---|---|-----|
| i) | Carbon Steel Pipe | : | 100 |
| ii) | C.I Pipe | : | 100 |
| iii) | Carbon Steel Pipe (inside rubber lined) | : | 120 |
| iv) | PVC / HDPE / GRP / CPVC pipes | : | 140 |

For calculating the pump head, at least 10% margin shall be taken over the pipe friction losses.

4.07.00 **Piping Layout**

4.07.01 Piping shall be grouped together as far as practicable and routed to present a neat appearance and orientation. All piping shall generally be installed perpendicular or parallel to the major equipment, building structure and floor. Pipe routing shall be such as to provide sufficient clearance for removal and maintenance of equipment, easy access to valves, instruments and other accessories. The piping shall not encroach on the withdrawal space of other equipment. Piping shall be routed to avoid interferences with other pipes, hangers, structures, equipment electrical trays, HVAC ducts etc. Convenient





- supporting points, adequate flexibility for thermal expansion and neat appearance shall be considered in piping layout work.
- 4.07.02 Provision shall be made while preparing piping layout to accommodate all system accessories such as valves/ expansion bellows/instrument stubs/instruments/ specialties as per P&ID.
- 4.07.03 All local instruments on the pipeline shall be located such that the reading can be observed without inconvenience.
- 4.07.04 Overhead indoor piping shall have a vertical clearance of minimum 3.0 m above finished floor level of working areas / walkways. Overhead outdoor piping shall have a vertical clearance of minimum 4.0 m above finished ground level and minimum 7.5 m above finished road level unless addressed otherwise elsewhere in this specification. When several pipe lines are laid parallel, flanged joints must be staggered. Welded and flanged joints should as far as possible located at one third span from supports. If the support is situated right under the welded joints this joint must be reinforced with a strap. Flanged and welded joints must be avoided in the middle of the span. Valves should be located in such a manner so as to ensure their convenient operation from the floor or the nearest platform.
- 4.07.05 In specific cases (subject to instruction by Purchaser for any site specific reason), pipes may be routed overground on RCC pedestals with bottom of pipes minimum 300 mm above finished ground level.
- 4.07.06 Pipe, when specifically addressed, shall be laid in trenches or buried. All buried pipes in general shall be laid with the top of the pipe 1.2 m to 1.5 m below the finished ground level unless mentioned otherwise. Full length of buried piping shall be provided with 100 mm thick sand bed.
- 4.07.07 Openings provided to accommodate pipelines must be closed with bricks and mortar with 10 mm to 12 mm clearance between brick work and pipe. The clear space must be filled with felt or approved filling compound. The details of wall sealing arrangement shall be approved by Purchaser.
- 4.07.08 Drains shall be provided at low points and at pockets in piping such that complete drainage of system is possible. Vent connections shall be provided at high points where air or gas pockets may occur. Vent for use during hydrostatic test shall be plugged after the completion of the test. Vents shall not be less than 15 mm size. Plugs / cocks required for vent/drain system shall form part of the piping system and shall be supplied by Bidder as per finalized flow diagram. All vent valves & drain valves shall be arranged with easy reach of operation. All pipelines shall be given proper slope towards the drain points.
- 4.07.09 To facilitate dismantling of piping at the valves and equipment, break up flange/unions shall be provided. The location shall be decided as per the system requirement during detailed engineering.



4.08.00 Line Joints

Line Joints shall be envisaged as follows:

| | | |
|-------------------|---|--|
| CS and SS pipes | : | Welded (socket welded for 50 mm NB & below & butt welded for 65 mm NB and above) |
| Galvanized Pipes | : | Screwed |
| Rubberlined Pipes | : | Flanged |

4.08.01 Welded joints

For making welded joints (socket weld or butt weld) the welding shall be performed by manual shielded metal arc process. Any welder employed for carrying out welding shall be qualified as per ASME-Section IX for the type of joints to be welded. Jointing by butt weld or socket weld shall depend upon the respective piping material specification.

For Stainless Steel piping atleast the root run shall be welded with Tungsten Inert Gas (TIG).

Butt welding edge preparation shall be done as per ANSI-B 16.25.

All welding electrodes and welding rods including special ones, if any shall be furnished by the Bidder.

4.08.02 Screwed joints

Threading of pipes shall be carried out after bending, heat treatment etc. If not possible, threading may be done prior to these operations but proper care should be taken to protect them from damage. Threads shall be to ANSI-B 2.1 (taper) NPT / IS 554, unless specified otherwise.

Teflon tapes shall be used to seal screwed joints and it shall be applied to the male threads only. Threaded parts shall be wiped clean of oil or grease (with appropriate solvent if necessary) and dried before applying the sealant. Pipe ends shall be reamed or filed out to size of bore and all chips shall be removed. Screwed flanges shall be attached by screwing the pipe through the flange and the pipe as well as the flange shall be refaced accurately.

4.08.03 Flanged joints

All flanges and flange drilling shall be to ANSI-B 16.5 of applicable pressure/temperature class. However in case of interface with the pipe of Purchaser, the flange/interconnection details shall be designed to match the applicable interface piping and concerned details.





When weld neck or socket weld flanges are used, their bore must be made the same as that of the pipe being welded to. Socket welded or threaded flanges may be used, with the appropriate piping system for connection of pipe to the flanged equipment.

Drilling of flanges on piping must match with the drilling of flanges on the valves /equipments to which the piping is to be connected.

While fitting the mating flanges, care shall be taken to properly align the pipes and to check the flanges to trueness so that the faces of the flanges can be pulled up together without producing any stress on the adjacent pipes and equipment flanges.

Flanges shall be generally Slip-On / Blind Flat Face type. The packing ring or gasket of the flanged joint shall be of full face type. Flanged joints shall not be buried.

4.08.04 With reference to maintenance for carbon steel pipes, three piece socket welded unions for sizes 50 mm NB and below shall be used. For higher sizes, flanged joints shall be used.

4.09.00 **Fabrication of Pipes**

4.09.01 **General Requirements**

The Bidder shall prepare necessary fabrication drawings based on approved piping layouts.

Flanges and their contact surfaces shall be concentric with the pipe axis and shall be accurately machined and drilled true to template.

Where welded pipe and fittings are used, the longitudinal weld seams of adjoining sections shall be staggered by 90 degree.

Prefabrication shall be carried out in the fabrication shop to ensure quality of work and to minimize work on the field.

Where fabricated reducers have been specified, they shall be fabricated from parent pipes by the 'cut and shut' method.

All bends, tees and reducers shall be fabricated as per the latest edition of power piping code, ANSI-B 31.1 or approved equivalent. Reinforcement wherever required, shall be provided.

Only shop fabricated mitre bends or mitre fittings shall be acceptable. Mitre bends will not be accepted for steel pipes of 350 NB and below. For sizes 400 mm NB and above, the mitre bends shall conform to BS-534.



For easy handling & removal of equipment, valves etc. and for maintenance purpose, break up flanges shall be provided for 65 mm NB and above. For flanged joints of 50 mm NB and below, suitable type of compression flexible coupling shall be provided.

4.09.02 Rolled and Welded /Spiral Welded Pipes

Pipes of larger diameter shall be fabricated from steel plates conforming to IS-2062 by rolling and welding or spiral welded pipes shall be used.

Where pipe lengths need to be erected before the circumferential joints is welded, the pipe ends at these joints shall be beveled so that the top half is welded mostly from outside and the bottom half mostly from inside of pipe.

Beveled (single V / double V) ends shall be provided for butt welding as per Welding Procedure Specification.

4.09.03 Fabrication of flanges for large diameter pipes (sizes 600 mm NB and above)

Flanges fabricated from plates shall conform to AWWA-C 207 / BS-4504 / ANSI-B 16.47.

All welds in fabricated flanges shall be subjected to 10% radiographic examination.

Flanges shall be flat faced machined to 10 microns surface finish. Back face of the flanges shall also be machined to 25 microns surface finish.

Inspection holes shall be provided at suitable locations for pipes 800 mm NB and above as required for periodic observations and inspection purposes.

4.09.04 Rubber Lined Pipes

All rubber lined pipes shall be seamless or bead removed ERW pipes. Inside surface of the pipes shall be completely cleaned and made suitable for lining.

All rubber lined pipes shall have flanged joints. Pipes shall be welded with flanges before rubber lining.

For rubber lined pipe, natural rubber lining should be applied in two (2) layers on the inside surface of pipes, giving a total thickness not less than 3 mm. Surface hardness of rubber lining shall be 65 + 5 Shore A class.

4.09.05 Welding

Welding shall be carried out by manual shielded metal arc and Tungsten Inert Gas Welding process. Electrodes used shall be of Purchaser approved make. Electrodes shall be kept dry and electrode containers shall be protected against moisture. Electrodes that show sign of deterioration or damage shall not be used. Automatic or semiautomatic welding shall be done with the specific approval of Purchaser.



The Bidder shall submit procedures for welding, stress relieving, dye penetrant testing radiography etc. for prior approval of the Purchaser.

Weld shall not be made in pipe bends.

4.10.00 Supports for Overground Pipe

4.10.01 Complete supporting system for the pipe line shall be designed, fabricated and supplied by the Bidder. Inside the building, the overhead portion of the pipe line may be supported from the building structures. No support shall be taken from the brick wall. Outdoor pipes shall run on steel trestles wherever required. All the steel structure for the pipe rack and the supporting posts/trestles along with all necessary hangers, clamps, connecting steel, fixing bolts, nuts etc. shall be supplied and erected by the Bidder.

4.10.02 Hangers and supports shall be capable of carrying the sum of all concurrently acting loads. They shall be designed to provide the required supporting effects and allow pipe line movements as necessary. All guides, anchors, braces, dampener, expansion joint and structural steel to be attached to the building/structure, trenches etc. shall be provided. Type of hangers and components for all piping shall be selected and approval obtained from the Purchaser.

4.10.03 The supports shall meet the general guidelines indicated in the following code / standards:

MSS-SP 58 : Pipe hangers & supports - Materials, design and manufacture.

MSS-SP 69 : Pipe hangers & supports Selection and application.

ANSI-B 31.1 : Power Piping Codes

4.10.04 Bidder shall locate, design, fabricate, supply and erect all supports, restraints and anchors required for supporting of over ground portion of piping under this contract

4.10.05 Support drawings for piping shall be got approved from the Purchaser. BOM for each support shall also be submitted.

4.10.06 All material for supports shall be of tested quality.

4.10.07 All structural steel required for supports shall be provided by the Bidder at no extra cost to the Purchaser.

4.10.08 All pipe supporting element, guides, sliding support, beams, channel section, attachment to supports, beam clamps etc. shall be provided by the Bidder.





- 4.10.09 Support locations will be shown in the layout drawing to be submitted by the Bidder.
- 4.10.10 Fabrication, supply and installation of brackets, pipe shoes, saddles etc. shall be included in the scope of Bidder and the same shall be carried out as per approved drawings.
- 4.10.11 If an outdoor saddle support is assumed to permit sliding movement of piping over the support, consideration shall be given in selection of supporting material at the interface so that no rust formation takes place and the actual sliding movement is feasible in practice.
- 4.10.12 All pipe supports shall be designed to fully sustain the pipe in normal operating position, allow free and ample expansion or contraction except where anchored and prevent excessive stress.
- 4.10.13 Sway braces, cushioned clamps or other vibration control equipment shall be used in order to prevent unwanted movements of the piping due to vibration, shock or other causes. These shall be of such design as to protect piping against these movements regardless of direction.
- 4.10.14 The supports shall be so interspaced as to minimize sagging of the pipes and to keep them within permissible limits where pipes are full with the conveying media.
- 4.10.15 All piping supports shall be designed to avoid interference with other piping hangers, electrical conduits equipment and structures etc.
- 4.10.16 Saddles, supports etc. shall be capable of carrying the sum of all concurrent acting loads and shall be fabricated from plates/pipes sections conforming to SA 53 / IS-2062 or equivalent. They shall be designed to provide the requirement of supporting effects and allow pipe line movements as necessary. The structural work shall be as per IS-800 / BS-4360.
- 4.10.17 The maximum spans of the supports of straight lengths shall not exceed the recommended values indicated in ANSI-B 31.1. The spans shall be suitably reduced considering the following:
- a) Point loads due to valves and specialties, branch lines etc.
 - b) Pipe bends
 - c) Structural Steel beams.
 - d) Facilities for maintenance of flanged joints.
 - e) Minimum loads on equipment.
- 4.10.18 All vertical lines shall be properly supported on the vertical run and additionally provided with adequate number of lateral-restraints where the length of vertical run exceeds 5M.



- 4.10.19 At all sliding surfaces of restraints and supports Bidder shall provide a teflon lining to minimize sliding friction.
- 4.10.20 Pipe clamps shall have a minimum thickness of 5 mm for indoor piping and 6 mm for outdoor piping.
- 4.11.00 **Erection**
- 4.11.01 The Bidder shall coordinate the erection of the piping system as required with the erection schedule of other concerned systems. The sequence of work shall be carefully planned to minimize interference with other groups working in the same area. The actual sequence to be followed shall be to the approval of Purchaser who may at any time, direct the Bidder to reschedule his work as per the status of work site
- 4.11.02 Prior to making interface connections with equipment / system supplied by others, the Bidder shall obtain the approval of the concerned authority.
- 4.11.03 All workmanship shall be accomplished using accepted methods and procedures of the highest recognized fabrication and erection code / standards. Workmanship not conforming to the intent of this specification shall be liable to rejection by the Purchaser at any time, during the progress of work. The Bidder shall correct the workmanship immediately at no extra cost to the Purchaser.
- 4.11.04 The Bidder shall make all interface joints of the piping system, covered under this specification at the connecting points with equipment/piping supplied by others.
- 4.11.05 It is the responsibility of the Bidder to ensure correct orientation of all valves, instrument stubs etc. in line with final piping drawings.
- 4.11.06 The Bidder shall utilize the existing structures if any, to support the piping as far as practicable. All auxiliary steels required shall be supplied by the Bidder.
- 4.11.07 Before performing any welding, all corrosion products, dust, grease and other foreign material shall be cleaned from the surfaces to be joined.
- 4.11.08 Piping on both sides of the joint shall be adequately supported during all welding. Temporary supports, if used shall be so designed that no stress due to pipe weight comes on the joints during the joining.
- 4.11.09 All pipes shall be located and laid in accordance with the approved layout drawings. No deviation will be allowed unless written consent is issued by Purchaser in specific case(s).
- 4.11.10 Before laying the pipes, the coordinates and levels of the pipes shall be checked by the Bidder. Any discrepancies between the execution and approved drawings shall be brought to the notice of the Purchaser and corrections shall be carried out as per his instructions.



4.11.11 During erection of piping, the Bidder shall provide proper number and size of bolts and nuts as per drawings and specification. The Bidder shall provide approved quality of grease mixed with graphite powder thoroughly on all the bolts, nuts and washers immediately after erection and when the flange joints are dismantled for flushing, testing and alignment of equipment etc. to prevent rusting of nuts, bolts and gaskets. The grease and graphite powder shall be supplied by the Bidder

4.12.00 **Cleaning and Flushing**

The exterior and interior surface of all piping shall be thoroughly cleaned of all sand, mill scale, grease, oils, dirt and other foreign materials. After cleaning, the interior surfaces of all piping shall be thoroughly blown dry and protected with a completely water soluble preventive coating.

Flange faces shall be coated with an easily removable rust preventive coating.

Machined surface shall be coated with rust preventive paint. The paint shall be consumable in the welding process.

4.13.00 Pipes and Fittings if any, coming under purview of IBR, should meet its requirements and getting the approval from IBR in respect of the same shall be under the scope of the Bidder.

4.14.00 **Valves & Isolation Gates**

Valves will be used to start/stop or control flow.

All valves, shall be suitable for service conditions i.e. flow, temperature and pressure under which they are required. The valves shall be of standard pressure rating as per the applicable code/ standard. The pressure rating of diaphragm valves shall be selected considering the maximum expected operating differential pressure. Sample valves will be used in sample collection lines.

Gates will be primarily used for isolation of flow in open channels although these should be capable of throttling the flow too.

For location and type of Valves / Isolation Gates, Bidder need to refer to the P&I drawings enclosed with this specification.

4.14.01 Sluice / Gate Valves (for river water / clarified water / filtered water / similar application)

Sluice / Gate valve shall conform to IS-14846 PN1.6 minimum. Stem, seat ring and wedge facing ring shall be of stainless steel construction. Other parts shall be as per IS-14846. Valves shall be of outside screw and rising stem type. Ends will be flanged and compatible with ANSI-B 16.5 Cl. 150 (minimum) piping flanges.



Sluice / Gate valves for sizes 50 mm NB and below shall conform to IS-778 Class-2 / ANSI-B 16.34 straight, rising stem; with outside screw.

Sluice / Gate valves shall be provided with the following accessories in addition to the standard items.

- a) Hand wheel
- b) Gear Reduction Unit Operator for valves 250 mm NB and above.
- c) Bypass valve for valve of sizes 300 mm NB and above.
- d) Draining / Flushing arrangement wherever required.
- e) Arrow indicating flow direction.
- f) Position indicator.

Sluice / Gate Valves shall be provided with back seating bush to facilitate gland renewal during full open condition.

For lower sizes, the gate valves will be screwed bonnet with outside screw rising stem as per IS-778. The material of construction will be gun metal body, with brass stem and trim. Ends will be screwed to ANSI-B 2.1.

Gate valve on galvanized iron pipe shall be gun metal construction as per IS-778 Class 2. Ends will be screwed to ANSI-B 2.1.

4.14.02 Butterfly Valves (for river water / clarified water / filtered water / similar application)

Butterfly valves shall be of double flanged or lugged wafer type of low leakage rate conforming to AWWA-C 504 class 150 (min.) or BS-5155 PN 10 / class 150 (minimum)

The various components of butterfly valves shall be of the following:

- i) Body : Cast Iron – ASTM-A 48 Cl.40;
BS-1452 Grade220
SG Iron – BS-2789.
Cast Iron IS-210 Grade FG 260
Cast Steel – ASTM-A 216 Grade WCB;
BS- 1504 or Equivalent grade (subject to approval by Purchaser).
- ii) Disc : Cast Iron – ASTM-A 48 Cl.40;
BS-1452 Grade220
SG Iron – BS-2789.
Cast Iron IS-210 Grade FG 260
Cast Steel – ASTM-A 216 Grade WCB;
BS-1504 or Equivalent grade (subject to approval by Purchaser).



- iii) Shaft : ASTM-A 296 Grade CF 8M / AISI 316:
AISI-420;
BS-970 Grade 316;
BS-970 Grade 420 S45.
- iv) Seat rings : Nitrile rubber, EPDM (Ethylene propylene rubber), Hypalon.

Butterfly valves shall be fitted with sleeve type bearing such as PTFE. Valves of size 350 mm NB and above shall be provided with one or two thrust bearings to hold the disc securely in the centre of valve seat without hydraulic or external axial shaft loads. Sleeve and other bearings fitted into the valves body shall be of self lubricated materials that do not have any effect on the fluid handled and other components of the valves.

All the butterfly valves shall be provided with Hand wheel or lever/wrench operated as per the requirements.

The use of lever operators shall be limited to valves requiring a maximum of 90 degree stem rotation from full open to full closed position. For lever/wrench operated valves, means shall be provided for positively holding the disc in not less than three intermediate positions

For larger sizes i.e. 150 mm NB and above, hand wheel shall be provided.

Manually operated valves shall be provided with reduction gear unit for valves of size 250 mm NB and above. Valve provided with motorised or pneumatic actuator shall be provided with a hand wheel for manual operation.

All the valves shall be equipped with adjustable mechanical stop-limiting devices to prevent over travel of the valve disc in the open and closed positions. The valve operators (Handwheel or Gear reduction unit or Motor actuator etc.) shall be designed as per applicable International Standard.

All the butterfly valves shall be provided with an indicator to show the position of the disc. Ends will be flanged and compatible with ANSI-B 16.5 Cl. 150 (minimum) piping flanges.

4.14.03 Butterfly Valves (for decationized water / deanionized water / demineralized water / desalinated water / similar application)

The butterfly valves shall conform to the requirements addressed under Cl. No. 4.14.02 above along with the requirements delineated below:

- a) Body shall be lined (minimum 3 mm) with natural rubber, ebonite, polypropylene or PVDF.
- b) Disc shall be either lined with PVDF, polypropylene, or natural rubber or shall conform to ASME-SA 479 Grade 316.



4.14.04 Ball Valves (for river water / clarified water / filtered water / similar application)

Ball valves may be used for sizes 40 mm NB and below. Ball valves shall conform to the following technical specifications:

- a) Design Standard BS:5351
- b) Type Screwed / Welded / Flanged ends; Full Bore: Split Body & Seat supported construction
- c) Material of Construction
 - Body Carbon Steel to ASME-216 WCB / Cast Iron to IS-210 Grade 220 or better.
 - Ball Stainless steel ASME-SA 479 Grade 316 or 410.
 - Seat ring PTFE
 - Stem Stainless steel ASME-SA 479 Grade 304 or 316 or 410.
 - Seats Nitrile rubber; PTFE
- d) Valves shall be designed to be directly operable by a wrench / hand lever.
- e) Suitable stops shall be provided for both the fully open & close condition.
- f) All the valves shall be provided with an indicator for showing the position of the ball port.
- g) Ends will be flanged and compatible with ANSI-B 16.5 Cl. 150 (minimum) piping flanges

4.14.05 Globe Valves (for river water / clarified water / filtered water / similar application)

Globe valves shall conform to the following technical specifications:

For sizes 50 mm NB and below

- i) Design Standard : IS-778 Class-2 / BS-1873
- ii) Type : Straight, rising stem, with outside screw.



iii) Material of Construction

| | | |
|------|---|--|
| i) | Body, Bonnet, Stuffing Box & seat rings | Leaded Tin Bronze con forming IS-318 Grade 2 |
| ii) | Stem | Stainless Steel, AISI-316 |
| iii) | Disc | IS-318 Grade 2/AISI-316 |

Note: However, valves in the flushing water lines shall be of type and material specified for the chemicals which are being flushed by the line.

For sizes above 50 mm NB

- i) Design Standard : BS-13789 PN 10 (minimum).
- ii) Type : Double Flanged or wafer body, outside screw and rising stem type.
- iii) Material of construction
 - a) Body : Cast iron: IS-210 Grade FG260 / BS-1452 Grade14.
 - b) Stem : Stainless steel AISI-410 / 13% chrome steel.
 - c) Disc : Cast iron IS-210 Grade 260 / BS-1452 Grade 14.
 - d) Packing : PTFE
 - e) Seat & seat rings : 13% chromium steel
 - f) Gland & gland nut : AISI-420
 - g) Hand wheel : Cast Iron or Malleable Iron
- iv) Back seat shall be provided on the stem or on the disc.
- v) Renewable disc assembly shall consist of disc holder, disc, disc guide, check nut and disc retaining nut with washer.



- vi) Disc of globe valve may be provided with renewable rubber seating ring.
- vii) Handwheels shall be marked with the word. OPEN or SHUT with arrow to indicate direction of opening or closing.

Ends will be flanged and compatible with ANSI-B 16.5 Cl. 150 (minimum) piping flanges

Globe valve on galvanized iron pipe shall be gun metal construction as per IS-778 class 2. Ends will be screwed to ANSI-B 2.1.

Note: However, valves in the flushing water lines shall be of type and material specified for the chemicals which is being flushed by the line.

4.14.06 Diaphragm Valves (for river water / clarified water / filtered water / similar application)

Metallic Unlined Diaphragm valves (manual / auto as specified elsewhere in this specification) may be used for isolation purposes.

The Metallic Unlined Diaphragm valves shall conform to the requirements addressed under Cl. No. 4.14.07 below except the requirements with reference to lining for body and integral flanges.

4.14.07 Diaphragm Valves (for decationized water / deanionized water / demineralized water / desalinated water / dilute and concentrated acidic solution / dilute and concentrated alkaline solution / similar application)

Metallic Diaphragm valves (manual / auto as specified elsewhere in this specification) may be used for isolation purposes.

The metallic diaphragm valves shall conform to the following requirements.

- a) Design Standard : BS EN-13397 or Equivalent (subject to approval by Purchaser) of required rating/class. (minimum rating of valves should be PN 10).
- b) Type : Flanged and lined body ends, sealed bonnet, weir pattern, tight shut off type.



c) Material of Construction

| | | |
|-------------|---|---|
| Body/Bonnet | : | Cast Iron IS-210 Grade FG.260 or Equivalent (subject to approval by Purchaser). |
| | | Cast steel ASTM-A 216 Grade WCB. |
| Body lining | : | Soft Natural rubber - 3 mm thick as per IS-4682 (hardness 85-90 on shore A), Ebonite polypropylene, PVDF. |
| Diaphragm | : | Reinforced rubber, Hypalon |
| Handwheel | : | Cast Iron |
| Compressor | : | Stainless Steel |
| Stem & Bush | : | Stainless Steel |

- d) Ends will be flanged and compatible with ANSI-B 16.5 Cl. 150 (min.) piping flanges, full face rubber lined and shall be cast / integral with the body.
- e) Handwheels shall be marked with the direction of closure.
- f) Valves shall be provided with a position indicator to show the open and closed condition.
- g) Valves provided with pneumatic actuators shall be provided with a handwheel for manual operation. The valves operators shall be designed as per applicable International Standard.
- h) The testing of valves will be as per BS EN-13397 and rubber lining will be tested as per IS-4682.

Note: For valves which may come in contact with concentrated acid/ alkali, the material of construction of diaphragm shall be as follows:

Diaphragm shall be of reinforced Teflon, EPDM for acid services and reinforced Neoprene / Hypalon for alkali services.

Use of Nonmetallic Diaphragm Valves for any specific / critical application shall be subject to approval by Purchaser and shall conform to the requirements of BS EN ISO 16138 - Industrial valves. Diaphragm valves of thermoplastics materials.



4.14.08 Plug Valves (for lime solution / sludge / similar application)

The plug valves shall conform to the following requirements.

| | | |
|----|--------------------------|--|
| a) | Design Standard | BS-5158 or Equivalent (subject to approval by Purchaser) |
| b) | Type | Flanged and non lubricated, regular pattern, plug valves. |
| c) | Material of Construction | |
| | Body | Cast Iron IS-210 Grade FG 260 or Equivalent (subject to approval by Purchaser) |
| | Plug | Stainless Steel AISI-316 |
| | Body Sleeve or Seat | PTFE |
| | Seat | PTFE |
| | Gland | AISI-304 / AISI-316 |
| | Cover | Cast Steel ASTM-A 216 Grade WCB |
| | Gland Nut | AISI-304 / AISI-316 |

- d) Valves shall be operated by permanently fitted wrench or Hand lever. Wrench shall be mounted so that they are parallel to the valve bore axis when the valve is in fully open condition.
- e) All valves shall be provided with an indicator for the position of the plug part.
- f) Suitable stops shall be provided for the fully open and fully closed positions of the valve.
- g) Valves of size of 250 mm NB and above shall be provided with a suitable reduction gear unit.
- h) Ends will be flanged and compatible with AISI-16.5 Cl. 150 (minimum) piping flanges.



4.14.09 Non Return or Check Valve (for river water / clarified water / filtered water / similar application)

Non return valves shall be of swing check (reflux) type or dual plate type.

The valves shall conform to the following specifications.

- i) Design Standard : IS-5312, BS-1868, BS-5153, API-594 / API-60 or equivalent (subject to approval by Purchaser)
- ii) Type : Swing check Type and Flanged ends.
- iii) Material of Construction:

| | | |
|----|-------------------------------|--|
| a) | Body & Cover Hinge Disk/Door | Cast iron IS-210 Grade FG 260 / Cast Iron BS-1452 Grade 220 or equivalent (subject to approval by Purchaser) |
| b) | Hinge Pin and Door / Disc Pin | Cast steel ASTM-A 216 Grade WCB High tensile Brass IS-320 HT 2 or BS-2872 equivalent (subject to approval by Purchaser) |
| c) | Disc facing ring | Stainless steel |
| d) | Body Seat ring | Stainless steel |
| e) | Bearing bushes | Leaded Tin Bronze IS-318 Grade 2 |
| f) | Bolts | Carbon Steel |

Ends will be flanged and compatible with ANSI-B 16.5 Cl. 150 (minimum) piping flanges.

Body shall be permanently marked with an "arrow" inscription indicating the direction of motion of the fluid for all the check valves.

For sizes 50 mm NB and below, check valves shall be gun metal body swing type as per IS-778. Ends will be screwed type to ANSI-B 2.1.



- 4.14.10 Non Return Valve (for decationized water / deanionized water / demineralized water / desalinated water / dilute and concentrated acidic solution / dilute and concentrated alkaline solution / similar application)

The valves shall conform to Cl. No. 4.09.00 above along with the following requirements:

- a) The body, cover & Disc shall be lined with natural Rubber, PTFE or Viton. The Hinge, Hinge Pin & Disc Pin shall be coated with PVDF, or suitable elastomer. The bearing bushes shall be PTFE or Equivalent (subject to approval by Purchaser) material (subject to approval by Purchaser). Bolting shall be of stainless steel. In the absence of lining/coating, the complete valve shall be of stainless steel construction (AISI-316).
- b) For only acid services Non- Return valves shall be of lined construction & Flap type.
- c) For alkali services, the complete valve shall be stainless steel construction (AISI-316) or of lined construction as specified above.

4.14.11 **Valves for Sampling / Instrument Isolation Service**

Each sampling valve / instrument isolation valve shall be full bore ball type.

Ball valves shall conform to the requirements stipulated under Cl.4.04.00 above. However, Body material shall be Stainless Steel (AISI-316).

4.14.12 **Valves for Air Service**

For Air services globe valves or Ball valves may be used for sizes 50 mm NB and below.

For sizes higher than 50 mm NB, either Butterfly valve or Ball valves shall be used.

Globe valves shall generally conform to Cl. 4.05. 00 above.

Ball valves shall conform to the requirements stipulated in Cl.4.04.00 above. However, Body material shall be leaded Tin Bronze (IS-318 Grade2) or stainless steel (AISI-304 / 316).

Butterfly valves shall conform to the Cl.4.03.05 to 4.03.09 of this section. However, the body & Disc shall be either cast iron lined with elastomer such as PVDF or PTFE or stainless steel construction (AISI-304 / 316).



4.14.13 Safety / Relief Valves

The safety valves / relief valves at the downstream of positive displacement type metering pumps shall be of the standard type manufactured by the pump manufacturer and the material of construction shall suit to the fluid handled.

4.14.14 Valves for Resin Transfer Line

In resin transfer line two way eccentric plug valve shall be used. The valves, shall have type 316 stainless steel body and bearings, resilient faced plug and flanged ends.

4.14.15 Isolation Gates

Design standard for gates shall be IS-3042 or Equivalent (subject to approval by Purchaser).

The gates shall be rectangular or square sluice, rising spindle type conforming to class-1 of IS-3042.

Material of Construction

| | | |
|------|------------------------|-----------------------------|
| i. | Frame and Door | Cast Iron IS-210 Grade 20 |
| ii. | Spindles, bolts & nuts | M.S. to IS-2062 |
| iii. | Face & seat rings | Gun metal (as per IS-3042). |

All the parts of gates shall be applied with the coats of heavy duty bitumastic paint.

Each of the gates shall be provided with handwheel, and a position indicator.

The gates for DM plant drains shall be rubber lined to a minimum thickness of 4.5 mm.

4.15.00 Strainers

4.15.01 Basket Strainers

a) Basket strainers of simplex design shall have the following materials of construction for raw/clarified/filtered water application.

- i. Body Fabricated mild steel : IS-2062 (Tested quality)





- ii. Strainers Wire shall be stainless steel (AISI:316 18 BWG 30 mesh suitably reinforced. Reinforcement material shall also be of stainless steel construction.

- iii. Drain Plug / Nuts Gun metal

- b) Inside and outside of basket body shall be protected with one coat of high build zinc phosphate primer and three coats of Chlorinated rubber paint to a total thickness of 200 microns.
- c) Suitable Vent and drain valves shall be provided for the strainers.
- d) Screen (strainer) flow area shall be at least four times pipe sectional area. Flow area in any portion of Basket strainer assembly shall not be less than the pipe cross sectional area.
- e) Pressure drop in clean condition shall not be more than 1.0 mwc at full flow.
- f) Basket Strainer shall be provided with lifting lugs and suitable mounting arrangement.
- g) For DM water service, body shall be rubber lined to minimum 4.5 mm thickness (soft rubber of shore Hardness $65 \pm 5^{\circ}A$).

4.15.02 Y-Type Strainer

- a) Y-Type strainer for water application shall be constructed of following materials:
 - i. Body Cast Iron IS-210 Grade FG 260
 - ii. Strainers Wires of stainless steel AISI-316, 18 BWG 30 mesh suitably reinforced. Reinforcement material shall also be of stainless steel construction.
 - iii. Drain Plug / Nuts Gun metal (threaded construction)

- b) Y-Type strainers shall also conform to Cl. 4.15.01 (b), (c), (d), (e) and (f).
- c) Body of the Y-type strainers of alkali, and demineralised water shall be of Cast Iron (IS-210 Grade FG 260) and lined with soft or hard rubber to a thickness of 3 mm.



- d) For acid services, apart from the rubber lined body material, the screen material, shall be Polypropylene or HDPE wire cloth of suitable mesh and thickness.

4.16.00 Resin Traps

The resin traps for the Ion exchange vessels shall be provided for the collection of Ion exchange resin shall conform to the following:

- 4.16.01 The body shall be of mild steel (IS-2062) and lined internally with rubber (Hard/Soft rubber), Saran or polypropylene. The internals (rod and screen) for all resin traps shall be of AISI-316 construction. All screen components shall be welded at each intersection of wire and support rod for good strength, Resin traps screen opening shall not exceed 120 percent of the associated process vessel under drain/backwash collection header nozzle screen opening and shall be suitably selected to retain even the minimum size of the resin selected for the process.

- 4.16.02 The resin traps shall be provided with a draining arrangement with a valve for collection of trapped resins. Resin trap body shall have lifting lug for easy handling during maintenance/erection.

4.17.00 General Requirements for Valves, Gates, Strainers and Resin traps

- 4.17.01 All the items shall be suitable for service conditions i.e. flow, temperature and pressure to which they may be subjected to.

- 4.17.02 All the items shall be of proven design for the duty conditions and the Bidder or manufacturer shall have sufficient experience in using the above equipment in water treatment application in the plants supplied earlier by them.

- 4.17.03 In case Purchaser desires, the experience list/feedback from the users shall be made available to Purchaser for any or all the equipments during the detailed engineering phase.

- 4.17.04 Valves will be used to start/stop or control flow. Gates will be primarily used for isolation of flow in open channels although these should be capable of throttling the flow too. Sample valves will be used in sample collection lines.

- 4.17.05 All valves shall be suitable for service conditions i.e. flow, temperature and pressure under which they are required. All the valves shall be of standard pressure rating of the applicable design code / standard. Non standard pressure rating shall not be accepted. The pressure and temperature rating of the valve shall not be less than the maximum expected pressure and temperature plus 5% additional margin of the system in which valves are proposed to be installed.



- 4.17.06 Valves pressure classes, sizes, types, body materials, and end preparation shall generally be as described herein, unless mentioned otherwise elsewhere in Bid Specification. All valves shall conform to the requirements of the governing codes, and the requirements specified.
- 4.17.07 Valves (including safety, relief and control valves) body materials shall be compatible with the piping with which they are used. If the body material is not of the same type as the material of the connecting pipe work, the valves shall be fitted with suitable welding nozzles to avoid dissimilar butt welds at site.
- 4.17.08 Each modulating control valve shall be provided with isolation valves. Manual bypass valve shall be provided for each modulating control valve to achieve safe and reliable manual operation.
- 4.17.09 All the actuators of the valves shall be designed to handle the maximum expected pressure differential across the valves and to overcome friction forces and unbalance forces due to the flow through valve.
- 4.17.10 Valve bodies and bonnets shall be designed to support the valve operators (handwheel, gear, or motor) with the valve in any position without external support.
- 4.17.11 Valve ends and size limitations are as follows:
- a) 50mm NB and smaller valves - Class 800 minimum with socket weld ends. (For instruments connections/ isolation valves screwed ends may be acceptable)
 - b) 65mm NB and larger size valves - Class 150 minimum (butt-weld ends or flanged or wafer style).
 - c) Flanged steel butterfly valves - 750mm and larger size; pressure class per AWWA / BS-5155.
- 4.17.12 Gate, globe and angle valves shall be outside stem and yoke construction.
- 4.17.13 Valves sizes 65 mm NB and larger shall have a non-rising handwheel.
- 4.17.14 All the actuator operated valves shall be fitted with handwheel for manual operation. The pneumatic actuators shall be selected based on the available air pressure and operating air pressure (maximum and minimum). The supporting calculations for selection of actuators shall be furnished for Purchaser's approval before finalization of all the actuators.
- 4.17.15 Valves coming under the purview of IBR if any shall meet its requirements and the approval of the same shall be obtained by the Bidder.
- 4.17.16 Sizes of the valves shall be same as that of the interconnected pipe sizes except for the control valves.



- 4.17.17 The various items shall be installed such so that they are easily approachable for the operating and maintenance personnel. All valves shall be accessible without chain pulls, as far as possible. Generally Valves shall be located about 1.2 meter to 1.5 meter from the operating platform and also they shall not be located below the ground level such as beneath the trenches etc. In such cases, extended spindle shall be provided with chain operating from operating floor. Valves which are installed below the ground floor shall be provided with a floor mounted pedestal at the top of the operating floor. Valves which are installed below the ground floor shall be provided with a floor mounted pedestal at the top of the operating floor. The position indicator for such valves shall be also provided along with the stand.
- 4.17.18 All valves shall be provided with hand wheels. Wherever necessary, chain operator shall be provided so that the valve may be operated from the ground floor.
- 4.17.19 All valves shall be provided with cast heat marks on casting of Body and Bonnet.
- 4.17.20 Whenever screwed valves will be installed in a pipe line, it will always be followed by screwed three piece union of same material as that of pipe.
- 4.17.21 Short pieces used for welding of different pipe fittings and valves shall not be less than 80 mm in length.
- 4.17.22 However valves which are provided (in the buried pipe line) with a valves chamber shall have manual operator/Handwheel inside the valve chamber. The valve chamber shall be provided with built in ladders/staircases and sufficient operating space within the chamber shall also be provided for easy operation of such valves.
- 4.17.23 All the valves, strainers, resin traps etc. shall be provided with external painting as that of the interconnected piping as specified in Clause 3.03.14 above. However, surfaces such as Stainless Steel, aluminium, copper, brass, bronze and other non-ferrous materials shall not be painted. No paint or filter shall be applied until all repairs, hydrostatic tests and final shop inspections are completed, but shall be applied prior to shipment.
- 4.18.00 **Rubber Expansion Joint**
- 4.18.01 The inner cover (i.e. the tube) and also the outer cover shall be made up of natural or synthetic rubber of adequate thickness. The carcass between the tube and the cover shall be made up of high quality cotton and rayon cord having suitable number of plies and impregnated with rubber or synthetic compounds. Moreover, to ensure adequate strength, reinforcements consisting of metal rings embedded in the carcass, shall be provided.
- 4.18.02 In all cases, the expansion joints shall be integral flanges at both ends complete with split retaining rings.



4.18.03 Each of the expansion joint shall be provided with adequate number of limit rod assemblies which shall be tightened after erection of the entire suction branch of the pumps, in order to avoid transmittal of undue pressure thrust on to the pump foundation. Each of these limit rod assemblies shall consist of a long bolt and two connecting plates which are, in turn securely bolted to opposite flanges. Each plate is to be drilled with three holes, two for bolting to the flange, the third for passage of the stretcher belt. Rubber washers backed with metal washer shall be placed under the head of the bolt and under the nut.

4.19.00 **Protective Lining and Painting**

The supply and application of Protective Lining and Painting with reference to Piping, Fittings and Valves need to be as per **Sub Section: Section-XIII of V.III-C– Technical Specification for Protective Lining and Painting**, attached herewith.

5.00.00 **TESTS AND INSPECTION**

5.01.00 **Tests & Inspection for Pipes and Fittings**

5.01.01 **Shop Tests**

Shop test shall include all tests to be carried out at supplier's work, works of sub suppliers and at works where raw materials supplied for manufacture of equipment are produced. The supplier shall carryout a comprehensive inspection and testing program during manufacture at works. Necessary Manufacturing and Field Quality Plans shall be prepared by supplier and submitted for approval by Purchaser for all checks conducted on raw materials, fabrication etc.

Calibrated instruments required for measuring / testing of pipes shall be arranged by manufacturer at their works during inspection.

Purchaser shall be given full access to all tests. The manufacturer shall inform Purchaser of the testing well in advance so that Purchaser at own option may witness the test.

All the test certificates and reports shall be submitted to Purchaser for approval.

All the mechanical and chemical tests including optional tests if any as per the applicable codes / standards shall be carried out and the test certificates for the same shall be submitted for approval by Purchaser. Material Certificate shall be furnished for each grade / lot of pipes. All material test certificates shall carry material specification, size, class, length, chemical composition, physical properties and heat number or other acceptable reference to enable correlation of the certificate with the pipe. IBR / CCE / TAC approval certificates / any other statutory approval certificates as required shall be furnished.



Welding procedure and welder performance qualifications shall be carried out. Mechanical and chemical tests shall be carried out as per code. Spot radiography check shall be carried out for all butt welds. D.P.T shall be carried out for all root run welds. Segmented flanges exceeding 30 mm thickness shall be stress relieved. Tensile test, eddy current test, bend test, flattening test and dimensional checks as per applicable code shall be carried out.

All rubber lining is to be subjected to the following tests as per IS-4682 Part I:

- a) Adhesion test.
- b) Tests to check resistance to bleeding.
- c) Measurement of thickness of lining.
- d) Shore hardness test.
- e) Spark test at High voltage 5 KV / mm of thickness.

Galvanizing shall be carried out as per IS-4736 / IS-2629 and tested as per IS-2633 / BS- 729. The test shall include weight of coating, uniformity of thickness and adhesion test.

All pipes and fittings shall be subjected to hydraulic tests as per applicable code / standard. When rubber lined, hydraulic tests shall be carried out before and after rubber lining.

Buried pipes where wrapping and coating is done, material for wrapping and coating shall be tested as per applicable code. Procedure for wrapping and coating and its testing shall be submitted for approval by Purchaser. Entire wrapping and coating shall be checked for thickness and Holiday test. Peel test shall be done to ensure proper bonding of coating to surface.

5.01.02

Site Test

Hydraulic tests of the piping system at 1.5 times the design pressure or twice the working pressure whichever is higher shall be carried out for a period of minimum 30 minutes. However, if the Code / standard of supplied piping specifies more stringent requirements than the above criteria, then the hydraulic tests shall be conducted as per the applicable piping code / standard.

Pneumatic tests shall be carried out for all pressure piping that shall not be subjected to water filling.

The Bidder shall make all temporary closures/connections as required for hydrostatic/pneumatic testing and clean/remove the same after successful completion of the test.

The procedure for hydro test and pneumatic test shall be submitted by the Bidder for review and approval by Purchaser.



All tests as indicated in FQP approved

by Purchaser shall also be carried out.

5.02.00 Tests & Inspection for Valves / Gates / Strainers

5.02.01 Shop Tests

Chemical composition of all material, castings, forgings, etc. shall be tested for various components of the valves, gates, strainers and test certificates shall be submitted for approval by Purchaser.

Mechanical tests including optional tests if any shall be performed as per the applicable code / standard and the test certificates for the same shall be submitted for approval by Purchaser. The performance requirements of the valves shall also be tested as per the applicable code / standard.

Elastomer wherever coated or lined for the valves shall be tested for the corrosion resistance against the medium for which those are selected as per applicable code / standard and the test certificates shall be furnished for approval by Purchaser.

Rubber lining on Valves / Gates / Strainers / Resin Traps shall be checked in accordance with IS-4682 Part I including Spark Testing at high voltage (5 KV/mm of thickness).

All the valves shall be hydraulically tested for the body, seat, back seat and all valves shall be pneumatically tested for seat as per the applicable code / standard to which these are designed irrespective of the working pressure for which valves are selected.

Wherever specifically required, pressure drop across each type and each size of the valve at various flows shall be conducted, and test reports shall be submitted for approval by Purchaser. Type test report for this test (if already carried out by the manufacturer) may be submitted to fulfill this requirement.

Gates shall be tested against leakage and strength as required in the code / standard.

Strainer shall be hydraulically tested its strength and the pressure drop across the strainer assembly shall be verified at design flow for clean condition.

5.02.02 Site Tests

All valves, gates, resin traps, strainers and other fittings after erection at site shall be tested to hydraulic test pressure of two times the operating pressure or 1.5 times the maximum allowable pressure whichever is higher for a period of 120 minutes.

All valves / gates (Manual / Automatic) shall be operated throughout 100% of the travel manually and as well as from control panel and these should function without any trouble whatsoever.



ANNEXURE-I

SPECIFICATION OF PIPES FOR DIFFERENT SERVICES

| | A | | B | | C | D |
|-----------------------------|--|----------------------|--|----------------------|--|--|
| Services | 1. Clarified Water piping | | 1. Drinking/ Potable Water Supply, piping (Clarified water, chlorinated) | | 1. Demineralised Water, DMCW piping, Service and Instrument Air Piping less than and equal to 50 NB | 1. Demineralised Water, 2. DMCW piping, Service and Instrument air piping for sizes equal to greater than 65 NB |
| 1.00.00 Material of Pipe | Carbon Steel IS-1239 Heavy Grade upto 150 NB and IS-3589 for sizes above 150 NB with minimum pipe thickness of 6 mm. | | Carbon Steel as per IS-1239 Heavy Grade for sizes upto 150 NB and IS-3589 for sizes above 150 NB with minimum pipe thickness of 6 mm. The pipes shall be galvanized as per IS-4736 | | Stainless Steel as per ASTM A-312 Gr. 304. Thickness- as per schedule 40S, ANSI B36.19 | Stainless Steel as per ASTM A-312 Gr. 304. Thickness- as per schedule 10S, as per ANSI B36.19 |
| 2.00.00 Construction | ERW / Seamless | | ERW / Seamless | | Seamless | ERW |
| 3.00.00 Joints | Slip-on Flange and butt weld for size 65 NB and above and Socket weld joint for size 50 NB and below. | | Screwed flange for sizes 65 NB and above and screwed for size 50 NB and below. Pipe to pipe joint shall be with union as per IS:1239, Part-II. | | Socket welded for size 50 NB and below | Slip-on flange and butt weld joint. |
| 4.00.00 Fittings | Pipe Sizes > = 65 NB | Pipe Sizes < = 50 NB | Pipe Sizes > = 65 NB | Pipe Sizes < = 50 NB | | |





WBPDCCL

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

| | A | | B | | C | D |
|-------------------------|---|---|---|--|--|--|
| Services | 1. Clarified Water piping | | 1. Drinking/ Potable Water Supply, piping (Clarified water, chlorinated) | | 1. Demineralised Water, DMCW piping, Service and Instrument Air Piping less than and equal to 50 NB | 1. Demineralised Water, 2. DMCW piping, Service and Instrument air piping for sizes equal to greater than 65 NB |
| 4.01.00 Materials | ASTM-A-234 Gr. WPB | ASTM-A-105 | ASTM-A-234 Gr. WPB galvanized as per IS-4736 | ASTM-A-105 galvanised as per IS-4736 | ASTM-A-182 F304 | ASTM-A-351-CF8 or ASTM-A-403 WP304 |
| 4.02.00 Construction | Welded/ Seamless | Forged | Welded/ Seamless | Forged | Forged | Welded/Seamless |
| 4.03.00 Standard | ANSI-B-16.9 for Butt welding fittings and fabricated fitting AWWA-C- 208 | ANSI-B-16.11 or IS:1239, Part-II | ANSI-B-16.9 | ANSI-B-16.11 or IS:1239, Part-II | ANSI-B-16.11 | ANSI-B-16.9 |
| 4.04.00 End details | Pipe size >=65 NB Bevel ended as per ANSI- | Pipe size <=50 NB Socket welded as per ANSI-B- | Pipe size >=65 NB Screwed Flanged | Sizes <=50 NB Screwed socketed as per ANSI-B-16.11. | Socket welded as per ANSI-B-16.11 | Bevel ended as per ANSI- B-16.25 |



Development Consultants Pvt. Ltd.

Page 16 of 21

**Volume: II-J1
Section: VI
Low Pressure Piping, Valves**



| | A | | B | | C | D |
|---|---|-------|--|--|---|--|
| Services | 1. Clarified Water piping | | 1. Drinking/ Potable Water Supply, piping (Clarified water, chlorinated) | | 1. Demineralised Water, DMCW piping, Service and Instrument Air Piping less than and equal to 50 NB | 1. Demineralised Water, 2. DMCW piping, Service and Instrument air piping for sizes equal to greater than 65 NB |
| | B-16.25 | 16.11 | | | | |
| 5.00.00 Flanges | 150 lb (min) class as per ANSI-B-16.5 complete with nuts, bolts and gaskets | | As per ANSI-B-16.5 pressure class 150lbs (min) - galvanised-complete with nuts, bolts and gaskets. | | As per ANSI-B-16.5 pressure class 150lb (min) complete with nuts, bolts and gaskets. Material as per class 4.01.00. | 150lb (min) class, flat face, as per ANSI-B-16.5 complete with nuts, bolts and gaskets. |
| Pipes which fall under IS:1239 shall be hydrostatically tested according to the said code, for others refer Vol.: II-A. | | | | | | |





ANNEXURE-II

SERVICES OF VARIOUS CATEGORIES OF VALVES

| Valve Classification | | Service | |
|----------------------|--|--|--|
| A. | Cast iron body Gate/Globe/Check Valve | i) Service Water ii) Clarified Water iii) Drinking/ Potable Water | For sizes 65 NB and above. |
| B. | Stainless steel body/ Gate/Globe /Check/Ball Valve | i) For Demineralised water ii) Service and Instrument Air iii) Inhibited Demineralised Water | For all sizes For all sizes. Ball valves to be used in air line. For all sizes |
| C. | Steel Body valves | i) Service Water ii) Clarified Water iii) Drinking/ Potable Water | For sizes less than and equal to 50 NB |
| D. | Cast Iron body butterfly valve | i) Service Water ii) Clarified Water iii) Filtered Water | For butterfly valve specification refer Annexure II, Sec.V of Vol. II-J1. |



ANNEXURE-III

SPECIFICATION OF VALVES

| | | A. Cast Iron Body Gate/ Globe/Check Valve | B. Stainless steel Body Gate/Globe/Check/Ball Valve | C. Steel Body Gate/ Globe/Check Valve/ Ball Valve |
|---------|---------------------------|--|---|---|
| 1.00.00 | Valve Classification Code | CIGC | SSGC | STGC |
| 2.00.00 | Basic Design Code | | | |
| | a) Gate | a) i) IS 780 for 50 mm - 300 mm NB ii) IS2906 for 350 mm NB and above or as per MSS-SP-70 | a, b, c) ANSI-B-16.34 | i) API 600 for 50mm ii) API 602 for size |
| | b) Globe | b) MSS - SP - 85 | | b) BS-1873/ANSI-B-16.34 |
| | c) Check | c) IS-5312/MSS - SP -71 | | c) BS-1868/ANSI B16.34 |
| | d) Ball | | d) BS-5351 | |
| 3.00.00 | Pressure Class | To be suitably chosen considering the pressure requirement. Refer Clause No. 4.01.08 in this regard. | | |
| 4.00.00 | Construction | Cast body and bonnet / cover | Forged body up to 50 NB | Forged body up to 50 NB and |





| | | A. Cast Iron Body Gate/ Globe/Check Valve | B. Stainless steel Body Gate/Globe/Check/Ball Valve | C. Steel Body Gate/ Globe/Check Valve/ Ball Valve |
|---------|----------------------|---|--|---|
| 5.00.00 | Material | | and Cast body above that | Cast body above that |
| 5.01.00 | Body & Bonnet/ cover | IS 210 Gr. FG 260 or ASTM A216 Class B. | ASTM-A-182 F304 for Ball Valves: A351 CF8M for cast body, A 182 F304 for forged body. | ASTM-A-216 Gr. WCB for cast body & ASTM-A-105 for forged body |
| 5.02.00 | Trim / Disc. | IS-210 Gr. FG 260 or ASTM A216 Class B. | ASTM-A-182 F304 for Gate, Globe, Check valves and 351CF8M for Ball valves. For DKW system : ASTM-A-182 F6A (min. 250 HB) | 13% Cr Steel as per ASTM-A-182 Gr. F6 heat treated and hardened (min 250 NB) for cast body and ASTM-A-105 Hard faced with Stellite (min 350 HB) for forged body |
| 5.03.00 | Seating surface | 13% Cr steel as per IS 1570 | For Ball valves PTFE seats and seals. | 13% Cr. Steel as per ASTM-A-182 Gr. F6 |
| 6.00.00 | End Preparation | Socket welded for size equal to and below 50 NB and flanged with counter flanges for 65 NB and above. | | |





WBPDCCL

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

| | | A. Cast Iron Body Gate/ Globe/Check Valve | B. Stainless steel Body Gate/Globe/Check/Ball Valve | C. Steel Body Gate/ Globe/Check Ball Valve |
|---------|----------|--|---|--|
| 7.00.00 | Testing | | | |
| | a) Gate | i) As per IS - 780 for 50 mm - 300 mm NB ii) IS-2906 for sizes equal to and above 350 mm NB | As per ANSI B-16.34 | API-598 |
| | b) Globe | Hydrostatic Test as per MSS-SP-85 | | BS-1873 |
| | c) Check | IS-5312/MSS-SP-71 | | BS--1868 |



Development Consultants Pvt. Ltd.

Page 21 of 21

**Volume: II-J1
Section: VI
Low Pressure Piping, Valves**



WBPDCL

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

**VOLUME : IIIG
SCHEDULE-IIIG/2
VENTILATION SYSTEM**



Development Consultants Pvt. Ltd.

**Volume : IIIG
Schedule : IIIG/2
Ventilation System**



This pro-forma shall be filled for each of the equipment included in ventilation system.

1.00.00 CENTRIFUGAL FAN (For each fan)

1. Manufacturer :
2. Model No. :
3. Type :
4. Number quoted :
5. Capacity (M³ / Hr.) :
6. Specific weight of air at temperature :
considered (Kg / M³) :
7. Rated speed in R.P.M. :
8. Total head at above speed (mm WG) :
9. Static head at rated speed (mm WG):
10. Critical speed of fan and shaft (RPM) :
11. Fan power at rated speed (BKW) :
12. Fan total efficiency at rated speed (%) :
13. Wheel diameter (mm) :
14. Overall Wheel width (mm) :
15. Outlet velocity (M / Sec) :
16. Material used in wheel and
its thickness :
17. Material used in shaft :
18. Type of bearing :
19. Type of fan drive :
20. Drive manufacturer :
21. Number of belts :
22. Size of belts :





- 23. Vibration Isolator Manufacturer :
 - 24. Vibration Isolator size and No. :
 - 25. Outlet damper size :
 - 26. Outlet damper type :
 - 27. Material and thickness of louver and casing :
 - 28. Inlet damper type :
 - 29. Inlet damper size :
 - 30. Material and thickness of plate used in the casing and flap on the damper :
 - 31. Rated volt of motor :
 - 32. Rated KW of motor offered :
 - 33. Type of insulation :
 - 34. Motor ambient temperature (oC) :
 - 35. Type of enclosure :
 - 36. Overall dimension including fan & motor :
 - 37. Painting detail :
- 2.00.00 AXIAL FLOW FANS (For each Fan)**
- 1. Manufacturer :
 - 2. Model No.:
 - 3. Type :
 - 4. Number quoted :
 - 5. Specific weight of air at temperature considered (Kg / M3) :
 - 6. Capacity (M3 / Hr.) :
 - 7. Static head at rated speed (mm WG):





- 8. Total head at rated speed (mm WG) :
- 9. Rated speed (RPM) :
- 10. Critical speed of fan (RPM) :
- 11. Fan power at rated speed (BKW) :
- 12. Fan efficiency at rated speed (%) :
- 13. Wheel diameter (mm) :
- 14. No. of blades in wheel :
- 15. Outlet velocity in (M / Sec) :
- 16. Material used in fan wheel :
- 17. Material in other parts :
- 18. Type of fan bearing :
- 19. Type of drive :
- 20. Rated volt of motor :
- 21. KW of motor offered :
- 22. Type of insulation :
- 23. Motor ambient temperature (oC) :
- 24. Type of enclosure :

3.00.00 AIR WASHER EQUIPMENT (for each unit)

- 1. Manufacturer's Name :
- 2. Model No. :
- 3. No. of such units for various areas :
- 4. Material and thickness of casing :
- 5. Pressure drop for face velocity 2.5 m/sec.

Capacity, CMH :

Saturation Efficiency (%) :

CELL DECK





Type and Material :

Depth, mm :

Face Area, M2 :

No. of Tires :

Water Flow rate, CMH :

Air Pressure drop, mm of WG :

9. WATER SPRAY NOZZLES

Nozzle size and type :

Capacity in liters / min. :

Pressure drop in mm of WG :

Material used :

Number of nozzles for each unit :

10. WATER FLOODED STAINLESS STEEL MESH FILTER

a) Size (mesh) :

b) Filter material :

c) Filter frame material :

d) Velocity across filter :

e) Pressure drop (clean) :

f) Pressure drop (dirty) :

g) No. of layers :

h) Efficiency :

11. MOISTURE ELIMINATOR

a) Thickness and material used for baffle plates :

b) Spacing of baffle plates :

c) Bend angles of baffle plates with :





respect of direction of air flow

- d) Whether baffle plates are machine pressed :

12. CASING

CONSTRUCTION

- a) Size :
- b) Material :
- c) Thickness :
- d) Whether allotted space is adequate :

13. Water Sump

- a) Size :
- b) Material :
- c) Thickness :

4.00.00 UNITARY AIR FILTRATION UNIT

- 1. Manufacturer :
- 2. Air quantity :
- 3. Type and Model No. :
- 4. Pressure drop :
- 5. No. Quoted :
- 6. Total weight of the unit :

7. WATER FLOODED STAINLESS STEEL MESH FILTER

- a) Size (mesh) :
- b) Filter material :
- c) Filter frame material :
- d) Velocity across filter :
- e) Pressure drop (clean) :





- f) Pressure drop (dirty) :
- g) No. of layers :
- h) Efficiency :

8. MOISTURE ELIMINATOR

- a) Thickness and material used for baffle plates :
- b) Spacing of baffle plates :
- c) Bend angles of baffle plates with respect of direction of air flow :
- d) Whether baffle plates are machine pressed. :

9. WATER SPRAY NOZZLES

- a) Manufacturer :
- b) Nozzle size and type :
- c) Capacity in liters / min. :
- d) Pressure drop in mm of WG :
- e) Material used :
- f) Number of nozzles for each unit :

10. CASING

CONSTRUCTION

- a) Size :
- b) Material :
- c) Thickness :
- d) Whether allotted space is adequate :

11. Water Sump

- a) Size :
- b) Material :





c) Thickness :

5.00.00

CENTRIFUGAL PUMP

(Furnish separate sheets for each type of Pump sets)

1. Manufacturer :
2. Model No. :
3. Total nos. required :
4. Type :
5. PERFORMANCE
 - a. Rated capacity, litres / min. :
 - b. Efficiency at rated capacity :
 - c. Total head at rated capacity, M water column :
 - d. Pump input H.P. :
 - e. Pump speed, RPM :
 - f. Permissible suction lift, M water column :
 - g. Design conform to relevant IS / BS Standards : Yes/No
(Mention the standard)
6. CONSTRUCTION
 - a) No. of stages :
 - b) Pump Bearing : Ball / Roller / Journal
 - c) Connection sizes : Inlet :
Outlet :
 - d) Material of construction
Casing :
Impeller wearing ring :





- Impeller :
- Casing wearing ring :
- Shaft :
- Shaft sleeve :
- Stuffing box :
- Stuffing box housing :
- Sealing :

7. ACCESSORIES SUPPLIED

- Pump motor base frame :
- Pressure gauges :
- Coupling guard :
- Suction / Delivery :
- Pump bearings life
(Minimum forty thousand hours) :

6.00.00 DUCT WORK

- 1. Maximum air velocity M / Second
 - a) Main supply ducts :
 - b) Branch supply ducts :
- 2. Layout of ducting location and number of air grilles and diffusers etc. conform to the arrangement shown in the drawing : Yes / No
- 3. Ducting to be fabricated at site : Yes / No
- 4. Construction of ducts conforms to IS-655 ? : Yes / No
(In case there is any contradiction between this specification and IS-655, this specification shall overrule)
- 5. Type of duct seal filter material :
- 6. Duct supports provided ? : Yes / No





- a) Spacing center to center meters :
 - b) Type of construction :
 - c) Material of construction :
 - d) Fixing arrangement with reinforced Concrete work conforms to the requirement of specification :
7. Large size duct bends provided with straightener vanes ?
8. Flexible connection between duct work and fan units
- a) Material :
 - b) Thickness, mm :
9. SUPPLY AIR DIFFUSERS / GRILLES
- a) Outlet air velocity, Meters / Second :
 - b) Size, mm dia :
 - c) Type :
 - d) Type of damper :
 - e) MATERIAL OF CONSTRUCTION
 - ❖ Cône :
 - ❖ Internals :
 - ❖ Damper Louvres :
 - f) Type and thickness of finish painting :

7.00.00 BACK DRAFT DAMPER

1. Material of construction
- a) Frame :
 - b) Louver :
2. Thickness :
- a) Frame :
 - b) Louvre :





- c) Is frame hot dip galvanized or epoxy painted :

8.00.00 FIRE DAMPER (Motor Operated or fusible link type)

1. Material of construction

- a) Frame :
- b) Louver :

2. Thickness :

- a) Frame :
- b) Louvre :
- c) Is frame hot dip galvanized or epoxy painted :

9.00.00 MISCELLANEOUS INSTRUMENTS

9.01.00. Humidistat :

- a) Name of manufacturer :
- b) Model number :
- c) Number furnished :
- d) Type :

9.02.00 Pressure indicators :

9.02.01 Name of manufacturer :

9.02.02 Type :

9.02.03 Dial size, mm :





**TECHNICAL PARTICULARS
(ELECTRICAL)**

(To be filled up by the Bidder)

| | | |
|----------------|---|---|
| 1.00.00 | A.C. MOTORS | |
| 1.01.00 | General | |
| 1.01.01 | Application | : |
| 1.01.02 | Quantity | : |
| 1.01.03 | Make | : |
| 1.01.04 | Frame Size | : |
| 1.01.05 | Applicable Standard | : |
| 1.02.00 | Type And Rating | |
| 1.02.01 | Type of Motor | : |
| 1.02.02 | Service | : |
| 1.02.03 | Duty Cycle/Designation | : |
| 1.02.04 | Rated Continuous output | : |
| | At 40 °C ambient KW | : |
| | At 45 °C ambient KW | : |
| | At 50 °C ambient KW | : |
| 1.02.05 | Rated Speed r.p.m. | : |
| 1.02.06 | Rated Voltage & % variation | : |
| 1.02.07 | Rated Frequency & % variation | : |
| 1.02.08 | Full load current | : |
| 1.02.09 | No load current | : |
| 1.02.10 | Rated Power Factor | : |
| 1.02.11 | Efficiency at rated voltage and Frequency | |





- a) Full load % :
- b) 3/4 load % :
- c) 1/2 load % :

- 1.03.00 Performance
- 1.03.01 Method of starting :
- 1.03.02 Starting time at : 80%V 100%V 110%V
 - a) With load Sec. :
 - b) Without load (driven equipment coupled) Sec. :
- 1.03.03 Safe stall time at : 80%V 100%V 110%V
 - a) Hot condition Sec. :
 - b) Cold condition Sec. :
- 1.04.00 Construction
- 1.04.01 Degree of protection Enclosure :
- 1.04.02 Motor Terminal Box
 - a) Suitable for cable size :
 - b) Cable glands and lugs finished :
- 2.00.00 LOCAL PUSH BUTTON STATION**
- 2.01.00 Make :
- 2.02.00 Type :
- 2.03.00 Enclosure :
- 2.04.00 Degree of Protection :
- 2.05.00 Lockout switches enclosure furnished with :
 - a) Inscription plate :
 - b) Knockout for cable/circuit entry :
- 2.06.00 Contacts Of Each Push Button





- a) Number furnished :
 - b) Current rating :
 - c) Make & Continuous :
 - d) Break (Inductive) :
- 2.06.01 Stop Push Button having provision of position locking in lockout :
- 3.00.00 LOCALSTARTER CUM CONTROL PANEL (LSCP)
/ LOCAL STARTER PANEL (LSP)**
- 3.01.00 General Constructional Details**
- 3.01.01 Material of Construction :
 - 3.01.02 Thickness (Minimum) :
 - 3.01.03 Colour :
 - 3.01.04 Wiring :
 - 3.01.05 Construction :
 - 3.01.06 Door :
 - 3.01.07 Internal Illumination :
 - 3.01.08 Enclosure :
 - 3.01.09 Wiring Standard :
 - 3.01.10 Anti vibration mounting :
 - 3.01.11 Earthing :
 - 3.01.12 Cable Entry :
- 3.02.00 Enclosure**
- 3.02.01 Degree of Protection
 - 3.02.02 Dimension of various Panels : (L x D x H) mm
 - a) :
 - b) :
 - c) :





d)

- 3.03.00 **All meters, lamps etc. flush mounted type ?**
- 3.04.00 **Make of LSCP / LSP**
- 3.05.00 **Switch**
 - 3.05.01 Make :
 - 3.05.02 Type :
- 3.06.00 **Fuse** :
- 3.06.01 Rupturing capacity : Ka rms (sym)
- 3.07.00 **Contactors**
 - 3.07.01 Make :
 - 3.07.02 Type :
- 3.08.00 **Push Button**
 - 3.08.01 Make :
 - 3.08.02 Type :
- 3.09.00 **Lamps** :
- 3.09.01 Make :
- 3.09.02 Type :
- 3.10.00 **Meter**
 - 3.10.01 Make :
 - 3.10.02 Size :
 - 3.10.03 Accuracy class :
- 3.11.00 **Meter Selector Switch**
 - 3.11.01 Make :
 - 3.11.02 Type :
- 3.12.00 **Current Transformer**





- 3.12.01 Make :
- 3.13.00 **Secondary Wiring**
- 3.13.01 Type of Insulation :
- 3.13.02 Voltage Grade :
- 3.13.03 Conductor Material :
- 3.13.04 Current size (minimum)
 - a) Potential Circuit : Sq. mm
 - b) Current & Control Circuit : Sq. mm
- 3.14.00 **Terminal Block**
- 3.14.01 Make :
- 3.14.02 20% spare terminals furnished :
- 3.15.00 **Cable Termination**
- 3.15.01 Cable entry provision from top & bottom? :
- 3.16.00 **Ground Bus**
- 3.16.01 Ground bus furnished? :
- 3.16.02 Material :
- 3.16.03 Size Size :
- 3.17.00 **Name Plate**
- 3.17.01 Material :
- 3.18.00 **Space Heater/Plug Socket**
- 3.18.01 Cubicle Heater
 - Thermostat controlled : Yes/No.
- 3.18.02. Plug Socket
 - Make :





- 3.18.03 Provision made for motor heater supply :
- 3.18.04 Cubicle/Motor heater provided with individual switch fuse units :
- 3.19.00 **Tropical Protection**
 - a) Any special treatment for tropical protection :
 - b) Screens are of corrosion resistant materials :
- 3.20.00 **Painting**
 - Finish
 - a) Inside :
 - b) Outside :
- 3.21.00 **Test**
- 3.21.01 Routine tests to be performed :
 - a)
 - b)
 - c)
 - d)
- 3.22.00 **Typical drawings/data furnished**
- 3.22.01 General arrangement :
- 3.22.02 Foundation plan :
- 4.00.00 ANNUNCIATION SYSTEM**
- 4.01.01 Type :
- 4.01.02 Architecture :
- 4.01.03 Type of contact :
- 4.01.04 Available Power Supply :





- 4.01.05 Indication on Card :
- 4.01.06 Input Isolation :
- 4.01.07 Contact Interrogation Voltage :
- 4.01.08 Lamp Per-facia :
- 4.01.09 Changing of lamp :
- 4.01.10 Size of Facia :
- 4.01.11 Inscription type :
- 4.01.12 Cabling between Facia & Control Cabinet :
- 4.01.13 Audible Alarm :
- 4.01.14 Mounting of Audible Alarm :
- 4.01.15 Tone Generator :
- 4.01.16 Sound Intensity :
- 4.01.17 Preferred Sequence :
- 4.01.18 Make :
- 4.01.19 Model No. :

- | 5.00.00 | CABLES | L. V. Power
Cables | CONTROL
Cables |
|----------------|--------------------------------------|-------------------------------|---------------------------|
| 5.01.00 | Make | : | |
| 5.02.00 | Type | : | |
| 5.03.00 | Applicable Standard | : | |
| 5.04.00 | Voltage Grade | : | |
| 5.05.00 | Suitable For System With | | |
| | a) Service Voltage | : | |
| | b) Neutral Earthing | : | |
| 5.06.00 | Maximum Conductor Temperature | | |
| | a) Continuous (°C) | : | |
| | b) Short Time (°C) | : | |





- 5.07.00 Conductor**
- a) Material :
 - b) Size : Sq. mm.
 - c) No. of Diameter of wire in each conductor : No./ mm
- 5.08.00 Shielding On Conductor**
- a) Material :
 - b) Type :
 - c) Thickness : mm
- 5.09.00 Insulation**
- a) Material :
 - b) Type :
 - c) Thickness : mm
- 5.10.00 Shielding On Insulation**
- a) Material :
 - b) Type :
 - c) Thickness : mm
- 5.11.00 Inner Sheath**
- a) Material :
 - b) Type :
 - c) Thickness : mm
 - d) Extruded : Yes / No.
 - e) Approx. Outside dia. over sheath : mm
- 5.12.00 Overall Sheath**
- a) Material :
 - b) Type :





- c) Thickness :
- 5.13.00 Approximate overall diameter : (mm)
- 5.14.00 Standard drum length with tolerance (M) :
- 5.15.00 Net Weight of Cable :
- 5.16.00 Continuous Current Rating for Standard IS Condition laid Direct
 - a) In Ground :
 - b) In Duct :
 - c) In Air :
- 5.17.00 Short Circuit Current for 1 Sec. (KA) :

NOTE : These data shall be furnished for each size of cable.

6.00.00 CABLE SYSTEM

6.01.00 Cable Trays

- 6.01.01 Make :
- 6.01.02 Type/Material :
- 6.01.03 Load Bearing Capacity between two supported points : KG
- 6.01.04 Cable Trays are furnished complete with all accessories? :
- 6.01.05 i) Cable trays & accessories properly galvanised?:
 - ii) Thickness of Galvanised : micron
- 6.01.06 Standard width of cable trays furnished : mm
- 6.01.07 Reference Standard :
- 6.01.08 Thickness of sheet of cable tray and covers :
- 6.02.00 **Conduits**
- 6.02.01 Make :
- 6.02.02 Type/Material :





| | | |
|---------|---------------------------------------|---|
| 6.02.03 | Reference Standard | : |
| 6.02.04 | Gauge : | |
| | up to 25 mm dia. | : |
| | above 25 mm dia. | : |
| 6.03.00 | Cable Lug | |
| 6.03.01 | Make | : |
| 6.03.02 | Type/Material | : |
| 6.03.03 | Sizes furnished as specified | : |
| 6.03.04 | Reference Standard | : |
| 6.03.05 | Whether drawings/catalogues enclosed? | : |
| 6.04.00 | Ferrules | |
| 6.04.01 | Make | : |
| 6.04.02 | Type/Material | : |
| 6.04.03 | Colour | : |
| 6.04.04 | Interlocked type? | : |
| 6.04.05 | Reference Standard | : |
| 6.05.00 | Cable Clamps | |
| 6.05.01 | Make | : |
| 6.05.02 | Type/material | : |
| 6.06.00 | Fire Sealing Compound | |
| 6.06.01 | Make | : |
| 6.06.02 | Type | : |
| 6.07.00 | Grounding | |
| 6.07.01 | Material | : |
| 6.07.02 | Size | : |





**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
PROJECT SPECIFIC GENERAL
REQUIREMENTS**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

SUB-SECTION : C 2B

REV. 00

DATE: MARCH 2022

**SECTION: I
SUB-SECTION: C 2B
CUSTOMER SPECIFICATIONS
PROJECT SPECIFIC GENERAL REQUIREMENTS**



WBPDCL

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

**SECTION-V
GENERAL TECHNICAL REQUIREMENTS**



Development Consultants Pvt. Ltd.

**Volume : II-A
Section : V
General Technical Requirements**



WBPDC

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

CONTENTS

| CLAUSE NO. | DESCRIPTION | PAGE NO. |
|--------------------|---|-----------------|
| 1.00.00 | CODES AND STANDARDS | 1 |
| 2.00.00 | RESPONSIBILITY FOR DESIGN | 1 |
| 3.00.00 | NAME PLATES (RATING PLATES) | 2 |
| 4.00.00 | SAFETY AND SECURITY | 2 |
| 5.00.00 | GUARDS | 3 |
| 6.00.00 | LOCATION AND LAYOUT REQUIREMENTS | 3 |
| 7.00.00 | OPERATION AND MAINTENANCE | 5 |
| 8.00.00 | MATERIALS | 5 |
| 9.00.00 | LUBRICATION | 6 |
| 10.00.00 | LUBRICANTS, SERVO FLUIDS AND CHEMICALS | 6 |
| 11.00.00 | PLANT LIFE AND MODE OF OPERATION | 7 |
| 12.00.00 | PACKAGING & MARKING | 7 |
| 13.00.00 | PROTECTION | 7 |
| 14.00.00 | PAINTING | 8 |
| 15.00.00 | COLOUR CO-ORDINATION AND FINISH | 12 |
| 16.00.00 | ENVIRONMENT PROTECTION AND NOISE LEVEL REQUIREMENT | 13 |
| 17.00.00 | INSPECTION AND TESTING | 14 |
| 18.00.00 | TRAINING OF OWNER'S PERSONNEL | 16 |
| ATTACHMENTS | | |
| ANNEXURE-I | LIST OF STANDARDS FOR REFERENCE | 19 |
| ANNEXURE-II | CRITERIA FOR LAYOUT | 21 |



Development Consultants Pvt. Ltd.

**Volume : II-A
Section : V
General Technical Requirements**

**SECTION-V****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.

| SI. 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:

- a) Surface preparation profile.
- b) Catalysis ratio for two component paints.
- c) Pot life.
- d) Minimum and maximum top coating times.
- e) Type and quantity of thinners (if required)
- f) Viscosity
- g) Soundness of previous coating.
- h) 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 of 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.



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.



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/consales 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.



WBPDC

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

SECTION-VI

PROJECT MANAGEMENT AND SITE SERVICES



Development Consultants Pvt. Ltd.

**Volume : II-A
Section : VI
Project Management and Site Services**



WBPDC

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

CONTENT

| CLAUSE NO. | DESCRIPTION | PAGE NO. |
|-------------------|-----------------------------|-----------------|
| 1.00.00 | PROJECT MANAGEMENT SERVICES | 1 |
| 2.00.00 | SITE SERVICES | 9 |
| 3.00.00 | PROTECTION & CARE | 18 |
| | | |
| ANNEXURE-I | LIST OF SUB-VENDORS | |



Development Consultants Pvt. Ltd.

**Volume : II-A
Section : VI
Project Management and Site Services**



SECTION-VI

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 | 36 months from LOA |
| 3. | Synchronization | 38 months from LOA |
| 4. | Completion of Trial Operation | 42 months from LOA |
| 5. | System & Completion of all facilities as per contract and handing over | 45 months from LOA After rectifying all jobs as identified in the Punch List to the satisfaction of the Owner. |
| 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.



“The Vendor list as included is not exhaustive and prepared from prior experience of WBPDCCL. In case of items not covered in the list or if the bidder seeks additional vendor on the items already covered in the list, the same should be done with proper written request for approval from WBPDCCL enclosing the vendor credentials. Maximum effort should be exercised to include only such proven vendors who are already registered in the Bidder’s Vendor directory and the bidder has prior experience of supply items from such reputed vendors.”

| Sl. No. | Item Description | Vendor Name | |
|---------|---|-------------|-----------------------------------|
| 1 | SEVERE SERVICE CONTROL VALVE. (PRDS & SH/RH ATTEMPERATION APPLICATION) | 1 | CONTROL COMPONENTS INC |
| | | 2 | DRESSER VALVE INDIA PVT.LTD. |
| 2. | BFP RECIRCULATION CONTROL VALVE | 1 | CONTROL COMPONENTS INC |
| | | 2 | DRESSER VALVE INDIA PVT.LTD. |
| 3. | NORMAL SERVICE CONTROL VALVE | 1 | MIL CONTROLS LTD. |
| | | 2 | FISHER SANMAR LTD. |
| | | 3 | DRESSER VALVE INDIA PVT.LTD. |
| | | 4 | CONTROL COMPONENTS INC |
| 4. | OIL TRIP VALVES (FUEL OIL SYSTEM) | 1 | MIL CONTROLS LTD. |
| | | 2 | KHUME ARMATUREN GMBH |
| | | 3 | DRESSER VALVE INDIA PVT. LTD. |
| 5. | STEEL GATE / GLOBE / NR VALVES | 1 | WEIR B.D.K VALVES INDIA PVT. LTD. |
| | | 2 | KIRLOSKAR BROTHERS LTD. |
| | | 3 | LEADER VALVES LTD. |
| | | 4 | KSB VALVES |
| | | 5 | FOURESS ENGG.INDIA LTD. |
| | | 6 | VAG VALVES |
| | | 7 | AUDCO INDIA |
| | | 8 | DEWARANCE |
| 6. | BALL VALVES | 1 | FLOW CHEM INDUSTRIES |
| | | 2 | FISHER SANMAR LIMITED |
| | | 3 | KIRLOSKAR BROS. LTD. |
| | | 4 | LEADER VALVES LTD. |
| | | 5 | KSB VALVES |
| | | 6 | WEIR B.D.K VALVES INDIA PVT. LTD. |
| | | 7 | VAG VALVES |
| 7. | CAST IRON GATE /GLOBE/ NR/ SAFETY RELIEF VALVES | 1 | H.SARKER & COMPANY |
| | | 2 | G.M.DALUI & SONS PVT.LTD. |
| | | 3 | KIRLOSKAR BROS. LTD. |



| Sl. No. | Item Description | Vendor Name | |
|---------|--|-------------|--|
| | (CENTRIFUGAL)FOR TDBFP | 2 | KIRLOSKAR EBARA, KIRLOSKARWADI |
| | | 3 | SULZER, MUMBAI. |
| 27. | LUBE OIL PUMPS (SCREW TYPE) FOR TDBFP | 1 | ALLWEILER, GERMANY |
| | | 2 | IMO PUMP, USA |
| | | 3 | TUSHACO, DAMAN |
| | | 4 | LEISTRITZ (EMPIRE), GERMANY |
| 28. | JACKING OIL PUMP TDBFP | 1 | TUSHACO, (DELTA CORP) |
| | | 2 | HAGULLAND DENSION |
| 29. | SCANNER AIR FAN | 1 | M/S.C.DOCTOR & CO.PVT.LTD. |
| | | 2 | M/S PATELS AIRFLOW LTD. |
| | | 3 | M/S.AIR CONTROL & CHEMICAL ENGG. CO.LTD. |
| 30. | FLOW ELEMENTS | 1 | MICRO PRECISION PRODUCTS |
| | | 2 | M/S ESPL KOLKATA |
| | | 3 | IL PALGHAT |
| 31. | OIL PURIFICATION UNIT (OIL CENTRIFUGE)/PORTABLE OIL PURIFIERS | 1 | PENNWALT LIMITED, INDIA |
| | | 2 | ALFA LAVAL LIMITED, INDIA |
| | | 3 | SERVIZE INDUSTRIAL, ITALY |
| 32. | ELECTRICAL HOIST | 1 | AVON CRANES PVT.LTD. |
| | | 2 | LIFTING EQUIPMENTS & ACCESSORIES |
| | | 3 | REVA INDUSTRIES LTD |
| | | 4 | CONSOLIDATED HOIST PVT LTD |
| | | 5 | TUOBRO FURGUSON(INDIA)PVT.LTD |
| | | 6 | HERCULES HOISTS LTD. |
| | | 7 | DYNAMECH CRANES (P) LTD. |
| | | 8 | UNIVERSAL HOIST – O- FABRIK |
| | | 9 | ARMSEL MHE PVT.LTD |
| 33 | CHAIN PULLEY BLOCK | 1 | ARMSEL MHE PVT LTD |
| | | 2 | LIFTING EQUIPMENT & ACCESPROES |
| | | 3 | UNIVERSAL HOIS –O-FABRIK |
| | | 4 | HERCULES HOISTS LTD. |
| | | 5 | TUOBRO FURGUSON(INDIA)PVT.LTD |
| 34 | DOUBLE GIRDER EOT CRANE ABOVE 50T TO 150T (TG/GT HALL & OTHER AREAS) | 1 | HEAVY ENGG. CORPORATION LTD. |
| | | 2 | MUKAND LIMITED, |
| | | 3 | THE TATA IRON & STEEL CO.LTD |
| | | 4 | UNIQUE INDUSTRIAL HANDLERS PVT.LTD |
| | | 5 | WMI CRANES LTD. |
| | | 6 | FURNACE & FOUNDRY EQUIPMENT |



| Sl. No. | Item Description | Vendor Name | |
|---------|---------------------------------------|-------------|-------------------------------|
| | | 4 | GE – POWER |
| | | 5 | ABB |
| 36 | TIMER | 1 | BCH |
| | | 2 | ALSTOM |
| | | 3 | L&T |
| | | 4 | SCHNEIDER |
| | | 5 | ABB |
| 37 | TERMINALS BLOCK (FIXED / DRAW OUT) | 1 | PHOENIX |
| | | 2 | CONNECT WELL |
| | | 3 | ELEMEX |
| | | 4 | WAGO |
| | | 5 | ESSEN DEINKI |
| 38 | VOLTMETER (INDICATING) | 1 | AUTOMATIC ELECTRIC |
| | | 2 | IMP |
| | | 3 | RISHABH INDUSTRIAL (L&T) |
| 39 | LT PVC CONTROL CABLES | 1 | CABLE CORPORATION OF INDIA |
| | | 2 | CORDS CABLE INDUSTRIES LTD |
| | | 3 | DELTON CABLES LTD. |
| | | 4 | KEC |
| | | 5 | CRYSTAL CABLE INDUSTRIES LTD. |
| | | 6 | KEI INDUSTRIES LTD. |
| | | 7 | NICCO CORPORATION LTD. |
| | | 8 | POLYCAB WIRES PVT.LTD |
| | | 9 | TORRENT CABLES LTD. |
| | | 10 | UNIVERSAL CABLES D. |
| | | 11 | RPG |
| 40 | LT XLPE POWER CABLES | 1 | CABLE CORPORATION OF INDIA |
| | | 2 | HINDUSTHAN VIDYUT PRODUCTS |
| | | 3 | KEC INTERNATIONAL |
| | | 4 | TORRENT CABLES LTD. |
| | | 5 | UNIVERSAL CABLES LTD. |
| | | 6 | POLYCAB WIRES PVT.LTD |
| | | 7 | KEI INDUSTRIES LTD. |
| | | 8 | NICCO |
| | | 9 | CRYSTAL CABLE INDUSTRIES LTD. |
| 41 | LT PVC POWER CABLES | 1 | CORDS CABLE INDUSTRIES LTD |
| | | 2 | CRYSTAL CABLE INDUSTRIES LTD. |
| | | 3 | HINDUSTHAN VIDYUT PRODUCTS |
| | | 4 | KEI INDUSTRIES LTD. |



| Sl. No. | Item Description | Vendor Name | |
|---------|--|-------------|--|
| | | 5 | NICCO CORPORATION LTD. |
| | | 6 | POLYCAB WIRES PVT.LTD |
| | | 7 | TORRENT CABLES LTD. |
| | | 8 | UNIVERSAL CABLES LTD. |
| | | 9 | CABLE CORPORATION OF INDIA |
| 42 | HT XLPE POWER CABLES | 1 | CABLE CORPORATION OF INDIA |
| | | 2 | KEI INDUSTRIES LTD. |
| | | 3 | HINDUSTHAN VIDYUT PRODUCTS |
| | | 4 | NICCO CORPORATION LTD. |
| | | 5 | UNIVERSAL CABLES LTD. |
| 43 | SCREENED CONTROL CABLES | 1 | DELTON CABLES LTD. |
| | | 2 | KEI INDUSTRIES LTD. |
| | | 3 | NICCO CORPORATION LTD. |
| | | 4 | POLYCAB WIRES PVT.LTD |
| | | 5 | CORDS CABLE INDUSTRIES LTD |
| | | 6 | THERMO CABLES |
| 44 | 220V DC LEAD ACID BATTERIES (TUBULAR AND PLANTE) | 1 | EXIDE INDUSTRIES LTD |
| | | 2 | HOPPECKE, GERMANY / MALAYSIA |
| 45 | NICKEL – CADMIUM BATTERY | 1 | HBL POWER SYSTEMS, HYDERABAD |
| 46 | 220V DC BATTERY CHARGER (More than 100 AH) | 1 | CHLORIDE POWER SYSTEMS & SOLUTIONS LTD |
| | | 2 | STATCON POWER LTD. |
| | | 3 | HBL POWER SYSTEMS LTD |
| 47 | 220V DC BATTERY CHARGER (Upto 100 AH) | 1 | CHHABI ELECTRICALS PVT. LTD. |
| | | 2 | AMARA RAJA POWER SYSTEMS PVT. LTD |
| | | 3 | CHLORIDE POWER SYSTEMS & SOLUTIONS LTD |
| | | 4 | STATCON POWER LTD. |
| | | 5 | HBL POWER SYSTEMS LTD |
| 48 | TRANSFORMER (DRY TYPE) | 1 | VOLTAMP |
| | | 2 | BHARAT BNLEE |
| | | 3 | AREVA |
| | | 4 | CGL |
| | | 5 | SUDHIR TRANSFORMER |
| | | 6 | BHEL |
| 49a | HT MOTORS (above 500 kW) | 1 | ABB |
| | | 2 | BHEL |
| | | 3 | SIEMENS |



| Sl. No. | Item Description | Vendor Name | |
|---------|---|-------------|---|
| 49b | HT MOTORS (upto 500 kW) | 1 | ABB |
| | | 2 | BHEL |
| | | 3 | SIEMENS |
| | | 4 | CROMPTON GREAVES |
| | | 5 | MARATHON |
| 50 | LT MOTORS | 1 | ABB |
| | | 2 | SIEMENS |
| | | 3 | CROMPTON GREAVES |
| | | 4 | KIRLOSKAR |
| | | 5 | BHARAT BIJLEE |
| | | 6 | MARATHON |
| 51 | LIGHTING SYSTEM | 1 | BAJAJ ELECTRICALS LTD. |
| | | 2 | CROMPTON GREAVES LTD. |
| | | 3 | PHILIPS INDIA LTD. |
| 52 | LIGHTING MAST, LIGHTING TOWER | 1 | CGL |
| | | 2 | BAJAJ |
| | | 3 | PHLLIPS |
| 53 | LIGHT FITTINGS | 1 | BAJAJ |
| | | 2 | PHLLIPS |
| | | 3 | CGL |
| 54 | CABLE TERMINATION & JOINTING KITS | 1 | RAYCHEM RPG LIMITED,MUMBAI |
| | | 2 | 3M ELECTRO & COMMUNICATION |
| 55 | CABLE TRAYS & ACCESSORIES | 1 | JAMNA METAL COMPANY |
| | | 2 | UNITECH FABRICATORS & ENGINEERS |
| | | 3 | PATNY SYSTEMS (P) LTD. |
| | | 4 | RATAN PROJECTS & ENGINEERING CO. PVT.LTD. |
| | | 5 | INDUSTRIAL PERFORATION (INDIA) PRIVATE LIMITED. |
| | | 6 | RABI ENGINEERING WORKS , |
| | | 7 | PREMIER POWER PRODUCTS PVT.LTD. |
| | | 8 | PARMAR METAL PVT. LTD. |
| 56 | CABLE TRAYS SUPPORT SYSTEM WELDED TYPE (HOT DIP GALVANIZED) | 1 | JAMNA METAL COMPANY |
| | | 2 | INDUSTRIAL PERFORATION (INDIA) PRIVATE LIMITED. |
| | | 3 | PATNY SYSTEMS (P) LTD. |
| | | 4 | RATAN PROJECTS & ENGINEERING CO. PVT.LTD. |
| | | 5 | RABI ENGINEERING WORKS |



| Sl. No. | Item Description | Vendor Name | |
|---------|---|-------------|---|
| | | 3 | IEC |
| 76 | MOOSE CONDUCTOR | 1 | HINDUSTAN VIDYUT PRODUCTS LTD., HARYANA |
| | | 2 | GUPTA POWER INFRASTRUCTURE LTD., BHUBANESWAR |
| | | 3 | HIREN ALUMINIUM Ltd., SILVASSA DADRA & NAGAR HAVELI |
| 77 | ALUMINIUM TUBE | 1 | HINDALCO INDUSTRIES LIMITED |
| | | 2 | JINDAL ALUMINIUM LIMITED |
| | | 3 | BALCO |
| 78 | STRUCTURE HARDWARE | 1 | DEEPAK FASTNERS LTD |
| | | 2 | NAVEEN METAL INDUSTRIES, KOLKATA |
| | | 3 | NEW INDIA ENGINEERING CORPORATION |
| 79 | LUGS | 1 | UNIVERSAL MACHINES |
| | | 2 | COMET |
| | | 3 | MAHAVEER ENGINEERING |
| | | 4 | DOWELLS |
| | | 5 | SUNIL & CO. PVT. LTD. |
| 80 | FAST BUST TRANSFER | 1 | AARTECH SOLONICS LTD, MP |
| | | 2 | ABB |
| 81 | RAIL POLE | 1 | SAIL |
| | | 2 | RINL |
| | | 3 | TATA |
| 82 | FRP JUNCTION BOXES/ JUNCTION BOXES (POWER/CONTROL), LIGHTING JB | 1 | SCHNEIDER |
| | | 2 | CONTROL DEVICE |
| | | 3 | SWITCHING CIRCUIT |
| | | 4 | JASPER ENGINEERS |
| | | 5 | BAJAJ ELECTRICALS |
| | | 6 | AJMERA |
| | | 7 | S B EIEC. EENGINEERING CORP. Ltd |
| | | 8 | PYROTECH |
| | | 9 | ENGG. CONSTRUCTION CORP. |
| | | 10 | L&T |
| 83 | LOCAL STARTER PANEL, LOCAL CONTROL PANEL, LIGHTING PANEL, ACELP, DCELP | 1 | PYROTECH |
| | | 2 | L&T |
| | | 3 | CONTROL DEVICE |
| | | 4 | SCHNEIDER |
| 84 | LIGHTING WIRE | 1 | ISI MARK |





| Sl. No. | Item Description | Vendor Name | |
|---------------|---|--------------|----------------------------|
| 85 | ACTUATOR | 1 | AUMA |
| | | 2 | LIMITORQUE |
| 86 | CABLE for ROLLED E CHAIN | 1 | IGUS |
| 87 | CABLE GLAND | 1 | SUNIL & COMPANY |
| | | 2 | ARUP ENGG. & FOUNDRY WORKS |
| | | 3 | COMMET BRASS PRODUCTS |
| | | 4 | ELECTROMAC INDUSTRIES |
| | | 5 | BALIGA LIGHTING EQPT. |
| 88 | BAY CONTROL UNIT | 1 | ALSTOM |
| | | 2 | SIEMENS |
| | | 3 | ABB |
| 89 | TRANSFORMER BUSHING | 1 | ABB |
| | | 2 | AREVA |
| | | 3 | ALSTOM |
| | | 4 | BHEL |
| 90 | EARTH LEAKAGE CB | 1 | SCHNEIDER |
| | | 2 | L&T |
| | | 3 | SIEMENS |
| | | 4 | ABB |
| 91 | EARTH LEAKAGE RELAY [ELR] ALONG WITH CBCT | 1 | AREVA |
| | | 2 | PRO'KDEVICES |
| 92 | PUSH BUTTON | 1 | BCH |
| | | 2 | L&T |
| | | 3 | SCHNEIDER |
| | | 4 | SIEMENS |
| | | 5 | TECKNIC CONTROL |
| | | 6 | GE – POWER |
| | | 7 | ABB |
| 93 | RELAYS (OTHER THAN INTERPOSING & NUMERICAL RELAYS) | 1 | ABB |
| | | 2 | AREVA |
| | | 3 | SIEMENS |
| | | 4 | GE – POWER |
| | | 5 | ALSTOM |
| 94 | ENERGY MANAGEMENT SYSTEM | 1 | SCHNEIDER |
| | | 2 | SECURE |
| | | | |
| | | | |





| Sl. No. | Item Description | Vendor Name | |
|---|--|-------------|------------------------------------|
| CONTROL & INSTRUMENTATION SYSTEM VENDORS | | | |
| 1 | DISTRIBUTED CONTROL SYSTEM | 1 | ABB |
| | | 2 | HONEYWELL |
| | | 3 | EMERSON |
| | | 4 | VALMET (FORMERLY METSO) |
| 2 | PLC (Programmable Logic Controller) | 1 | ROCKWELL AUTOMATION INDIA LTD. |
| | | 2 | GE |
| | | 3 | SCHNEIDER ELECTRIC INDIA PVT.LTD. |
| 3 | DIGITAL INDICATOR | 1 | ABB |
| | | 2 | GOSSEN / CAMILLE BAUER / METRAWATT |
| | | 3 | YOKOGAWA |
| 4 | VERTICAL MOVING COIL INDICATOR | 1 | ABB |
| | | 2 | GOSSEN |
| | | 3 | CAMILLE BAUER |
| | | 4 | METRAWATT |
| | | 5 | YOKOGAWA |
| 5 | TRANSDUCERS | 1 | SIEMENS |
| | | 2 | ABB |
| | | 3 | CAMILLEBAUER |
| | | 4 | ELSTER |
| | | 5 | PYROTECH |
| | | 6 | SOUTHERN TRANSDUCERS |
| | | 7 | ADEPT |
| 6 | LARGE VIDEO SCREEN | 1 | BARCO |
| | | 2 | PLANAR |
| 7 | PC | 1 | DELL |
| 8 | TFT MONITOR | 1 | DELL |
| | | 2 | HP |
| | | 3 | IBM-LENOVO |
| 9 | DOT MATRIX PRINTERS | 1 | EPSON |
| | | 2 | TVS |
| 10 | PRINTERS (LASER) | 1 | HP |
| | | 2 | IBM |
| 11 | COMPUTER FURNITURE | 1 | ADARSH CONTROLS |
| | | 2 | COSMOS MEDIA |
| | | 3 | FEATHER LITE |
| | | 4 | GODREJ |
| | | 5 | OTS |





| Sl. No. | Item Description | Vendor Name | |
|---------|------------------------|-------------|--------------------------------|
| | | 6 | PYROTECH |
| 12 | CONTROL PANEL/RACK | 1 | PYROTECH |
| | | 2 | RITTAL |
| 13 | PRESSURE GAUGES | 1 | A. N. INSTRUMENTS PVT. LTD. |
| | | 2 | ASHCROFT INDIA |
| | | 3 | GENERAL INSTRUMENTS CONSORTIUM |
| | | 4 | MANOMETER (INDIA) PVT.LTD |
| | | 5 | WIKA |
| | | 6 | FORBES MARSHALL LTD. |
| | | 7 | GLUCK (INDIA) MFG.CO. |
| | | 8 | WAAREE INDUSTRIES |
| | | 9 | BUDENBERG GAUGE CO. LTD. |
| 14 | PRESSURE SWITCHES | 1 | ASHCROFT INDIA |
| | | 2 | INDFOS INDUSTRIES LTD. |
| | | 3 | SOR INC. |
| | | 4 | SWITZER INSTRUMENT CO. |
| | | 5 | TRAFAG-INDIA |
| | | 6 | DELTA CONTROLS LTD. |
| 15 | ELECTRONIC TRANSMITTER | 1 | EMERSON PROCESS |
| | | 2 | HONEYWELL |
| | | 3 | YOKOGAWA |
| | | 4 | FUJI |
| 16 | TEMPERATURE GAUGE | 1 | A. N INSTRUMENTS PVT. LTD. |
| | | 2 | ASHCROFT INDIA |
| | | 3 | GENERAL INSTRUMENTS CONSORTIUM |
| | | 4 | GOA THERMOSTATIC INSTUMENTS |
| | | 5 | WIKA |
| | | 6 | FORBES MARSHALL |
| | | 7 | WAREE |
| 17 | TEMPERATURE SWITCH | 1 | GENERAL INSTRUMENTS CONSORTIUM |
| | | 2 | INDFOS INDUSTRIES LTD. |
| | | 3 | SWITZER INSTRUMENT CO. |
| | | 4 | AN INSTRUMENTS |
| 18 | TEMPERATURE ELEMENT | 1 | DETRIVE |
| | | 2 | GENERAL INSTRUMENS CONSORTIUM |



| Sl. No. | Item Description | Vendor Name | |
|---------|-----------------------------------|-------------|-------------------------------------|
| | | 3 | INDUSTRIAL INSTRUMENTS |
| | | 4 | PYRO ELEC INSTRUMENTS GOA P. LTD. |
| | | 5 | TEMPSENS INSTRUMENTS (I) PVT. LTD. |
| 19 | ROTA METER | 1 | EUREKA |
| | | 2 | FLUIDYNE INSTRUMENTS |
| | | 3 | IEPL |
| | | 4 | PLACKA INSTRUMENTS INDIA PVT. LTD. |
| | | 5 | TRAC |
| 20 | SIGHT FLOW INDICATOR | 1 | CHEMTROLS SAMIL |
| | | 2 | LEVCON INSTRUMENTS PVT. LTD. |
| | | 3 | V.AUTOMAT & INSTRUMENTS PVT LTD. |
| | | 4 | FORBES MARSHALL LTD. |
| 21 | FLOW SWITCH | 1 | GENERAL INSTRUMENTS CONSORTIUM |
| | | 2 | KROHNE MARSHALL |
| | | 3 | SWITZER INSTRUMENT CO. |
| 22 | IMPACT HEAD TYPE ELEMENT | 1 | DETRIECH / EMERSON PROCESS |
| | | 2 | MIDWEST |
| | | 3 | STARMECH |
| | | 4 | SWITZER INSTRUMENT CO. |
| | | 5 | VERIS INC. |
| 23 | LEVEL GAUGE | 1 | CHEMTROLS ENGG. (P) LTD. |
| | | 2 | LEVCON INSTRUMENTS (P) LTD. |
| | | 3 | S. B. ELECTRO-MECHANICALS PVT. LTD. |
| | | 4 | V. AUTOMAT & INSTRUMENTS PVT. LTD. |
| | | 5 | DK INSTRUMENTS |
| | | 6 | SIGMA INSTRUMENTS COMPANY |
| 24 | LEVEL SWITCH (FLOAT TYPE) | 1 | CHEMTROLS |
| | | 2 | MAGNETROL INTERNATIONAL NV |
| | | 3 | DK INSTRUMENTS |
| | | 4 | LEVCON INSTRUMENTS P LTD. |
| 25 | LEVEL SWITCH (CONDUCTIVITY TYPE) | 1 | LEVEL STATE, UK |
| | | 2 | SOLARTON/MOBREY, UK |
| | | 3 | YARWAY |
| 26 | LEVEL SWITCH | 1 | ENDRESS + HAUSER |



| Sl. No. | Item Description | Vendor Name | |
|---------|---|-------------|--|
| | (CAPACITANCE TYPE) | 2 | DK INSRTUMENTS |
| 27 | LEVEL SWITCH (DISPLACEMENT TYPE) | 1 | DRESSER VALVES INDIA LTD. |
| | | 2 | CHEMTROLS |
| | | 3 | DK INSRTUMENTS |
| | | 4 | ECKARDT |
| 28 | LEVEL TRANSMITTER (ULTRASONIC TYPE) | 1 | EMERSON PROCESS |
| | | 2 | ENDRESS + HAUSER |
| | | 3 | SIEMENS MIL TRONICS |
| | | 4 | VEGA |
| 29 | LEVEL TRANSMITTER (RADAR Type) | 1 | ENDRESS + HAUSER |
| | | 2 | VEGA |
| 30 | BUNKER/SILO LEVEL 3D MONITORING (ULTRASONIC TYPE) | 1 | E & H |
| | | 2 | SIEMENS |
| | | 3 | VEGA-GERMANY |
| 31 | VIBRATION MONITORING SYSTEM /TURBINE SUPERVISORY MONITORING SYSTEM | 1 | GE (for BENTLY NEVADA SYSTEM) |
| | | 2 | MEGGIT |
| | | 3 | SHINKAWA, JAPAN |
| 32 | MERCURY MONITORING | 1 | DURAG GMBH AND CO KG |
| | | 2 | SICK |
| | | 3 | SHINKAWA |
| 33 | Dust Density Monitor | 1 | CODEL INTERNATIONAL LTD. |
| | | 2 | DURAG GMBH AND CO KG |
| | | 3 | LAND INSTRUMENTS INTERNATIONAL |
| | | 4 | SICK GMBH |
| 34 | CO Analyzer (in situ type) | 1 | CODEL INTERNATIONAL LTD. |
| | | 2 | LAND INSTRUMENTS INTERNATIONAL |
| | | 3 | SICK GMBH |
| 35 | Oxygen Analyzer (Zirconia Probe type) | 1 | EMERSON PROCESS MANAGEMENT |
| 36 | SO ₂ -NO _x /CO/CO ₂ Analyzer(Insitu Type) | 2 | CODEL INTERNATIONAL LTD |
| | | 3 | PROCAL |
| | | 4 | SICK GMBH |
| 37 | SWAS system (with selected analysers from Rosemount Analytical / Hack Ultra-France, Orion – USA, Hach-USA. ABB – UK, Polymetron- France/Zeltwegger -Analyticals) | 1 | ABB LTD. |
| | | 2 | EMERSON PROCESS MANAGEMENT INDIA PVT. |
| | | 3 | FORBES MARSHALL |
| 38 | DUST MONITOR | 1 | SIEMENS MILLTRONICS |



| Sl. No. | Item Description | Vendor Name | |
|---------|---|-------------|-----------------------------------|
| | | 2 | FILTER SENSE |
| | | 3 | BIN MASTER |
| 39 | PULSE JET CONTROLLER | 1 | SWITCHING CIRCUIT |
| | | 2 | ADVANCE CONCEPT |
| | | 3 | VOLT CRAFT |
| | | 4 | SQUARE M |
| | | 5 | MICRO SYSTEM |
| 40 | AIR FILTER REGULATOR | 1 | JRU INSTRUMENTS (Formerly PLACKA) |
| | | 2 | SHAVO NORGREN (INDIA) PVT. LTD. |
| 41 | ELECTRO PNEUMATIC CONTROLLER | 1 | MTL INDIA PVT. LTD. |
| | | 2 | WATSON SMITH LTD. |
| | | 3 | FAIRCHILD |
| 42 | SMART POSITIONER | 1 | EMERSON PROCESS MANAGEMENT |
| | | 2 | SIEMENS |
| | | 3 | ABB |
| 43 | SOLENOID VALVE | 1 | ASCO (I) LTD. |
| | | 2 | ROTEX AUTOMATION LTD. |
| | | 3 | NUCON INDUSTRIES PVT LTD |
| 44 | FEP INSULATED CABLE (For TG control) | 1 | DELTON CABLES |
| | | 2 | HABIA CABLES |
| | | 3 | LAPP CABLES |
| | | 4 | LEONI KERPEN |
| | | 5 | TEMPENS INSTRUMENTS (I) PVT. LTD. |
| | | 6 | THERMOELECTRIC |
| 45 | PTFE INSULATED CABLES (For TG control) | 1 | ADVANCE CABLES TECHNOLOGIES |
| | | 2 | DELTON CABLES |
| | | 3 | FLUTEF INDUSTRIES |
| | | 4 | RELIANCE INDUSTRIES |
| | | 5 | RJ INDUSTRIAL CORPORATION |
| | | 6 | TEMPSENS INSTRUMENTS (I) PVT. LTD |
| | | 7 | TOSHNIWAL CABLES PRIVATE LTD |
| | | 8 | UNIVERSAL CABLES LIMITED |
| 46 | INSTRUMENTATION CONTROL CABLE/ COMPENSATING CABLE / THERMOCOUPLE EXTENSION CABLES | 1 | ADVANCE CABLES TECHNOLOGIES |
| | | 2 | CORDS CABLE INDUSTRIES PVT. LTD. |
| | | 3 | DELTON CABLES LTD. |
| | | 4 | HABIA CABLES |
| | | 5 | KEI INDUSTRIES LTD. |
| | | 6 | KERPEN CABELS |



| Sl. No. | Item Description | Vendor Name | |
|---------|--------------------------------|-------------|-----------------------------|
| | | 7 | LAPP CABLES |
| | | 8 | NICCO CABLE |
| | | 9 | POLYCAB WIRES PVT.LTD |
| | | 10 | THERMO CABLES LTD. |
| | | 11 | THERMO ELECTRIC |
| | | 12 | UNIVERSAL CABLES LTD. |
| 47 | POWER CABLE (LT) | 1 | CCIL |
| | | 2 | KEI INDUSTRIES LTD. |
| | | 3 | POLYCAB |
| | | 4 | RELIANCE ENGRS. |
| | | 5 | THERMO ELECTRIC |
| | | 6 | ADVANCE CABLES TECHNOLOGIES |
| | | 7 | RELIANCE ENGRS. |
| | | 8 | CORDS CABLES |
| | | 9 | DELTON CABLES |
| | | 10 | INCAB |
| | | 11 | PARAMOUNT CABLES |
| | | 12 | RADIANT CABLES |
| | | 13 | TORRENT |
| | | 14 | UNIVERAL CABLES |
| 48 | FO CABLES | 1 | SYSTIMAX |
| | | 2 | TYCO/AMP |
| | | 3 | MOLEX |
| 49 | UPS & ACDB | 1 | EMERSON NETWORK |
| | | 2 | MERLINEGERINE |
| | | 3 | HITACHI HIREL ELECTRONICS |
| 50 | 24 V DC BATTERY CHARGER & DCDB | 1 | CALDYNE |
| | | 2 | CHHABI ELECTRICALS |
| | | 3 | HBL POWER SYSTEMS |
| | | 4 | DB POWER |
| 51 | HART COMMUNICATOR (HAND HELD) | 1 | EMERSON PROCESS |
| | | 2 | YOKOGAWA |
| | | 3 | ABB |
| | | 4 | HONEYWELL |
| 52 | MASTER & SLAVE CLOCK SYSTEM | 1 | HATHWAY |
| | | 2 | HOPF |
| | | 3 | SERTEL ELECTRONICS |
| | | 4 | MASIBUS |





| Sl. No. | Item Description | Vendor Name | |
|---------|---|-------------|---|
| 53 | PUBLIC ADDRESSING SYSTEM (ANALOG SYSTEM) | 1 | BOSCH SECURITY SYSTEMS |
| | | 2 | STENTOFONE (from ZENITAL GROUP) |
| | PUBLIC ADDRESSING SYSTEM (IP ADDRESSABLE) | 3 | INDUSTRONIC |
| | | 4 | COMMEND |
| 54 | EPABX | 1 | ABB INDIA PVT. LTD. |
| | | 2 | BPL TELECOM PVT. LTD. |
| | | 3 | CROMPTON GREAVES LTD. |
| | | 4 | HCL INFINET LTD. |
| | | 5 | SIEMENS LTD. |
| | | 6 | ABC INDIA PVT LTD. |
| 55 | CCTV System | 1 | BOSCH |
| | | 2 | HONEYWELL |
| | | 3 | PELCO |
| 56 | LIE/LIR | 1 | CHEMIN CONTROLS |
| | | 2 | ELECTRONICS CORP. OF INDIA LTD. |
| | | 3 | PYROTECH |
| | | 4 | FORBES MARSHAL |
| | | 5 | INSTRUMENTATION LIMITED |
| | | 6 | PRAMMEN INDUSTRIES |
| 57 | CONDENSATE POTS | 1 | FLOWTECH |
| | | 2 | INSTRUMENTATION LIMITED |
| | | 3 | PRECISION ENGG INDUSTRIES |
| | | 4 | BALDOTA VALVE AND FITTING CO. PVT LTD. |
| | | 5 | METPRESS ENGINEERING WORKS |
| | | 6 | MICROPRECISION |
| 58 | IMPULSE PIPES | 1 | BHARAT HEAVY ELECTRICALS LTD. |
| | | 2 | INDIA SEAMLESS METAL TUBES LTD. (only for CS Pipes) |
| | | 3 | JINDAL SAW PIPES LTD. |
| | | 4 | MAHARASHTRA SEAMLESS (only for CS Pipes) |
| | | 5 | MANNESMANN AG |
| | | 6 | SUMITOMO CORPORATION |
| | | 7 | TPS TECHNITUBE ROHREN WERKE GMBH |
| | | 8 | TROUVAY CAUVIN GULF E.C. DUBAI |
| | | 9 | BALDOTA VALVE AND FITTING CO. PVT. LTD. |



| Sl. No. | Item Description | Vendor Name | |
|--|-------------------------------|-------------|---------------------------------------|
| | | 10 | BHARAT HEAVY ELECTRICALS LTD. |
| | | 11 | EXCEL HYDRO – PNEUMATICS PVT. LTD. |
| | | 12 | INSTRUMENTATION LTD. |
| | | 13 | METPRESS ENGINEERING WORKS |
| | | 14 | MAHALAKSHMI SEAMLESS |
| | | 15 | RATNAMANI METALS & TUBES LTD. |
| 59 | INSTRUMENT VALVES / MANIFOLDS | 1 | BHARAT HEAVY ELECTRICALS LTD. |
| | | 2 | BALDOTA VALVE AND FITTING CO PVT LTD. |
| | | 3 | INSTRUMENTATION LIMITED |
| | | 4 | METPRESS ENGINEERING WORKS |
| | | 5 | EXCEL HYDRO-PNEUMATICS PVT. LTD. |
| | | 6 | METPRESS ENGINEERING WORKS |
| | | 7 | FLOWTECH |
| 60 | COMPRESSION FITTINGS | 1 | PARKER HANNIFIN |
| | | 2 | PRECISION ENGG INDUSTRIES |
| | | 3 | TROUVAY & CAUVIN |
| | | 4 | HOKE (TECHNICAL PARTS CO. MUMBAI) |
| | | 5 | SWAGELOCK |
| | | 6 | METPRESS ENGINEERING WORKS |
| 61 | SOCKET WELD FITTINGS | 1 | EXCEL HYDRO-PNEUMATICS PVT. LTD. |
| | | 2 | METPRESS ENGINEERING WORKS |
| | | 3 | V.K. INDUSTRIES |
| | | 4 | VIKAS INDUSTRIAL PRODUCTS |
| | | 5 | BALDOTA VALVE AND FITTING CO PVT LTD. |
| | | 6 | FLOWTECH |
| FIRE DETECTION AND HYDRANT SYSTEM VENDORS | | | |
| 1 | HYDRANT VALVES | 1 | SHAH BHOGILAL |
| | | 2 | SUKAN |
| | | 3 | NEWAGE |
| | | 4 | VENUS |
| | | 5 | WINCO |
| 2 | FIRE HOSES | 1 | NEWAGE |
| | | 2 | CHATTARIA RUBBER |
| 3 | WATER MONITOR & WATER- | 1 | SHAH BHOGILAL |



| Sl. No. | Item Description | Vendor Name | |
|----------------------------|--|-------------|---|
| | | 6 | GENT |
| 15 | ADDRESSABLE HEAT DETECTORS | 1 | SIMPLEX |
| | | 2 | SCHRACK |
| | | 3 | ESSER HONEYWELL |
| | | 4 | DETECTOMAT |
| | | 5 | SECUTRON |
| | | 6 | GENT |
| 16 | INFRA RED DETECTORS | 1 | PATOL |
| | | 2 | SYSTEM SENSOR |
| 17 | COATING & WRAPPING MATERIAL/ TAPE (COAL TAR BASED) | 1 | IWL LTD. |
| | | 2 | RUSTECH |
| 18 | INERT GAS SYSTEM | 1 | GINGEKERR |
| | | 2 | ANSUL |
| | | 3 | SRI |
| | | 4 | SIEMENS |
| 19 | BATTERY | 1 | EXIDE |
| | | 2 | AMCO |
| 20 | FIRE SURVIVAL CABLES | 1 | POLYCAB |
| | | 2 | RRKABEL |
| | | 3 | KEI |
| | | 4 | DELTON |
| 21 | HOSE REEL | 1 | SIEMENS |
| | | 2 | WINCO |
| 23 | FIRE EXTINGUISHER | 1 | BIS APPROVED SOURCES WITH VALID LICENSE |
| 24 | PROBE TYPE HEAT DETECTOR | 1 | KIDDE |
| | | 2 | TYCO |
| HVAC SYSTEM VENDORS | | | |
| 1 | AIR WASHER & UAF | 1 | HYDERABAD POLLUTION CONTROL |
| | | 2 | ADVANCE VENTILATION |
| | | 3 | DRAFT AIR |
| | | 4 | BLUE STAR |
| | | 5 | VOLTAS |
| | | 6 | STERLING WILSON |
| | | 7 | ROOTS COOLING SYSTEM |
| | | 8 | C DOCTOR |
| 2 | CENTRIFUGAL FAN | 1 | FLAKT |
| | | 2 | KRUGER |



| Sl. No. | Item Description | Vendor Name | | | |
|---------|-----------------------------|-------------|---|---|----------------------------|
| | | 3 | DRAFT AIR | | |
| | | 4 | HYDERABAD POLUTION CONTROL | | |
| | | 5 | ADVANCE VENTILATION | | |
| | | 6 | PATEL AIR | | |
| | | 7 | MARATHON | | |
| | | 8 | CB DOCTOR | | |
| | | 9 | SARLA | | |
| | | 3 | FRESH AIR/ SUPPLY/ EXHAUST/ RE UNIT FANS / PROPELLAR | 1 | HYDERABAD POLUTION CONTROL |
| | | | | 2 | ADVANCE VENTILATION |
| 3 | KRUGER | | | | |
| 4 | NICOTRA | | | | |
| 5 | MARATHON | | | | |
| 6 | FLAKT | | | | |
| 7 | CB DOCTOR | | | | |
| 8 | KHAITAN | | | | |
| 4 | PUMPS | 1 | BEST & CROMPTON | | |
| | | 2 | JYOTI | | |
| | | 3 | SAM TURBO | | |
| | | 4 | KBL | | |
| | | 5 | KSB | | |
| | | 6 | M&P | | |
| | | 7 | VOLTAS | | |
| | | 8 | WORTHINGTON | | |
| | | 9 | FLOWMORE | | |
| | | 10 | SULZER PUMPS INDIA LTD. | | |
| | | 11 | FLOWSERVE INDIA CONTROL PVT LTD | | |
| 5 | LV MOTORS (NON FLAME PROOF) | 1 | SIEMENS | | |
| | | 2 | ABB | | |
| | | 3 | CGL | | |
| | | 4 | MARATHON | | |
| | | 5 | KEC | | |
| | | 6 | BHARAT BIJLEE | | |
| | | 7 | NGEF | | |
| 6 | AIR FILTER | 1 | PUROLATOR | | |
| | | 2 | FMI | | |
| | | 3 | ANFILCO | | |
| | | 4 | JOHN FOWLER | | |
| | | 5 | SPECTRUM | | |



| Sl. No. | Item Description | Vendor Name | |
|---------|--|-------------|----------------------------|
| | | 6 | AIR TECH |
| | | 7 | PUROMATIC |
| 7 | INSULATION MATERIAL | 1 | BEARDSHEL |
| | | 2 | ARMAFLEX |
| | | 3 | LLOYDS |
| | | 4 | UP TWIGA |
| | | 5 | AEROCELL |
| 8 | FIRE DAMPER | 1 | TSC |
| | | 2 | CARRYAIRE |
| | | 3 | RAVISTAR (SYSTEM AIR) |
| 9 | GRILL/ DIFFUSER/ VOLUME CONTROL DAMPER | 1 | CARRYAIRE |
| | | 2 | RAVISTAR (SYSTEM AIR) |
| 10 | HUMIDISTAT | 1 | JHONSON CONTROL |
| | | 2 | HONEYWELL AUTOMATION |
| | | 3 | PENN |
| 11 | SCREW CHILLER | 1 | CARRIER |
| | | 2 | KIRLOSKAR |
| | | 3 | DUNHAM BUSH |
| | | 4 | BLUE STAR |
| | | 5 | VOLTAS |
| | | 6 | MCQUAY (DAIKIN) |
| | | 7 | CLIMAVENETA |
| 12 | PRECISION AC | 1 | STULZ |
| | | 2 | UNIFLAIR |
| | | 3 | BLUEBOX |
| | | 4 | EMERSON PROCESS MANAGEMENT |
| | | 5 | CLIMAVENETA |
| 13 | SPLIT AC | 1 | VOLTAS |
| | | 2 | BLUE STAR |
| | | 3 | CARRIER |
| | | 4 | HITACHI |
| | | 5 | DAIKIN |
| | | 6 | LG |
| 14 | AIR HANDLING UNITS | 1 | VOLTAS |
| | | 2 | BLUE STAR |
| | | 3 | ZECO |
| | | 4 | CARRYAIRE (flakt) |
| | | 5 | EDGETECH |



| Sl. No. | Item Description | Vendor Name | |
|---------|-----------------------------|-------------|---------------------------------|
| | | 6 | ETHOS |
| | | 7 | SYSTEM AIR |
| | | 8 | WAVES AIRCON |
| 15 | AHU FAN (CENTRIFUGAL FAN) | 1 | CB DOCTOR |
| | | 2 | FLAKT |
| | | 3 | KRUGER |
| | | 4 | NICOTRA |
| | | 5 | COMEFRI |
| | | 6 | MARATHON |
| | | 7 | ADVANCE |
| | | 8 | DRAFT AIR |
| | | 9 | HYDERABAD POLLUTION |
| 16 | PUMPS | 1 | BEST & CROMPTON |
| | | 2 | JYOTI |
| | | 3 | SAM TURBO |
| | | 4 | KBL |
| | | 5 | KSB |
| | | 6 | M&P |
| | | 7 | VOLTAS |
| | | 8 | BEACON-WEIR |
| | | 9 | WORTHINGTON |
| | | 10 | FLOWMORE |
| | | 11 | SULZER PUMPS INDIA LTD. |
| | | 12 | FLOWSERVE INDIA CONTROL PVT LTD |
| | | 13 | V-FLOW PUMPS & SYSTEMS CO |
| 17 | COOLING TOWER | 1 | PAHARPUR COOLING TOWER |
| | | 2 | FLOWTECH |
| | | 3 | BELL |
| 18 | LV MOTORS (NON FLAME PROOF) | 1 | SIEMENS |
| | | 2 | ABB |
| | | 3 | CGL |
| | | 4 | MARATHON |
| | | 5 | KEC |
| | | 6 | BHARAT BIJLEE |
| | | 7 | NGEF |
| | | 8 | JYOTI |
| 19 | AIR FILTER | 1 | PUROLATOR |



| Sl. No. | Item Description | Vendor Name | |
|---------|---|-------------|------------------------------------|
| | | 2 | FMI |
| | | 3 | ANFILCO |
| | | 4 | TENACITY |
| | | 5 | JOHN FOWLER |
| | | 6 | SPECTRUM |
| | | 7 | AIR TECH |
| | | 8 | PUROMATIC |
| | | 20 | BALANCING VALVE |
| 21 | 4 WAY MIXING VALVE WITH ACTUATING MOTOR | 1 | SIEMENS BUILDING TECHNOLOGY |
| | | 2 | JOHNSON |
| | | 3 | BELIMO |
| | | 4 | HONEYWELL AUTOMATION |
| | | 5 | RAPID CONTROL |
| | | 6 | ALC |
| 22 | Y / POT STRAINER | 1 | MULTITEX |
| | | 2 | GREAVES COTTON |
| | | 3 | JAYPEE |
| | | 4 | SANT VALVES |
| | | 5 | OTOKLIN |
| | | 6 | GUJARAT OTOFILT |
| | | 7 | DS ENGG |
| | | 8 | SAROJINI ENTERPRISE |
| | | 9 | BHATIA ENGINEERING |
| | | 10 | FILTRATION ENGINEERS INDIA PVT LTD |
| 23 | STRIP HEATER | 1 | ESCORTS |
| | | 2 | RACOLDS |
| | | 3 | ALCO |
| | | 4 | HEATCO |
| 24 | PAN HUMIDIFIER | 1 | RAPID COOL |
| | | 2 | HOTSET |
| | | 3 | ALCO |
| 25 | RELIEF / PURGE VALVE | 1 | BRASSOMATIC |
| 26 | THERMOSTATS | 1 | HONEYWELL AUTOMATION |
| | | 2 | RANCO |
| | | 3 | PENN |
| | | 4 | DANFOSS |
| | | 5 | RANUTROL |
| | | 6 | INDFOSS JHONSON CONTROL |



WBPDCCL

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

Annexure-I

| Sl. No. | Item Description | Vendor Name | |
|---------|------------------------|-------------|----------------------------------|
| 27 | ANTI FREEZE THERMOSTAT | 1 | RANCO |
| | | 2 | HONEYWELL AUTOMATION |
| | | 3 | PENN |
| | | 4 | DANFOSS |
| | | 5 | INDFOSS |
| 28 | RH SENSOR/TEMP SENSOR | 1 | HONEYWELL AUTOMATION |
| | | 2 | JOHNSON |
| | | 3 | SIEMENS |
| | | 4 | GENERAL INSTRUMENT CONSORTIUM |
| 29 | WATER SOFTENING PLANT | 1 | THERMAX |
| | | 2 | ION EXCHANGE |



Development Consultants Pvt. Ltd.

Page 40 of 40

Volume : II-A
Section : VI
Project Management and Site Services



WBPDC

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

**SECTION-VII
ENGINEERING SERVICES**



Development Consultants Pvt. Ltd.

**Volume : II-A
Section : VII
Engineering Services**



WBPDCL

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

CONTENTS

| CLAUSE NO. | DESCRIPTION | PAGE NO. |
|-------------------|---|-----------------|
| 1.00.00 | GENERAL | 1 |
| 2.00.00 | DESIGN COORDINATION MEETING | 1 |
| 3.00.00 | CO-OPERATION WITH OTHER SUCCESSFUL BIDDERS AND CONSULTANTS | 1 |
| 4.00.00 | GUIDELINES FOR OWNER'S ENGINEERING SERVICES | 2 |
| 5.00.00 | INSTRUCTION MANUALS | 3 |
| 6.00.00 | PLANT HANDBOOK | 5 |
| 7.00.00 | TENDER STAGE DOCUMENT SUBMISSION | 5 |
| 8.00.00 | CONTRACT STAGE DOCUMENT SUBMISSION AND APPROVAL PROCEDURE | 6 |



Development Consultants Pvt. Ltd.

**Volume : II-A
Section : VII
Engineering Services**

**SECTION-VII****OWNER'S ENGINEERING SERVICES****1.00.00 GENERAL**

1.01.00 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 the purpose of 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.

1.02.00 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.

2.00.00 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 information on similar equipment and plants Owner's Engineered by the Bidder. 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 embedments, 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**

5.05.01 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 equipments 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) Check-list 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 step-by-step 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 and catalogue and Pro-forma for ordering spares.
- b) Location and identification guide for bearings of various equipments 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 & specialities 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
- g) Shop Inspection and Testing Procedures, Test Set-up & Instrumentation, Acceptance Criteria and Codes / Standards followed, correction curves / charts, etc.
- h) Performance Test Procedures, Instrumentation, Acceptance Criteria and Codes / Standards followed, correction curves / charts, etc.
- i) 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.
- b) Equipment cross-section drawings, product literature etc. which are of proprietary nature.
- c) Predicted performance curves of equipment.
- d) Various bills of quantity, schedules etc.
- e) Piping fabrication drawings, isometrics etc.
- f) Panel wiring diagrams.
- g) Instruction/Operation manuals.
- h) Service manuals and trouble shooting guide for C & I system including field instruments.
- i) Operation logic diagrams.
- j) 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 WBPDC corporate office and 4 sets at WBPDC 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**

SECTION-VIII QUALITY ASSURANCE REQUIREMENTS



Development Consultants Pvt. Ltd.

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



CONTENT

| CLAUSE NO. | DESCRIPTION | PAGE NO. |
|-------------------|--|-----------------|
| 1.00.00 | QUALITY ASSURANCE PROGRAMME | 1 |
| 2.00.00 | GENERAL REQUIREMENTS QUALITY ASSURANCE | 2 |
| 3.00.00 | QUALITY ASSURANCE DOCUMENTS | 4 |
| 4.00.00 | INSPECTION, TESTING & INSPECTION CERTIFICATES | 5 |





SECTION-VIII

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 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/Owners 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.





WBPDC

- 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.





WBPDC

FORMAT OF QUALITY ASSURANCE PROGRAMME

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





WBPDCCL

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 | 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





WBPDCL

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

SECTION-IX

PERFORMANCE GUARANTEES AND TESTS



Development Consultants Pvt. Ltd.

Volume : II-A
Section : IX
Performance Guarantees And Tests

**CONTENT**

| CLAUSE NO. | DESCRIPTION | PAGE NO. |
|-------------------|--|-----------------|
| 1.00.00 | PERFORMANCE GUARANTEES, PERFORMANCE/ ACCEPTANCE TESTS & LIQUIDATED DAMAGES FOR SHORTFALL IN PERFORMANCE | 1 |
| 2.00.00 | START-UP, INITIAL OPERATION, TRIAL OPERATION AND PERFORMANCE TESTS | 2 |
| 3.00.00 | SCHEDULE OF GUARANTEES WHICH ATTRACT LIQUIDATED DAMAGES [CATEGORY-A] | 6 |
| 4.00.00 | SCHEDULE OF GUARANTEES WHICH DO NOT ATTRACT LIQUIDATED DAMAGES [CATEGORY-B] | 7 |
| 5.00.00 | SCHEDULE OF DEMONSTRATION | |
| 6.00.00 | PERFORMANCE/ ACCEPTANCE TESTS PROCEDURES | 13 |





SECTION-IX

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.



3.00.00

SCHEDULE OF GUARANTEES WHICH ATTRACT LIQUIDATED DAMAGES [CATEGORY-A]

| Sl. No. | Package System | Parameter for Performance Guarantee | Liquidated Damages | Acceptable Shortfall Limit with LD |
|---------|------------------------|--|--|---|
| 3.01.00 | Steam Generator | | | |
| 3.01.01 | Capacity | Capacity in T/HR of steam at 100% TMCR (660MW) Unit Load with rated steam parameters at super heater outlet with combination of mills working as per Owner's choice and the coal being fired within range specified. | Rs. 32,580,000/- or equivalent foreign currency for every 1T/hr. deficiency in Steam Generator capacity | (-) 1% of the Guaranteed Steam Generator capacity. |
| 3.01.02 | Efficiency | Efficiency in percentage corresponding to : i) 100% turbine load under rated steam parameters at Super- heater & reheater outlet, under Condenser Vacuum at 33 Deg.C CW temperature and zero percent make up with combination of mills working as per Owner's choice. ii) 80% turbine loads (with MS & RH Control Valve wide open condition) under corresponding sliding steam pressure with rated steam temperature (s) at Super- heater & reheater outlet, under corresponding Condenser Vacuum at 33 Deg.C CW temperature and zero percent make up with combination of mills working as per Owner's choice. | Rs. 206,980,000 /- or equivalent foreign currency for every 0.1% decrease in weighted average Steam Generator efficiency - | (-) 1% of the Guaranteed Steam Generator efficiency |



| Sl. No. | Package System | Parameter for Performance Guarantee | Liquidated Damages | Acceptable Shortfall Limit with LD |
|---------|-------------------------------------|--|--|---|
| 3.02.00 | Turbine Generator | | | |
| 3.02.01 | Heat Rate | Heat rate in kCal/ kWh corresponding to : i) 100% turbine load under rated steam parameters, under Condenser Vacuum at 33 Deg.C CW temperature and zero percent make up ii) 80% turbine loads (with MS & RH Control Valve wide open condition) under corresponding steam parameters, under corresponding Condenser Vacuum at 33 Deg.C CW temperature and zero percent make up | Rs. 110,520,000/- or equivalent foreign currency for every kCal/ kWh increase in weighted average Turbine heat rate over guaranteed value. | (+) 2.5% of the Guaranteed Turbine heat rate. |
| 3.02.00 | Output | Output (100 % TMCR) in kW under rated steam conditions and Condenser Vacuum with CW temp. of 33°C and zero percent make up and all heaters in service. | Rs. 270,000/- or equivalent foreign currency for every one (1) kW shortfall in output from guaranteed value. | (-) 2.0% of the Turbine generator output. |
| 3.03.00 | Total Auxiliary Power Consumption | Total Auxiliary power consumption (in kW) of the unit under rated steam conditions and Condenser Vacuum with CW temp. of 33°C and zero percent make up at 100% Turbine load. | Rs. 462,000/- or equivalent foreign currency for every one (1) kW excess auxiliary power consumption over guaranteed value. | (+) 1% of the Guaranteed Auxiliary Power Consumption. |
| 3.04.00 | Coal Pulveriser wear parts warranty | Guaranteed wear life of all wear parts of the mill when grinding the specified range of coals. | To be calculated as per clause 6.02.04 of this section | (-) 500 hours |

**3.05.00 Flue Gas Desulphurization Plant**

- (i) SO
- ₂
- removal Efficiency at 100% TMCR unit load, worst Coal Firing

The Bidder shall guarantee that SO₂ removal efficiency shall not be less than 95.0% at 100% TMCR unit load, worst Coal Firing. In the Bid guarantee sheet specific reference to the concentration of SO₂ (mg/Nm³) at 6% O₂ on dry basis (less than 100 mg/Nm³) in the flue gas exit from FGD plant shall also be mentioned.

- (ii) Limestone consumption of FGD system

Limestone consumption of FGD system in kg/hr at 100% TMCR unit load with worst coal firing and SO₂ removal efficiency of not less than 95.0%.

AMOUNT OF LIQUIDATED DAMAGES (LD) APPLICABLE

| Sl. No. | GAURANTEE | RATE OF LIQUIDATED DAMAGES (LD) | ACCEPTABLE SHORTFALL LIMIT WITH LD |
|---------|--|---|--|
| (i) | For shortfall in guaranteed SO ₂ removal efficiency in percentage points under conditions stipulated in clause 3.05.00 above. | Rs 675,000/- (Rupees Six hundred Seventy Five Thousand only) or equivalent foreign currency for every 0.01% point shortfall in SO ₂ removal efficiency from the guaranteed value | (-) 1% point from the guaranteed SO ₂ removal efficiency. |
| (ii) | For increase in the limestone consumption of FGD system in T/hr under conditions stipulated in clause 3.05.00 above. | Rs 2,500,000/- (Rupees Two Million Five Hundred Thousand only) or equivalent currency for every 100 kg/hr increase in Lime stone consumption from guaranteed value. | (+) 10% of the guaranteed limestone consumption. |

3.06.00 Auxiliary Power Consumption

The auxiliary power consumption shall be calculated using the following relationship:

$$P_a = P_u + T_L$$

$$P_u = \text{SUM} (P_i \times D_i)$$





- Pa = Guaranteed Auxiliary Power Consumption.
- Pu = Power consumed by the auxiliaries of the unit under test.
- TL = Losses of the transformers supplied by bidder based on works test reports.
- Pi = Power consumed by each auxiliary
- Di = Duty factor to be considered
- (Where duty factor is not indicated, same to be considered as 1.0)

While guaranteeing the auxiliary power consumption the bidder shall necessarily include all continuously operating unit and Station auxiliaries.

Measurement Points:

Total power consumption (Pu) required for continuous unit operation corresponding to turbine heat rate guarantee points at 100% and 80% TMCR load shall be measured during PG test as sum of the power measurement at the following terminals-

- 1) 11KV/3.3KV Switchgear terminals for all 11KV/3.3KV motors
- 2) Switchgear Incomers/Switch Gear end terminals for LT Loads.
- 3) Switchgear Terminals of any other load connected to owner existing switchgear.

Further the power consumption for the equipment being fed from switchgear but not to be considered for guaranteed power consumption shall be measured separately at their respective MCC/LT & HT switchgear input terminals and shall be subtracted from the total power consumption measured. However if conditions permit, such equipment may not be operated during power measurement duration.

The auxiliaries to be considered shall include but not be limited to the following:

| | |
|--|---|
| LIST OF AUXILIARIES | |
| A) UNIT AUXILIARIES | |
| STEAM GENERATOR & AUXILIARIES | |
| 1. | ESP (with all fields of all ESP passes working and rapping system in normal operation (as measured at the input terminals of TR set) |
| 2. | Pulverisers |
| 3. | PA Fans |
| 4. | FD Fans |
| 5. | ID Fans |
| 6. | Air Heaters drives |
| 7. | Coal Feeders. |
| 8. | Compressor of Mill Reject System (duty factor 1.0) |
| 9. | Fuel Oil pressurising pump. |
| 10. | Lube Oil pumps for fans, Air, heaters, Mills. |
| 11. | Seal Air Fans. |
| 12. | Scanner Air fans. |
| 13. | DM Cooling Water pumps for SG Auxiliaries. |
| 14. | Power consumption of one Instrument air compressor and its air drying plant, |





| | |
|--|--|
| | one service air compressor and its air drying plant.(Duty factor for IA compressor shall be 0.67 and that of SA compressor shall be 0.33, duty factor of ADP shall be 0.5) |
| 15. | Steam Generator Startup Water Recirculation Pump (if in operation) |
| 16. | Electricheaters for fans, Air heaters, Mills Lub Oil systems. |
| 17. | Chemical Feed pumps (if any) |
| 18. | Blowers/seal air fans for Guillotine gates/dampers |
| 19. | Power consumption for electric Heat tracing of HFO line. |
| 20. | Continuous running auxiliaries of selective Catalyst Reduction System. |
| 21. | Power consumption of any other operating auxiliaries for unit operation at different guarantee point loads. |
| TURBINE & GENERATOR AUXILIARIES | |
| 1. | Turbine Unit Oil purifiers. |
| 2. | Turbine Unit control Oil purifiers. |
| 3. | Electric oil heater for turbine Lube Oil system. |
| 4. | Feed and discharge pumps of turbine oil purification system. |
| 5. | Circulating Water (CW) Pumps. |
| 6. | Auxiliary Cooling water (ACW) Pumps. |
| 7. | Condensate Extraction Pumps. |
| 8. | Main Turbine condenser air evacuation pumps. |
| 9. | Main Turbine Condenser tube cleaning system pumps. |
| 10. | DM Cooling Water pumps for TG Auxiliaries. |
| 11. | BFP drive turbine condenser air evacuation pumps (if envisaged). |
| 12. | BFP drive turbine condenser tube cleaning system pumps (if envisaged). |
| 13. | Drip Pump (if envisaged). |
| 14. | BFP drive turbine Condensate Extraction Pumps (if envisaged). |
| 15. | Oil purifiers of 2x50% TDBFPs and their feed and discharge pumps. |
| 16. | Lube oil pumps of 2x50% TDBFPs and the electrical oil heater for lube oil. |
| 17. | Auxiliary oil Pump for MDBFP. |
| 18. | Oil pumps for HP-LP bypass system. |
| 19. | BFP Booster Pumps (if separately driven) |
| 20. | Heater, Circulation pumps, Control fluid pump for control fluid system |
| 21. | DMSW Pumps. |
| 22. | Motor Driven Boiler Feed Pump (For this purpose only 15% of the deemed power consumed by the MDBFP at 100% TMCR unit load shall be considered. |
| 23. | Ammonia Dosing Pump |
| 24. | Hydrazine Dosing Pump |
| 25. | Power consumption of any other operating auxiliaries for unit operation at different guarantee point loads. |
| FGD System Auxiliaries- | |
| 1. | Booster Fans- if provided separately (duty factor 1.0) |
| 2. | Lub oil pumps and heaters for separate Booster Fans(duty factor 1.0) |
| 3. | Absorber Recirculation Pumps(duty factor 1.0). |
| 4. | Gypsum Bleed pumps(duty factor 1.0). |
| 5. | Oxidation Air compressors(duty factor 1.0). |
| 6. | Agitators (duty factor 1.0). |
| 7. | Flue gas cooling pump (if any) (duty factor 1.0) |
| 8. | Process Water Pumps, Mist eliminator wash pumps(duty factor 0.5) |
| 9. | Scavanging Air Fans (duty factor 1.0) |
| 10. | Absorber Drain Pit Pumps (duty factor 0.5) |
| 11. | Seal Air Fans for duct dampers (duty factor 1.0). |



| | |
|-------------------------------|---|
| 12. | Power consumption of any other operating auxiliaries for unit operation at different guarantee point loads. |
| AHP System Auxiliaries | |
| 1. | Clinker Grinder(duty factor 0.5) |
| 2. | BA Overflow Pump(duty factor 1.0) |
| 3. | Ash slurry Pump (duty factor 0.5) |
| 4. | HR Water Pump (duty factor 0.5) |
| 5. | LP water pump (duty factor 1.0) |
| 6. | Instrument Air Compressor and its air dryer (duty factor 1.0) |
| 7. | Seal Water Pump (duty factor 1.0) |
| 8. | Transport Air Compressors (duty factor 1.0) |
| 9. | Recycle Water Pumps (duty factor 1.0) |
| 10. | Ash conditioning water Pumps (duty factor 0.5) |
| 11. | Vacuum Pumps (duty factor 1.0) |
| 12. | ESP Fluidising Blowers and heaters (duty factor 1.0) |
| 13. | SILo equipments like aeration Blower & heater, Vent Fan (duty factor 1.0) |
| 14. | ECO Water Pumps (duty factor 1.0) |
| 15. | Power consumption of any other operating auxiliaries for unit operation at different guarantee point loads. |
| Auxiliaries of CHP | |
| 1. | <p>Power consumption figure provided by the bidder as per the following path, which shall be considered to arrive at guaranteed Power (GP) for Performance Guarantee purpose. The guaranteed power for Performance Guarantee purpose will be calculated by the following formula:-</p> <p>GP=1 x GP of Flow Path</p> <p>Flow Path: From wagon tippler to boiler bunker of Unit #5 through both conveyor no. BCN #27A and BCN #27B (longest path) running simultaneously</p> <p>(Duty factor for CHP shall be 1.0)</p> <p>The following facilities (auxiliaries) need not be considered for Auxiliary Power Consumption of CHP.</p> <ul style="list-style-type: none"> • Coal Sampling unit, • Dust suppression & Dust extraction • Ventilation System, • Service Water System • Potable water system, • Service air system |
| Other Auxiliaries | |
| 1. | <p>Air Conditioning Plant Load for TG bldg., ESP control bldg., FGD control room and all other areas covered with Air Conditioning Plant.</p> <p>Non-plant buildings and areas covered with Split type air-conditioners (stand alone) need not be considered.</p> <p>Bidder shall consider Power consumption at motor input terminals of working units (i.e. excluding stand-by) at its rated duty point of Chilling machines, Chilled water Pumps, Condenser water Pumps, Air handling unit (AHU) fans, for the Air conditioning system of TG building, FGD control room, ESP control room.</p> |
| 2. | Ventilation System Loads for whole plant (except non-plant bldgs) |





| | |
|--|---|
| | Bidder shall consider Power consumption at motor input terminals for fans of Air washer units for TG building and fans of air filtration units for ESP and FGD buildings, and AHP switchgear at its rated duty point. |
| 3. | Continuously running miscellaneous pumps like RO Feed Pump, RO clarifier, DMF feed pump, air blowers for DMF and UF, UF backwash pumps, RO High Pressure Pumps for Zero discharge system, hydrant pumps at its rated duty point Intermediate operating pumps like waste water transfer pumps, Jockey pumps for firefighting system need not be considered. |
| 4. | CW treatment and Chlorination Plant |
| 5. | Illumination system Loads (Duty factor 1.0 for Indoor and 0.6 for outdoor area). |
| 6. | Power consumption of UPS, DC system. |
| 7. | Power consumption of any other operating auxiliaries during unit operation at different guarantee point loads. |
| Total Losses (No Load, Load Loss, Auxiliary Loss) of the Transformers | |
| 1. | Generator Transformers (Three single phase + one spare single phase transformer) |
| 2. | Station Transformers (One three winding transformer) |
| 3. | Unit transformers (Two numbers) |
| 4. | Unit Aux. Transformers (Two numbers) |
| 5. | Stn. Aux Transformers (Two numbers) |

Note :

- 1) The load of the followings items shall not be considered during measurement of Total Aux. power consumption for guarantee-
 - a) Hoists and EOT cranes.
 - b) Welding receptacles.
 - c) Elevator.
 - d) Sump pumps.
- 2) Number of coal mill and coal feeders shall be considered corresponding to the design coal, as applicable.
- 3) **No Load Losses and, Aux. Losses** of the transformers supplied by the bidder would be based on the works test report. **For Load losses, bidder shall consider loading of transformer (100% TMCR guarantee condition) as per bidder's offered design/system corroborating the Works test report at the corresponding Transformer loading.**
- 4) For items 3.01.02 & 3.02.01 the weightage factor shall be considered as 5 and 4 for 100% and 80% turbine rated loads respectively.



WBPDCL

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

SECTION-X

REQUIREMENTS OF SPARES, TOOLS & TACKLES



Development Consultants Pvt. Ltd.

**Volume : II-A
Section : X
Requirements Of Spares, Tools & Tackles**



CONTENTS

| CLAUSE NO. | DESCRIPTION | PAGE NO. |
|-------------------|--------------------|-----------------|
| 1.00.00 | TOOLS AND TACKLE | 1 |
| 2.00.00 | SPARES | 1 |

ATTACHMENT

| | |
|-------------|-------------------------|
| ANNEXURE-I | MANDATORY SPARES LIST |
| ANNEXURE-II | LIST OF TOOLS & TACKLES |



**SECTION-X****REQUIREMENTS OF SPARES, TOOLS & TACKLE****1.00.00 TOOLS & TACKLE**

The Bidder shall supply with the equipment one complete set of special tools and tackles required for the erection, assembly, dis-assembly & proper maintenance of the plant and equipments and systems (including software). These special tools shall also include special material handling equipment, jigs & fixtures for maintenance and calibration/ re-adjustment, checking & measurement aids etc. A list of such tools & tackles shall be submitted by the Bidder along with the offer. Detailed description of each tool/tackles, its function along with the equipment/part for which it is meant for, shall also be indicated in the offer. These tools & tackles 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, commissioning and initial operation. For this period, the Bidder shall bring his own tools and tackles. All the tools and tackles shall be of reputed make acceptable to Owner.

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 Bidder 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 Owner.

2.01.04 The Bidder shall also guarantee supply of spare parts, which shall be made, based on manufacturer's drawings on special order from the Owner for 30 years after commissioning of the plant.

2.01.05 Warranty period for all kinds of spares shall be six thousand (6000) hours of operation.





- 2.01.06 Design & Engineering details of all spares (make, model, rating, drawing, data sheet etc.) shall be submitted to the Owner prior to dispatch from manufacturers' works.
- 2.02.00 **Recommended Spares**
- 2.02.01 The Bidder shall provide a list of recommended spares for 3 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.
- 2.03.00 **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. The list of commissioning spares to be brought by the Bidder to ensure smooth commissioning of the plant shall be subject to the Owner's approval. 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 Bidder, 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.
- 2.04.00 **Mandatory Spare Parts**
- 2.04.01 The Owner considers some of the spares are essential for running the equipment irrespective of whether they are included in the list of recommended spares by the Bidder as mentioned above.
- Since the components involved can not be foreseen at the bidding stage, only broad requirements of the Owner in this respect are outlined hereinafter. The bidder shall include his proposal, on the basis of these guidelines, an item-wise list of all components recommended as mandatory spares with the quantity. This list shall be separate from the list of recommended spares and shall be used for bid evaluation purposes. Any clarification in this respect may be obtained by the Bidder at the pre-bidding stage. During finalization of detailed engineering if some component, equipment, system, sub-system found to undergo change, then the Owner/Consultant shall revise the list for compliance by the Bidder without any implication to the Owner.
- 2.04.02 For Mandatory Spares refer Annexure-I of this section.



| SI. No. | Equipment/Package Name | Quantity to be supplied for the Package |
|---------|--|--|
| (i) | Axle Bearings | 1Set for each type & capacity of EOT |
| (ii) | Set of Gearbox Bearings with Sleeves | 1Set for each type & capacity of EOT |
| (iii) | Set of seals for Gearbox | 1Set for each type & capacity of EOT |
| (iv) | Cross Travel end Shaft Bearing | 1Set for each type & capacity of EOT |
| (v) | Cross travel Brake Shoes Liners | 2Sets for each type & capacity of EOT |
| (vi) | Complete Set of Hydraulic Thruster for Brakes (if applicable) | 1 No. for each type & capacity of EOT |
| (vii) | Brake Spring | 1Set for each type & capacity of EOT |
| (viii) | Brake Coil | 2Sets for each type & capacity of EOT |
| (ix) | Motor | 1 No. for each type & capacity of EOT |
| 6.01.03 | Hoist | |
| (i) | Main Hoist Pulley Bearings [All Bearings of Each Type and size used in all Gear Assemblies, Lifting Hook, Trolley wheels etc.] | 1 Set for each type & capacity of EOT |
| (ii) | Set of Bearings for Gear box | 1 Set for each type & capacity of EOT |
| (iii) | Set of seals for Gearbox | 1 Set for each type & capacity of EOT |
| (iv) | Aux. Hoist Gearbox Bearings | 1 Set for each type & capacity of EOT |
| (v) | Aux. Hoist Gearbox Seals | 1 Set for each type & capacity of EOT |
| (vi) | Complete Set of Hydraulic Thruster for Brakes (if applicable) | 1 No. for each type & capacity of EOT |
| (vii) | Main & Aux. Hoist Brake Shoes [Brake shoes with lining for each size of brake (Pair of each size)] | 2 Sets for each type & capacity of EOT |
| (viii) | Main & Aux. Hoist Brake Springs | 2 Sets for each type & capacity of EOT |
| (ix) | Main & Aux. Hoist Brake shoe liners | 2 Sets for each type & capacity of EOT |
| (x) | Motor for Main Hoist & Auxiliary Hoist | 1 No. for each type & capacity of EOT |
| (xi) | Brake Coil | 2 Sets for each type & capacity of EOT |
| (xii) | Wire Rope for Aux. Hook | 100% of one crane for each type & capacity of EOT |
| 6.01.04 | Electrical | |
| (i) | Other Electrical Spares as applicable as per the Electrical List | Applicable Item & Quantity same as indicated in Electrical list 'B' Sl. No.7.08.00, 7.21.00. |
| (ii) | Limit Switches for: | |
| (a) | Main Hoist | 1 Set for each type & capacity of EOT |
| (b) | Aux. Hoist | 1 Set for each type & capacity of EOT |
| (c) | Cross Travel | 1 Set for each type & capacity of EOT |
| (d) | Long Travel | 1 Set for each type & capacity of EOT |
| (iii) | Master Controller for : | |
| (a) | Aux. Hoist | 1 No. for each type & capacity of EOT |
| (b) | Cross Travel | 1 No. for each type & capacity of EOT |
| (c) | Long Travel | 1 No. for each type & capacity of EOT |
| (iv) | VVVF Drive Complete Set for: | |
| (a) | Main Hoist | 1 No. for each type & capacity of EOT |
| (b) | Aux. Hoist | 1 No. for each type & capacity of EOT |
| (c) | Cross Travel | 1 No. for each type & capacity of EOT |
| (d) | Long Travel | 1 No. for each type & capacity of EOT |
| 6.02.00 | Electrical Hoist | |
| 6.02.01 | Bearings for Long Travel Wheels [Bearing | 1 Set for each type & capacity of Hoist |





| SI. No. | Equipment/Package Name | Quantity to be supplied for the Package |
|--------------------|---|--|
| | of each type and size used in motors] | |
| 6.02.02 | Bearings for Cross Travel Wheels [Bearing of each type and size used in motors] | 1 Set for each type & capacity of Hoist |
| 6.02.03 | Bearings for each type of Gear Boxes of the Hoist | 1 Set for each type & capacity of Hoist |
| 6.02.04 | Brake Liner for all the Brakes of the Hoist | 100% for each type & capacity of Hoist |
| 6.02.05 | Hydraulic Thruster for Brakes | 1 No. for each type & capacity of Hoist |
| 6.02.06 | Oil Seals for all types of the Hoist | 100% for each type & capacity of Hoist |
| 6.02.07 | Brake Springs for all Brakes | 100% for each type & capacity of Hoist |
| 6.02.08 | Wire Rope for Aux. Hook | 100% of one Hoist for each type & capacity of Hoist |
| 6.02.09 | Electrical | |
| (i) | Other Electrical Spares as applicable as per the Electrical List | Applicable Item & Quantity same as indicated in Electrical list Sl. No.7.08.00,7.12.00 & 7.21.00 |
| (ii) | Limit Switches for: | |
| (a) | Hoist | 1Set. for each type & capacity of Hoist |
| (b) | Cross Travel | 1Set. for each type & capacity of Hoist |
| (c) | Long Travel | 1Set. for each type & capacity of Hoist |
| (iii) | Control Trailing Cable for Electrical Hoist | 100% of one Hoist for each type & capacity of Hoist |
| (iv) | Power Trailing Cable for Electrical Hoist | 100% of one Hoist for each type & capacity of Hoist |
| 6.03.00 | Elevator (Goods / Passenger) | |
| 6.03.01 | Control Panel Items | |
| (i) | Complete Set of Cortactors each type and rating | 10% of total population or 1No. which ever is higher for each type of Elevator |
| (ii) | Coils for contactors | 2Nos. of each type and rating for each type of Elevator |
| (iii) | Control Transformer | 1No. each type, and rating for each type of Elevator |
| (iv) | Relays | 2Nos. of each type & model for each type of Elevator |
| (v) | Relay Coils | 2Nos. of each type & model for each type of Elevator |
| (vi) | Resistors | 3Nos. for each type of Elevator |
| (vii) | Over Current Relay | 1No. for each type of Elevator |
| (viii) | Capacitors | 100% for each type of Elevator |
| (ix) | Control Rectifier | 1No. of each type for each type of Elevator |
| (x) | Time Device | 1No. of each type for each type of Elevator |
| (xi) | Suppressor Unit | 100% for each type of Elevator |
| (xii) | Fuses | 100% for each type of Elevator |
| (xiii) | Complete set of Controller | 1No. of each type for each type of Elevator |
| (xiv) | VVVF Drive Complete Set for Speed Control | 1No. each Card for each type of Elevator |
| 6.03.02 | Elevator Car | |
| (i) | Fixed contact assembly | 6Nos. each type & rating for each type of Elevator |
| (ii) | Moving contact assembly | 6Nos. each type & rating for each type of Elevator |
| (iii) | Operating Lever | 4Nos. each type for each type of Elevator |





| Sl. No. | Equipment/Package Name | Quantity to be supplied for the Package |
|---------|--|---|
| (v) | Coupling | |
| (a) | Complete Set of Coupling (Motor to Compressor) | 1Set (one set means complete replacement for one compressor) |
| (b) | Flexible Rubber for Coupling | 4Nos. |
| 6.05.18 | Drain Moisture Trap | 2Sets (one set means complete replacement for one compressor) |
| 6.05.19 | Safety Valve's Springs & Gasket for LP Stage | 1Set (one set means complete replacement for one safety valve) |
| 6.05.20 | Safety Valve's Springs & Gasket for HP Stage | 1Set (one set means complete replacement for one safety valve) |
| 6.05.21 | Oil Pump & Motor Complete Assembly | 1Set |
| 6.05.22 | Drive Motor | 1No. |
| 6.05.23 | Other Spares as applicable as per the Electrical List | Applicable Item & Quantity same as indicated in Electrical list Sl. No.7.08.00, 7.12.00 & 7.21.00 |
| 6.05.24 | Compressed Air Line Valves | As applicable as per Sl. No.5.05.02 |
| 6.05.25 | C&I Items | |
| (i) | PLC with MMI System | Applicable Item & Quantity same as indicated in C&I list Sl. No. 8.03.00 |
| (ii) | Field Instruments & Others as applicable as per the C&I List | Applicable Item & Quantity same as indicated in C&I list Sl. No. 8.04.00, 8.07.00 & 8.10.00 |
| 6.05.26 | Air Drying Plant (HOC Type) | |
| (i) | Pre-filter Elements | 2Sets (one set means complete replacement for one drier filter) |
| (ii) | After-filter Elements | 2Sets (one set means complete replacement for one drier filter) |
| 6.06.00 | Ventilation System | |
| 6.06.01 | Centrifugal Fans | |
| (i) | Set of Bearings for Air Washer Fans | 1Set for each Type of Fan |
| (ii) | Set of Bearings for U.A.F. Fans | 1Set for each Type of Fan |
| (iii) | Impeller for the Fan | 1Set for each Type of Fan |
| (iv) | Drive Motor | 1No. for each Type of Fan |
| (v) | Electrical Spares as applicable as per the Electrical List | Applicable Item & Quantity same as indicated in Electrical list Sl. No. 7.21.00 |
| 6.06.02 | Centrifugal Pumps | |
| (i) | Set of Bearings for Air Washer Pumps | 1Set for each Type and rating of Pump |
| (ii) | Set of Bearings for U.A.F. Pumps | 1Set for each Type and rating of Pump |
| (iii) | Gland Packing, Shaft Sleeve & Casing Wearing Ring | 1Set for each Type and rating of Pump |
| (iv) | Impeller for the Pump | 1Set for each Type and rating of Pump |
| (v) | Electrical Spares as applicable as per the Electrical List | Applicable Item & Quantity same as indicated in Electrical list Sl. No. 7.21.00 |
| 6.06.03 | Spray Nozzles | |
| (i) | Spray nozzles for air washer unit | 1Set (one set means complete replacement for one air washer) |
| (ii) | Spray nozzles for U.A.F. unit | 1Set (one set means complete replacement for one UAF) |
| 6.06.04 | SS Filters | |
| (i) | SS Filters for Air washer | 1Sets (one set means complete replacement for one air washer) |
| (ii) | SS Filter for Unitary air filtration unit | 1Sets (one set means complete replacement for one UAF) |





| SI. No. | Equipment/Package Name | Quantity to be supplied for the Package |
|--------------------|--|---|
| 6.06.05 | Flow Regulating Valve | |
| (i) | For Air Washer | 1No. each type & size |
| (ii) | For Unitary Air Filtration Unit | 1No. each type & size |
| 6.06.06 | Basket for POT Strainer | |
| (i) | Strainer Basket for Air Washer | 1No. for each type and size |
| (ii) | Strainer Basket for Unitary Air Filtration unit | 1No. for each type and size |
| 6.06.07 | Valves | |
| (i) | Gate valve for Air washer | 2Nos. each type & size |
| (ii) | NR Valve for Air Washer | |
| (iii) | Gate valve for Unitary Air Filtration Unit | 2Nos. each type & size |
| (iv) | NR valve for Unitary Air Filtration Unit | 1No. each type & size |
| (v) | Gate Valve for Make-up Drain of Air washer | 1No. each type & size |
| (vi) | Gate valve for UAF | 2Nos. each type & size |
| 6.06.08 | Electrical Spares as applicable as per the Electrical List | Applicable Item & Quantity same as indicated in Electrical list SI. No. 7.12.00, 7.13.00. |
| 6.06.09 | Field Instruments & Others as applicable as per the C&I List | Applicable Item & Quantity same as indicated in C&I list SI. No. 8.04.00, 8.07.00 & 8.10.00 |
| 6.07.00 | Air Conditioning System | |
| 6.07.01 | Reciprocating Compressors of all categories | |
| (i) | Piston Ring | 1Set for each categories |
| (ii) | Piston | 1Set for each categories |
| (iii) | Complete Set of Bearing | 1Set for each categories |
| (iv) | Complete Set of Seal and other wear out parts | 1Set for each categories |
| (v) | Complete set of Valve Head Assembly | 2Sets for each categories |
| (vi) | Crank Shaft complete set | 1Set for each categories |
| (vii) | Connecting Rod | 1Set for each categories |
| 6.07.02 | Centrifugal pumps of all categories | |
| (i) | Impeller | 1Set for each categories |
| (ii) | Wearing Rings | 1Set for each categories |
| (iii) | Complete Set of Bearing | 1Set for each categories |
| (iv) | Complete Set of Seal and other wear out parts | 1Set for each categories |
| (v) | Strainer Basket | 1Set for each categories |
| 6.07.03 | Centrifugal Blowers of All AHU | |
| (i) | Rotating Assembly | 1Set for each categories |
| (ii) | Complete Set of Bearing | 1Set for each categories |
| 6.07.04 | Heat Exchangers | |
| (i) | Plug for condenser Tube | 10Nos. |
| (ii) | Sight Glass | 2Nos. each type |
| (iii) | Safety Relief valves | 1No. each type |
| 6.07.05 | Cooling Tower | |
| (i) | Spray nozzles | 1Set (one set means complete replacement for one cooling tower) |
| (ii) | Set of fills | 10% (rounded off to the next higher integer) of total quantity used one Tower |
| 6.07.06 | Valves | 1No. for each type, Class and size |





| Sl. No. | Equipment/Package Name | Quantity to be supplied for the Package |
|-----------|--|--|
| (d) | Voltmeter Selector Switch | 3 nos of each type. |
| (xvii) | Isolation switch for the control supply (AC Supply On / Off Switch, DC Supply On / Off Switch, Motor Heater On /Off Switch etc.) | 3 nos of each type. |
| (xviii) | Operating mechanism rod for each rating | 3 nos |
| (xix) | Set of gaskets of each rating | 2 sets |
| (xx) | Ammeter of each type & range | 2 no of each type & range |
| (xxi) | Voltmeter of each type & range | 1 no of each type &range |
| (xxii) | Circuit breaker aux. contact assembly:- | 10% (ronded off to the next higher integer)of total nos. or minimum 5 nos whichever is higher for each type and rating used in each switchgear |
| (a) | 52 a & b | |
| (b) | 52 c & d | |
| (xxiii) | Indicating Lamps | |
| (a) | Indicating lamps (Red, amber, green, white, blue) | 5% (ronded off to the next higher integer)of total nos. for each type |
| (b) | Indicating lamp covers of all colours, lamp resistors & holders | 5% (ronded off to the next higher integer)of total nos. for each type and rating used in each switchgear |
| (xxiv) | Fuse base and holder of each type & rating | 6 nos. of each type. |
| (xxv) | MCB & Fuse of each type & rating | 12 nos of each. |
| (xxvi) | Maintenance tools and accessories for maintenance (bidder to list) | 1 set. |
| (xxvii) | Carbon brushes for spring charging motor (if applicable) | 20 sets |
| (xxviii) | Breaker jaw contact (Bus -end & breaker-end) assembly | 2 sets (1 set consists of 3 nos.)of each rating |
| (xxix) | Terminal blocks | 12 nos. of each type and rating |
| (xxx) | Arc chute (if applicable for each rating) | 3 nos. |
| (xxxi) | DC Supply Source Selector Switch (3-position) | 3 nos. |
| (xxxii) | Bearings for spring charging motor | 6 sets |
| (xxxiii) | Multiple pin plug contact assy. with cables (male & female) | 6 sets |
| (xxxiv) | Guide for moving contact set | 6 sets (complete) |
| (xxxv) | Interphase barrier | 3 nos. for each type |
| (xxxvi) | Contactors with HRC fuses | 10 % (ronded off to the next higher integer)of each type and rating |
| (xxxvii) | Aux. contactors | 10 % (ronded off to the next higher integer)of each type and rating |
| (xxxviii) | Control supply transformers (If applicable) | 1 no of each type. |
| (xxxix) | Dash pot complete assembly | 1 no. with each type |
| (XL) | Surge Arrester | 5 nos. of each type and rating |
| (XLI) | Transducer | 2 nos. for each type and Rating |
| (XLII) | Energy Meter | 1 no of each type and rating |
| (XLIII) | HT fuse of PT | 3 nos. of each type and rating |
| 7.08.00 | 415V System | |
| 7.08.01 | 11/0.415KV Transformer (for Each make, type and rating of Transformer) | |
| (i) | Door Limit Switch complete set | 1 set (1 set means total requirement for one |





| SI. No. | Equipment/Package Name | Quantity to be supplied for the Package |
|---------|--|---|
| | | Transformer) |
| (ii) | Neutral CT | 1 no of each type and rating |
| (iii) | Temperature scanner | 1 no. |
| (iv) | bhy | 3 No |
| (v) | LV Bushing with metal parts, connectors and gaskets | 3 No |
| (vi) | LV neutral Bushing with metal parts, connectors and gaskets | 1 No |
| (vii) | Post Insulator | 1 set (1 set means total requirement for one Transformer) |
| (viii) | Limb of complete LT & HT of temperature sensing devices | 1 Set (1 set means total requirement for one Transformer) |
| 7.08.02 | 415V Air Circuit Breaker (for Each make, type and rating of ACB) | |
| (i) | Trip Coil | 20% of total nos. or minimum 5 nos whichever is higher for each type and rating used in each switchgear (PCC/PMCC/MCC/ACDB) |
| (ii) | Closing Coil | 20% of total nos. or minimum 5 nos whichever is higher for each type and rating used in each switchgear (PCC/PMCC/MCC/ACDB) |
| (iii) | Spring Charging Motor | 2 nos. |
| (iv) | Spring Charging Motor with complete Mechanism | 2 nos. |
| (v) | Spring Charged Limit Switch | 5 nos. |
| (vi) | Thermal Overload for Spring Charging Motor | 2 nos. |
| (vii) | Main Contact (Fixed and moving) assembly | 5 sets (1 set consists of 3 nos.) for each type and rating |
| (viii) | Arcing Contact (Fixed and moving) assembly | 5 sets (1 set consists of 3 nos.) for each type and rating |
| (ix) | Breaker Jaw Contact (Bus-end & Breaker- end) assembly | 5 sets (1 set consists of 3 nos.) for each type and rating |
| (x) | Sliding Contact (Fixed & Moving) | 3 sets. |
| (xi) | Breaker Auxiliary Contact Block | 5 nos. |
| (xii) | Arcing Chute | 2 sets (1 set consists of 3 nos.) for each type and rating |
| (xiii) | Plug Socket with Prefab cable | 3 nos |
| (xiv) | Position Limit Switch | 5 sets |
| 7.08.03 | 415V PCC, PMCC, MCC, ACDB, DCDB, Elect. Control Panel (For each PCC, PMCC, MCC, ACDB, DCDB and Elect. Control Panel) (applicable items of PCC, PMCC, MCC, ACDB, DCDB and Elect. Control Panel shall be considered) | |
| (i) | Indicating Lamps complete assembly | |
| (a) | Red | 3 nos of each make and type. |
| (b) | Blue | 3 nos of each make and type. |
| (c) | Green | 3 nos of each make and type. |
| (d) | White | 3 nos of each make and type. |
| (e) | Amber | 3 nos of each make and type. |
| (ii) | CT | 2 nos. for each make, type and Rating |





| SI. No. | Equipment/Package Name | Quantity to be supplied for the Package |
|----------|---|--|
| (iii) | Transducer | 2 no for each make, type and Rating |
| (iv) | Trip / Neutral / close Control Switch | 2 nos. for each make, type and Rating |
| (v) | Switch gear or MCC / Trial / Normal selector switch | 2 nos. for each make, type and Rating |
| (vi) | Local/Remote selector switch | 2 nos. for each make, type and Rating |
| (vii) | AC Supply On / Off Switch | 1 no. for each make, type and Rating |
| (viii) | DC Supply On / Off Switch | 1 no. for each make, type and Rating |
| (ix) | Motor Heater On /Off Switch | 1 no. for each make, type and Rating |
| (x) | DC Supply Source Selector Switch (3-position) | 1 no. for each make, type and Rating |
| (xi) | Ammeter Selector Switch | 1 no. for each make, type and Rating |
| (xii) | Voltmeter Selector Switch | 1 no. for each make, type and Rating |
| (xiii) | Voltmeter | 2 no. for each make, type and Rating |
| (xiv) | Ammeter | 2 no. for each make, type and Rating |
| (xv) | Auxiliary Control Contactor | |
| (a) | Auxiliary Control Contactor complete assembly | 10% of total nos for each make, type and Rating. |
| (b) | Auxiliary Control Contactor spare kits | 10% of total nos. for each make, type and Rating. |
| (c) | Auxiliary Control Contactor Coils | 10% of total nos for each make, type and Rating. |
| (xvi) | Power Contactor | |
| (a) | Power Contactor Complete Assembly | 10% of total nos for each make, type and rating |
| (b) | Power Contactor spare kits | 10% of total nos for each make, type and Rating. |
| (c) | Power Contactor Coils | 10% of total nos for each make, type and Rating. |
| (xvii) | MCCB | 5% of total nos. for each make, type and rating. |
| (xviii) | MCB | 5% of total nos. for each make, type and rating. |
| (xix) | Switch Fuse Unit (DC) | 10% of total nos. for each make, type and rating. |
| (xx) | Power Fuse | 5% of total nos. for each make, type and rating. |
| (xxi) | Control Fuse | 5% of total nos. for each make, type and rating. |
| (xxii) | Thermal Overload Relay | 5% of total nos. for each make, type and rating. |
| (xxii) | Sliding contact (Fixed and moving) Complete assembly | 2 sets of each make, type and rating |
| (xxiii) | Busbar to module Lira Contact assembly | 2 sets of each make, type and rating (1 set means all 3 ph+ neutral) |
| (xxiv) | Control and Aux. Transformer | 1 no of each make, type and rating |
| (xxv) | Delay Timer | 2 no of each make, type and rating |
| (xxvi) | Power Terminal Block | 2 sets for each make, type and rating |
| (xxvii) | Control Terminal Block | 2 sets for each make, type and rating |
| (xxviii) | End plate for Power and Control terminal block | 2 sets for each make, type and rating |
| (xxix) | Energy meter | 1 no for each make, type and rating |
| (xxx) | Relays (Other than numerical relay): | |
| (a) | Conventional (Electromagnetic/Static type) Relay | 2 no for each make, type and rating |
| (b) | Aux. relays & Lock out relays & TIMERS | 2 nos for each make, type and rating |
| (xxxi) | MCCB Status (On/off) Monitoring Switch/Contact | 2 nos for each make, type and rating |
| (xxxii) | Push Button (On/Off) Complete Assembly | 2 nos for each make, type and rating |
| (xxxiii) | Annunciation Facia with lamps complete set (if applicable) | 1 set for each make, type and rating |





| SI. No. | Equipment/Package Name | Quantity to be supplied for the Package |
|--------------------|--|--|
| 7.11.06 | UPS Battery (Ni-Cad Type) | |
| (i) | Battery Cell (Uncharged, Dry) | 10Nos. each type |
| (ii) | Inter connecting cell strips | 10Nos. each type |
| (iii) | Vent cap | 10Nos. each type |
| (iv) | Hydrometer | 1No. |
| (v) | Rubber gloves | 1Pair |
| (vi) | Voltmeter for measuring cell voltage (Center zero type) | 1No. |
| (vii) | Funnel | 1No. |
| (viii) | Jug | 1No. |
| (ix) | Apron & Goggles | 1Set |
| (x) | Cell lifting puller | 1No. |
| (xi) | Insulated socket spanner with handle | 1No. |
| (xii) | Terminal screw with Belleville washer | 5% of total quantity used |
| (xiii) | Plastic filling bottle | 1No. |
| (xiv) | Thermometer | 1No. |
| 7.11.06 | Other Electrical Items | For other applicable items SI No.7.12.00 & 7.08.00 of this document shall be followed. |
| 7.12.00 | Control Panel/Desk Mounted Items | |
| 7.12.01 | Push Button Complete assembly | 10Nos for each colour |
| 7.12.02 | Push Button Contact Element (1NO + 1NC) Block | 20Nos. |
| 7.12.03 | Selector Switch | 10Nos. for each type and rating |
| 7.12.04 | Meter (Analog and Digital) | |
| (i) | Ammeter | 2Nos. for each type and range |
| (ii) | Voltmeter | 2Nos. for each type and range |
| (iii) | Frequency | 2Nos. for each type and range |
| (iv) | MW | 2Nos. for each type and range |
| (v) | MVAR | 2Nos. for each type and range |
| (vi) | Power Factor | 2Nos. for each type and range |
| (vii) | Synchroscope | 1No. for each type and range |
| (viii) | Synchrocheck Relay complete set | 1No. for each type and range |
| (ix) | Transducer | 1No. for each type and range |
| 7.12.05 | Indicating Lamps complete assembly | 20Nos. for each Colour and type |
| 7.12.06 | Mimic Lamps | 10Nos. for each Colour and type |
| 7.12.07 | MCB | 5Nos. for each type and rating |
| 7.12.08 | Door Limit Switch | 5Nos. |
| 7.12.09 | Annunciation system | |
| (i) | Lamp Box with Facia & Lamps (LED type) | 25Nos. |
| (ii) | Hooter | 1No. |
| (iii) | Each type of PCB (for non-PLC driven system) | 1(one) no. |
| 7.13.00 | Actuator | |
| 7.13.01 | Complete set of Actuator | 2Nos. for each type, make and rating, 1 no. for H2 cooler Temperature controller and 1 no. for stator water temperature controller |
| 7.13.02 | Power Unit for Modulating Actuator | 4Nos. of each type |





| SI. No. | Equipment/Package Name | Quantity to be supplied for the Package |
|--------------------|--|--|
| 7.13.03 | DC-DC Power Pack Unit | 4Nos. of each type |
| 7.13.04 | Electronic cards | 4Nos. of each type |
| 7.13.05 | Position Feed Back Transmitters | 4Nos. of each type |
| 7.13.06 | Control Unit | 4Nos. of each type |
| 7.13.07 | Limit Switch Assembly | 2 Nos each type and rating |
| 7.13.08 | Torque Switch Assembly | 2 Nos each type and rating |
| 7.13.09 | Power Contactor | 5Nos. for each type and rating |
| 7.13.10 | Auxiliary Contactor | 5Nos. for each type and rating |
| 7.13.11 | Thermal Over Load Relay | 2Nos. for each type and rating |
| 7.13.12 | Motor | 1No. each type and rating |
| 7.13.13 | Complete Seal kit | 2Sets for each type and rating |
| 7.13.14 | Complete O-Ring Set | 2Sets for each type and rating |
| 7.14.00 | Illumination | |
| 7.14.01 | Lighting fixtures without light | 20 Sets for each make, type and rating |
| 7.14.02 | MCCB | 5 Nos for each make, type and rating . |
| 7.14.03 | MCB | 20 Nos for each make, type and rating . |
| 7.14.04 | Power and Control Contactor | 5 Nos for each make, type and rating |
| 7.14.05 | Switches | 5 Nos for each make, type and rating . |
| 7.14.06 | Receptacles with plug | 5 Nos for each make, type and rating |
| 7.14.07 | Rotary switches | 2 Nos for each make, type and rating . |
| 7.14.08 | LED light | 50 nos for each make, type and rating . |
| 7.14.09 | Clock switch type Time Switch | 2 nos for each make, type and rating . |
| 7.14.10 | Lighting Transformer | 1 no for each make, type and rating . |
| 7.15.00 | Cable | |
| 7.15.01 | 11KV Grade HT Power Cable | 2 (Two) Kms. of each type, size & rating of Cables |
| 7.15.02 | 3.3KV Grade HT Power Cable | 2 (Two) Kms. of each type, size & rating of Cables |
| 7.15.03 | LT Power Cable | 2(Two)Kms of each type, size & rating of Cables |
| 7.15.04 | Control Cable | 2(Two)Kms. of each type, size & rating of Cables |
| 7.15.05 | Fire Survival Cable | 1(One)Km of each type, size & rating of Cables |
| 7.16.00 | Neutral Grounding Registor | |
| 7.16.01 | NGR complete with all accessories | 1 set of each make, type and rating |
| 7.16.02 | Insulator | 2 nos for each make, type, rating and size |
| 7.16.03 | Neutral CT(if applicable) | 1 no of each type and rating |
| 7.17.00 | DG Set | |
| 7.17.01 | Diesel Engine | |
| (i) | Element Corrosion Resistor | 8Nos. |
| (ii) | Element lub oil Filter | 8Nos. |
| (iii) | Element lub oil by pass Filter | 8Nos. |
| (iv) | Element Fuel Filter | 16Nos. |
| (v) | Plate corrosion Resistor | 16Nos. |
| (vi) | Element Air cleaner outer | 2Nos. |
| (vii) | Element Air cleaner Inner | 2Nos. |
| (viii) | Fuel Oil Pump | 1No. |





| SI. No. | Equipment/Package Name | Quantity to be supplied for the Package |
|--------------------|--|--|
| (viii) | Voltmeter for measuring cell voltage (Center zero type) | 1No. |
| 7.18.02 | Float -cum- Boost Charger (For each make, Type and Rating) | |
| (i) | Electronic Module, PCB, Cards of each type and rating (with all components mounted) | 2 Set |
| (ii) | Fuses of each type and rating | 100% of total quantity. |
| (iii) | SCR of each type and rating | 2 Nos. |
| (iv) | Blocking Diode of each type and rating | 5 Nos. of each type |
| (v) | Potentiometer of each type and rating | 1 Set |
| (vi) | Pulse transformer | 1 Set of each type |
| (vii) | Main and Aux. transformer | 1 no of each type and rating |
| (viii) | Capacitor | 2 no of each type and rating |
| (ix) | Meters | 1 No of each type |
| (x) | Transducer | 1 No of each type |
| (xi) | Selector Switch | 1 no of each type |
| (xii) | Control Switch | 1 no of each type |
| (xiii) | Current transformer(if applicable) | 1 no of each type and rating |
| (xiv) | Push button complete set | 1 no of each type |
| (xv) | Annunciation window | 1No. |
| (xvi) | Indicating Lamps complete assembly | 2 Nos of each type. |
| 7.19.00 | 24V DC System | |
| 7.19.01 | Battery | |
| (i) | Battery Cell (Uncharged, Dry) | 10Nos |
| (ii) | Inter connecting cell strips | 10Nos |
| (iii) | Vent plug | 5Nos |
| (iv) | Teak wood cable clamps with hardware | 2Nos |
| (v) | Hydrometer | 1No. |
| (vi) | Rubber gloves | 1pair |
| (vii) | Voltmeter for measuring cell voltage (Center zero type) | 1No. |
| (viii) | Insulated socket spanner with handle | 1No. |
| (ix) | Thermometer | 1No. |
| 7.20.02 | Float -cum- Boost Charger | |
| (i) | Fuses & fuse links | 100% of total quantity for each type, rating of fuses used in the system |
| (ii) | SCR | 100% Used in the System |
| (iii) | Diode | 100% Used in the System |
| (iv) | Indicating lamps | 100% Used in the System |
| (v) | All types of Electronic Module/ PCB/Card | 2Nos. each type used in the system |
| (vi) | pulse transformer | 1 set |
| 7.20.03 | Othe DCDB Spares items as applicable as per the Electrical List | Item & Quantity same as indicated in Electrical list Sl. No.7.09.00 |
| 7.20.04 | Other Electrical Spares as applicable as per the Electrical List | Item & Quantity same as indicated in Electrical list Sl. No.7.08.00 & 7.12.00 |
| 7.21.00 | Motor | |
| 7.21.01 | 11 KV & 3.3 KV Motor | |
| (i) | Motor of each type and rating (Note :) | 10% of the installed quantity or minimum 1 |





| SI. No. | Equipment/Package Name | Quantity to be supplied for the Package |
|---------|--|---|
| | motors covered in mechanical spare items need not to be included here again) | number whichever be higher |
| (ii) | Neutral End Terminal Bushing with Fasteners | 1 no. for each type and rating of Motor |
| (iii) | Bearing Temperature Gauge Driving & Non-Driving End | 1 set for each type and rating of Motor |
| (iv) | Phase segregated terminal boxes | 2 Nos. for each type and rating of Motor |
| (v) | Heaters | 2 sets for each type and rating of Motor |
| (vi) | Complete Set of Coupling | 1 set for each type and rating of Motor |
| (vii) | Bearings (DE) for each type and rating of motors | 2 sets for each type and rating of Motor |
| (viii) | Bearings (NDE) for each type and rating of motors | 2 sets for each type and rating of Motor |
| (ix) | Cooling Fan Internal & External | 1 set for each type and rating of Motor |
| (x) | Neutral CT for differential protection (For motor rating >1000 KW) | 2 no of each type and rating. |
| (xi) | End Termination kits | 2 Nos. of each type and rating |
| (xii) | Indicating Instruments/gauges other than Bearing temperature gauge (as applicable) | 1 set for each type and rating of Motor |
| (xiii) | Phase side Bushing and Insulator | 1Set for each type and rating of Motor |
| (xiv) | Oil Seal Ring (as applicable) | 1Set for each type and rating of Motor |
| 7.21.02 | 415 Volt Motor | |
| (i) | Motor of each type and rating (Note : motors covered in mechanical spare items need not to be included here again) 10% of the installed quantity or minimum 1 number whichever be higher | 10% of the installed quantity or minimum 1 number whichever be higher |
| (ii) | End Shield Cover Driving & Non-Driving End | 1 set for each type and rating of Motor |
| (iii) | Heaters | 2 sets for each type and rating of motor |
| (iv) | Bearings (DE and NDE) for each type and rating of motor | 2 sets |
| (v) | Cooling Fan for all type and rating of LT motors | One (1) set |
| (vi) | Dust seals and gaskets for each type of motors | 1 Set |
| (vii) | Motor Terminal Block | 1 no. for each type and rating of Motor |
| (viii) | Complete Set of Coupling | 1 set for each type and rating |
| 7.21.04 | DC Motor | |
| (i) | Motor of each type and rating (Note : motors covered in mechanical spare items need not to be included here again) | 10% of the installed quantity or minimum 1 number whichever be higher |
| (ii) | Carbon brushes | 2 sets for each type and rating of Motor |
| (iii) | Brush assemblies | 2 sets for each type and rating of Motor |
| (iv) | Terminal blocks | 1 set for each type and rating of Motor |
| (v) | Heaters | 1 set for each type and rating of Motor |
| (vi) | Complete Set of Coupling | 1 set for each type and rating of Motor |
| (vii) | Bearings (DE and NDE) for each type and rating of motor | 1 set for each type and rating of Motor |
| (viii) | Cooling Fan | 1 set for each type and rating of Motor |
| 7.22.00 | Local Control Station | |





| SI. No. | Equipment/Package Name | Quantity to be supplied for the Package |
|--------------------|---|--|
| 8.03.27 | Micro PLC system (i.e. integrated CPU & I/O system, where above mentioned components are not applicable) | One Complete Set |
| 8.04.00 | Field Instrument | |
| 8.04.01 | Electronic Transmitters | |
| (i) | Pressure | 1(One) no. complete set for each type and model/range used in the system |
| (ii) | Differential Pressure | 1(One) no. complete set for each type and model/range used in the system |
| (iii) | Level | 1(One) no. complete set for each type and model/range used in the system |
| (iv) | Speed | 1(One) no. complete set for each type and model/range used in the system |
| (v) | Flow Transmitter | 1(One) no. complete set for each type and model/range used in the system |
| (vi) | 3-D Ultrasonic level Transmitter | 1(One) no. complete set for each type and model/range used in the system |
| 8.04.02 | Different type of Switches | |
| (i) | Pressure Switch | 2(two)no. of each type & model/range used in the system |
| (ii) | Differential Pressure Switch | 2(two)no. of each type & model/range used in the system |
| (iii) | Level Switch | 2(two)no. of each type & model/range used in the system |
| (iv) | Flow Switch | 2(two)no. of each type & model/range used in the system |
| (v) | Temperature Switch | 2(two)no. of each type & model/range used in the system |
| (vi) | Dust Detector | 1(one)no. of each type & model used in the system |
| 8.04.03 | Thermocouple | 10% 100% of each type and length used in one unit |
| 8.04.04 | RTD | 100% of each type and length used in one unit |
| 8.04.05 | Thermo-well for both TC and RTD | 2(Two) nos. for each type and rating/length used in the system |
| 8.04.06 | Solenoid Valve | |
| (i) | Complete Solenoid Valve Assembly | 2Nos. for each type and rating used in the system |
| (ii) | Coil (single or double coil type) | 10% of total nos. used in the system or minimum 5(five) Nos. whichever is more for each type and rating. |
| 8.04.07 | Different types of Gauge | 10% of total nos. used in the system or minimum 1(one) no. whichever is more for each type and range. |
| (i) | Pressure Gauge | 10% of total nos. used in the system or minimum 1(one) no. whichever is more for each type and range. |
| (ii) | Differential Pressure Gauge | 10% of total nos. used in the system or minimum 1(one) no. whichever is more for each type and range. |
| (iii) | Temperature Gauge | 10% of total nos. used in the system or minimum 1(one) no. whichever is more for each type and range. |





| SI. No. | Equipment/Package Name | Quantity to be supplied for the Package |
|--------------------|---|--|
| (iv) | Magnetic Level Gauge | 10% of total nos. used in the system or minimum 1(one) no. whichever is more for each type and range. |
| 8.04.08 | Air Filter Regulator including moisture separator complete set with pressure gauges | 10Nos. |
| 8.04.09 | Rotameter | 10% of total nos. used in the system or minimum 2(Two) nos. whichever is more for each type, rating,/model and size used in the system. |
| 8.04.10 | Gauge Glass | 1No. for each type and size |
| 8.04.11 | Erection Hardware | |
| (i) | Transmitter's Manifold | 10% of total nos. used in the system or minimum 2(Two) nos. whichever is more for each type, rating,/model and size used in the system. |
| (ii) | Impulse Line Root/Source valve | 10% of total nos. used in the system or minimum 4(four) nos. whichever is more for each type, rating,/model and size used in the system. |
| (iii) | Impulse Line Isolation valve | 10% of total nos. used in the system or minimum 4(four) nos. whichever is more for each type, rating,/model and size used in the system. |
| (iv) | Impulse Line Drain valve | 10% of total nos. used in the system or minimum 4(four) nos. whichever is more for each type, rating,/model and size used in the system. |
| (v) | Impulse Line fittings | Each type/size 25Nos. |
| (vi) | Impulse Pipe | Each type/size 100Mtrs. |
| (vii) | Copper/SS Tube | Each type/size 100Mtrs. |
| (viii) | Fittings for Copper/SS Tube | Each type/size 100Nos. |
| 8.04.13 | Conductivity Type Level Switch | |
| (i) | Conductivity Ttype level Probes | 10% of total nos. used in the system or minimum 4(four) nos. whichever is more. |
| (ii) | Complete Electronics unit | 1Set |
| (iii) | Isolating/Root Valve | 2Nos. |
| 8.04.14 | Cable This particulat items shall be common for BTG , CHP and AHP areas. | |
| (i) | Thermocouple Cable | 3(three)Kms. of each type, size & rating of Cables |
| (ii) | Control & Instrumentation Cable | 3(three)Kms. of each type, size & rating of Cables |
| 8.04.15 | Cold Junction Compensation Boxes | 10% of total nos. used in the system or minimum 2(two) nos. for each type/size whichever is more. |
| 8.04.16 | Current/Voltage Transducers | 1(one) no. each type/rating used in the system |
| 8.04.17 | MWatt/MVAR Transducer | 1(one) no. each type/rating used in the system |
| 8.04.18 | Chlorine Leak Detector System | |
| (i) | Sensor Unit (complete) | 2No. |
| (ii) | Transmitter/Processing Unit (complete) | 2No. |
| 8.05.00 | SWAS | |
| 8.05.01 | Conductivity | |
| (i) | Conductivity Sensor/cell for each type of Cell Constant | 20% of the total no. used in the system or minimum 2(two) nos. whichever is higher. |
| (ii) | Conductivity Transmitter Complete Set | 20% of the total no. used in the system or |





| SI. No. | Equipment/Package Name | Quantity to be supplied for the Package |
|----------------|---|--|
| (x) | Regulator & Gauge Assembly | 1Set |
| 8.06.03 | Oxygen Analyser | |
| (i) | Field Sensor | 4Nos. complete unit |
| (ii) | Field Transmitter/complete Electronic unit | 2Nos. complete unit |
| (iii) | Power supply Card | 2Nos. |
| (iv) | Instrumentation Hardware (viz, isolation valve, solenoid valve etc.) | 2Nos. each items/type |
| 8.07.00 | Pneumatic Control Valve & Power Cylinder (Applicable for all Modulating Type & On-Off/Isolating Type) | |
| 8.07.01 | Control Valve | |
| (i) | Pneumatic Diaphragm for Diaphragm actuated valve | 2(two) nos. for each type of Actuator |
| (ii) | Actuator Seal Kit for Pneumatic Cylinder actuated valve | 2(two) nos. for each type of Actuator |
| (iii) | Gland Packing | 1(one) set for each type of Control Valve |
| (iv) | Stem | 1(one) No. for each type of Control Valve |
| (v) | Plug | 1(one) No. for each type of Control Valve |
| (vi) | Seat | 1(one) No. for each type of Control Valve |
| (vii) | Cage | 1(one) No. for each type of Control Valve |
| (viii) | Retainer Ring | 1(one) set for each type of Control Valve |
| (ix) | Seal Ring | 1(one) set for each type of Control Valve |
| (x) | Gasket | 2(two) Sets. for each type of Control Valve |
| (xi) | Smart Positioner of the Valve | 10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model. |
| (xii) | Seal Kit for the Positioner | 2(two) Sets. for each type of Positioner |
| (xiii) | Position Feedback Transmitter (applicable if it is not integral with the Smart Positioner) | 10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model. |
| (xiv) | Complete Set of Solenoid Valve for Pneumatic type On/Off Valve | 2Nos. for each type & ratings |
| (xv) | Solenoid Coil for Pneumatic type On/Off Valve | 5Nos. for each type & ratings |
| 8.07.02 | Power Cylinder | |
| (i) | Actuator Seal Kit | 2(two) nos. for each type of Power Cylinder |
| (ii) | Gasket | 2(two) Sets. for each type of Power Cylinder |
| (iii) | Complete Set of Power Cylinder | 1(one) no. each type for all application |
| (iv) | Smart Positioner of the Valve | 10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model. |
| (v) | Seal Kit for the Positioner | 2(two) Sets. for each type of Positioner |
| (vi) | Position Feedback Transmitter (applicable if it is not integral with the Smart Positioner) | 10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model. |
| (vii) | Complete Set of Solenoid Valve for Pneumatic type On/Off Power Cylinder | 2Nos. for each type & ratings |
| (viii) | Solenoid Coil for Pneumatic type On/Off Power Cylinder | 5Nos. for each type & ratings |
| (ix) | Position Limit Switch for Pneumatic type On/Off Power Cylinder | 10Nos. for each type & ratings |





| SI. No. | Equipment/Package Name | Quantity to be supplied for the Package |
|--------------------|---|---|
| 8.07.03 | I/P Converter for Control Valve/Power Cylinder (if applicable) | 10% of total quantity used in the system or minimum 5(five) nos. whichever is more for each type and model. |
| 8.07.04 | Air Lock Relay | 10Nos. for each type |
| 8.07.05 | Signal Air Booster Unit | 2Nos. for each type |
| 8.08.00 | Turbine Supervisory Instruments & Plant Rotating Machinery Monitoring System | |
| 8.08.01 | Probes with extension cable | 10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model. |
| 8.08.02 | Signal Converter/Proximitors for Transducer system | 10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model. |
| 8.08.03 | Rack Mounted Monitors for Transducer system | 10% of total quantity used in the system or minimum 1(one) no. whichever is more for each type and model. |
| 8.08.04 | Rack Interface Modules | 10% of total quantity used in the system or minimum 1(one) no. whichever is more for each type and model. |
| 8.08.05 | Configurable type Relay Output Modules | 10% of total quantity used in the system or minimum 1(one) no. whichever is more for each type and model. |
| 8.08.06 | Communication/Gateway Modules | 10% of total quantity used in the system or minimum 1(one) no. whichever is more for each type and model. |
| 8.08.07 | Rack Mounted Power Supply Modules | 10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model. |
| 8.09.00 | Closed Circuit Television System | |
| 8.09.01 | Complete Camera Unit | Each type 1(one) no. |
| 8.10.00 | Control Panel And Local/Remote Control Desk | |
| 8.10.01 | Mosaic/Conventional Type Push button Station | 10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model. |
| 8.10.02 | Mosaic Type Push button Station with LED Indication | 10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model. |
| 8.10.03 | Mosaic Type LED Indication Station | 10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model. |
| 8.10.04 | Simaphore Indicator | 2(two)Nos. each type |
| 8.10.05 | Annunciation System | |
| (i) | Each type of PCB (for non-PLC driven system) | 1(one) No. each |
| (ii) | Lamp Box with Facia & Lamps (LED type) | 10(ten)Nos. |
| (iii) | Hooter | 1(one) No. |
| 8.11.00 | Thermocouple for Furnace Temperature Probes | 2Nos. |
| 8.12.00 | Mill and Air Heater Fire Detection System | |
| 8.12.01 | Thermocouple | 10% or 1 no. whichever is more |
| 8.12.02 | Process Actuator Switches | 10% or 1 no. whichever is more |





WBPDC

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

**SECTION-XI
PROTECTIVE COATING AND PAINTING**



Development Consultants Pvt. Ltd.

**Volume : II-A
Section : XI
Protective Coating and Painting**



WBPDC

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

CONTENTS

| CLAUSE NO. | DESCRIPTION | PAGE NO. |
|-------------------|---|-----------------|
| 1.00.00 | INTENT OF SPECIFICATION | 1 |
| 2.00.00 | CODES AND STANDARDS | 1 |
| 3.00.00 | GENERAL REQUIREMENTS | 2 |
| 4.00.00 | EQUIPMENT, MATERIAL AND SERVICES TO BE FURNISHED BY THE BIDDER | 3 |
| 5.00.00 | COATING PROCEDURE AND APPLICATION | 5 |
| 6.00.00 | TEST REQUIREMENTS | 6 |
| 7.00.00 | INFORMATION/DATA REQUIRED | 10 |



Development Consultants Pvt. Ltd.

**Volume : II-A
Section : XI
Protective Coating and Painting**

**SECTION-XI****PROTECTIVE COATING 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 / Sa2½ : Near White Blast Cleaning
- b) SSPC PA 2 : Measurement of dry film coating thickness with magnetic gauges.
- c) ASTM D 45 : 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 of 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.
- 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)
- k) ISC HD 20 (11902) : Polyurethane coating for Interior and Exterior of steel pipe and fittings.
- l) ISC HD 20 (11055) : Solvent less Liquid epoxy system by application of Interior and Exterior surface of steel pipeline.

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.
- 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 up to SSPC SP10/NACE2/Sa2½ level to get “near white metal” surface 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.

4.03.00 **Painting**

4.03.01 Specification for application of paints for external surfaces protection of vessels / tanks / equipment / piping / fittings / valves shall be as follows :

- a) Surface preparation shall be done by means of sand blasting, which shall conform to SSPC SP10/NACE 2/Sa2½ 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.

4.03.02 Specification for application of paints for external surfaces protection of steel pipes and fittings which are buried underground / laid inside a Hume Pipe & or submerged Under Water and laid under Pipe Trenches (in road/rail/pipe or trench crossings) shall be as follows :

- a) Surface preparation by means of sand blasting and shall conforms to SSPC SP10/NACE2/ Sa2½.
- b) 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 1500 micron including primer coat.





4.03.03 Specification for application of paints for internal surface protection of large diameter pipes, if any, shall be as follows :

- a) Surface preparation by means of sand blasting which shall conform to SSPC SP10/NACE2/Sa2½ standard.
- b) 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.
- c) 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.
- d) The minimum dry film thickness (DFT) of internal lining shall be 500 micron.

4.03.04 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.

4.03.05 All motors, local push button stations, cable racks, structures used for supports etc. are to be painted with acid proof paint.

4.03.06 The following surfaces shall not be painted - stainless steel, galvanized steel, aluminum, copper, brass, bronze and other nonferrous materials.

4.03.07 No painting or filler shall be applied until all repairs, hydrostatic tests and final shop inspection are completed.

4.03.08 All machined surfaces shall have two (2) coats of water repellent 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 at least 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 at least 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 ±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) Test**

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.

6.02.02 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.

6.02.03 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.

6.02.04 Any audio visual sound or spark leads to indicate pinhole, break or conductive particle.

6.03.00 **Adhesion Pull off Test**

After holiday the coated surface is subjected to adhesion pull off test as per ASTM D 4541.

6.03.01 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.

6.03.02 **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.

6.03.03 **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.

6.03.04 **Select an adhesive**

Use araldite, a 100% solid epoxy adhesive. This adhesive requires at least 24 hours at room temperature to cure.

6.03.05 **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.





6.03.06 **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 hand wheel 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.

6.04.00 **Coating Repair**

Defective Coating shall be repaired in accordance with the following subsections.

6.04.01 **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 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.

6.04.02 Areas not accessible for coating repair such as interior surfaces of small diameter pipe shall be reprocessed and recoated.

6.04.03 **Coating Application**

The coating system shall be applied to the prepared areas in accordance with procedure.

6.04.04 Repair Inspection:

Repaired portion shall be electrically inspected using a holiday detector.





6.05.00 Welded Field Joints

6.05.01 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.

6.05.02 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.



WBPDCL

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

**SECTION-XII
SALIENT DESIGN DATA
[TABLE-I TO TABLE-VIII]**



Development Consultants Pvt. Ltd.

**VolumE : II-A
Section : XII
Salient Design Data**



CONTENT

| TABLES | DESCRIPTION | PAGE NO. |
|---------------|---------------------------------|-----------------|
| TABLE-I | ANALYSIS OF COAL | 1 |
| TABLE-II | ANALYSIS OF ASH | 2 |
| TABLE-III | HEAVY FUEL OIL ANALYSIS | 3 |
| TABLE-IV | LIGHT DIESEL OIL ANALYSIS | 4 |
| TABLE-V | DESIGN RAW WATER ANALYSIS | 5 |
| TABLE-VI | DESIGN CLARIFIED WATER ANALYSIS | 6 |
| TABLE-VII | CHEMICAL ANALYSIS OF LIMESTONE | 7 |
| TABLE-VIII | DESIGN DM WATER ANALYSIS | 8 |





ANALYSIS OF COAL

| Sl. No. | Characteristics | Unit | Design Coal | Worst Coal | Best Coal |
|---------|--|---------|-------------|------------|-----------|
| 1. | Proximate Analysis (As received basis) :- | | | | |
| | Total Moisture | % | 13.1 | 13.7 | 12.4 |
| | Ash | % | 41.0 | 43.7 | 38.1 |
| | Volatile Matter | % | 20.2 | 22.2 | 17.7 |
| | Fixed Carbon | % | 25.8 | 23.7 | 28.2 |
| 2. | Ultimate Analysis (As received basis) :- | | | | |
| | Carbon | % | 37.87 | 33.74 | 42.52 |
| | Hydrogen | % | 1.74 | 2.09 | 1.09 |
| | Nitrogen | % | 0.92 | 0.45 | 1.84 |
| | Oxygen | % | 5.19 | 5.92 | 3.96 |
| | Sulphur | % | 0.18 | 0.40 | 0.09 |
| | Carbonates | % | - | - | - |
| | Phosphorous | % | - | - | - |
| | Total Moisture | % | 13.1 | 13.7 | 12.4 |
| | Ash | % | 41.0 | 43.7 | 38.1 |
| | Gross Calorific Value | Kcal/Kg | 3200 | 3100 | 3450 |
| | Hard Grove Index | | 62.6 | 70.0 | 52.0 |
| | YGP Index | mg/kg | - | - | - |



ANALYSIS OF ASH

| ASH ANALYSIS | | | | | | |
|--|---------------------------------|---------------------------------------|-------------|------------|-----------|------------------------|
| Sl. No. | Description | Symbol | Design Coal | Worst Coal | Best Coal | Range of Adequacy Coal |
| 1 | Silica | (SiO ₂)% | 59.79 | 61.30 | 56.70 | 62.00 - 56.00 |
| 2 | Alumina | (Al ₂ O ₂)% | 25.36 | 26.00 | 23.00 | 28.00 - 23.00 |
| 3 | Iron Oxide | (Fe ₂ O ₂)% | 7.20 | 6.00 | 1000 | 6.00- 10.00 |
| 4 | Titania | (TiO ₂)% | 1.20 | 1.00 | 1.50 | 1.00- 1.70 |
| 5 | Phosphoric Anhydride | (P ₂ O ₅)% | 2.60 | 1.50 | 3.00 | 1.00-3.00 |
| 6 | Lime | (CaO)% | 0.88 | 0.50 | 1.50 | 050-1.70 |
| 7 | Magnesia | (MgO)% | 0.55 | 0.40 | 1.00 | 0.40- 1.10 |
| 8 | Sulphuric Anhydride | (SO ₂)% | 1.20 | 0.50 | 1.40 | 0.50- 1.70 |
| 9 | Alkalies (by diff.) | (Na ₂ O+K ₂ O)% | 1.22 | 080 | 1.40 | 0.60- 1.80 |
| ASH FUSION RANGE (Under reducing atmosphere) | | | | | | |
| 1 | Initial Deformation Temperature | IDT ^o C | 1100 | 1100 | 1100 | 1100-1150 |
| 2 | Hemispherical Temperature | HT ^o C | 1300 | 1250 | 1350 | 1250-1400 |
| 3 | Flow Temperature | ET ^o C | 1400 | 1400 | 1400 | 1400- 1450 |





HEAVY FUEL OIL ANALYSIS

| | | Heavy Fuel Oil (HFO) |
|------------|--|---------------------------------|
| Properties | | As per IS-1593 1971 Heavy Grade |
| 1.0 | Viscosity CS | 370 maximum at 50 °C |
| 2.0 | Flash point, minimum, °C (pensky – Martens closed) | 66 |
| 3.0 | Pour Points °C | |
| 4.0 | GCV, Kcal/Kg. | 10,000 |
| 5.0 | Ash content (by weight) % maximum | 0.1 |
| 6.0 | Total sulphur (by weight) % maximum | 4.5 |
| 7.0 | Sediment (by weight) % maximum | 0.25 |
| 8.0 | Water content (by volume) % maximum | 1.0 |
| 9.0 | Acidity (inorganic) | Nil |
| 10.0 | Carbon residue (Ramsbottom) (by weight) % maximum | - |

Note : For calculation, in case of HFO, 30% wax content with latent heat of fusion 54 Kcal/Kg. Has been assumed.



**LIGHT DIESEL OIL ANALYSIS**

| | | | |
|-----|--|---|----------------------------|
| 1. | Specification | : | IS-1460 (latest revision). |
| 2. | Acidity (Inorganic) | : | Nil. |
| 3. | Ash Content | : | 0.02% (Maximum) by weight. |
| 4. | Flash Point (Pensky-Martens, closed) | : | 66 Deg.C. |
| 5. | Pour Point (Winter) | : | 12 Deg.C. |
| | Pour Point (Summer) | : | 18 Deg.C. |
| 6. | Kinematic Viscosity at 38 Deg.C | : | 2.5 to 15.7 Centi-stokes. |
| 7. | Sediment by weight | : | 0.10% (maximum). |
| 8. | Water Content by volume | : | 0.25% (maximum). |
| 9. | Sulphur by weight | : | 1.8% (maximum). |
| 10. | Carbon Residue (Ramsbottom) by weight | : | 1.5% (maximum). |
| 11. | Gross Calorific Value | : | 10,000 Kcal/Kg. |
| 12. | Specific gravity | : | 0.85 at 15° C. |



DESIGN RAW WATER ANALYSIS

| SL.NO. | Different Characteristic | Results |
|--------|---|------------|
| 1. | Calcium (Ca ⁺⁺) as CaCO ₃ | 86 |
| 2. | Magnesium (Mg ⁺⁺) as CaCO ₃ | 52 |
| 3. | Sodium & Potassium (Na ⁺ & K ⁺) as CaCO ₃ | 138 |
| | Total Cations | 276 |
| 4. | Bicarbonates (HCO ₃) as CaCO ₃ | 200 |
| 5. | Carbonates (CO ₃) as CaCO ₃ | - |
| 6. | Hydroxyde (OH) as CaCO ₃ | - |
| 7. | Sulphate (SO ₄) as CaCO ₃ | 35 |
| 8. | Chloride (Cl) as CaCO ₃ | 41 |
| 9. | Nitrate (NO ₃) as CaCO ₃ | - |
| 10. | Phosphate (PO ₄) as CaCO ₃ | - |
| | Total Anions | 276 |
| 11. | Total Hardness (as CaCO ₃) | 138 |
| 12. | Permanent Hardness (as CaCO ₃) | - |
| 13. | Temporary Hardness (as CaCO ₃) | 138 |
| 14. | Methyl Orange Alkalinity (as CaCO ₃) | 200 |
| 15. | Phenolphthalein Alkalinity (as CaCO ₃) | - |
| 16. | Iron (Original) (as Fe) | - |
| 17. | Iron (in solution) (as Fe) | 1.0 |
| 18. | Manganese (as Mn) | - |
| 19. | Ammonia, free (as NH ₃) | - |
| 20. | Carbon Dioxide free (as CO ₂) | - |
| 21. | Silica (in solution (as SiO ₂)) | 20.0 |
| 22. | Dissolved Oxygen (O ₂) | - |
| 23. | Suspended Solids | - |
| 24. | Dissolved Solids | 438 |
| 25. | pH at 25 °C | 7.5 – 8.0 |
| 26. | Organic Matter (in terms of Oxygen absorbed from acid permanganate solution in 4 hours) | 2.0 |
| 27. | Appearance | Turbid |
| 28. | Odour | Nil |
| 29. | Turbidity | 500 NTU |



DESIGN CLARIFIED WATER ANALYSIS

| CONSTITUENTS | As | CONTENT |
|---|-------------------|-----------|
| Calcium | CaCO ₃ | 105 ppm |
| Magnesium | CaCO ₃ | 52 ppm |
| Sodium and Potassium | CaCO ₃ | 138 ppm |
| Hydrogen (FMA) | CaCO ₃ | -- |
| TOTAL CATIONS | CaCO ₃ | 295 ppm |
| Bicarbonate | CaCO ₃ | 196.5 ppm |
| Carbonate | CaCO ₃ | - |
| Chloride | CaCO ₃ | 41 ppm |
| Sulphate | CaCO ₃ | 57.5 ppm |
| Nitrate | CaCO ₃ | - |
| TOTAL ANIONS | CaCO ₃ | 295 ppm |
| M.O. Alkalinity | CaCO ₃ | 196.5 ppm |
| P. Alkalinity | CaCO ₃ | |
| Total Hardness | CaCO ₃ | 157 ppm |
| Carbon-di-oxide | CO ₂ | 3.5 |
| Dissolved Silica | SiO ₂ | 20 ppm |
| Total Iron | Fe | 1 ppm |
| pH Value | - | 7.9 – 8.0 |
| Turbidity, NTU | - | 20 |
| Organic Matter Content in terms of Oxygen in absorbed from (KMnO ₄ (4 Hrs.)) | | 5 ppm |

Note:

The analysis of the clarified water is exhibited here, shall be multiplied with 5.0 COC to derive the circulating water analysis.

**CHEMICAL COMPOSITION OF LIMESTONE**

| | | | |
|-----|--------------------------------|---|-----------|
| 1. | CaO | % | 45.9-51.0 |
| 2. | MgO | % | 0.9-3.8 |
| 3. | Fe ₂ O ₃ | % | 0.45-1.0 |
| 4. | Al ₂ O ₃ | % | 1.19-2.1 |
| 5. | Si ₂ O ₃ | % | 2.1-4.5 |
| 6. | Mn ₂ O ₃ | % | <0.12 |
| 7. | P ₂ O ₅ | % | Traces |
| 8. | Cl ₂ | % | <0.015 |
| 9. | Na ₂ O | % | <0.16 |
| 10. | K ₂ O | % | <0.01 |
| 11. | TiO ₂ | % | <0.02 |
| 12. | Total Sulphur | % | <0.1 |
| 13. | LOI | % | 38.0-41.3 |

Physical Properties:

| | | | |
|----|--------------|-------|--------|
| 1. | Bond Index | kWh/t | 13 |
| 2. | Granule size | | (-) 20 |

Note: The final chemical composition and properties shall be provided to successful bidder during detail engineering



DESIGN DM WATER ANALYSIS

| Sl. No. | Description | Max. Limit |
|----------------|---|----------------------------|
| 1.00 | Total Electrolyte | 0.1 ppm, max. |
| 2.00 | Total SiO ₂ | 0.01 ppm, max. |
| 3.00 | Iron as Fe | Nil |
| 4.00 | Free CO ₂ ppm as CO ₂ | Nil |
| 5.00 | Total Hardness | Nil |
| 6.00 | pH value at 25 Deg.C | 6.8 – 7.2 |
| 7.00 | Conductivity, micro mho/cm | Less than 0.1 at 25 Deg. C |



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
TECHNICAL SPECIFICATION
(ELECTRICAL PORTION)**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

SUB-SECTION : C-3

REV. 00

DATE: MARCH 2022

SECTION: I

SUB-SECTION: C-3

TECHNICAL SPECIFICATION (ELECTRICAL PORTION)

**THE WEST BENGAL POWER DEVELOPMENT
CORPORATION LIMITED**

**SAGARDIGHI THERMAL POWER PROJECT
1X660MW UNIT NO. 5, PHASE-III**

VENTILATION SYSTEM

**TECHNICAL SPECIFICATION
(ELECTRICAL PORTION)**



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, UP (INDIA) – 201301**



TITLE:
**TECHNICAL SPECIFICATION
FOR
VENTILATION SYSTEM**

**SAGARDIGHI THERMAL POWER PROJECT
1 X 660 MW UNIT NO. 5, PHASE-III**

SPECIFICATION NO.
VOLUME NO. : **II-B**
SECTION: **C**
REV NO. : **00** DATE:
SHEET: 1 OF 1

CONTENTS

| SECTION | TITLE | NO OF SHEETS |
|---------|---|--------------|
| I | SPECIFIC TECHNICAL REQUIREMENTS | 2 |
| I | ELECTRICAL SCOPE BETWEEN BHEL & VENDOR (ANNEXIRE-I) | 2 |
| I | ELECTRICAL LOAD DATA FORMAT (ANNEXURE-II) | 1 |
| I | CABLE SCHEDULE FORMAT (ANNEXURE-III) | 1 |
| I | EXPLANATORY NOTES FOR CABLE ROUTING | 1 |
| I | TECHNICAL SPECIFICATION FOR MOTORS | 10 |
| II | MOTOR DATASHEET-A | 1 |
| II | MOTOR DATASHEET-C | 2 |
| II | GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS | 4 |
| II | SQP_LV MOTORS (UPTO 55 KW) | 2 |
| II | SQP_LV MOTORS (MOTORS 55 KW & ABOVE) | 9 |
| II | CABLE TRAY DRAWING | 2 |

THE REQUIREMENT MENTIONED IN SECTION-I SHALL PREVAIL AND GOVERN IN CASE OF CONFLICT BETWEEN THE SAME AND THHE CORRESPONDING REQRUMENTS MENTIONED IN THE DESCRIPTIVE PORTION IN SECTION-II.



| | |
|--|---------------------------|
| TITLE: TECHNICAL SPECIFICATION FOR VENTILATION SYSTEM SAGARDIGHI THERMAL POWER PROJECT 1 X 660 MW UNIT NO. 5, PHASE-III | SPECIFICATION NO. |
| | VOLUME NO. : II-B |
| | SECTION: C |
| | REV NO. : 00 DATE: |
| | SHEET: 1 OF 1 |

SPECIFIC TECHNICAL REQUIREMENT: ELECTRICAL

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

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

- a) Services and Equipment as per "Electrical Scope between BHEL and Vendor".
- b) 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.
- c) Supply of mandatory spares as specified in the specifications of mechanical equipments.
- d) Electrical load requirement for **Ventilation System**.
- e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
- f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer / BHEL approval without any commercial and delivery implications to BHEL.
- g) Various drawings including GA drg, 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.
- h) The sub-vendor list for various electrical items is subject to BHEL/Customer approval without any commercial implications.
- i) Motors shall meet minimum requirement of Electric motor specification.
- j) All routine tests and type tests reports as per applicable standards shall be furnished at contract stage.
- k) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
- l) Cable BOQ worked out based on routing of cable listing provided by the vendor for "both end equipment in vendor's scope" shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:

Refer "Electrical Scope between BHEL and Vendor".

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

3.1 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical / quality assurance requirements stipulated in the form of compliance certificate/ NO deviation certificate.

3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

4.0 LIST OF ENCLOSURES

- 4.1 Electrical scope between BHEL & vendor
- 4.2 Load Data Format. (Annexure –II)
- 4.3 BHEL Cable listing format (Annexure –III)
- 4.4 Technical specification – Specification for Electric Motors/Actuators.
- 4.5 Datasheets & quality plan for motors.

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGES: VENTILATION SYSTEM

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 1X660 MW SAGARDIGHI TPS

| S.NO | DETAILS | SCOPE SUPPLY | SCOPE E&C | REMARKS |
|------|--|----------------------|------------------------|--|
| 1 | 415V MCC | BHEL | BHEL | 240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor. |
| 2 | Local Push Button Station (for motors) | BHEL | BHEL | Located near the motor. |
| 3 | Power cables, control cables and screened control 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 3.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 shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor. |
| 4 | Junction box for control & instrumentation cable | Vendor | Vendor | Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 mtrs) and trunk cable. |
| 5 | Any special type of cable like compensating, co-axial, prefab, MICC, optical fibre etc. | Vendor | Vendor | Refer C&I portion of specification for scope of fibre Optical cables if used between PLC/ microprocessor & DCS. |
| 6 | Cable trays, accessories & cable trays supporting system 100/ 50 mm cable trays/ Conduits/ Galvanised steel cable troughs for local cabling | BHEL Vendor | BHEL Vendor | Local cabling from nearby main route cable tray (BHEL scope) to equipment terminal (vendor's scope) shall be through 100/ 50 mm. cable trays/ conduits/ Galvanised steel cable troughs, as per approved layout drawing during contract stage. |
| 7 | Cable glands ,lugs and bimetallic strip for equipment supplied by Vendor | Vendor | Vendor | 1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power and control cables. |
| 8 | Conduit and conduit accessories for cabling between equipment supplied by vendor | Vendor | Vendor | Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537. |
| 9 | Lighting | BHEL | BHEL | |
| 10 | Equipment grounding (including electronic earthing) & lightning protection | BHEL | BHEL | Refer note no. 4 for electronic earthing |

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGES: VENTILATION SYSTEM

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 1X660 MW SAGARDIGHI TPS

| S.NO | DETAILS | SCOPE SUPPLY | SCOPE E&C | REMARKS |
|------|--|----------------------------|-------------|--|
| 11 | Below grade grounding | BHEL | BHEL | |
| 12 | LT Motors with base plate and foundation hardware | Vendor | Vendor | Makes shall be subject to customer/ BHEL approval at contract stage. |
| 13 | Mandatory spares | Vendor | - | Vendor to quote as per specification. |
| 14 | Recommended O & M spares | Vendor | - | As specified elsewhere in specification |
| 15 | Any other equipment/ material/ service required for completeness of system based on system offered by the vendor (to ensure trouble free and efficient operation of the system). | Vendor | Vendor | |
| 16 | a) Input cable schedules (Control & Screened Control Cables) b) Cable interconnection details for above c) Cable block diagram | Vendor Vendor Vendor | - - - | Cable listing for Control and Instrumentation Cable and electronic earthing cable in enclosed excel format shall be submitted by vendor during detailed engineering stage. |
| 17 | Electrical Equipment & cable tray layout drawings | Vendor | - | For ensuring cabling requirements are met, vendor shall furnish Electrical equipment layout & cable tray layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipment requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Cabling arrangement of the same (wherever overhead cable trays, trenches, cable ducts, conduits etc.) shall be decided during contract stage. Electrical equipment layout & cable tray layout drawing shall be subjected to BHEL/ customer approval without any commercial implications to BHEL. |
| 18 | Electrical Equipment GA drawing | Vendor | - | For necessary interface review. |

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 QPs 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 mis-match 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 in their Civil assignment drawing.

| LOAD TITLE | RATING (KW / A) | | UNIT (U)/STN (S) | Nos. | | VOLTAGE CODE* | FEEDER CODE** | EMER. LOAD (Y) | CONT.(C)/ INTT.(I) | STARTING TIME >5 SEC (Y) | LOCATION | BOARD NO. | CABLE | | BLOCK CABLE DRG. No. | CONT ROL CODE | REMA RKS | LOAD No. | VERIFICATI ON FROM MOTOR DATASHEE T (Y/N) | KKS NO |
|------------|-----------------|----------------------------------|------------------|---------|---------|---------------|---------------|----------------|--------------------|-----------------------------|----------|-----------|--------------|-----|-------------------------|---------------------|-------------|-------------|---|--------|
| | NAME PLATE | MAX. CONT. DEMAND (MCR) | | RUNNING | STANDBY | | | | | | | | SIZE CODE | NOs | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |

| | | | | | | | | | | | | | | | | | | | | |
|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |

NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)/ CUSTOMER
2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V
: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)

| | | | | | | |
|-----------------------------------|-------------------------|-------------------------|---------------------------|---------|------------------------------|--|
| LOAD DATA (ELECTRICAL) | JOB NO. | 445 | ORIGINATING AGENCY | | PEM (ELECTRICAL) | |
| | PROJECT TITLE | 1X660 MW SAGARDIGHI TPS | NAME | | | |
| | SYSTEM | VENTILATION SYSTEM | SIGN. | | | |
| | DEPTT. / SECTION | MAX | SHEET 1 OF 1 | REV. 00 | DATA FILLED UP ON | |
| | | | | | DATA ENTERED ON | |
| | | | | | DE'S SIGN. & DATE | |

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

**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.





SECTION-I

- 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 (CACW).
- 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.
- 6.03.00 **Winding and Insulation**
- 6.03.01 All insulated winding shall be of copper.
- 6.03.02 HT motors shall have Class F insulation with winding temperature limited to 120°C. Windings shall be impregnated to make them non-hygroscopic and oil resistant. The lightning impulse and coil inter-turn insulation surge withstand level shall be as per IEC-60034 – Part 15.
- 6.03.03 LT motors shall have Class F or higher insulation with temperature limited to 120°C.
- 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.

7.03.00 Temperature Detectors

7.03.01 All HT motors shall be provided with minimum four (4) numbers simplex or two (2) numbers duplex platinum resistance type winding temperature detectors per phase.

7.03.02 Each bearing of HT shall be provided with minimum one (1) duplex or two (2) simplex type temperature detectors.

7.03.03 The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0°C.

7.04.00 Indicator/Switch

7.04.01 Dial type local indicator with alarm contacts shall be provided for the following: -

- a) HT motor bearing temperature.
- b) Hot and cold air temperature of the closed air circuit for CACA and CACW motor.

7.04.02 Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used.

7.04.03 Alarm switch contact rating shall be minimum 0.5 A at 220V D.C. and 5A at 240V A.C.

7.05.00 Current Transformer for Differential Protection

7.05.01 Motor above 1000 kW shall be provided with three differential current transformers (PS class) mounted over the neutral leads within the enclosure. Matching three (3) numbers PS class CTs shall be mounted on the switchgear end.

7.05.02 The arrangement shall be such as to permit easy access for C.T. testing and replacement. Current transformer characteristics shall match Owner's requirements to be intimated later.

**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

SECTION-I

DESIGN DATA

1.0 AUXILIARY POWER SUPPLY

| Supply | Description | Consumer |
|-------------|---|--|
| H.T. Supply | 11 kV, 3 \emptyset /, 3W, 50 Hz Non-effectively earthed Fault level 40 KA symm. for 3 second. | Motors above 1500 kW |
| H.T. Supply | 3.3 kV, 3 \emptyset /, 3W, 50 Hz Non-effectively earthed Fault level 40 KA symm. for 3 second. | Motors above 160kW upto 1500 kW. |
| L.T. Supply | 415V, 3 \emptyset /, 3W, 50 Hz Effectively earthed Fault level 50 KA symm. for 1 seconds. | Motors above 200W upto 160 kW |
| | 240V, 1 \emptyset /, 2W, 50 Hz Effectively earthed | Motors below 200W Lighting, space heating, A.C. control protective devices |
| D.C. Supply | 220V, 2W, unearthed Fault level 25* KA for 1 second (Min.) | D.C. alarm, control protective devices |

* However actual value shall be substantiated by the bidder through calculation.

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





TITLE

LV MOTORS DATA SHEET-A

**SAGARDIGHI THERMAL POWER PROJECT
1 x 660 MW UNIT NO. 5, PHASE – III**

SPECIFICATION NO.

VOLUME II B

SECTION D

REV NO. 00 DATE 05.04.21

SHEET 1 OF 1

- 1.0 Design ambient temperature : 50 °C
- 2.0 Maximum acceptable kW rating of LV motor : Upto & Including 160KW
- 3.0 Installation (Indoors/ Outdoors) : As required
- 4.0 Details of supply system
- a) Rated voltage (with variation) : 415V ± 10%
- b) Rated frequency (with variation) : 50 Hz (Variation: +5% TO –5%)
- c) Combined voltage & freq. variation : 10% (sum of absolute values)
- d) System fault level at rated voltage : 50 kA for 1 sec
- e) Short time rating for terminal boxes
- *Above 90 kW upto & including 160kW(Breaker Controlled) : 50 KA for 0.25 sec.
- * Rated upto & including 90 kW (Contactor Controlled) : 50 KA protected by MCCB
- f) LV System grounding : Solidly
- 5.0 Class of insulation : Class 'F', with temp rise limited to class B.
- 6.0 Minimum voltage for starting : 80% of rated voltage
- 7.0 Power cables data : Shall be given during Detailed engg.
- 8.0 Earth Conductor Size & Material : Shall be given during Detailed engg.
- 9.0 Space heater supply (30KW & ABOVE) : 240 V, 1Φ , 50 Hz
- 10.0 Rating up to which Single phase motor : Acceptable below 0.20 Kw
- 11.0 Locked rotor current
- a) Limit as percentage of FLC : As per IS 12615
- 12.0 Makes : BHEL/ Customer approval (Package owner to take care)
- 13.0 Paint shade : RAL 7032
- 15.0 Additional tests : As per QP
- 14.0 Degree Of protection for motor/ terminal box : IP 55

* LT motors of continuous duty shall be energy efficient IE3 class conforming to IS-12615

15.0 TESTING REQUIREMENTS: IN LINE WITH SPECIFICATION

➤ **Also detailed Customer spec. for Motors is to be referred as enclosed with technical spec.**


ANNEXURE-I

SUB-VENDOR LIST

The list of approved make of the LT Motors are as mentioned below:


| S.No. | LIST OF LT MOTORS |
|--------------|----------------------------|
| 1. | BHARAT BIJLEE LTD. |
| 2. | CROMPTON GREAVES |
| 3. | ASEA BROWN BOVERI |
| 4. | KIRLOSKAR ELECTRIC CO LTD. |
| 5. | NGEF |
| 6. | SIEMENS |
| 7. | MARATHON |
| 8. | GE-POWER |
| 9. | RAJINDRA ELECT INDUSTRIES |
| 10. | LAXMI HYDRAULICS PVT. LTD |

However, the final list of makes for the LT Motors is subjected to BHEL/Customer approval, during contract stage, without any commercial implications.

| | | |
|---|--|-------------------|
|  | TITLE | SPECIFICATION NO. |
| | HT AND LT MOTOR | VOLUME II B |
| | DATA SHEET – C | SECTION D |
| | SAGARDIGHI THERMAL POWER PROJECT 1 x 660 MW UNIT NO. 5, PHASE – III | REV NO.00 DATE |
| | | SHEET 1 OF 2 |

| S. No. | Description | Data to be filled by successful bidder |
|-----------|--|--|
| A. | General | |
| 1 | Manufacturer & country of origin | |
| 2 | Motor type | |
| 3 | Type of starting | |
| 4 | Name of the equipment driven by motor & Quantity | |
| 5 | Maximum Power requirement of driven equipment | |
| 6 | Rated speed of Driven Equipment | |
| 7 | Design ambient temperature | |
| B. | Design and Performance Data | |
| 1 | Frame size & type designation | |
| 2 | Type of duty | |
| 3 | Rated Voltage | |
| 4 | Permissible variation for | |
| 5 | a) Voltage | |
| 6 | b) Frequency | |
| 7 | c) Combined voltage & frequency | |
| 8 | Rated output at design ambient temp (by resistance method) | |
| 9 | Synchronous speed & Rated slip | |
| 10 | Minimum permissible starting voltage | |
| 11 | Starting time in sec with mechanism coupled | |
| 12 | a) At rated voltage | |
| 13 | b) At min starting voltage | |
| 14 | Locked rotor current as percentage of FLC (including IS tolerance) | |
| 15 | Torque | |
| | a) Starting | |
| | b) Maximum | |
| 16 | Permissible temp rise at rated output over ambient temp & method | |
| 17 | Noise level at 1.0 m (dB) | |
| 18 | Amplitude of vibration | |
| 19 | Efficiency & P.F. at rated voltage & frequency | |
| | a) At 100% load | |
| | c) At 75% load | |

| | | | | | |
|----------------|-----------|------|------|------|--|
| NAME OF VENDOR | | | SEAL | REV. | |
| NAME | SIGNATURE | DATE | | | |
| | | | | | |

| | | |
|---|--|-------------------|
|  | TITLE | SPECIFICATION NO. |
| | LV MOTOR | VOLUME II B |
| | DATA SHEET – C | SECTION D |
| | SAGARDIGHI THERMAL POWER PROJECT 1 x 660 MW UNIT NO. 5, PHASE – III | REV NO.00 DATE |
| | | SHEET 2 OF 2 |

| S. No. | Description | Data to be filled by successful bidder |
|-----------|--|--|
| | c) At starting | |
| C. | Constructional Features | |
| 1 | Method of connection of motor driven equipment | |
| 2 | Applicable Standard | |
| 3 | DOP of Enclosure | |
| 4 | Method of cooling | |
| 5 | Class of insulation | |
| 6 | Main terminal box | |
| | a) Type | |
| | b) Power Cable details (Conductor, size, armour/unarmour) | |
| | c) Cable Gland & lugs details (Size, type & material) | |
| | d) Permissible Fault level (kArms & duration in sec) | |
| 7 | Space heater details (Voltage & watts) | |
| 8 | Flame proof motor details (if applicable) | |
| | a) Enclosure | |
| | b) suitability for hazardous area | |
| | i Zone | O / I / II |
| | ii Group | IIA / IIB / IIC |
| 9 | No. of Stator winding | |
| 10 | Winding connection | |
| 11 | Kind of rotor winding | |
| 12 | Kind of bearings | |
| 13 | Direction of rotation when viewed from NDE | |
| 14 | Paint Shade & type | |
| 15 | Net weight of motor | |
| 16 | Outline mounting drawing No (To be enclosed as annexure) | |
| D. | Characteristic curves/ drawings (To be enclosed for motors of rating $\geq 55KW$) | |
| | a) Torque speed characteristic | |
| | b) Thermal withstand characteristic | |
| | c) Current vs time | |
| | d) Speed vs time | |

| | | | | | |
|----------------|-----------|------|------|------|--|
| NAME OF VENDOR | | | SEAL | REV. | |
| NAME | SIGNATURE | DATE | | | |
| | | | | | |



TITLE :
GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS


SPECIFICATION NO.
PE-SS-999-506-E101
VOLUME NO. : **II-B**
SECTION : **D**
REV NO. : **00** DATE : 29/08/2005
SHEET : 1 OF 1

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.: PE-SS-999-506-E101 Rev 00

| | | |
|--|--------------------------------|--------------------------------|
|  | TITLE : | SPECIFICATION NO. |
| | GENERAL TECHNICAL REQUIREMENTs | PE-SS-999-506-E101 |
| | FOR | VOLUME NO. : II-B |
| | LV MOTORS | SECTION : D |
| | | REV NO. : 00 DATE : 29/08/2005 |
| | | SHEET : 1 OF 4 |

1.0 INTENT OF SPECIFICATION

The specification covers the design, materials, constructional features, manufacture, inspection and testing at manufacturer's work, and packing of Low voltage (LV) squirrel cage induction motors along with all accessories for driving auxiliaries in thermal power station.

Motors having a voltage rating of below 1000V are referred to as low voltage (LV) motors.

2.0 CODES AND STANDARDS

Motors shall fully comply with latest edition, including all amendments and revision, of following codes and standards:

| | |
|-----------|--|
| IS:325 | Three phase Induction motors |
| IS : 900 | Code of practice for installation and maintenance of induction motors |
| IS: 996 | Single phase small AC and universal motors |
| IS: 4722 | Rotating Electrical machines |
| IS: 4691 | Degree of Protection provided by enclosures for rotating electrical machines |
| IS: 4728 | Terminal marking and direction of rotation rotating electrical machines |
| IS: 1231 | Dimensions of three phase foot mounted induction motors |
| IS: 8789 | Values of performance characteristics for three phase induction motors |
| IS: 13555 | Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment |
| IS: 2148 | Flame proof enclosures for electrical appliance |
| IS: 5571 | Guide for selection of electrical equipment for hazardous areas |
| IS: 12824 | Type of duty and classes of rating assigned |
| IS: 12802 | Temperature rise measurement for rotating electrical machines |
| IS: 12065 | Permissible limits of noise level for rotating electrical machines |
| IS: 12075 | Mechanical vibration of rotating electrical machines |

In case of imported motors, motors as per IEC-34 shall also be acceptable.

3.0 DESIGN REQUIREMENTS


3.1 Motors and accessories shall be designed to operate satisfactorily under conditions specified in data sheet-A and Project Information, including voltage & frequency variation of supply system as defined in Data sheet-A

3.2 Motors shall be continuously rated at the design ambient temperature specified in Data Sheet-A and other site conditions specified under Project Information
Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment, under entire operating range including voltage & frequency variation specified above.

3.3 Starting Requirements

3.3.1 Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.

3.3.2 Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.

| | | |
|--|--------------------------------|--------------------------------|
|  | TITLE : | SPECIFICATION NO. |
| | GENERAL TECHNICAL REQUIREMENTS | PE-SS-999-506-E101 |
| | FOR | VOLUME NO. : II-B |
| | LV MOTORS | SECTION : D |
| | | REV NO. : 00 DATE : 29/08/2005 |
| | | SHEET : 2 OF 4 |

The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.

3.3.3 The following frequency of starts shall apply

- i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.
- ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)
- iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for minimum 20,000 starts during the life time of the motor

3.4 Running Requirements

3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.

3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.

3.5 Stress During bus Transfer

3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechanical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.

3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.

3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.


4.0 CONSTRUCTIONAL FEATURES

4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy

4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.

Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled


4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.

| | | |
|--|--------------------------------|--------------------------------|
|  | TITLE : | SPECIFICATION NO. |
| | GENERAL TECHNICAL REQUIREMENTS | PE-SS-999-506-E101 |
| | FOR | VOLUME NO. : II-B |
| | LV MOTORS | SECTION : D |
| | | REV NO. : 00 DATE : 29/08/2005 |
| | | SHEET : 3 OF 4 |


- 4.4. Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.
- 4.5. Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.
- 4.6. In case Class 'F' insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation.
In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.
- 4.7. **Terminals and Terminal Boxes**
- 4.7.1 Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.

Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet "A".
- 4.7.2 unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.
- 4.7.3 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively.
- 4.7.4 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.
- 4.7.5 Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.
- 4.7.6 Degree of protection for terminal boxes shall be IP 55 as per IS 4691.
- 4.7.7 Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.
- 4.7.8. Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.
- 4.7.9 Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.
- 4.8 Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.


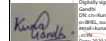


4.9 **General**


| | | |
|--|--------------------------------|--------------------------------|
|  | TITLE : | SPECIFICATION NO. |
| | GENERAL TECHNICAL REQUIREMENTS | PE-SS-999-506-E101 |
| | FOR | VOLUME NO. : II-B |
| | LV MOTORS | SECTION : D |
| | | REV NO. : 00 DATE : 29/08/2005 |
| | | SHEET : 4 OF 4 |

- 4.9.1 Motors provided for similar drives shall be interchangeable.
- 4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.
- 4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.
- 4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.
- 4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.
- 4.9.6 Name plate with all particulars as per IS: 325 shall be provided
- 4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.
- 5.0 INSPECTION AND TESTING**
- 5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.
- 5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.
- 5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.
- 5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.
- 6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT**
- a) OGA drawing showing the position of terminal boxes, earthing connections etc.
- b) Arrangement drawing of terminal boxes.
- c) Characteristic curves:
(To be given for motor above 55 kW unless otherwise specified in Data Sheet).
- i) Current vs. time at rated voltage and minimum starting voltage.
- ii) Speed vs. time at rated voltage and minimum starting 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.

| | | | | | | | | | |
|--|--|--|--|---------|---------------------------------|-------------|------------------|--------------|--|
|  | MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS | STANDARD QUALITY PLAN | | | SPEC. NO : | | DATE: | | |
| | | CUSTOMER : | | | QP NO.: PE-QP-999-Q-006, REV-02 | | DATE: 17.04.2020 | | |
| | | PROJECT: | | | PO NO.: | | DATE: | | |
| | | ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V)) | | SYSTEM: | | SECTION: II | | SHEET 1 of 2 | |

| S. NO. | COMPONENT & OPERATIONS | CHARACTERISTICS | CLASS | TYPE OF CHECK | QUANTUM OF CHECK | | REFERENCE DOCUMENT | ACCEPTANCE NORMS | FORMAT OF RECORD | AGENCY | REMARKS | | | |
|--------|------------------------|---|-------|----------------------|------------------|------|--|--|---------------------|--------|---------|----|----|--------------------|
| | | | | | M | C/ N | | | | | | * | ** | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | D | M | C | N | | |
| 1.0 | ASSEMBLY | 1.WORKMANSHIP | MA | VISUAL | 100% | - | MFG. SPEC. | MFG. SPEC. | LOG BOOK | | P | - | - | |
| | | 2.DIMENSIONS | MA | VISUAL | 100% | - | MFG. DRG./ MFG. SPEC. | MFG. DRG./ MFG. SPEC. | LOG BOOK | | P | - | - | |
| | | 3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE | MA | VISUAL | 100% | - | MFG.SPEC./ | MFG.SPEC. | LOG BOOK | | P | - | - | |
| 2.0 | PAINTING | 1.SHADE | MA | VISUAL | SAMPLE | - | MFG. SPEC/ APPROVED DATASHEET | MFG. SPEC/ APPROVED DATASHEET | LOG BOOK | ✓ | P | V | - | |
| 3.0 | TESTS | 1.ROUTINE TEST INCLUDING SPECIAL TEST | MA | VISUAL | 100% | - | IS-325 / IS-12615/ APPROVED DATA SHEET | IS-325 / IS-12615/ APPROVED DATA SHEET | TEST/ INSPN. REPORT | ✓ | P | V* | - | * NOTE -1 |
| | | 2.OVERALL DIMENSIONS & ORIENTATION | MA | MEASUREMENT & VISUAL | 100% | - | APPROVED DRG/ DATA SHEET | APPROVED DRG/ DATA SHEET | TEST/ INSPN. REPORT | ✓ | P | V* | - | * NOTE -1 & NOTE-2 |

| BHEL | | | | | | BIDDER/ SUPPLIER | | FOR CUSTOMER REVIEW & APPROVAL | | | |
|---------------|---|---------------|----------------------|---|----------------------|------------------|--|--------------------------------|-------------|------|------|
| ENGINEERING | | | QUALITY | | | Sign & Date | | Doc No: | | | |
| Prepared by: | Sign & Date | Name | Checked by: | Sign & Date | Name | Seal | | Reviewed by: | Sign & Date | Name | Seal |
| HEMA KUSHWAHA |  | HEMA KUSHWAHA | KUNAL GANDHI |  | KUNAL GANDHI | | | | | | |
| PRAVEEN DUTTA |  | PRAVEEN DUTTA | RITESH KUMAR JAISWAL |  | RITESH KUMAR JAISWAL | | | | | | |

| | | | | | | | | | | | | | |
|--|--|--|--|---------|--|---------------------------------|--|--|--|------------------|--|--|--|
|  | MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS | STANDARD QUALITY PLAN | | | | SPEC. NO : | | | | DATE: | | | |
| | | CUSTOMER : | | | | QP NO.: PE-QP-999-Q-006, REV-02 | | | | DATE: 17.04.2020 | | | |
| | | PROJECT: | | | | PO NO.: | | | | DATE: | | | |
| | | ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V)) | | SYSTEM: | | SECTION: II | | | | SHEET 2 of 2 | | | |



| | | | | | | | | | | | | | | |
|-----|---------|-------------------------------|----|--------|------|------|---|-----------------------------|---------------------|---|---|---|---|------------------|
| | | 3.NAMEPLATE DETAILS | MA | VISUAL | 100% | - | IS-325 / IS-12615 / APPROVED DATA SHEET | SAME AS COL. 7 | TEST/ INSPN. REPORT | ✓ | P | V | - | |
| 4.0 | PACKING | SURFACE FINISH & COMPLETENESS | MA | VISUAL | 100% | 100% | AS PER MFG. STANDARD / (#) | AS PER MFG. STANDARD / (#). | INSPC. REPORT | ✓ | P | W | - | (#) REFER NOTE-8 |


NOTES:

1. Routine tests on 100% motors shall be done by the vendor. However, BHEL/ Customer shall witness routine tests on random samples. The sampling plan shall be mutually agreed upon.
2. For exhaust/ventilation fan motors of rating up to 1.5 KW, only routine test certificates shall be furnished for scrutiny.
3. In case test certificates for these tests on similar type, size and design of motor from independent laboratory are available, the same is valid for 5 years.
4. BHEL reserves the right to perform repeat test, if required.
5. After packing and prior to issue MDCC, photographs of items to be despatched shall be sent to BHEL for review.
6. In case of any changes in QP commented by customer at contract stage, same shall be carried out by bidder without any implication to BHEL/ Customer.
7. Project specific QP to be developed based on customer requirement.
8. For export job, BHEL technical specification for seaworthy packing to be followed.
9. Packing shall be suitable for storage at site in tropical climate conditions.
10. Latest revision/ year of issue of all the standards (IS/ ASME/ IEC etc.) indicated in QP shall be referred.




LEGENDS:

*RECORDS, IDENTIFIED WITH "TICK"(✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,
 ** **M:** SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, **B:** MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **C:** CUSTOMER,
P: PERFORM, **W:** WITNESS, **V:** VERIFICATION, AS APPROPRIATE
MA: MAJOR, **MI:** MINOR, **CR:** CRITICAL
D: DOCUMENTATION

| BHEL | | | | | | BIDDER/ SUPPLIER | | FOR CUSTOMER REVIEW & APPROVAL | | | |
|--------------|---------------|---------------|--------------|---|----------------------|------------------|--|--------------------------------|------|------|--|
| ENGINEERING | | | QUALITY | | | Sign & Date | | Doc No: | | | |
| | Sign & Date | Name | | Sign & Date | Name | Seal | | Sign & Date | Name | Seal | |
| Prepared by: | HEMA KUSHWAHA | HEMA KUSHWAHA | Checked by: |  | KUNAL GANDHI | | | | | | |
| Reviewed by: | PRAVEEN DUTTA | PRAVEEN DUTTA | Reviewed by: |  | RITESH KUMAR JAISWAL | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |


| | | | | | | |
|---|--|--|--|---------------------------------|--|---|
|  | MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS | STANDARD QUALITY PLAN | | SPEC. NO. : | | DATE:17.04.2020 SHEET 1 OF 9 |
| | | CUSTOMER : | | QP NO.: PE-QP-999-Q-007, REV-04 | | |
| | | PROJECT: | | PO NO.: | | |
| | | ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V)) | | SYSTEM: | | |

| SI No. | Component & Operations | Characteristics | Class | Type of Check | Quantum Of check | | Reference Document | Acceptance NORMS | FORMAT OF RECORD | AGENCY | | | | |
|--------|--|----------------------------------|-------|------------------|------------------|------------|--------------------------|--|------------------|--------|-----|---|---|---|
| | | | | | M | C/N | | | | D | M | C | N | |
| 1.0 | RAW MATERIAL & BOUGHT OUT CONTROL | | | | | | | | | | | | | |
| 1.1 | SHEET STEEL, PLATES, SECTION, EYEBOLTS | 1.SURFACE CONDITION | MA | VISUAL | 100% | - | - | FREE FROM BLINKS, CRACKS, WAVINESS ETC | LOG BOOK | | P | - | - | |
| | | 2.DIMENSIONS | MA | MEASUREMENT | SAMPLE | - | MANUFACTURER'S DRG./SPEC | MANUFACTURER'S DRG./SPEC | LOG BOOK | | P | - | - | |
| | | 3.PROOF LOAD TEST (EYE BOLT) | MA | MECH. TEST | SAMPLE | - | MANUFACTURER'S DRG./SPEC | MANUFACTURER'S DRG./SPEC | TEST REPORT | | P/V | - | - | |
| 1.2 | HARDWARES | 1.SURFACE CONDITION | MA | VISUAL | 100% | - | - | FREE FROM CRACKS, UN-EVENNESS ETC. | TEST REPORT | | P | - | - | |
| | | 2.PROPERTY CLASS | MA | VISUAL | SAMPLES | - | MANUFACTURER'S DRG./SPEC | MANUFACTURER'S DRG./SPEC | TC | | P/V | - | - | PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR |
| 1.3 | CASTING | 1.SURFACE CONDITION | MA | VISUAL | 100% | - | MANUFACTURER'S DRG./SPEC | FREE FROM CRACKS, BLOW HOLES ETC. | LOG BOOK | | P/V | - | - | |
| | | 2.CHEM. & PHY. PROP. | MA | CHEM & MECH TEST | 1/HEAT NO. | - | MANUFACTURER'S DRG./SPEC | MANUFACTURER'S DRG./SPEC | TC | | P/V | - | - | HEAT NO. SHALL BE VERIFIED |
| | | 3.DIMENSIONS | MA | MEASUREMENT | 100% | - | MANUFACTURER'S DRG. | MANUFACTURER'S DRG. | LOG BOOK | | P/V | - | - | |
| 1.4 | PAINT & VARNISH | 1.MAKE, SHADE, SHELF LIFE & TYPE | MA | VISUAL | 100% | CONTINUOUS | MANUFACTURER'S DRG./SPEC | MANUFACTURER'S DRG./SPEC | LOG BOOK | | P/V | - | - | |


| BHEL | | | | | |
|--------------|---|----------------|--------------|---|--------------|
| ENGINEERING | | | QUALITY | | |
| | Sign & Date | Name | | Sign & Date | Name |
| Prepared by: | HEMA KUSHWAHA | HEMA KHUSHWAHA | Checked by: |  | KUNAL GANDHI |
| Reviewed by: |  | PRAVEEN DUTTA | Reviewed by: |  | R K JAISWAL |

| BIDDER/ SUPPLIER | |
|------------------|--|
| Sign & Date | |
| Seal | |

| FOR CUSTOMER REVIEW & APPROVAL | | | |
|--------------------------------|-------------|------|------|
| Doc No: | | | |
| | Sign & Date | Name | Seal |
| Reviewed by: | | | |
| Approved by: | | | |


| | | | | | | |
|---|--|--|--|---------------------------------|--|-----------------|
|  | MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS | STANDARD QUALITY PLAN | | SPEC. NO : | | |
| | | CUSTOMER : | | QP NO.: PE-QP-999-Q-007, REV-04 | | DATE:17.04.2020 |
| | | PROJECT: | | PO NO.: | | |
| | | ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V)) | | SYSTEM: | | SECTION: II |

| SI No. | Component & Operations | Characteristics | Class | Type of Check | Quantum Of check | | Reference Document | Acceptance NORMS | FORMAT OF RECORD | | AGENCY | | | |
|--------|--|-------------------------------------|-------|------------------------|---------------------------------------|-----|----------------------------|--|-------------------|---|--------|---|---|--|
| | | | | | M | C/N | | | 9 | . | ** | D | M | C |
| 1.5 | SHAFT (FORGED OR ROLLED) | 1. SURFACE COND. | MA | VISUAL | 100% | - | - | FREE FROM VISUAL DEFECTS | LOG BOOK | | P | - | - | VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED |
| | | 2. CHEM. & PHYSICAL PROPERTIES | MA | CHEM. & PHYSICAL TESTS | 1/HEAT NO. OR HEAT TREATMENT BATCH NO | - | MANUFACTURER'S DRG./ SPEC. | MANUFACTURER'S DRG./ STD. | TC | | P/V | - | | |
| | | 3. DIMENSIONS | MA | MEASUREMENT | 100% | - | MANUFACTURER'S DRG./ SPEC. | MANUFACTURER'S DRG. | LOG BOOK | | P/V | - | | |
| | | 4. INTERNAL FLAWS | CR | ULTRASONIC TEST | 100% | - | ASTM-A388 | MANUFACTURER'S STD. | INSPECTION REPORT | ✓ | P/W | V | - | |
| 1.6 | SPACE HEATERS, CONNECTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S | 1. MAKE & RATING | MA | VISUAL | 100% | - | MANUFACTURER'S DRG./STD. | MANUFACTURER'S DRG./STD. | INSPECTION REPORT | | P/V | - | - | |
| | | 2. PHYSICAL COND. | MA | VISUAL | 100% | - | MANUFACTURER'S DRG./STD. | NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY | INSPECTION REPORT | | P/V | - | - | |
| | | 3. DIMENSIONS (WHEREVER APPLICABLE) | MA | MEASUREMENT | SAMPLE | - | MANUFACTURER'S DRG./ STD | MANUFACTURER'S DRG. / STD. | INSPECTION REPORT | | P/V | - | - | |
| | | 4. PERFORMANCE/ CALIBRATION | MA | TEST | 100% | - | MANUFACTURER'S DRG./ STD | MANUFACTURER'S DRG. / STD. | TEST REPORT | | P/V | - | - | |



| BHEL | | | | | |
|--------------|---------------|----------------|--------------|---|--------------|
| ENGINEERING | | | QUALITY | | |
| | Sign & Date | Name | | Sign & Date | Name |
| Prepared by: | HEMA KUSHWAHA | HEMA KHUSHWAHA | Checked by: |  | KUNAL GANDHI |
| Reviewed by: | PRAVEEN DUTTA | PRAVEEN DUTTA | Reviewed by: | RITESH KUMAR JAISWAL | R K JAISWAL |

| BIDDER/ SUPPLIER | |
|------------------|--|
| Sign & Date | |
| Seal | |

| FOR CUSTOMER REVIEW & APPROVAL | | | |
|--------------------------------|-------------|------|------|
| Doc No: | | | |
| | Sign & Date | Name | Seal |
| Reviewed by: | | | |
| Approved by: | | | |


| | | | | | |
|---|--|--|---------|---------------------------------|-----------------|
|  | MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS | STANDARD QUALITY PLAN | | SPEC. NO.: | |
| | | CUSTOMER : | | QP NO.: PE-QP-999-Q-007, REV-04 | |
| | | PROJECT: | | PO NO.: | |
| | | ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V)) | SYSTEM: | SECTION: II | DATE:17.04.2020 |
| | | | | SHEET 3 OF 9 | |

| SI No. | Component & Operations | Characteristics | Class | Type of Check | Quantum Of check | | Reference Document | Acceptance NORMS | FORMAT OF RECORD | | AGENCY | | | |
|--------|--|--|-------|---------------------|------------------|-----|----------------------------|------------------------------------|-------------------------------|---|--------|---|---|---|
| | | | | | M | CIN | | | 9 | . | ** | D | M | C |
| 1.7 | OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC. | 1. SURFACE COND. ETC. | MA | VISUAL | 100% | - | - | NO VISUAL DEFECTS | TEST REPORT | | P/V | - | - | |
| | | 2.DIMENSION(BORE DIA, WALL THICKNESS, BDV AS RECEIVED, BDV AFTER FOLDING AT 180° | MA | TEST | SAMPLE | - | MANUFACTURER'S STD. | MANUFACTURER'S STD. | LOG BOOK AND OR SUPPLIER'S TC | | P/V | - | - | |
| 1.8 | SHEET STAMPING (PUNCHED) | 1. SURFACE COND. | MA | VISUAL | 100% | - | - | NO VISUAL DEFECTS (FREE FROM BURS) | LOG BOOK | | P | - | - | |
| | | 2.DIMENSIONS INCLUDING BURS HEIGHT | MA | MEASUREMENT | SAMPLE | - | MANUFACTURER'S DRG. | MANUFACTURER'S DRG. | LOG BOOK | | P/V | - | - | |
| | | 3. ACCEPTANCE TESTS | MA | ELECT. & MECH TESTS | SAMPLE | - | MANUFACTURER'S DRG./ STD. | MANUFACTURER'S DRG./ STD. | TC | | P/V | - | - | |
| 1.9 | CONDUCTORS | 1. SURFACE FINISH | MA | VISUAL | 100% | - | - | FREE FROM VISUAL DEFECTS | LOG BOOK | | *P/V | - | - | * MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY |
| | | 2.ELECT. PROP. & MECH. PROP | MA | ELECT. & MECH.TEST | SAMPLES | - | MANUFACTURER'S DRG./ SPEC. | MANUFACTURER'S / SPEC. | TC & VENDOR'S TEST REPORTS | | P/V | - | - | |


| BHEL | | | | | |
|--------------|---------------|---------------|--------------|---|--------------|
| ENGINEERING | | | QUALITY | | |
| | Sign & Date | Name | | Sign & Date | Name |
| Prepared by: | HEMA KUSHWAHA | HEMA KUSHWAHA | Checked by: |  | KUNAL GANDHI |
| Reviewed by: | PRAVEEN DUTTA | PRAVEEN DUTTA | Reviewed by: |  | R K JAISWAL |

| BIDDER/ SUPPLIER | |
|------------------|--|
| Sign & Date | |
| Seal | |

| FOR CUSTOMER REVIEW & APPROVAL | | | |
|--------------------------------|-------------|------|------|
| Doc No: | | | |
| | Sign & Date | Name | Seal |
| Reviewed by: | | | |
| Approved by: | | | |


| | | | | | |
|---|--|---|----------------|--|---|
|  | MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS | STANDARD QUALITY PLAN | | SPEC. NO. : | DATE:17.04.2020 SHEET 4 OF 9 |
| | | CUSTOMER : | | QP NO.: PE-QP-999-Q-007, REV-04 | |
| | | PROJECT: | | PO NO.: | |
| | | ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V)) | SYSTEM: | SECTION: II | |

| SI No. | Component & Operations | Characteristics | Class | Type of Check | Quantum Of check | | Reference Document | Acceptance NORMS | FORMAT OF RECORD | | AGENCY | | | |
|--------|---------------------------------|----------------------------|-------|---------------|------------------|-----|--|--|------------------|---|--------|-----|---|---|
| | | | | | M | C/N | | | 9 | . | ** | D | M | C |
| 1.10 | BEARINGS | 3.DIMENSIONS | MA | MEASUREMENT | SAMPLES | - | MANUFACTURER'S DRG/ SPEC. | MANUFACTURER'S / SPEC. | LOG BOOK | | | P/V | - | - |
| | | 1.MAKE & TYPE | MA | VISUAL | 100% | - | MANUFACTURER'S DRG/ APPROVED DATASHEET | MANUFACTURER'S DRG/ APPROVED DATASHEET | LOG BOOK | | | P/V | - | - |
| | | 2.DIMENSIONS | MA | MEASUREMENT | SAMPLE | - | APPROVED DATASHEET | APPROVED DATASHEET/ BEARING MANUF'S CATALOGUES | LOG BOOK | | | P/V | - | - |
| 1.11 | SLIP RING (WHEREVER APPLICABLE) | 3.SURFACE FINISH | MA | VISUAL | 100% | - | - | FREE FROM VISUAL DEFECTS | LOG BOOK | | | P/V | - | - |
| | | 1.SURFACE COND. | MA | VISUAL | 100% | - | - | FREE FROM VISUAL DEFECTS | LOG BOOK | | | P | - | - |
| | | 2.DIMENSIONS | MA | MEASUREMENT | SAMPLE | - | MANUFACTURER'S DRG | MANUFACTURER'S DRG | LOG BOOK | | | P | - | - |
| 1.12 | OIL SEALS & GASKETS | 3.TEMP WITH-STAND CAPACITY | MA | ELECT.TEST | SAMPLE | - | MANUFACTURER'S STD/ APPROVED DATASHEET | MANUFACTURER'S STD/ APPROVED DATASHEET | LOG BOOK | | | P/V | - | - |
| | | 4.HV/IR | MA | -DO- | 100% | - | MANUFACTURER'S STD/ APPROVED DATASHEET | MANUFACTURER'S STD/ APPROVED DATASHEET | LOG BOOK | | | P/V | - | - |
| | | 1.MATERIAL OF GASKET | MA | VISUAL | 100% | - | MANUFACTURER'S DRG/SPECS | MANUFACTURER'S DRG/ SPECS. | LOG BOOK | | | P | - | - |
| | | 2.SURFACE COND. | MA | VISUAL | 100% | - | - | FREE FROM VISUAL DEFECTS | LOG BOOK | | | P | - | - |
| | | 3.DIMENSIONS | MA | MEASUREMENT | SAMPLE | - | MANUFACTURER'S DRG | MANUFACTURER'S DRG | LOG BOOK | | | P | - | - |



| BHEL | | | | | |
|--------------|---------------|----------------|--------------|---|--------------|
| ENGINEERING | | | QUALITY | | |
| | Sign & Date | Name | | Sign & Date | Name |
| Prepared by: | HEMA KUSHWAHA | HEMA KHUSHWAHA | Checked by: |  | KUNAL GANDHI |
| Reviewed by: | PRAVEEN DUTTA | PRAVEEN DUTTA | Reviewed by: | RITESH KUMAR JAISWAL | R K JAISWAL |

| BIDDER/ SUPPLIER | |
|------------------|--|
| Sign & Date | |
| Seal | |

| FOR CUSTOMER REVIEW & APPROVAL | | | |
|--------------------------------|-------------|------|------|
| Doc No: | | | |
| | Sign & Date | Name | Seal |
| Reviewed by: | | | |
| Approved by: | | | |


| | | | | | | |
|---|--|---|--|--|--|------------------------|
|  | MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS | STANDARD QUALITY PLAN | | SPEC. NO : | | DATE:17.04.2020 |
| | | CUSTOMER : | | QP NO.: PE-QP-999-Q-007, REV-04 | | |
| | | PROJECT: | | PO NO.: | | |
| | | ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V)) | | SYSTEM: | | |

| SI No. | Component & Operations | Characteristics | Class | Type of Check | Quantum Of check | | Reference Document | Acceptance NORMS | FORMAT OF RECORD | | AGENCY | | | | | | |
|--------|---|---|-------|---------------------------|------------------|-----|--|---|------------------|---|--------|-----|---|---|---|--|--|
| | | | | | M | C/N | | | 9 | . | ** | D | M | C | N | | |
| 2.0 | IN PROCESS | | | | | | | | | | | | | | | | |
| 2.1 | STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR) | 1.WORKMANSHIP & CLEANNESS | MA | VISUAL | 100% | - | MANUFACTURER'S DRG | GOOD FINISH | LOG BOOK | | | P/W | - | - | | | |
| | | 2.DIMENSIONS | MA | MEASUREMENT | 100% | - | MANUFACTURER'S DRG | MANUFACTURER'S DRG | LOG BOOK | | | P | - | - | | | |
| 2.2 | MACHINING | 1.FINISH | MA | VISUAL | 100% | - | -DO- | GOOD FINISH | LOG BOOK | | | P | - | - | | | |
| | | 2.DIMENSIONS | MA | MEASUREMENT | 100% | - | MANUFACTURER'S DRG | MANUFACTURER'S DRG | LOG BOOK | | | P | - | - | | | |
| | | 3.SHAFT SURFACE FLOWS | MA | PT | 100% | - | MANUFACTURER'S STD./ASTM-E165 | MANUFACTURER'S STD./APPROVED DATASHEET. | LOG BOOK | ✓ | | P | V | - | | | |
| 2.3 | PAINTING | 1.SURFACE PREPARATION | MA | VISUAL | 100% | - | MANUFACTURER'S STD./APPROVED DATASHEET | MANUFACTURER'S STD./APPROVED DATASHEET | LOG BOOK | | | P | - | - | | | |
| | | 2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT) | MA | MEASUREMENT BY ELCOMETER | SAMPLE | - | MANUFACTURER'S STD./APPROVED DATASHEET | MANUFACTURER'S STD./APPROVED DATASHEET | LOG BOOK | | | P | - | - | | | |
| | | 3.SHADE | MA | VISUAL | SAMPLE | - | MANUFACTURER'S STD./APPROVED DATASHEET | MANUFACTURER'S STD./APPROVED DATASHEET | LOG BOOK | | | P | - | - | | | |
| | | 4.ADHESION | MA | CROSS CUTTING & TAPE TEST | SAMPLE | - | MANUFACTURER'S STD./APPROVED DATASHEET | MANUFACTURER'S STD./APPROVED DATASHEET | LOG BOOK | | | P | - | - | | | |


| BHEL | | | | |
|----------------------------|----------------|--|--------------|--|
| ENGINEERING | | QUALITY | | |
| Sign & Date | Name | Sign & Date | Name | |
| Prepared by: HEMA KUSHWAHA | HEMA KHUSHWAHA | Checked by:  | KUNAL GANDHI | |
| Reviewed by: PRAVEEN DUTTA | PRAVEEN DUTTA | Reviewed by:  | R K JAISWAL | |

| BIDDER/ SUPPLIER | |
|------------------|--|
| Sign & Date | |
| Seal | |

| FOR CUSTOMER REVIEW & APPROVAL | | | |
|--------------------------------|------|------|--|
| Doc No: | | | |
| Sign & Date | Name | Seal | |
| Reviewed by: | | | |
| Approved by: | | | |

| | | | | | | |
|---|--|---|----------------|--|---------------------|------------------------|
|  | MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS | STANDARD QUALITY PLAN | | SPEC. NO : | | DATE:17.04.2020 |
| | | CUSTOMER : | | QP NO.: PE-QP-999-Q-007, REV-04 | | |
| | | PROJECT: | | PO NO.: | | |
| | | ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V)) | SYSTEM: | SECTION: II | SHEET 6 OF 9 | |

| SI No. | Component & Operations | Characteristics | Class | Type of Check | Quantum Of check | | Reference Document | Acceptance NORMS | FORMAT OF RECORD | AGENCY | | | |
|--------|------------------------|----------------------------|-------|---------------|------------------|-----|--|--|--------------------|--------|----|---|------------------------|
| | | | | | M | C/N | | | | D | M | C | N |
| 1 | 2 | 3 | 4 | 5 | 6 | | 7 | 8 | 9 | . | .. | | |
| 2.4 | SHEET STACKING | 1.COMPLETENESS | MA | MEASUREMENT | SAMPLE | - | MANUFACTURER'S STD. | MANUFACTURER'S STD. | LOG BOOK | | P | - | - |
| | | 2.COMPRESSION & TIGHTENING | MA | MEASUREMENT | 100% | - | MANUFACTURER'S STD. | MANUFACTURER'S STD. | LOG BOOK | | P | - | - |
| 2.5 | WINDING | 1.COMPLETENESS | CR | VISUAL | 100% | - | MANUFACTURER'S STD./APPROVED DATASHEET | MANUFACTURER'S STD./APPROVED DATASHEET | LOG BOOK | | P | - | - |
| | | 2.CLEANLINESS | CR | VISUAL | 100% | - | MANUFACTURER'S STD./APPROVED DATASHEET | MANUFACTURER'S STD./APPROVED DATASHEET | LOG BOOK | | P | - | - |
| | | 3.IR-HV-IR | CR | ELECT. TEST | 100% | - | IS-325//IS-12615/IEC-60034 PART-1 | IS-325//IS-12615/IEC-60034 PART-1 | TEST/INSPC. REPORT | ✓ | P | V | - |
| | | 4.RESISTANCE | CR | ELECT. TEST | 100% | - | IS-325//IS-12615/IEC-60034 PART-1 | IS-325//IS-12615/IEC-60034 PART-1 | TEST/INSPC. REPORT | ✓ | P | V | - |
| | | 5.INTERTURN INSULATION | CR | ELECT. TEST | 100% | - | IS-325//IS-12615/IEC-60034 PART-1 | IS-325//IS-12615/IEC-60034 PART-1 | TEST/INSPC. REPORT | | P | - | - |
| 2.6 | IMPREGNATION | 1.VISCOSITY | MA | PHY. TEST | AT STARTING | - | MANUFACTURER'S STANDARD | MANUFACTURER'S STANDARD | LOG BOOK | | P | - | - |
| | | 2.TEMP. PRESSURE VACCUM | MA | PROCESS CHECK | CONTINUOUS | - | MANUFACTURER'S STANDARD | MANUFACTURER'S STANDARD | LOG BOOK | | P | - | - |
| | | 3.NO. OF DIPS | MA | PROCESS CHECK | CONTINUOUS | - | MANUFACTURER'S STANDARD | MANUFACTURER'S STANDARD | LOG BOOK | ✓ | P | V | - |
| | | | | | | | | | | | | | THREE DIPS TO BE GIVEN |

| BHEL | | | | | |
|--------------|---------------|----------------|--------------|---|--------------|
| ENGINEERING | | | QUALITY | | |
| | Sign & Date | Name | | Sign & Date | Name |
| Prepared by: | HEMA KUSHWAHA | HEMA KHUSHWAHA | Checked by: |  | KUNAL GANDHI |
| Reviewed by: | PRAVEEN DUTTA | PRAVEEN DUTTA | Reviewed by: | RITESH KUMAR JAISWAL | R K JAISWAL |

| BIDDER/ SUPPLIER | |
|------------------|--|
| Sign & Date | |
| Seal | |

| FOR CUSTOMER REVIEW & APPROVAL | | | |
|--------------------------------|-------------|------|------|
| Doc No: | | | |
| | Sign & Date | Name | Seal |
| Reviewed by: | | | |
| Approved by: | | | |



MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS

STANDARD QUALITY PLAN

SPEC. NO :

CUSTOMER :

QP NO.: PE-QP-999-Q-007, REV-04

DATE:17.04.2020

PROJECT:

PO NO.:

ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))

SYSTEM:

SECTION: II


SHEET 7 OF 9

| SI No. | Component & Operations | Characteristics | Class | Type of Check | Quantum Of check | | Reference Document | Acceptance NORMS | FORMAT OF RECORD | | AGENCY | | | |
|--------|---------------------------|--|-------|-------------------------|------------------|-----|---|---|--------------------|---|--------|---|---|---|
| | | | | | M | C/N | | | 9 | . | ** | D | M | C |
| 1 | 2 | 3 | 4 | 5 | 6 | | 7 | 8 | | | | | | |
| 2.7 | COMPLETE STATOR ASSEMBLY | 4.DURATION 1.COMPACTNESS & CLEANLINESS | MA | PROCESS CHECK VISUAL | CONTINUOUS | - | MANUFACTURER'S STANDARD | MANUFACTURER'S STANDARD | LOG BOOK | ✓ | P | V | - | |
| 2.8 | BRAZING/COMPRESSION JOINT | 1.COMPLETENESS | CR | VISUAL | 100% | - | MANUFACTURER'S STANDARD | MANUFACTURER'S STANDARD | LOG BOOK | | P | - | - | |
| 2.9 | COMPLETE ROTOR ASSEMBLY | 2.SOUNDNESS | CR | MALLET TEST & UT | 100% | - | MANUFACTURER'S STANDARD | MANUFACTURER'S STANDARD | TEST/INSPC. REPORT | ✓ | P | V | - | |
| | | 3.HV | MA | ELECT. TEST | 100% | - | MANUFACTURER'S STANDARD | MANUFACTURER'S STANDARD | TEST/INSPC. REPORT | ✓ | P | V | - | |
| 2.10 | ASSEMBLY | 1.RESIDUAL UNBALANCE | CR | DYN. BALANCE | 100% | - | MANUFACTURER'S SPEC./ ISO 1940 | MANUFACTURER'S DWG. | LOG BOOK | | P | - | - | |
| | | 2.SOUNDNESS OF DIE CASTING | CR | ELECT. (GROWLER TEST) | 100% | - | MANUFACTURER'S SPEC. | MANUFACTURER'S SPEC. | TEST/INSPC. REPORT | ✓ | P | V | - | |
| | | 1.ALIGNMENT | MA | MEAS. | 100% | - | MANUFACTURER'S SPEC. | MANUFACTURER'S SPEC. | LOG BOOK | | P | - | - | |
| | | 2.WORKMANSHIP | MA | VISUAL | 100% | - | MANUFACTURER'S SPEC. | MANUFACTURER'S SPEC. | LOG BOOK | | P | - | - | |
| | | 3.AXIAL PLAY | MA | MEAS. | 100% | - | MANUFACTURER'S SPEC. | MANUFACTURER'S SPEC. | LOG BOOK | ✓ | P | V | - | |
| | | 4.DIMENSIONS | MA | MEAS. | 100% | - | MANUFACTURER'S DRG./ MANUFACTURER'S SPEC. | MANUFACTURER'S DRG./ MANUFACTURER'S SPEC. | LOG BOOK | | P | - | - | |
| | | 5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE | MA | VISUAL | 100% | - | MANUFACTURER'S SPEC. | MANUFACTURER'S SPEC. | LOG BOOK | | P | - | - | |
| | | 6. RTD, BTD & SPACE HEATER MOUNTING. | MA | VISUAL | 100% | - | MANUFACTURER'S SPEC. | MANUFACTURER'S SPEC. | LOG BOOK | ✓ | P | V | - | |


| BHEL | | | | | |
|----------------------------|----------------|--------------------------|----------------|--------------|--|
| ENGINEERING | | | QUALITY | | |
| Sign & Date | Name | | Sign & Date | Name | |
| Prepared by: HEMA KUSHWAHA | HEMA KHUSHWAHA | Checked by: KUNAL GANDHI | KUNAL GANDHI | KUNAL GANDHI | |
| Reviewed by: PRAVEEN DUTTA | PRAVEEN DUTTA | Reviewed by: R K JAISWAL | RITESH JAISWAL | R K JAISWAL | |

| BIDDER/ SUPPLIER | |
|------------------|--|
| Sign & Date | |
| Seal | |

| FOR CUSTOMER REVIEW & APPROVAL | | | |
|--------------------------------|-------------|------|------|
| Doc No: | | | |
| | Sign & Date | Name | Seal |
| Reviewed by: | | | |
| Approved by: | | | |


| | | | | | | |
|---|--|---|----------------|---|--|---|
|  | MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS | STANDARD QUALITY PLAN | | SPEC. NO : | | DATE:17.04.2020 SHEET 8 OF 9 |
| | | CUSTOMER : | | QP NO. : PE-QP-999-Q-007, REV-04 | | |
| | | PROJECT: | | PO NO.: | | |
| | | ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V)) | SYSTEM: | SECTION: II | | |

| SI No. | Component & Operations | Characteristics | Class | Type of Check | Quantum Of check | | Reference Document | Acceptance NORMS | FORMAT OF RECORD | | AGENCY | | | |
|--------|------------------------|--|-------|-----------------------------------|------------------|-------------|---|---|--------------------|---|--------|----------------|---|---|
| | | | | | M | C/N | | | 9 | . | ** | D | M | C |
| 3.0 | TESTS | 1.TYPE TESTS INCLUDING SPECIAL TESTS | MA | ELECT.TEST | 1/TYPE/SIZE | 1/TYPE/SIZE | IS-325//IS-12615/APPROVED DATASHEET | IS-325//IS-12615/APPROVED DATASHEET | TEST REPORT | ✓ | P | W* | - | * NOTE - 1 |
| | | 2.ROUTINE TESTS INCLUDING SPECIAL TEST | MA | ELECT.TEST | 100% | - | IS-325//IS-12615/APPROVED DATASHEET | IS-325//IS-12615/APPROVED DATASHEET | TEST REPORT | ✓ | P | V ^s | - | [§] NOTE - 2 |
| | | 3.VIBRATION & NOISE LEVEL | MA | ELECT.TEST | 100% | - | IS: 12075 / IEC 60034-14 & IS-12065 | IS: 12075 / IEC 60034-14 & IS-12065 | TEST REPORT | ✓ | P | V ^s | - | [§] NOTE - 2 |
| | | 4.OVERALL DIMENSIONS AND ORIENTATION | MA | MEASUREMENT & VISUAL | 100% | 100% | APPROVED DRG/DATA SHEET | APPROVED DRG/DATA SHEET & | TEST/INSPC. REPORT | ✓ | P | W | - | |
| | | 5.DEGREE OF PROTECTION | MA | ELECT. & MECH. TEST | 1/TYPE/ SIZE | - | IEC 60034-5/IS-12615 | APPROVED DATASHEET | TC | ✓ | P | V | - | TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3 |
| | | 6. MEASUREMENT OF RESISTANCE OF RTD & BTD | MA | ELECT. & MECH. TEST | 100% | - | IS-325//IS-12615/IEC-60034 PART-1/IS: 12802 | IS-325//IS-12615/IEC-60034 PART-1/IS: 12802 | TC | ✓ | P | V ^s | - | [§] NOTE - 2 |
| | | 7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER | MA | ELECT. & MECH. TEST | 100% | - | IS-325//IS-12615/IEC-60034 PART-1 | IS-325//IS-12615/IEC-60034 PART-1 | TC | ✓ | P | V ^s | - | [§] NOTE - 2 |
| | | 8. NAME PLATE DETAILS | MA | VISUAL | 100% | - | IS-325//IS-12615& DATA SHEET | IS-325//IS-12615 & DATA SHEET | TEST/INSPC. REPORT | ✓ | P | V ^s | - | [§] NOTE - 2 |
| | | 9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED) | MA | EXPLOSION FLAME PROOF TEST | 1/TYPE | - | IS 2148 / IEC 60079-1 | IS 2148 / IEC 60079-1 | TC | ✓ | P | V | - | TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3 |
| | | 10. PAINT SHADE, THICKNESS & FINISH | MA | VISUAL & MEASUREMENT BY ELKOMETER | SAMPLE | SAMPLE | APPROVED DATASHEET | APPROVED DATASHEET | TC | ✓ | P | W ^s | - | SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY [§] NOTE - 2 |

| BHEL | | | | | |
|--------------|---------------|---------------|--------------|---|--------------|
| ENGINEERING | | | QUALITY | | |
| | Sign & Date | Name | | Sign & Date | Name |
| Prepared by: | HEMA KUSHWAHA | HEMA KUSHWAHA | Checked by: |  | KUNAL GANDHI |
| Reviewed by: | PRAVEEN DUTTA | PRAVEEN DUTTA | Reviewed by: | RITESH KUMAR JAISWAL | R K JAISWAL |

| BIDDER/ SUPPLIER | |
|------------------|--|
| Sign & Date | |
| Seal | |

| FOR CUSTOMER REVIEW & APPROVAL | | | |
|--------------------------------|-------------|------|------|
| Doc No: | | | |
| | Sign & Date | Name | Seal |
| Reviewed by: | | | |
| Approved by: | | | |

| | | | | | |
|---|--|---|----------------|---------------------------------|---|
|  | MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS | STANDARD QUALITY PLAN | | SPEC. NO.: | DATE:17.04.2020 SHEET 9 OF 9 |
| | | CUSTOMER : | | QP NO.: PE-QP-999-Q-007, REV-04 | |
| | | PROJECT: | | PO NO.: | |
| | | ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V)) | SYSTEM: | SECTION: II | |


| SI No. | Component & Operations | Characteristics | Class | Type of Check | Quantum Of check | | Reference Document | Acceptance NORMS | FORMAT OF RECORD | | AGENCY | | | |
|--------|------------------------|-------------------------------|-------|---------------|------------------|------|---------------------------------|---------------------------------|------------------|---|--------|---|---|-------------------|
| | | | | | M | C/N | | | 9 | . | ** | M | C | N |
| 4.0 | PACKING | SURFACE FINISH & COMPLETENESS | MA | VISUAL | 100% | 100% | AS PER MANUFACT. STANDARD / (#) | AS PER MANUFACT. STANDARD / (#) | INSPC. REPORT | ✓ | P | W | - | (#): REFER NOTE-8 |

NOTES:

- 1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.
- 2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL/CUSTOMER SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON.
- 3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THE SAME IS VALID FOR 5 YEARS.
- 4 BHEL RESERVES THE RIGHT TO PERFORM REPEAT TEST, IF REQUIRED.
- 5 AFTER PACKING AND PRIOR TO ISSUE MDCC, PHOTOGRAPHS OF ITEMS TO BE DESPATCHED SHALL BE SENT TO BHEL PURCHASE GROUP FOR REVIEW.
- 6 IN CASE , ANY CHANGES IN QP COMMENTED BY CUSTOMER AT CONTRACT STAGE SHALL BE CARRIED OUT BY BIDDER WITHOUT ANY IMPLICATION TO BHEL/ CUSTOMER.
- 7 PROJECT SPECIFIC QP TO BE DEVELOPED BASED ON CUSTOMER REQUIREMENT.
- 8 FOR EXPORT JOB, BHEL TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING TO BE FOLLOWED.
- 9 PACKING SHALL BE SUITABLE FOR STORAGE AT SITE IN TROPICAL CLIMATE CONDITIONS.
- 10 LATEST REVISION/ YEAR OF ISSUE OF ALL THE STANDARDS (IS/ ASME/ IEC ETC.) INDICATED IN QP SHALL BE REFERRED.

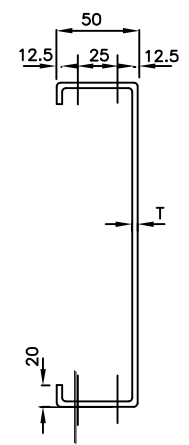
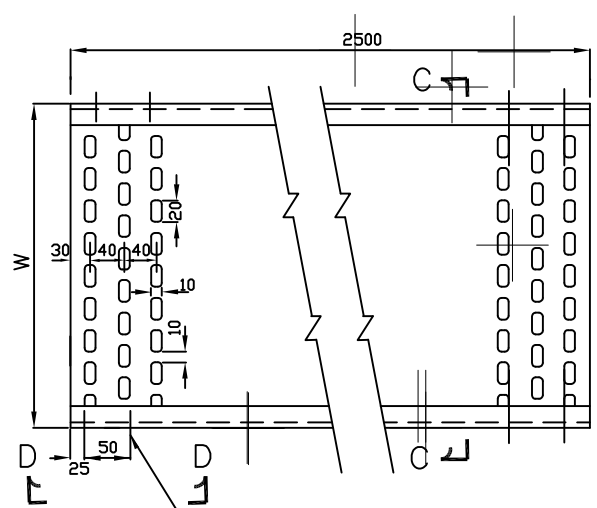
LEGENDS:

*RECORDS, IDENTIFIED WITH "TICK"(✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,
 ** M: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, B: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, C: CUSTOMER,
 P: PERFORM, W: WITNESS, V: VERIFICATION, AS APPROPRIATE
 MA: MAJOR, MI: MINOR, CR: CRITICAL
 D: DOCUMENT

| BHEL | | | | | |
|--------------|---------------|---------------|--------------|---|--------------|
| ENGINEERING | | | QUALITY | | |
| | Sign & Date | Name | | Sign & Date | Name |
| Prepared by: | HEMA KUSHWAHA | HEMA KUSHWAHA | Checked by: |  | KUNAL GANDHI |
| Reviewed by: | PRAVEEN DUTTA | PRAVEEN DUTTA | Reviewed by: | RITESH KUMAR | R K JAISWAL |

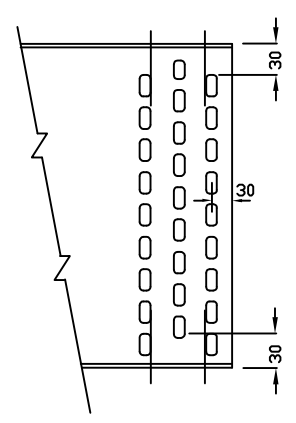
| BIDDER/ SUPPLIER | |
|------------------|--|
| Sign & Date | |
| Seal | |

| FOR CUSTOMER REVIEW & APPROVAL | | | |
|--------------------------------|-------------|------|------|
| Doc No.: | Sign & Date | Name | Seal |
| | | | |
| Reviewed by: | | | |
| Approved by: | | | |



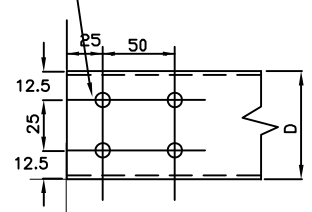
SECTION-CC
(100/50 TRAYS)

4 HOLES 10mm DIA.



ARRANGEMENT OF PERFORATIONS

4 HOLES 10mm DIA.

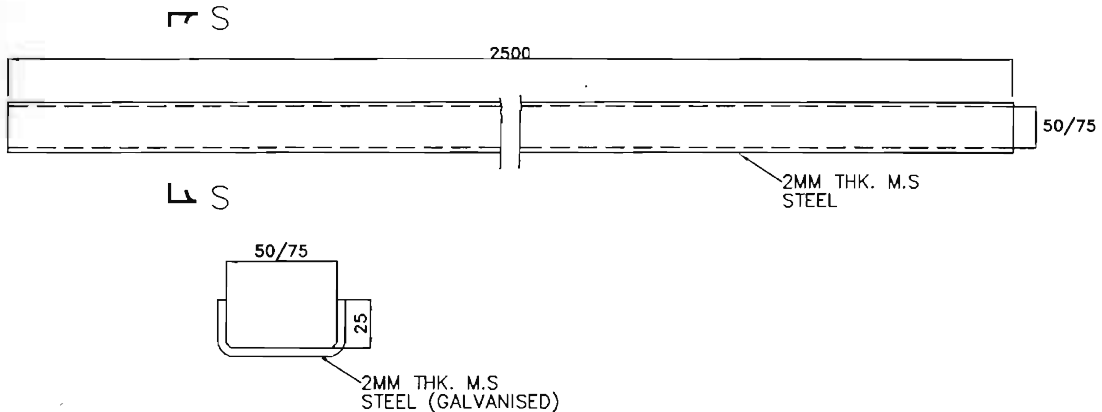


VIEW-DD
(100,50W TRAYS)

| | | |
|----------------------|-----|----|
| TRAY WIDTH W (mm) | 100 | 50 |
| TRAY DEPTH D (mm) | 50 | 50 |
| T (mm) | 2 | 2 |

PERFORATED TYPE TRAY





SECTION S-S

CABLE TROUGHS



TYPICAL DETAILS OF
CABLE TRAY AND ACCESSORIES

| Sl. No. | Description | Qty. | REMARKS |
|---------|--|---|---------|
| 7.14.01 | Lighting fixtures without light | 20 Sets for each make, type and rating | |
| 7.14.02 | MCCB | 5 Nos for each make, type and rating . | |
| 7.14.03 | MCB | 20 Nos for each make, type and rating . | |
| 7.14.04 | Power and Control Contactor | 5 Nos for each make, type and rating | |
| 7.14.05 | Switches | 5 Nos for each make, type and rating . | |
| 7.14.06 | Receptacles with plug | 5 Nos for each make, type and rating | |
| 7.14.07 | Rotary switches | 2 Nos for each make, type and rating . | |
| 7.14.08 | LED light | 50 nos for each make, type and rating . | |
| 7.14.09 | Clock switch type Time Switch | 2 nos for each make, type and rating . | |
| 7.14.10 | Lighting Transformer | 1 no for each make, type and rating . | |
| 7.15.00 | Cable | | |
| 7.15.01 | 11KV Grade HT Power Cable | 2 (Two) Kms. of each type, size & rating of Cables | |
| 7.15.02 | 3.3KV Grade HT Power Cable | 2 (Two) Kms. of each type, size & rating of Cables | |
| 7.15.03 | LT Power Cable | 2(Two)Kms of each type, size & rating of Cables | |
| 7.15.04 | Control Cable | 2(Two)Kms. of each type, size & rating of Cables | |
| 7.15.05 | Fire Survival Cable | 1(One)Km of each type, size & rating of Cables | |
| 7.16.00 | Neutral Grounding Registor | | |
| 7.16.01 | NGR complete with all accessories | 1 set of each make, type and rating | |
| 7.16.02 | Insulator | 2 nos for each make, type, rating and size | |
| 7.16.03 | Neutral CT(if applicable) | 1 no of each type and rating | |
| 7.18.00 | 220V DC System | | |
| 7.18.01 | Battery (For each make, Type and Rating) | | |
| (i) | Hydrameter | 2 Nos. of each type | |
| (ii) | Vent plugs | 5 Nos. of each type | |
| (iii) | Inter-cell, connector | 5 Nos. of each type | |
| (iv) | Set of nuts, bolts and washer | 5 Nos. of each type | |
| (v) | Insulated socket spanner with handle | 2 Nos. of each type | |
| (vi) | Thermometer | 2 Nos. of each type | |
| (vii) | Rubber gloves | 1pair | |
| (viii) | Voltmeter for measuring cell voltage (Center zero type) | 1No. | |
| 7.18.02 | Float -cum- Boost Charger (For each make, Type and Rating) | | |
| (i) | Electronic Module, PCB, Cards of each type and rating (with all components mounted) | 2 Set | |
| (ii) | Fuses of each type and rating | 100% of total quantity. | |
| (iii) | SCR of each type and rating | 2 Nos. | |
| (iv) | Blocking Diode of each type and rating | 5 Nos. of each type | |
| (v) | Potentiometer of each type and rating | 1 Set | |
| (vi) | Pulse transformer | 1 Set of each type | |
| (vii) | Main and Aux. transformer | 1 no of each type and rating | |
| (viii) | Capacitor | 2 no of each type and rating | |
| (ix) | Meters | 1 No of each type | |
| (x) | Transducer | 1 No of each type | |
| (xi) | Selector Switch | 1 no of each type | |
| (xii) | Control Switch | 1 no of each type | |
| (xiii) | Current transformer(if applicable) | 1 no of each type and rating | |
| (xiv) | Push button complete set | 1 no of each type | |
| (xv) | Annunciation window | 1No. | |
| (xvi) | Indicating Lamps complete assembly | 2 Nos of each type. | |
| (ix) | Thermometer | 1No. | |
| 7.21.00 | Motor | | |
| 7.21.01 | 11 KV & 3.3 KV Motor | | |
| (i) | Motor of each type and rating (Note : motors covered in mechanical spare items need not to be included here again) | 10% of the installed quantity or minimum 1 number whichever be higher | |

| Sl. No. | Description | Qty. | REMARKS |
|---------|---|---|---------|
| (ii) | Neutral End Terminal Bushing with Fasteners | 1 no. for each type and rating of Motor | |
| (iii) | Bearing Temperature Gauge Driving & Non-Driving End | 1 set for each type and rating of Motor | |
| (iv) | Phase segregated terminal boxes | 2 Nos. for each type and rating of Motor | |
| (v) | Heaters | 2 sets for each type and rating of Motor | |
| (vi) | Complete Set of Coupling | 1 set for each type and rating of Motor | |
| (vii) | Bearings (DE) for each type and rating of motors | 2 sets for each type and rating of Motor | |
| (viii) | Bearings (NDE) for each type and rating of motors | 2 sets for each type and rating of Motor | |
| (ix) | Cooling Fan Internal & External | 1 set for each type and rating of Motor | |
| (x) | Neutral CT for differential protection (For motor rating >1000 KW) | 2 no of each type and rating. | |
| (xi) | End Termination kits | 2 Nos. of each type and rating | |
| (xii) | Indicating Instruments/gauges other than Bearing temperature gauge (as applicable) | 1 set for each type and rating of Motor | |
| (xiii) | Phase side Bushing and Insulator | 1Set for each type and rating of Motor | |
| (xiv) | Oil Seal Ring (as applicable) | 1Set for each type and rating of Motor | |
| 7.21.02 | 415 Volt Motor | | |
| (i) | Motor of each type and rating (Note : motors covered in mechanical spare items need not to be included here again) 10% of the installed quantity or minimum 1 number whichever be higher | 10% of the installed quantity or minimum 1 number whichever be higher | |
| (ii) | End Shield Cover Driving & Non-Driving End | 1 set for each type and rating of Motor | |
| (iii) | Heaters | 2 sets for each type and rating of motor | |
| (iv) | Bearings (DE and NDE) for each type and rating of motor | 2 sets | |
| (v) | Cooling Fan for all type and rating of LT motors | One (1) set | |
| (vi) | Dust seals and gaskets for each type of motors | 1 Set | |
| (vii) | Motor Terminal Block | 1 no. for each type and rating of Motor | |
| (viii) | Complete Set of Coupling | 1 set for each type and rating | |
| 7.21.04 | DC Motor | | |
| (i) | Motor of each type and rating (Note : motors covered in mechanical spare items need not to be included here again) | 10% of the installed quantity or minimum 1 number whichever be higher | |
| (ii) | Carbon brushes | 2 sets for each type and rating of Motor | |
| (iii) | Brush assemblies | 2 sets for each type and rating of Motor | |
| (iv) | Terminal blocks | 1 set for each type and rating of Motor | |
| (v) | Heaters | 1 set for each type and rating of Motor | |
| (vi) | Complete Set of Coupling | 1 set for each type and rating of Motor | |
| (vii) | Bearings (DE and NDE) for each type and rating of motor | 1 set for each type and rating of Motor | |
| (viii) | Cooling Fan | 1 set for each type and rating of Motor | |
| 8.02.00 | Large Video Screen | | |
| 8.03.00 | PLC System | | |
| 8.03.01 | CPU Card | 1No. | |
| 8.03.02 | Communication Processor Module | 1No. for each type | |
| 8.03.03 | Binary Input Card | 10% of total nos. used in the system or minimum 4(four) nos. whichever is more. | |
| 8.03.04 | Pulse Input Card | 10% of total nos. used in the system or minimum 1(one) no. whichever is more. | |
| 8.03.05 | Analog Input Card (4 to 20 mA type) | 10% of total nos. used in the system or minimum 2(two) nos. whichever is more. | |
| 8.03.06 | Analog Input Card (TC input type) | 10% of total nos. used in the system or minimum 2(two) nos. whichever is more. | |



**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III
VENTILATION SYSTEM
TECHNICAL SPECIFICATION
(C&I PORTION)**

SPECIFICATION No: PE-TS-445-554-A002

SECTION : I

SUB-SECTION : C-4

REV. 00

DATE: MARCH 2022

SECTION: I

**SUB-SECTION: C-4
TECHNICAL SPECIFICATION (C&I PORTION)**



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

C&I TECHNICAL SPECIFICATION

FOR

VENTILATION SYSTEM



**CONTROL AND INSTRUMENTATION DEPARTMENT
PROJECT ENGINEERING MANAGEMENT
BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
NOIDA**

| PREPARED BY | CHECKED BY | APPROVED BY |
|--------------------|-------------------|--------------------|
| ANJALI RAMAN | SC SHARMA | SC SHARMA |
| MNGR. (C&I) | DGM (SH-I02,C&I) | DGM (SH-I02,C&I) |
| | | |



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

SECTION: C
SUB SECTION : C&I

**C&I SPECIFICATION FOR
VENTILATION SYSTEM**

INDEX

| S. No. | DESCRIPTION |
|--------|---|
| 1 | TITLE SHEET |
| 2 | INDEX SHEET |
| 3 | GENERAL TECHNICAL SPECIFICATION |
| 4 | C&I SPECIFIC TECHNICAL REQUIREMENTS |
| 5 | LIST OF DOCUMENTS/DELIVERABLES |
| 6 | MOTORISED VALVE ACTUATORS |
| 7 | FIELD & MEASURING INSTRUMENTS |
| 8 | SIGNAL EXCHANGE BETWEEN DRIVES & DCS |
| 9 | INSTRUMENT CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY |
| 10 | ERECTION HARDWARE |
| 11 | QUALITY ASSURANCE |
| 12 | TYPE TEST REQUIREMENT |
| 13 | APPLICABLE CODES AND STANDARDS |
| 14 | INSTRUMENT STUB DETAILS |
| 15 | INSTRUMENT INSTALLATION DRAWING |
| 16 | MANDATORY SPARE LIST |
| 17 | SUB VENDOR LIST |



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

SECTION: C
SUB SECTION : C&I

**C&I SPECIFICATION FOR
VENTILATION SYSTEM**

**GENERAL TECHNICAL
SPECIFICATION
CONTROL & INSTRUMENTATION**



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

SECTION: C
SUB SECTION : C&I

**C&I SPECIFICATION FOR
VENTILATION SYSTEM**

GENERAL REQUIREMENT

- 1.0 Bidder shall provide complete and independent control & instrumentation system with all accessories, auxiliaries and associated equipments 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, for 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 and delivery implication to BHEL.
- 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 the employer' 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 proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg / Cm². The contacts of equipment mounted instruments; sensors, switches etc. for external connection including spare contacts shall be wired out to suitably located junction boxes.
- 5.0 In case of any contradiction most stringent clause/condition shall prevail.



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

SECTION: C
SUB SECTION : C&I

**C&I SPECIFICATION FOR
VENTILATION SYSTEM**

C&I SPECIFIC TECHNICAL REQUIREMENT



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

SECTION: C
SUB SECTION : C&I

**C&I SPECIFICATION FOR
VENTILATION SYSTEM**

Specific Technical Requirements (C&I):

- 1) The control of Ventilation system shall be through DCS of AC system. This DCS shall be in BHEL's scope. The operation and control of Ventilation system shall be as per control philosophy given elsewhere in the specification. The DCS panel along with OWS/OEWS (in BHEL scope) shall be located in AC Plant Control Room.
- 2) The Contractor shall provide complete Instrumentation for control, monitoring and operation of entire Ventilation system. The requirements given are to be read in conjunction with detailed Technical specification enclosed in the specification. Further in case of any discrepancy in the requirement within the same section noted by the bidder in the specification, the same will be brought to the notice of BHEL in the form of pre- bid clarification. In absence of any pre-bid clarification, the more stringent requirement as per interpretation of Customer shall prevail without any commercial implication.
- 3) The instrumentation to be provided for Ventilation system shall be as per the technical specification document / drawings wherever provided for the respective systems as a minimum requirement for bidding purpose. However, for completeness of the system and its associated equipment, Bidder shall also provide all the necessary instruments to the process requirement even if not indicated in the given technical Specification document /drawings. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any technical, commercial and delivery implication to BHEL.
- 4) The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial and delivery implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.
- 5) Bidder to include in his scope the supply of local starter cum control panels for operation & control AWUs and UAFs.
- 6) Bidder to keep the provision for accepting fire signals from Fire Alarm & Protection System (supplied by others) and the closure of relevant fire dampers in in the event of fire. The no of IO & other specifications in this regard shall be finalized during detail engineering.
- 7) VFD panels for applicable drives are in Bidders scope. Typical signal exchange with DCS has been indicated in the specification elsewhere.
- 8) Electrical Actuators with integral starter shall be provided for all on/off and inching type valves along with necessary interface units for linking to corresponding Control System as applicable, typical Hook-up diagram of drives is



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

SECTION: C
SUB SECTION : C&I

**C&I SPECIFICATION FOR
VENTILATION SYSTEM**

included for reference. Non-contact type electronic 2-wire position transmitters shall be provided for all inching type motorised valves. The detailed specification is attached elsewhere in the specification.

- 9) The solenoid valves shall have limit switches for open/close feedback.
- 10) Interface of MCC, HT SWGR, Actuators, solenoid drives, control valves etc. with DCS based control system shall be as per Drive Control Philosophy attached in the specification.
- 11) All the instruments/drives shall be terminated on JBs/Panels in field. JBs/Panels shall be in Bidder's scope. Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 12-15 mtrs) and trunk cable.
- 12) RTD's shall be of duplex type. Both the elements of duplex temperature sensors shall be terminated to junction boxes. Temperature measurement shall have up scale / down scale drive to protect from process upset in case of sensor failure. For RTDs ring - tong type lugs shall be used at Junction Boxes.
- 13) All local gauges, transmitters and switches shall be mounted on suitable enclosures, racks subject to owner's approval. All transmitters shall be HART compatible.
- 14) Bidder to terminate all instrumentation and control elements in junction boxes. Bidder to provide input/output list, drives list, junction box schedule and termination details, recommended control logics / write-up etc. the list of documents to be submitted after award of contract is to be referred by bidder.
- 15) All field instruments enclosure shall be IP65. Local panel/cabinet enclosure shall be IP 55, unless otherwise specified. Electronics located outside control room shall be tropicalized and enclosed in dust & weatherproof cabinets (IP-65/67) suitable for the environment.
- 16) Components of instruments, control devices, accessories, piping etc. which contact steam, condensate or boiler feed water shall be manufactured from copper-free materials.
- 17) Primary sensor redundancy for Control/measurement shall be decided as per following general criteria:
 - a. Critical controls & respective measurements, measurements required for protection of auxiliaries & for major CLCS- Triple redundant.
 - b. Non-critical but important control & measurements and measurements required for other CLCS- Dual redundant.
- 18) All the instruments/ sensors/transmitters/switches meant for redundant applications shall have completely separate and independent impulse pipes/ root



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

SECTION: C
SUB SECTION : C&I

**C&I SPECIFICATION FOR
VENTILATION SYSTEM**

valves etc. No redundant instrument shall share a single process tapping. There will be separate and independent tapping for every individual instrument.

- 19) Double root valve shall be provided for all pressure tapings where the line pressure is 40kg/cm² and above. Single root valve for below 40Kg /sq. cm.
- 20) Bidder to comply with codes and standards as mentioned in the specification.
- 21) Instrument installation shall be as per the attached "Standard Hook-up diagram of instrument." However, any instrument/ analyser installation not covered in the same shall be subject to Customer and BHEL approval during detailed engineering.
- 22) Bidder shall provide erection hardware as per installation drawings.
- 23) Bidder to provide mandatory spares as per mandatory spares list attached elsewhere in the specification.
- 24) Bidder to perform tests of C&I items/instruments/systems as per Quality plans/type test attached in the specification. However, if any test not specified in the quality plan but specified in specification Tests for I&C equipment included elsewhere in specification will have to perform by Bidder without any cost implication. The make/model of various instruments/items/systems shall be as per Customer/BHEL approved vendor list. No commercial and delivery implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.
- 25) Bidder must offer general tools and tackles and special calibration instruments required during start-up, trial run, operation and maintenance of the system.
- 26) Redundant 230 VAC UPS feeders shall be provided by BHEL at a single point. Further distribution to various instruments shall be in Bidder's scope. Bidder to include necessary power distribution board (ACDB) (as per details attached elsewhere in this specification) in his scope. Any power supply other than the above, if required by any instrument/device, has to be derived by the Bidder from the above supply and all necessary hardware for the same shall be in bidder's scope. Bidder to furnish UPS power requirement along with the bid.
- 27) Bidder to furnish electrical load/UPS load data during detailed engineering.
- 28) Scope of Instrumentation cables (Screened Control Cables), Fibre Optic cable & Control cables shall be as per Electrical Cable scope matrix in Electrical portion of specification. Any cable in Bidder's scope shall be as per specification.



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

SECTION: C
SUB SECTION : C&I

**C&I SPECIFICATION FOR
VENTILATION SYSTEM**

- 29) Number of pairs to be selected for Screen /Control cable (Size : 0.5 mm²)
 - a) F-Type: 2P/4P/8P/12P
 - b) G-Type: 2P/4P/8P/12P
- 30) Number of cores to be selected for Control cable (Size: 2.5 mm²):
 - a) 3 Core
 - b) 5 Core
 - c) 12 Core
- 31) Any part/module of the C&I system which are not listed under recommended spares shall be deemed as having life expectancy not less than the expected life of the plant i.e. 30 years.
- 32) Instrument ranges shall be selected to have the normal reading, preferably between 50% and 70% of full scale for linear parameters and 70% to 80% for flow measurements. Deviation indicators shall have the null position at mid-scale. The normal operating parameter shall be identified with a clear green mark.
- 33) The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by bidder without any technical, commercial and delivery implication to BHEL.
- 34) The bidders shall specifically mention any deviation they would like to take on the C&I specification. In absence of only deviation, a No deviation certificate is to be furnished.
- 35) Contractor shall furnish Instrument Schedule, I/O list, Drive list, Cable Schedule, Cable interconnection (DCS end terminal details shall be provided to vendor during detail engineering to incorporate in cable interconnection), JB grouping, Annunciation list, SOE list, List of Instruments/devices for HART in BHEL approved format. Also reusable database format like MS Excel, MS Access etc. of these documents shall also be provided by Contractor in BHEL approved format. Soft copy of the formats shall be provided to the successful bidder.
- 36) In addition to requirements specified here, all C&I systems/ sub-systems/ equipment/ devices shall also meet other requirements stipulated under other Sub-sections/ parts/ sections of specification.
- 37) In case of any conflict and repetition of clauses in the specification, BHEL discretion will prevail.
- 38) All the outdoor field instruments such as analysers/transmitters/meters etc. shall be provided with suitable Free standing cabinet(s)/panel/rack so that the equipments are protected against rain/ sunlight etc. Site fabricated racks are not accepted



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

SECTION: C
SUB SECTION : C&I

**C&I SPECIFICATION FOR
VENTILATION SYSTEM**

- 39) Control & Instrumentation equipment shall be guaranteed against manufacturing defect for at least two (2) years from the date of handing over to Owner.
- 40) Bidder to delegate /depute their persons/experts (15 working days for minimum 3 tours) as per owner/consultants' requirement without any additional cost at site during commissioning.
- 41) Bidder's presence is required for 3 Man days (Excluding travel time) at EDN Bangalore during FAT of DDCMIS for certifying correctness & completeness of implementation of Control logic. Intimation to attained FAT shall be informed in 2 days advance. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope.
- 42) Bidder to ensure participation of their senior personnel and experts in discussions with Owners and other equipment bidders during various stages of contract implementation as required by the Owner.

**3.00.00 CONTROL PHILOSOPHY****3.01.01 Humidity Control (Air Washer System)**

To protect the equipment located in the ventilated space from effects of high humidity, control device using humidistat inter-locked with pump motor of the air washer unit shall be used in electrical areas. Humidity beyond 60% RH in these ventilated spaces shall automatically trip the respective AWU pump. The pump may be restarted automatically at about 50% RH. At least, Two (2) nos. humidistat (RH High and Low) shall be provided per pump of each Air Washer Unit. However, manual overriding facility shall be provided for humidistat controlled pumps for the Air Washer Unit. Selection and starting of stand by pump shall be manual. In any case the Pump sets for spraying water over the filters in Air Washer Unit will not be stopped.

Relative Humidity & Temperature to be displayed at least 3 locations of Switchgear Rooms.

3.01.02 Operation of Motorized Type Fire Damper

Motorized type electrically operated fire dampers shall be provided in the ventilation supply air ducting leading to Electrical Rooms like various MCC rooms, Switchgear rooms, cable spreader rooms and in the exhaust path of oil room. These dampers shall be operated with the help of signal from smoke detectors / thermal sensors. Motors shall remain energized in normal condition to effect opening of dampers. In the event of fire, the motors will be de-energized and the damper will close due to spring action. Smoke detector / thermal sensors will be supplied by the Bidder.





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

SECTION: C
SUB SECTION : C&I

**C&I SPECIFICATION FOR
VENTILATION SYSTEM**

C&I DELIVERABLES LIST

**LIST OF VENDOR DELIVERABLES FOR C&I FOR VENTILATION SYSTEM
(1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5))**

DOCUMENT NUMBER PE-GL-445-554-I001 SHEET 1 of 1

| SI.No. | DRAWING NO. | DRAWING/DOCUMENT TITLE | CATEGORY |
|--------|--------------------|--|----------|
| 1 | PE-V0-445-145-I901 | CONTROL & OPERATIONAL WRITE-UP FOR THE SYSTEM | A |
| 2 | PE-V0-445-145-I902 | CONTROL SCHEME/LOGIC DIAGRAM(TO BE IMPLEMENTED IN DDCMIS) | A |
| 3 | PE-V0-445-145-I903 | HMI PICTURES/PLANT SCHEMATICS | A |
| 4 | PE-V0-445-145-I904 | INSTRUMENT SCHEDULE WITH SET POINTS | A |
| 5 | PE-V0-445-145-I905 | DCS INPUT / OUTPUT LIST (ANALOG & BINARY) | A |
| 6 | PE-V0-445-145-I906 | DRIVE LIST/SOLENOID/ACTUATOR VALVE LIST WITH LOCATION DATA | A |
| 7 | PE-V0-445-145-I907 | FIELD JB/LIE/LIR DRIVES TERMINATIONS /GROUPING DOCUMENT | A |
| 8 | PE-V0-445-145-I908 | DATASHEETS FOR INSTRUMENTS, JBs, etc. | A |
| 9 | PE-V0-445-145-I909 | QUALITY PLANS (INSTRUMENTS, VMS, etc.)/ CHECK LIST | A |
| 10 | PE-V0-445-145-I910 | INSTRUMENT INSTALLATION/ HOOK UP DRAWINGS | A |
| 11 | PE-V0-445-145-I911 | THERMOWELL SIZING CALCULATION | A |
| 12 | PE-V0-445-145-I913 | CABLE SCHEDULE & INTERCONNECTION | A |
| 13 | PE-V0-445-145-I914 | ANNUNCIATION & SOE LIST | A |
| 14 | PE-V0-445-145-I915 | LOCAL STARTER CUM CONTROL PANEL DATA SHEET & WIRING DIAGRAM | A |
| 15 | PE-V0-445-145-I916 | PANEL LAYOUT & EXTERNAL/INTERNAL GA DRAWING (INCLUDING FOUNDATION DETAILS & FLOOR CUT-OUT) | A |
| 16 | PE-V0-445-145-I917 | LIST OF SIGNAL EXCHANGE WITH DDCMIS (BOTH HARDWIRED & SERIAL INTERFACE) | A |
| 17 | PE-V0-445-145-I918 | LCP QUALITY PLAN | A |

NOTES:

1. ANY OTHER DOCUMENT DECIDED DURING DETAILED ENGINEERING SHALL BE PROVIDED BY BIDDER WITHOUT ANY COMMERCIAL/TECHNICAL IMPLICATION.

2. CONTRACTOR TO SUBMIT REUSABLE DATABASE FORMATS IN BHEL/CUSTOMER APPROVED FORMATS LIKE MS EXCEL,MS ACCESS OF DOCUMENTS LIKE INSTRUMENT SCHEDULE, I/O LIST, DRIVE LIST,FIELD JB TERMINATIONS, CABLE SCHEDULE & INTERCONNECTION, etc. SOFT COPY OF FORMATS SHALL BE PROVIDED TO SUCCESSFUL BIDDERS.



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

SECTION: C
SUB SECTION : C&I

**C&I SPECIFICATION FOR
VENTILATION SYSTEM**

**SPECIFICATION FOR
MOTORISED VALVE ACTUATOR**



**SPECIFICATION
FOR
MOTORISED VALVE ACTUATOR**

DOCUMENT NO.: PE-ID-445-145-1902

VOLUME II B

SECTION D

REV. NO. 01

DATE:27/03/2020

SHEET 1

OF 5

Data Sheet A & B

DATA SHEET-A
(TO BE FILLED BY PURCHASER)

DATA SHEET-B
(TO BE FILLED-UP BY BIDDER)

| | | |
|--|---|--|
| GENERAL* | * PROJECT | 1 X 660 MW SAGARDIGHI STPP |
| | OFFER REFERENCE | |
| | * TAG NO. SERVICE | |
| | * DUTY | <input type="checkbox"/> ON / OFF <input type="checkbox"/> INCHING |
| | * LINE SIZE (inlet/outlet): MATERIAL | |
| | * VALVE TYPE | <input type="checkbox"/> GLOBE <input type="checkbox"/> GATE <input type="checkbox"/> REG. GLOBE <input type="checkbox"/> BUTTERFLY |
| | * OPENING / CLOSING TIME | |
| | * WORKING PRESSURE | |
| | AMBIENT CONDITION | SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF -20 to 70 DEG C AND RELATIVE HUMIDITY OF 0-95% IN HOT HUMID AND TROPICAL ATMOSPHERE AND HIGHLY POLLUTED AT PLACES OF COAL DUST AND FLY DUST |
| | VALVE SEAT TEST PRESS | BIDDER TO SPECIFY |
| | REQUIRED VALVE TORQUE | BIDDER TO SPECIFY |
| ACTUATOR RATED TORQUE | BIDDER TO SPECIFY | |
| CONSTRUCTION AND SIZING | CONSTRUCTION | TOTALLY ENCLOSED, WEATHER PROOF, DUST TIGHT SUITABLE FOR OUTDOOR USE WITHOUT CANOPY, NEMA6/IP:68 |
| | MECHANICAL POSITION INDICATOR | TO BE PROVIDED FOR 0-100% TRAVEL |
| | BEARINGS | DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION. |
| | GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION | METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED. |
| SIZING | OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. FOR INCHING SERVICE - 150 STARTS/HR MINIMUM & FOR REGULATING SERVICE - 600 STARTS/HR MINIMUM as per IEC60034-1 | |
| HANDWHEEL as per standard EN 12570:2000 | * REQUIRED | <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO |
| | * ORIENTATION | <input type="checkbox"/> TOP MOUNTED <input type="checkbox"/> SIDE MOUNTED |
| | *TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION. | |
| ELECTRIC ACTUATOR | ACTUATOR MAKE/MODEL | BIDDER TO SPECIFY |
| | MOTOR MAKE / MODEL / TYPE / RATING (KW) (REFER NOTE NO. 6 & 7) | BIDDER TO SPECIFY |
| | @ MOTOR TYPE | SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT-INCLUSIVE OF I.S. TOLERANCE |
| | ACTUATOR APPLICABLE WIRING DIAGRAM | <input checked="" type="checkbox"/> ENCLOSED (BIDDER TO CONFIRM) A: <input checked="" type="checkbox"/> DRG. NO. 3-V-MISC-24227 R00 B: <input type="checkbox"/> DRG. NO. 3-V-MISC-24550 R00 C: <input type="checkbox"/> DRG. NO. 3-V-MISC-24283 R00 D: <input type="checkbox"/> DRG. NO. 4-V-MISC-90271 R11 E: <input type="checkbox"/> For Thyristor based Integral starter, Bidder/Vendor to furnish wiring diagram |
| | COLOUR SHADE | <input type="checkbox"/> BLUE (RAL 5012) <input type="checkbox"/> <input checked="" type="checkbox"/> TO BE DECIDED DURING DETAILED ENGINEERING |
| | PAINT TYPE | <input type="checkbox"/> ENAMEL <input checked="" type="checkbox"/> EPOXY CONFIRMING TO CORROSION CATEGORY C5-I |
| | SHAFT RPM | BIDDER TO SPECIFY |
| | OLR SET VALUE | BIDDER TO SPECIFY |



**SPECIFICATION
FOR
MOTORISED VALVE ACTUATOR**

DOCUMENT NO.: PE-ID-445-145-1902

VOLUME II B

SECTION D

REV. NO. 01

DATE:27/03/2020

SHEET 2

OF 5

Data Sheet A & B

DATA SHEET-A
(TO BE FILLED BY PURCHASER)

DATA SHEET-B
(TO BE FILLED-UP BY BIDDER)

| | | | |
|--|--|--|--|
| | @ STARTING / FULL LOAD CURRENT | BIDDER TO SPECIFY | |
| | NO. OF REV FOR FULL TRAVEL | BIDDER TO SPECIFY | |
| | @ PWR SUPP TO MTR / STARTER | 415V, 3PH, AC | |
| | @ CONTROL VOLTAGE REQUIREMENT | TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER <input type="checkbox"/> 230 V <input type="checkbox"/> 110 V | |
| | @ ENCLOSURE CLASS OF MOTOR | <input type="checkbox"/> IP 67 <input checked="" type="checkbox"/> IP 68 <input type="checkbox"/> FLAME PROOF | |
| | @MOTOR BEARING WITH 2 EARTH TERMINALS | DOUBLE SHIELDED; GREASE LUBRICATED ANTI FRICTION | |
| | @ INSULATION CLASS | CLASS-F TEMP. RISE LIMITED TO CLASS-B | |
| | @ WINDING TEMP PROTECTION | <input checked="" type="checkbox"/> THERMOSTAT (3 Nos.,1 IN EACH PHASE) | |
| | SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION | REQUIRED (THERMISTOR PTC) | |
| INTEGRAL STARTER | INTEGRAL STARTER | <input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED | |
| | TYPE OF SWITCHING DEVICE | <input checked="" type="checkbox"/> CONTACTORS <input type="checkbox"/> THYRISTORS | |
| | TYPE | <input checked="" type="checkbox"/> CONVENTIONAL <input type="checkbox"/> SMART (NON-INTRUSIVE) | |
| | IF SMART (REFER BELOW POINT a – h) | | |
| | a) SERIAL LINK INTERFACE | <input type="checkbox"/> INTEGRAL <input type="checkbox"/> FIELD MOUNTED | |
| | b) SERIAL LINK PROTOCOL | <input type="checkbox"/> FOUNDATION FIELD-BUS <input type="checkbox"/> PROFI-BUS <input type="checkbox"/> DEVICE NET <input type="checkbox"/> | |
| | c) SERIAL LINK MEDIA | <input type="checkbox"/> TWISTED PAIR Cu-CBL <input type="checkbox"/> CO-AXIAL Cu-CBL <input type="checkbox"/> OFC | |
| | d) HAND HELD PROGRAMMER | <input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED | |
| | e) TYPE OF HAND HELD PROGRAMMER | <input type="checkbox"/> BLUETOOTH <input type="checkbox"/> INFRARED <input type="checkbox"/> | |
| | f) MASTER STATION | <input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED | |
| | g) MASTER STN INTRFACE WITH DCS | <input type="checkbox"/> MODBUS <input type="checkbox"/> TCP/IP | |
| | h) DETAILS OF SPECIAL CABLE | <input type="checkbox"/> ENCLOSED <input type="checkbox"/> NOT REQUIRED | |
| | STEP DOWN CONT. TRANSFORMER | <input checked="" type="checkbox"/> REQUIRED | |
| | OPEN / CLOSE PB | <input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED | |
| | STOP PB | <input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED | |
| | INDICATING LAMPS | <input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED | |
| | LOCAL REMOTE S/S | <input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED | |
| | STATUS CONTACTS FOR MONITORING | <input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED | |
| | INTEGRAL STARTER DISTURBED SIGNAL(Refer Note 14) | REQUIRED MOTOR THERMOSTSTRIP O/L RELAY OPTD, CONT./POWER SUPPLY FAILED, S/S IN LOCAL/REMOTE/OFF MODE, TORQUE SWITCH OPEN/CLOSE CUT OFF/STOP PB OPTD, VALVE JAMMED ETC) | |
| | ACTION ON LOSS OF EXTERNAL ELECTRIC POWER | <input checked="" type="checkbox"/> STAYPUT <input checked="" type="checkbox"/> FAIL SAFE TO BE DECIED DURING DETAILED ENGINEERING | |
| INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter) DATASHEET & WIRING DIAGRAM OF ISOLATION DEVICE TO BE PROVIDED | TYPE OF ISOLATING DEVICE | <input checked="" type="checkbox"/> INTERPOSING RELAY <input type="checkbox"/> OPTO COUPLER TO BE DECIED DURING DETAILED ENGINEERING | |
| | QUANTITY | <input type="checkbox"/> 2 NOs. <input checked="" type="checkbox"/> 3 NOs. | |
| | DRIVING VOLTAGE | <input checked="" type="checkbox"/> 20.5 – 24V DC <input type="checkbox"/> _____ V DC | |
| | DRIVING CURRENT | <input checked="" type="checkbox"/> 125mA MAX <input type="checkbox"/> _____ mA MAX | |
| | LOAD RESISTANCE | <input checked="" type="checkbox"/> > 192 ohms - <25 k ohms <input type="checkbox"/> > _____ ohms - < _____ ohms | |



**SPECIFICATION
FOR
MOTORISED VALVE ACTUATOR**

DOCUMENT NO.: PE-ID-445-145-I902

VOLUME II B

SECTION D

REV. NO. 01

DATE:27/03/2020

SHEET 3

OF 5

Data Sheet A & B

DATA SHEET-A
(TO BE FILLED BY PURCHASER)

DATA SHEET-B
(TO BE FILLED-UP BY BIDDER)

| | | | | |
|--|--|--|---------------|--|
| TORQUE SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes) | MFR & MODEL NO. | BIDDER TO SPECIFY | | |
| | OPEN / CLOSE | <input type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos. / <input type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos | | |
| | CONTACT TYPE | 2 NO + 2 NC | | |
| | RATING | 5A 240V AC AND 0.5A 220V DC | | |
| | CALIBRATED KNOBS(OPEN&CLOSE TS) | REQUIRED FOR SETTING DESIRED TORQUE | | |
| | ACCURACY | +3% OF SET VALUE | | |
| LIMIT SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes) | MFR & MODEL NO. | BIDDER TO SPECIFY | | |
| | OPEN : INT : CLOSE | <input type="checkbox"/> 1 No. <input type="checkbox"/> 2 Nos. | 2 Nos. (ADJ.) | <input type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos. |
| | CONTACT TYPE | 2 NO + 2 NC | | |
| | RATING (AC / DC) | 5A 240V AC AND 0.5A 220V DC | | |
| ACCURACY | 2% OF SET VALUE | | | |
| POSITION TRANSMITTER | POSITION TRANSMITTER (For inching duty & other specific applications**) | <input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED | | |
| | MFR & MODEL NO. | BIDDER TO SPECIFY | | |
| | TYPE | <input type="checkbox"/> ELECTRONIC (2 WIRE) R/I CONVERTER <input type="checkbox"/> ELECTRONIC (2 WIRE) CONTACTLESS | | |
| | SUPPLY | <input type="checkbox"/> 24V DC <input type="checkbox"/> | | |
| | OUTPUT | <input type="checkbox"/> 4-20mA | | |
| | ACCURACY | ± 1% FS | | |
| SPACE HEATER | @SPACE HEATER | REQUIRED | | |
| | @ POWER SUPPLY (NON INTEGRAL) | 230V AC,1 PH.,50 Hz | | |
| | @ POWER SUPPLY (INTEGRAL) | BIDDER TO SPECIFY | | |
| | @ RATING | | | |
| TERMINAL BOX | ACTUATOR/MOTOR TERMINAL BOX | REQUIRED | | |
| | ENCL CLASS ACTUATOR/MOTOR T.B. | @ <input type="checkbox"/> IP 68 @ <input type="checkbox"/> | | |
| | @ EARTHING TERMINAL | REQUIRED | | |
| | PLUG & SOCKET | <input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED | | |
| | NO. OF PINS REQUIRED(TO BE CHECKED AS PER SIGNALS IN DRIVE CONTROL PHILOSOPHY) | | | |
| | NOS. OF PLUG & SOCKET | <input type="checkbox"/> 1 Nos. for ON/OFF <input type="checkbox"/> 2 NOS. (for inching duty) <input type="checkbox"/> OTHER (TO BE SPECIFIED INLINE WITH DRIVE CONTROL PHILOSOPHY) | | |
| CABLE GLANDS | @ POWER CABLE GLAND | SIZE:----- | | |
| | @ SPACE HEATER CABLE GLAND | SIZE:----- | | |
| | CONTROL CABLE GLANDS-1 | CABLE GLAND SUITABLE FOR INSTRUMENTATION CABLE SIZE OF 4P X 1.5 SQMM | | |
| | CONTROL CABLE GLANDS-2 | CABLE GLAND SUITABLE FOR INSTRUMENTATION CABLE SIZE OF 8P X 0.5 SQMM | | |
| | CONTROL CABLE GLANDS-3 (Additional for inching duty) | CABLE GLAND SUITABLE FOR INSTRUMENTATION CABLE SIZE OF 2P X 0.5 SQMM | | |
| WEIGHT | TOTAL WEIGHT (ACTUATOR + ACCESSORIES) | BIDDER TO SPECIFY | | _____ Kg. |



**SPECIFICATION
FOR
MOTORISED VALVE ACTUATOR**

DOCUMENT NO.: PE-ID-445-145-I902

VOLUME II B

SECTION D

REV. NO. 01

DATE:27/03/2020

SHEET 4

OF 5

Data Sheet A & B

DATA SHEET-A
(TO BE FILLED BY PURCHASER)

DATA SHEET-B
(TO BE FILLED-UP BY BIDDER)


NOTES:

1. **SCOPE:** DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.
2. **CODES & STANDARDS:** DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATIONAL STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH: IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691, IS-4722, IEC 60947-5-1 AND EN 15714-3 .2010 OR LATEST VERSION.
3. TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
4. CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED.
5. THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION.THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE.
6. THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.
7. THE MOTOR SHALL BE CAPABLE OF STARTING AT 85 PERCENT OF RATED VOLTAGE RUNNING AT 80 PERCENT OF RATED VOLTAGE AT RATED TORQUE AND 85 PERCENT RATED VOLTAGE AT 33 PERCENT EXCESS RATED TORQUE FOR A PERIOD OF 5 MINUTES EACH.
8. IN ADDITION TO ABOVE REQUIREMENTS FOR LIMIT/TORQUE SWITCH, **MECHANICAL END STOP** WITH ACCURACY OF 2% SHALL BE SUPPLIED.
9. IT SHOULD BE POSSIBLE TO OPERATE THE ACTUATOR LOCALLY. LOCKABLE LOCAL/REMOTE SELECTION SHALL BE PROVIDED ON THE ACTUATOR.
10. LOCAL POSITION INDICATOR SHALL BE PROVIDED FOR 0 TO 100 % TRAVEL.
11. CONTROL WIRING SHALL BE SUITABLE VOLTAGE GRADE COPPER WIRE 1.5 SQ. MM.
12. ENDURANCE: RATED TORQUE RANGE SHOULD BE BASED ON ISO 5211, ISO5210.
13. TAG PLATE SHALL BE CONFIRMING TO STANDARD BS-15714.
14. THE ACTUATORS SHALL BE DESIGNED TO BE SELF-LOCKING UPON LOSS OF POWER. MOTOR SHALL BE DESIGNED TO CLOSE IN 30 SECS. FROM FULL OPEN POSITION AND SHALL HAVE ADEQUATE CAPACITY TO OPEN AND CLOSE UNDER FULL UNBALANCED DESIGN PRESSURE.
15. AUTOMATIC PHASE CORRECTION FACILITY AND POTENTIAL FREE CONTACT FOR ANNUNCIATION OF POWER FAILURE SHALL BE PROVIDED.
16. LIMIT SWITCHES SHALL BE SILVER PLATED WITH HIGH CONDUCTIVITY AND NON-CORROSIVE TYPE. CONTACT RATING SHALL BE SUFFICIENT TO MEET THE REQUIREMENT OF CONTROL SYSTEM SUBJECT TO A MINIMUM OF 60 V, 6 VA RATING. PROTECTION CLASS SHALL BE IP67.
17. THE TERMINAL BOX SHALL BE WEATHER PROOF WITH REMOVABLE FRONT COVER & CABLE GLANDS FOR CABLE CONNECTION.IT SHALL BE SUITABLE FOR 2.5 SQ MM COPPER CONDUCTOR.
18. ACTUATOR SHALL ATTAIN FULL SPEED OPERATIONS BEFORE VALVE LOAD IS ENCOUNTERED AND IMPART AN UNSEATING BLOW TO START THE VALVE IN MOTION (HAMMER BLOW EFFECT).
19. **** VALVES WITH 10 DEGREE/20DEGREE FEEDBACK REQUIREMENT FOR APPLICATIONS SUCH AS CW/ACW/PLANT WATER SYSTEM SHALL BE CONSIDERED AS INCHING DUTY VALVES. ACCORDINGLY, POSITION FEED BACK TRANSMITTER, PLUG & SOCKET REQUIREMENT SHALL BE CONSIDERED.**

\$\$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE.

| | PREPARED BY | CHECKED BY | APPROVED BY | VENDOR COMPANY SEAL |
|-----------|--------------|-------------------|---------------------|---------------------|
| NAME | ANJALI RAMAN | VIPUL KUMAR VERMA | SURESH CHAND SHARMA | NAME |
| SIGNATURE | | | | SIGNATURE |
| DATE | 27.03.2020 | 27.03.2020 | 27.03.2020 | DATE |

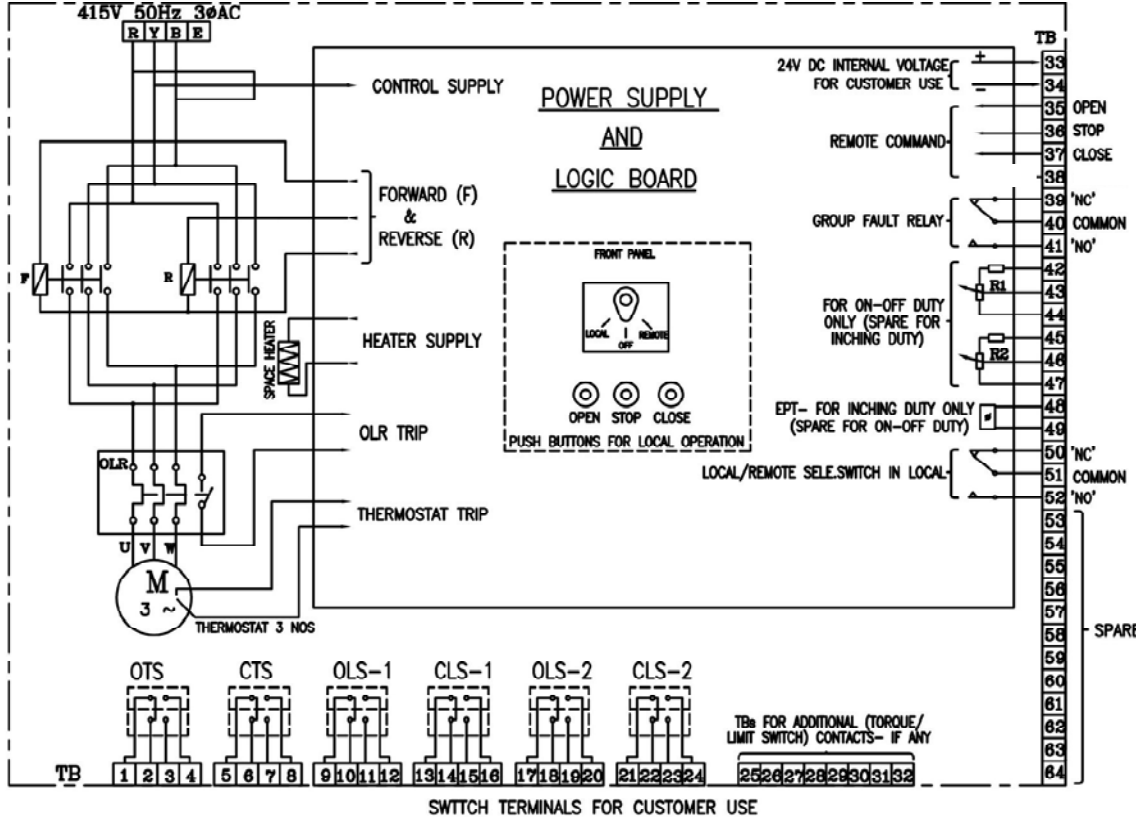
NOTES* = TO BE FILLED BY MPL (LEAD AGENCY), @ BE FILLED BY ES

| | | | | |
|---|---|---|------|-----------------|
|  | SPECIFICATION FOR MOTORISED VALVE ACTUATOR | DOCUMENT NO.: PE-ID-445-145-I902 | | |
| | | VOLUME | II B | |
| | | SECTION | D | |
| | | REV. NO. | 01 | DATE:27/03/2020 |
| | | SHEET | 5 | OF 5 |
| Data Sheet A & B | | | | |
| DATA SHEET-A (TO BE FILLED BY PURCHASER) | | DATA SHEET-B (TO BE FILLED-UP BY BIDDER) | | |

ADDITIONAL NOTES FOR SAGARDIGHI PROJECT:

- TEST WITNESS: TESTS SHALL BE PERFORMED IN THE PRESENCE OF OWNER/PURCHASER'S REPRESENTATIVE SO DESIRED BY THE OWNER/ PURCHASER. THE CONTRACTOR SHALL GIVE AT LEAST FIFTEEN (15) DAYS ADVANCE NOTICE OF THE DATE WHEN THE TESTS ARE TO BE CARRIED OUT.
- 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.
- ACTUATOR SHALL ATTAIN FULL SPEED OPERATIONS BEFORE VALVE LOAD IS ENCOUNTERED AND IMPART AN UNSEATING BLOW TO START THE VALVE IN MOTION (HAMMER BLOW EFFECT).
- A SPACE HEATER SHALL BE INCLUDED IN THE LIMIT SWITCH COMPARTMENT SUITABLE FOR 240V, 1 PHASE, 50 HZ SUPPLY.

3-V-MISC-24227
DRAWING NO.



CONTACT DEVELOPMENT DIAGRAM

| | | |
|--------|--------------|--|
| OTS | 1-2 | OPEN AT OVER TORQUE DURING OPENING TRAVEL |
| | 3-4 | CLOSE AT OVER TORQUE DURING OPENING TRAVEL |
| CTS | 5-6 | OPEN AT OVER TORQUE DURING CLOSING TRAVEL |
| | 7-8 | CLOSE AT OVER TORQUE DURING CLOSING TRAVEL |
| OLS-1 | 9-10 | INDICATES CONTACT CLOSED |
| | 11-12 | INDICATES CONTACT OPEN |
| CLS-1 | 13-14 | INDICATES CONTACT CLOSED |
| | 15-16 | INDICATES CONTACT OPEN |
| OLS-2 | 17-18 | INDICATES CONTACT CLOSED |
| | 19-20 | INDICATES CONTACT OPEN |
| CLS-2 | 21-22 | INDICATES CONTACT CLOSED |
| | 23-24 | INDICATES CONTACT OPEN |
| SWITCH | TERMINAL NO. | VALVE POSITION |
| | FULL OPEN | INTERMEDIATE |
| | FULL CLOSE | FULL CLOSE |

CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

| VALVES | OPEN | | CLOSE | |
|---|------|---------|-------|---------|
| | MAIN | BACK UP | MAIN | BACK UP |
| GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS | OLS | OTS * | CLS | CTS |
| ALL OTHER GATE & GLOBE VALVES | OLS | OTS * | CTS | # |

- CLS NOT TO BE CONNECTED IN TRIP CIRCUIT
* - BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)

- NOTE:-
- ALL TORQUE AND LIMIT SWITCHES (OTS,CTS,OLS1&2, CLS1&2) ARE WITH 2NO+2NC CONTACTS '1NO+1NC' IS TERMINATED IN TBS 1-24, REMAINING CONTACTS ARE FOR INTERNAL USE. ANY SPARE CONTACTS WHICH ARE NOT USED INTERNALLY ARE TO BE TERMINATED IN TBS 25-32
 - CTS - TORQUE SWITCHES FOR CW ROTATION (CLOSE)
 - OTS - TORQUE SWITCHES FOR CCW ROTATION (OPEN)
 - OLS-1, OLS-2 - LIMITSWITCHES FOR POSITION OPEN
 - CLS-1, CLS-2 - LIMITSWITCHES FOR POSITION CLOSE
 - EPT - ELECTRONIC POSITION TRANSMITTER (POTENTIOMETRIC TYPE, FOR INCHING DUTY)
 - R1-R2-POTENTIOMETER 2 x 100 OHMS (FOR ON-OFF DUTY)
 - FOR COMMANDS & EPT EITHER INTERNALLY GENERATED 24 VDC OR EXTERNAL SUPPLY OF 24VDC CAN BE USED
 - M - MOTOR 3φ 415V 50 Hz AC SUPPLY

| REV | DATE | ALTERED |
|-----|------|------------|
| | | CHD & APPD |

TYPE OF PRODUCT ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS
OR NAME OF (DRAWN FOR INTERMEDIATE POSITION OF VALVES)
CUSTOMER/PROJECT

| | | | | | | | |
|--|------|---------------|--------------|------------------------------------|-----------|----------------|-------------|
| BHARAT HEAVY ELECTRICALS LTD., UNIT: HIGH PRESSURE BOILER PLANT, TIRUCHIRAPALLI-620014. 365-121 | DRN | N.P.ESWAR | SIGN | N.P | DATE | 07.10.04 | NO. OF VAR. |
| | CHD | D.DINAKARAN | D.D | | 07.10.04 | | |
| | APPD | K.ARUNACHALAM | K.A | | 07.10.04 | | |
| DEPT | VL | SCALE | WEIGHT (KG). | REFERENCE INFORMATIONS | | | NO. OF TRIM |
| CODE | | | | TITLE | CARD CODE | DRAWING NO. | REV |
| | | | | WIRING DIAGRAM (TERMINAL PLAN) | U 01 | 3-V-MISC-24227 | 0 |
| | | | | FOR ACTUATOR WITH INTEGRAL STARTER | | | |

CAUTION: The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD. It must not be used directly or indirectly in any way detrimental to the interest of the company.



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

SECTION: C
SUB SECTION : C&I

**C&I SPECIFICATION FOR
VENTILATION SYSTEM**

SPECIFICATION FOR FIELD INSTRUMENTS



SECTION-VI

TECHNICAL SPECIFICATION

CONTROL AND INSTRUMENTATION SYSTEMS

1.00.00 FIELD INSTRUMENTS

This section provides general guidelines for field instruments and equipment to be supplied under this specification. All measuring instruments/equipment and subsystems offered by Bidder 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.

- i) HART management system shall be integral feature of the DDCMIS and shall be provided for centralised configuration, maintenance, diagnostics & record-keeping for all electronic transmitters.
- ii) Bidder shall provide following facilities as a minimum through software:
 - a) Constant scanning to monitor faults of changes to instrument configuration.
 - b) Owner-defined and standard calibration and configuration procedures for all transmitters.
 - c) Constant signal data collection facilities to maintain continuously updated records.
 - d) Automatic tracking of configuration changes made in the field, such as may be introduced by hand-held communicator. All configuration function associated with hand-held communicators shall be available in the system.
 - e) Event and log reports on screen as well as on printer.
 - f) Any addition/deletion of transmitter will be reported on printer and logged in hard disk.

1.01.00 PRESSURE TRANSMITTER

- 01. Type : Microprocessor based Smart, HART protocol compatible
- 02. Transmission : 2 - Wire





03. Output Signal : Simultaneous transmission of digital and 4-20 mA DC signal.
04. Signal Processing : Silicon solid state electronic circuitry
05. Sensor type : Capsule / Diaphragm
06. Element material : AISI-316 or better
07. Static Pressure : 150 % of maximum span continuously, without affecting the calibration.
08. Turn-down ratio : 10 : 1 for vacuum/very low pressure application ; 30 : 1 minimum for other applications.
09. Span and Zero : Locally adjustable non-interacting. Facility for elevation and suppression by 100% of span
10. Enclosure Class : Weather proof as per IP-65 with durable corrosion resistant epoxy coating (Explosion proof for NEC Class-1, Division 1 area wherever required)
11. Output Indicator : Backlit LCD type
12. Nameplate : Tag number, service engraved in stainless steel tag plate
13. Body : Forged Carbon Steel (SS for DM Water & corrosive service).
14. Power supply : 16 - 48 Volts D.C.
15. Load : 500 Ohms (min.) at 24 Volts D.C.
16. Ambient Temperature : 0 - 50°C
17. Performance :
 - i) Accuracy : $\pm 0.075\%$ of Span or better
 - ii) Repeatability : $\pm 0.05\%$ of Span or better
 - iii) Response time : 100 msec or better
 - iv) Stability : $\pm 0.1\%$ of Calibrated Span for 6 months up to 70 Kg/cm² and $\pm 0.25\%$ of Calibrated Span for more than 70 Kg/cm²
 - v) Zero and span drift : $\pm 0.015\%$ per deg. C at max span and 0.11% per deg. C at min span
18. Sealing/Isolation : Extended diaphragm with 5 meters SS armored capillary for corrosive, viscous and dirty fluid applications. Material for separator





diaphragm shall be as per application. Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application

- 19. Diagnostics : Self indicating feature
- 20. Accessories :
 - a) Universal mounting bracket suitable for 2" pipe mounting.
 - b) High tensile carbon steel U- bolts.
 - c) Installation accessories as per relevant installation drawing.
 - d) Syphons for steam and hot water services.
 - e) 1/2" NPT 2-valve stainless steel manifold for pressure transmitters constructed from SS316 bar stock. In case it becomes necessary to use a DP transmitter for gauge pressure measurement then a 2-valve manifold should be used in place of 5-valve manifold.
 - f) Companion flange with nuts, bolts and gaskets.
 - g) Hand held configurator kit for calibration of Smart Transmitter.

1.02.00 Differential Pressure Transmitter

- 01. Type : Microprocessor based Smart, HART protocol compatible
- 02. Transmission : 2-Wire
- 03. Output signal : Simultaneous transmission of digital and 4-20 mA DC signal.
- 04. Signal Processing Unit : Silicon solid-state electronic circuitry
- 05. Sensor type : Capsule/Diaphragm
- 06. Element material : AISI-316 (Stainless Steel) or better
- 07. Static Pressure/





- Overload Pressure : Maximum line (or static) pressure on either side without permanent deformation or loss of accuracy
08. Turn-down ratio : 10 :1for vacuum/very low pressure application; 30 : 1 minimum for other applications.
09. Span and Zero : Locally adjustable, non-interacting
10. Enclosure class : Weather proof as per IP-65 with durable corrosion resistant epoxy coating (Explosion proof for NEC Class-1, Division 1 area wherever required))
11. Zero suppression / elevation : At least 100% of Span
12. Output Indicator : Backlit LCD type
13. Nameplate : Tag number and Service engraved in stainless steel tag plate
14. Body : Forged Carbon Steel (SS for DM Water)
15. Ambient temperature : 0 - 50° C
16. Power supply : 16 - 48 Volts DC
17. Load : 500 Ohms (min.) at 24 Volts DC
18. Performance :-
- i) Accuracy : ± 0.2 % of span or better
 - ii) Repeatability : ± 0.05 % of span or better
 - iii) Response time : 100 msec or better
 - iv) Stability : ± 0.1 % of Calibrated Span for 6 months up to 70 Kg/cm²
 - v) Zero and span drift : ± 0.015 % per deg. C at max span and 0.11% per deg. C at min span
19. Sealing/Isolation : Extended diaphragm with 5 meters. SS armored capillary for corrosive, viscous and dirty fluid applications. Material for separator diaphragm, depending on application.
20. Diagnostics : Self indicating feature
21. Accessories : a) Universal mounting bracket suitable for 2" pipe mounting.



- b) High tensile carbon steel U-bolts.
- c) Installation accessories as per relevant installation drawing.
- d) Syphons for steam and hot water services.
- e) ½” NPT 5-valve stainless steel manifold, constructed from SS316 bar stock.
- f) Companion flange with nuts, bolts and gaskets.
- g) Hand held configurator kit for calibration of Smart Transmitter.

1.02.00 DISPLACER TYPE LEVEL TRANSMITTERS

- 01. Type : SMART
- 02. Stages of operation : Continuous
- 03. Material -
 - i) Displacer : AISI 316 SS
 - ii) Suspension wire : AISI 316 SS
 - iii) Torque tube housing application : Carbon steel or SS as per application
 - iv) Torque tube : Inconel
 - v) Displacer chamber : Carbon steel or SS as per process application
 - vi) Transmitter Housing : Die cast aluminium or better
- 04. Power supply : 16-48 Volts D.C.
- 05. Transmission : 2-wire
- 06. Output Signal : Simultaneous transmission of digital and 4-20 mA DC signal. Standard HART protocol.
- 07. Signal processing : Solid-state electronic circuitry
- 08. Static / overload pressure : Maximum static pressure without permanent deformation or loss of accuracy.
- 09. Turn-down ratio : 10 : 1 or better





- 10. Zero & Span : Easily accessible (local zero & span adjustment and non-interactive type)
- 11. Enclosure Class : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
- 12. Output Indicator : Yes, Backlit LCD type
- 13. Nameplate : Tag number and Service engraved in stainless steel tag plate
- 14. Ambient Temperature : 0 - 50°C
- 15. Load Impedance : 500 Ohms at 24 Volts (minimum)
- 16. Process Connection : 2" Companion flange with nuts, bolts and gaskets
- 17. Performance -
 - Accuracy : ± 0.2% of span or better
- 18. Accessories :
 - a) Counter Flange, nuts, bolts, gaskets etc.
 - b) Weights for 5 point calibration of instruments.
 - c) Vent and drain plugs
 - d) Special calibration tool/configurator, if any.
- 19. Preferred Features :
 - a) Test plug connection and cutout terminals physically separated from other electronics.
 - b) Electronic Damping facility (adjustable).

1.03.00 MASS FLOW METER

A. Sensor

- 01. Measuring Principle : Coriolis Mass flow.
- 02. Primary Element : Flow Tube of 316SS or better
- 03. Temperature Control : To be provided for heavy fuel oil application. Heating arrangement shall be integral. For Heating
- 04. Process Connection : Flanged and rating as per process requirement.
- 05. Drain : Self-draining facility





1.06.00

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.
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.

1.07.00

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 - 50°C
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..



- d) 5-valve SS316 manifold constructed from barstock for differential pressure gauge. Process connection 1/2" NPT.
- e) Union, nut & tail piece and other Installation accessories as required.
- f) Syphons for steam and hot water services.

- 20. Applicable standard : IS-3624 / 1996 , EN-837-1
- 21. Nameplate : Tag number, service engraved in stainless steel tag plate

1.08.00 Temperature Gauge

- 01. Type : Inert gas filled remote mounting system.
- 02. Sensing Element Material : Bourdon - AISI-316 SS
- 03. Capillary Armoring : Stainless steel flexible
- 04. Movement Material : AISI 304 SS
- 05. Bulb / Stem Diameter : 12 mm
- 06. Bulb / Stem Material : AISI 316
- 07. Capillary : Stainless Steel
- 08. Thermometer connection to well : 1/2" NPT
- 09. Case Material : Stainless steel
- 10. Dial Size : 150 mm in general (100 mm for SWAS gauges)
- 11. Scale : Black lettering on white background in 270 Deg. arc.
- 12. Mounting : Surface/Panel
- 13. Over range Protection : 125 % of range or more
- 14. Instrument connection : Bottom connection for local mounting and back connection for panel mounting.





- 15. Range : Normal temperature – 50 ~ 70% of range approximately.
- 16. Zero adjuster : Micrometer screw adjustable from front.
- 17. Window : Shatterproof glass.
- 18. Accuracy : ± 1 % or better
- 19. Enclosure Class : IP-65
- 20. Capillary : 5 meters (local)/15.0 meters (local panel) - armoured stainless steel
- 21. Compensation : Capillary and Case Compensation
- 22. Accessories : a) Forged/barstock SS316 thermowell screwed as per ASME PTC code. Process connection M 33X2 (M). Material of construction of thermowell:
1) SS 316: in general
2) Inconel: For flue gas application
3) Tungsten carbide: For coal mill application
b) Installation accessories as required.
- 23. Nameplate : Tag number, service engraved in stainless steel tag plate

1.09.00 Thermocouples

- 01. Type : a) Type-K (Chromel Alumel) / Type-R (Pt.-Rhodium Pt.) / Type-E (Chromel Constantan) [As per application]
b) Duplex (Triplex incase of turbine/Generator/excitor bearing temperature may be used)
c) Ungrounded
- 02. Wire gauge : 16 AWG for Type-K, 24 AWG for Type-R
- 03. Standard : ANSI-MC 96.1.
- 04. Protecting Tube :-
 - i) O.D. : 8 mm
 - ii) Material : 316-SS Seamless
 - iii) Filling : Magnesium Oxide (Purity above 99.4%)

