



CHAPTER 7 PROJECT MANAGEMENT

1.0 METHOD OF EXECUTING THE PROJECT

The entire work of project execution shall cover complete civil works, electrical, Instrumentation & mechanical systems for BTG and associated system as specified elsewhere in the specification is the responsibility for timely execution and performance of the plant. The contractor shall design, engineer, manufacture, and supply, erection, testing & commission the main plant package for generation of 800 MW nominal rating.

The BTG contractor shall be responsible for overall management of the project including contract scheduling, planning, monitoring, expediting at sub-contractor's works etc., in order to ensure that the contract schedule is maintained.

2.0 RESPONSIBILITY

The contractor shall identify a separate and independent project management team headed by a Project Manager for the execution of this Project. The Project management team shall cover the areas listed below:

- a) Planning and Monitoring
- b) Engineering Management
- c) Contracts Management
- d) Quality Assurance Services
- e) Construction Management
- f) Spares Management
- g) Commissioning Management
- h) Resource control
- i) Manufacturing and Production Control

Detailed responsibilities in the above areas except Quality Assurance Services are given below. The contractor shall comply with the requirements of Quality Assurance Services detailed in Volume-III, Part E of the technical specification.

3.0 ORGANIZATION

3.1 Organization Chart

The Contractor shall describe how his management organization will meet the requirements of this Technical Specification. The Contractor shall furnish a detailed organization chart for the project management team, clearly identifying the key personnel in each of the areas mentioned at 1.01.0 above. The expected number of executives, managerial and supervisory staff at different levels shall also be indicated separately for headquarters, central co-ordination cell and site organization indicating names, qualification and experience.



During construction phase, the Contractor shall notify any proposed changes to senior staffing numbers or arrangements to the Purchaser for approval.

3.2 Headquarters

The headquarters of the project management team shall be headed by a senior level executive designated as the Project Manager who shall be responsible to Purchaser for the execution of the Project.

Separately, designated leaders shall be identified for each of the areas mentioned under 1.01.0 who, in, will report to the Project Manager for all matters related to the contract.

3.3 Central Co-ordination

The central co-ordination cell shall preferably be based at or near site and shall have sufficient technical personnel to co-ordinate technical matters and to quickly resolve day-to-day queries or references made by Purchaser Engineer without having the need to refer to his headquarters each time.

3.4 Site Organization

The site should have a competent Construction Manager for all site operations with sufficient level of authority to take site decisions. The organization chart for site should indicate the various levels of experts to be posted for supervision in the civil, mechanical, electrical, control & instrumentation fields for construction, erection, testing & commissioning of the Project.

3.5 Management of Health & Safety

The Contractor shall provide the following before Effective Date of the Contract.

- A management structure for co-coordinating health and safety from the design stage through construction and final commissioning.
- A management system for ensuring arrangements for safety training, safety meetings and reporting of accidents.
- A method of assessing health and safety requirements during construction.
- A safety plan for the construction phase.

4.0 GENERAL REQUIREMENTS OF PROGRAMMES AND SCHEDULES

The programs supplied by the Contractor as part of the Contract shall fully inter-relate design, manufacture, erection and commissioning. Events shall be identified in all programs and agreed with the Purchaser / Purchasers Engineer. Events shall indicate points in the programs at which a significant stage has been reached and which is of sufficient status for reporting to management. All programs containing scheduled dates including those for Design, Manufacturing and for Site Erection shall be adhered to by the Contractor and shall not be changed except as may be agreed by the Purchaser / Purchaser's Engineer.

The Contractor shall designate a Planning Representative who shall be readily available at all reasonable times to the Purchaser / Purchaser's Engineer and who shall be of sufficient status to have free access to



the Contractor's management staff and to the Contractor's and sub contractors work / shops, site works etc. and shall be able to represent the Contractor on all matters of planning and progress.

5.0 Form of Programs

5.1 Bar Charts

Bar charts shall be submitted on standard metric sheets and shall be drawn to microfilm standards to permit reduction to A3 size. They shall have a date scale at the top and plant / areas of work sections identified at the left hand side. All floats shall be shown and where logical connections exist between activities, they shall be indicated.

5.2 Networks

Networks shall be drawn in the form of arrow or precedence diagrams with clearly defined plant / areas of work indexed at the left hand side. Where more than one sheet is used, the activities shall be cross-referenced to other sheets for ease of identification.

5.3 Computer Printouts

Each network submitted shall be supported by a manual or computer analysis which shall contain an activity list sorted on activity number and including activity description, duration, calendar, float predecessors and logical connections, target start and finish dates.

5.4 Schedules of Dates

Where appropriate, schedules of dates shall be submitted in support of Network activities. Gantt charts or detailed work schedules. These shall be to a standard format, preferably A4 size, for ease of filing and indexing and should clearly show the work / area of plant concerned at the bottom of the sheet with an identifying number and date.

5.5 Time Units

In all programs where time units are identified, calendar dates shall be used. For dating purposes the week shall start on Monday.

5.6 Abbreviations

A list of all standard abbreviations used on each network or bar chart shall be displayed on each individual sheet of the program.

6.0 IMPLEMENTATION SCHEDULE

The schedule for the completion of the 1x800 MW Power Project shall be as follows:

Milestone	Period in days from the Effective Date



Commissioning days for the unit

The Contractor shall include a Level-1 (L-1) network showing the major activities and various milestones to achieve the above mentioned completion schedule. The proposed schedule is enclosed in the bid.

To achieve the targets shown in L-1 network, the Contractor shall furnish to the Purchaser, various schedules as defined below.

6.1 Engineering Schedules

These schedules shall cover various design submissions indicating different engineering activities to be performed. Such schedules shall be furnished by the Contractor for each and every plant / systems / equipment item covered in the scope of this Technical Specification.

6.2 Manufacturing and Delivery schedule

The Contractor shall submit to the Engineer his manufacturing and delivery schedules for all equipment within sixty (60) days from the date of signing of the contract. 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 Purchaser/ Purchaser's engineer, once in every two months thereafter, by the contractor. Schedules shall also include the materials and equipment purchased from outside suppliers. In the dispatch program, the Contractor shall indicate a schedule of estimated program; tonnage's specifically identifying various oversize dimensioned consignments (ODC). All dispatch details and item lists shall be made available to both Purchaser & site immediately after shipping.

6.3 Erection Schedule

The Contractor shall provide the Purchaser all the information covering erection sequence, testing and commissioning activities. These schedules may be based on the recommended erection procedures and shall be subject to discussions/agreements with the Purchaser subsequent to the signing of the Contract.

The Contractor shall provide the Purchaser all such schedules in electronic media within a time schedule to be agreed between Purchaser and contractor. The Contractor's project management software shall be compatible with that of the Purchaser and the input data shall be furnished to the Purchaser in a form compatible with Purchaser's project management software.

7.0 DETAILED RESPONSIBILITIES

The Contractor shall provide effective management of the Contract, which shall be compatible with the Purchaser's requirements as set out in this Technical specification. He shall allow access to his works and those of his sub-contractors at all reasonable times to permit the Purchaser/Purchaser's Engineers participation if the Purchaser/Purchaser's Engineer considers it necessary in monitoring the contract. He shall also work with other contractors who interface with the contract in order to ensure the smooth development of the project completion. Such participation up to its completion shall not, in any way affect the contractor's obligations to complete the works in accordance with the contract.



8.0 Planning & Monitoring

a. Planning

The Contractor shall prepare a Master Network schedule in the form of PERT network consisting of at least 1000 activities. The network shall be prepared on a work breakdown structure.

The Master network shall identify milestones of key events for each system/package in the areas of engineering procurement, manufacture and dispatch and erection and commissioning. The master network shall represent the Level-1 plan and will form the basis for development of detailed second and third her execution plans.

The master network shall be mutually discussed and finalized and incorporated in the Contract. The master network shall clearly indicate the responsibility of the Contractor and project management team. The master network shall also identify a complete list of inputs to be furnished by the Purchaser, 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 finalized.

The contractor shall not change the Master Network without the prior approval of the Purchaser. In the event that the Purchaser approves a revision to the Master network the contractor shall submit a revised master network within two weeks thereafter. This program shall fully comply with the requirements of the technical specification and where necessary, reflect changes to the sequence or progress of the works directed by the Purchaser, or as proposed by the contractor and accepted by the Purchaser. Such an agreed revised program shall become the overall contract program for the outstanding works.

9.0 Monitoring & Progress Reporting, Management Information System

The progress reports would be issued every month, one from the head office of the contractor and another from the site office. Reports shall include such schedules, charts and drawings, as the Purchaser/Purchaser's engineer considers necessary for adequately monitoring the contract. The reports shall be made available to the Purchaser/Purchaser's engineer at least five working days prior to scheduled progress review meeting.

The progress report issued from the head office should necessarily include the following sections:

10.0 Report on key milestones

Management summary indicating critical areas with details of actions initiated and effect of any on the project.

Action needing attention of the Purchaser / Purchaser's engineer.

Detailed package wise status of engineering submissions, quality plan submissions and approval, procurement manufacture and dispatch.

The monthly report generated from the site office should necessarily include.



Details relating 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 report on progress in critical areas so that actions can be expedited. The exact format and contents of the progress reports shall be agreed at the time of signing of the contract.

11.0 Engineering Management

The contractor, based on the master network schedule for the project (L-1), shall prepare an exhaustive list of engineering activities for the equipment/system covered in his scope and a detailed program of accomplishing the same within the time frame specified in the master network schedule. The schedule will form the Level-2 (L-2) network for engineering activities.

Based on (L-2) network, the Contractor shall further develop the Level-3 (L-3) network for engineering activities, which will indicate schedule for data availability, drawing availability, drawing release date and document submission dates.

Detailed (L-2) and (L-3) networks shall be finalized sequentially by the Contractor within one month from the date of signing of the contract.

The engineering management team shall also co-ordinate all interface engineering activity between the contractor and the equipment sub-vendors so as to ensure the correctness and completeness of related engineering documentation before the same is submitted to the Purchaser.

12.0 Contracts Management

Based on the master network schedule the Contractor shall submit L-2 programs of manufacture and dispatch. In addition, the master network shall also include periods considered for site activities viz, erection, commissioning etc. These L-2 programs shall be finalized in One (1) months' time from the date of signing of the contract. The contractor shall also submit site mobilization plan.

The Contractor shall also submit L-3 programs for the manufacturing and dispatch of the various items. These networks shall also show the customer hold point (CHP) which have to be cleared by the Purchaser's Engineer before further manufacture can take place. These L-3 programs for the manufacture and dispatch shall clearly identify responsibilities of the contractor, Sub-contractor and Purchaser. These networks shall be submitted within one (1) month of the date of finalization of the various sub-contracts by the Contractor.

In case all the manufacturing is being done by the Contractor, then the L-2 programs shall be themselves amplified to cover details of the manufacture, inspection, clearance by Purchaser / Purchaser's Engineer and dispatch.

The contractor shall also submit the program for procurement of bought-out items and shipping schedule Purchaser's approval.



13.0 Construction Management

Within one (1) month of the signing of the Contract, the contractor shall submit a program of construction/erection/commissioning, either in continuation with the manufacture and dispatch or separately for the implementation. These programs shall 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 program with the first month's program being tentative based on the site conditions shall be prepared based on these L-3 programs. The contractor shall also be involved along with the Purchaser to tie up detailed resource mobilization plan over the period of time of the contract matching with the performance targets.

The L-3 program shall be jointly finalized by the site in-charge of the contractor with the Purchaser's project coordinator as well as the site-planning representative. The erection program will also identify the sequential erectable tonnages that are required for various equipment, which shall be taken care of in the dispatch programs.

Erection and commissioning of the equipment shall also be done under the supervision of experts from the respective equipment / system supplier.

14.0 Construction Methods, Logistics and Equipment

Contractor's Proposals

The Contractor shall furnish a write-up describing his proposed sequence of erection of major plant items and his proposed construction methods supplied by diagrams and drawings, as necessary. The sequence of operations shall incorporate the designers' health and safety requirements. The contractor shall relate movement of Major Contractor's equipment to the construction program time scale. The Contractor shall furnish his delivery methods and routes to the site and identify special or abnormal loads or cargoes with dimensions.

Contractor's Equipment

The Contractor shall detail in his write-up a; Contractor's equipment to be used on site including cranes, fixed workshop equipment and vehicles. The information shall include size and capacity and indicate the duty for which they are required. The Contractor shall describe the usage intended for each crane.

Contractor's Proposals

The Contractor's proposals with regard to construction methods, logistics and equipment confirming the above proposals shall be submitted along with his construction management program.

15.0 Spares Management

The contractor shall provide a suitable spares management system.



It is the responsibility of the contractor to ensure availability of spares during the period of testing and commissioning and all spares to meet Contractor's obligations under the Defects Liability Period.

The contractor shall provide a spare storage facility which shall be equipped with suitable lifting and handling devices where needed. The storage facility shall be designed for long term storage of spares.

Contractor shall define in his write-up the spares management system and the storage facilities provided.

16.0 Resource Control

To enable the Purchaser to assess that the Contractor's proposals are adequate to meet the contract program requirements, the Contractor shall describe his resource management system for the contract in his write-up.

17.0 Production Control and Manufacture

a. Manufacturer's Standards

The contractor shall state in the write-up, the standards to which manufactured equipment/components are offered where the Technical Specification has not specified any requirement.

b. Places of Manufacture

The manufacture and places of manufacture, testing and inspection of the various parts of the Contractor's works shall be stated in the write-up.

c. Sub-Contractors

The Contractor shall submit in his write-up, a list of all items that he deems necessary to be sub-contracted.

The contractor's orders to the Sub-Contractors shall quote the Purchaser's contract reference and station name, and instruct the sub-contractors to quote that number and name and also the order number in all correspondence.

d. Progress Reports

During the design and manufacturing stages in the contract, contractor shall submit to the Purchaser/Purchaser's Engineer reports and information on the progress and manufacture by himself and by the Sub-Contractors of all plant and materials required for the execution of the works. The reports shall be based on the plant manufacturing programs.

The detailed procedure and requirements for progress reporting will be agreed with Purchaser/Purchaser's Engineer during the early phase of the works, as part of regular contract/project status reporting.



e. Access for progress monitoring

The Purchaser's Engineer or his nominated representative shall be entitled at all reasonable times to visit all premises where design and manufacturing of the plant is being carried out in order to monitor and verify progress.

18.0 Commissioning Management

For commissioning of the various equipment/system covered under the scope of contract. Purchaser will form an organization 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 Purchaser.

- Steering committee
- Commissioning Panel
- Working Parties
- Testing Teams

Commissioning documents shall be prepared by the Contactor in the following manner and submitted for Purchaser's approval.

a. Paper

This document shall be prepared for the various equipments/systems under commissioning and shall have the following objectives to fulfill and shall be submitted for Purchaser's approval at least twelve (12) months before the actual commissioning.

1. Establish design data against which plant performance will be compared.
2. Set out the testing objectives and proposals.
3. Define the documentation required.

b. Testing / Commissioning Schedule

These shall be prepared for the various equipment/system under consideration and shall contain sections like detailed testing method, program, safety, individual responsibility and result.

c. Standard check lists

Standard check lists shall be prepared for use at the completion of erection to ensure correct erection, testing and to a limited extent operation for repetitive items.

d. Instrument Proving Schedules

These schedules shall be prepared for proving various instruments associated with all equipment/packages.

Schedules and lists under items (b), (c) and (d) above shall be submitted at least (6) months before the actual commissioning of the equipment/systems.



19.0 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, program schedules achieved and any other such information as required. These test reports shall be submitted in requisite number of copies to the Purchaser and this should be duly signed jointly by the Purchaser/Purchaser's Engineer and the Contractor/Equipment supplier, who are involved during the commissioning activities.

20.0 PURCHASER'S RIGHTS

The Purchaser reserves the right to evaluate and audit the Contractor's management systems and controls in the following areas:

- ❖ Contract Management,
- ❖ Management Information,
- ❖ Programme Management,
- ❖ Resource management,
- ❖ Quality Assurance,
- ❖ Design, Production and Manufacture,
- ❖ Industrial Relations,
- ❖ Erection, Testing, Commissioning,
- ❖ Sub-contract Control and Site management.

The contractor shall provide all necessary assistance to enable the Purchaser carry out such audits and evaluations. Such audits and evaluations shall not in any way relieve the contractor of any of his liabilities and responsibilities under the contract. A corrective action program shall be agreed and implemented in respect of any deficiencies revealed by such monitoring, without any cost implication to the Purchaser and impact on the time schedule for the project.

21.0 PROJECT PROGRESS REVIEW MEETINGS

Periodic project progress reviews will be held at least once every month at venues mutually agreed. These meetings will be attended by the Contractor and their leading sub-contractors. Action 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 and circulated to all concerned for reference and action. The contractor shall be responsible for ensuring that actions placed on such meetings are carried out in time.

In addition to the above, a suitable frequency and forum of periodic meeting between the contractor and the Purchaser/Purchaser's Engineer will be decided upon as part of erection co-ordination procedure.

Chapter 3

Scope of supply & Service



CHAPTER 3
SCOPE OF SUPPLY AND SERVICES

The Scope Shall cover Design, Engineering, Manufacture, supply, assembly, Inspection & Testing at manufacturer's works, Shop painting, packing for transportation, insurance during transit, Delivery to site, unloading at site, site transportation, safe storage at site, Civil, structure & architectural design, Demolition of existing structures, site grading / levelling and civil construction works & structure fabrication works at site, erection, pre-commissioning, commissioning, testing, Performance test at site, training of the Owner's personnel, handing over and other related items of work including supply of mandatory spares, special tools & tackles and 3 years operation and maintenance spares for Complete Steam Generator & Steam Turbine Generator along with their auxiliaries (BTG & its Auxiliaries) including of all Mechanical, Electrical, Civil, Instrumentations works as specified and as required for safe and trouble-free operation of 1X800MW Coal Based Supercritical North Chennai Thermal Power Project Stage-III in the premises of existing NCTPS at Ennore & Puzhuthivakkam Village, Ponneri Taluk, Tiruvallur District, Tamil Nadu, India.

2.1 Mechanical Works

- a) Steam Generator and its Auxiliaries
- b) Steam Turbine Set and its Auxiliaries
- c) Electrostatic Precipitator
- d) HP / LP Heater & Deaerator
- e) Power Cycle Pumps
- f) Equipment Cooling Water System
- g) Power Cycle Piping and Valves including HP/LP Bypass
- h) Low pressure Piping and valves
- i) Condensate Polishing unit
- j) Air Conditioning and ventilation System for TG Hall, ESP Control Room and DG Room
- k) Cranes and Hoist
- l) Elevators in TG Building, Service Building, ESP Control Room and Steam Generator etc.,
- m) Chemical Dosing System
- n) Condenser Online Tube Cleaning System
- o) Hot well Makeup System
- p) Boiler Initial fill System
- q) Mill Reject Handling System
- r) Auxiliary Boiler
- s) Fuel Oil Forwarding System
- t) Service & Potable Water System
- u) Service Air and Instrument air system
- v) Sewage Water System
- w) Effluent Water System

2.2 Electrical Works

- a) Generator Set & Its Auxiliaries



- b) Excitation System for Generator
- c) Generator Bus Duct(Isolated Phase Bus Duct)
- d) Generator Circuit Breaker
- e) Power Transformers(GT, UTs, UATs & ST)
- f) NGR for Transformers
- g) Control and Protection System for Generator, GT, UT and Unit Auxiliaries
- h) Unit Service Transformers – 11/0.433 kV or 6.6/0.433 kV
- i) Segregated and Non-Segregated Bus duct for Unit Switchgears
- j) HT / LT Switchgears
- k) Motors, Actuators, HT/LT cables along with trays and tray supports,
- l) Variable Frequency Drive
- m) Illumination system for SG, All floors of TG Building, ESP, ESP Control room, Service building, Compressor room, Transformer yard and DG Room
- n) Diesel Generator and its Auxiliaries
- o) Emergency MCC including supply feeders station emergency loads.
- p) DC System for Unit Auxiliaries(Unit Battery & Battery Chargers and DC Distribution board)
- q) Above & Below ground Earthing for SG, All floors of TG Building, ESP, ESP Control room, Service building, DG Room, mill reject Compressor room, Transformer yard and Unit Auxiliaries
- r) Lightning Protection System for SG, TG Building, ESP, ESP Control room, DG Room, Service building, mill reject Compressor room, Transformer yard and Unit Auxiliaries
- s) EDMS
- t) Lighting Arrestors for GT & ST bays with Gantry Supports, no supports shall be taken from TG Building structure.
- u) Terminal Connectors for GT and ST HV terminals suitable for Overhead conductors.
- v) Construction Power Supply.
- w) All electrical system for Steam Generator, Steam Turbine Generator, Electrostatic precipitator, Service building, DG room ,Air Conditioning and Ventilation system, Mill reject handling system, Auxiliary Boiler, Cranes and Hoists etc.,

2.3 Instrumentation Works

- a) DDCMIS control systems of SG, TG, ESP
- b) Control system for Air Conditioning, ventilation system for TG Hall, ESP Control Room and DG Room
- c) Control System for Condensate polishing unit
- d) Instrument & Control System of the Scope
- e) Performance Analysis Diagnostics Optimization(PADO) System
- f) C&I Laboratory and testing Instruments
- g) Steam & Water Analysis System (SWAS)
- h) Ambient Air Quality Monitoring System (AAQMS)
- i) Stack emission monitoring system
- j) Flue gas analysis
- k) Master & Slave Clock System
- l) Control & Monitoring of OFF Site plants
- m) Remote I/O Panel for Fuel Oil Forwarding system and Circulating water System along with Fibre Optic cable for Communication between DDCMIS and Remote I/O Panel.



- n) MMIPIS(Man Machine interface and Plant information system)
- o) PLC based miscellaneous system
- p) Field instrumentation, Signal cables, trays and accessories
- q) Station LAN, MIS System, WAN & ERP based System
- r) Electronic Earthing and panel Grounding
- s) Plant Security and Surveillance System
- t) Public Address System and Plant Communication System
- u) Vibrating Monitoring System (VMS)
- v) Operator Training Simulator for DDCMIS

2.4 Civil & Structural Works

- a) Demolition of Existing Building& Existing RCC structures in the BTG Area
- b) Geotechnical Investigation
- c) Tree Cutting, Site Levelling & Grading
- d) Roads & Trenches as indicated in Terminal Points
- e) TG Deck & TG Auxiliaries Foundation
- f) TG Building foundation
- g) TG Building Superstructure
- h) Service Building foundation
- i) Service Building superstructure
- j) Steam Generator & its Auxiliaries Foundation
- k) Steam Generator Superstructure
- l) ESP Foundation
- m) ESP Superstructure
- n) Pipe rack foundation and its superstructure with in BTG Battery limit
- o) Fan Foundations
- p) Transformer Yard
- q) ESP Control room
- r) DG Room
- s) Fuel Oil Pump house and equipment foundations.
- t) Mill reject Air Compressor Room
- u) Condensate Polishing unit civil foundations
- v) Necessary Air Conditioning and ventilation system civil works for TG Building; ESP Control Room and DG Room
- w) Floor wash, drains, Sump pits in BTG Area, oil water waste sump pit in BTG and Transformer yard.
- x) CPU Neutralization pit
- y) Storm water drain system within BTG Battery Limit
- z) Any other civil and structural works

2.5 General Works

- a) Erection Tools & Tackles
- b) Erection & Commissioning Hardware and Consumables
- c) Maintenance Tools & Tackles



1X800 MW COAL BASED NORTH CHENNAI THERMAL
POWER PROJECT STAGE III

EPC TENDER SPECIFICATION FOR BTG PACKAGE



- d) Special Tools & Tackles
- e) Mandatory Spares
- f) Recommended Spares for 3 years O&M
- g) Training of Plant O&M Personnel
- h) Complete Furniture's including Chairs, Tables, cupboards, racks etc.,
- i) Central Documentation facility either at Project Site or TANGEDCO HQ Project Wing

- 2.6 Solar Roof top is planned in this project. Hence Bidder to refer the Volume II Section 2 Part 2.4 Mechanical Works Clause 2.1.20
- 2.7 The works not covered above, but included in other areas of the specification shall also be considered.
- 2.8 The works not covered in the entire specification, but are essentially required for the effective commissioning of the BTG package offered should also be taken care of.



1X800 TANGEDCO NORTH CHENNAI TPP

**VENTILATION SYSTEM
PAINTING SPECIFICATIONS**

SPECIFICATION No: PE-TS-423-554-A001

SECTION : I

SUB-SECTION : C 2C

REV. 01

DATE: NOV 2017

SECTION: I

SUB-SECTION: C 2C

CUSTOMER SPECIFICATIONS

PAINTING SPECIFICATIONS



CHAPTER 8

PAINTING

1.0 SCOPE

This section defines the technical requirements for surface preparation, selection and application of paints on equipment, vessels, machinery, piping, ducts etc. However, manufacturers shall follow their standard procedures for painting their equipment. The bidder shall submit a detailed painting procedure for approval of owner/ owner's representative after the award of contract.

The following surface and material shall require painting:

- All un-insulated carbon steel and alloy steel equipment like columns, vessels, storage tanks, pumps, heat exchangers etc.
- All un-insulated carbon steel and low alloy piping, fitting and valves (including painting of identification marks).
- All pipe structural steel supports, walkways, platforms, handrails, ladders etc.

The following surfaces and materials shall not require painting:

- Non-ferrous materials
- Austenitic stainless steel
- Plastic and / or plastic coated materials
- Insulated surface of equipment and pipes except colour coating wherever required.
- Painted equipment like blowers, pumps, valves etc. with finishing coats in good condition and with matching colour code.

2.0 CODES AND STANDARDS

Painting of equipment shall be carried out as per the specifications indicated below and shall conform to the relevant IS specification for the material and workmanship.

The following Indian Standards may be referred to for carrying out the painting job:

IS:5	Colours for ready mixed paints and enamel
IS:1303	Glossary of terms relating to paints
IS:2379	Colour code for identification of pipelines
IS:1477	Code of practice for painting of ferrous metals in buildings (Parts I & II)
IS:2524 :	Code of practice for painting of non-ferrous metals in buildings (Parts I & II)
IS:2395	Code of practice for painting of concrete, masonry and plaster surfaces (Parts I & II)
IS:2338	Code of practice for finishing of wood and wood based materials (Parts I & II)
IS:158	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting.
IS:2074	Ready mixed paint, air drying, red Oxide Zinc Chrome, priming
IS:104	Ready mixed paint, brushing, Zinc Chrome, priming



1X800 MW COAL BASED NORTH CHENNAI THERMAL
POWER PROJECT STAGE III



EPC TENDER SPECIFICATION FOR BTG PACKAGE

IS:2932	Enamel Synthetic exterior (a) Undercoating (b) finishing
IS:4682	Code of practice for lining of vessels & equipment
SIS 559000	Swedish standard for blasting
ISO 8504-2	Preparation of steel substrates before application of paints and related products. Surface preparation methods Part 2 Abrasive blast cleaning
ISO 8501-1	Preparation of steel substrates before application of paints and related products. Visual assessment of surface cleanliness. Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings.
SIS 05 5800	Surface preparation by acid pickling
SSPC SP08	Surface preparation by acid pickling
IS 2629	Recommended practice for hot dip galvanizing of iron and steel
ASTM A780	Standard practice for repair of damaged galvanized coatings
SSPC	Steel structures painting council
NACE	National association of Corrosion Engineers
DIN	Deutshes Institute for Normung
BS	British Standard
ASTM	American Society for Testing material
AWWA	American Water works association

3.0 SURFACE PREPARATION

The surface shall be prepared in a manner suitable for coatings. Chemical derusters or rust converters shall not be applied. Acid cleaning is subject to approval of Purchaser/ Purchaser's representative.

3.1 BLASTING

The surface of the part/ component shall be blasted before the coating material is applied. Compressed air supply for blast cleaning shall be free of water and oil. Air compressors shall not be allowed to deliver air above 1100°C. Blasting activity shall be performed at temperatures 30°C above dew point and substrate temperature between 50°C & 500°C and relative humidity not exceeding 85% shall be maintained during painting. Necessary safety precautions for equipment and operator shall be adhered to and shall comply with applicable laws, regulations, ordinances etc., of the local authority, state or the nation pertains to the work. Abrasive used for blast cleaning carbon steel and alloy steel shall be as per ISO 8504-2 and SSPC painting manual. Suggested abrasives are chilled iron grit, shot steel, malleable iron grit and shots of non-metallic abrasive (aluminium oxide, copper slag, garnet etc.).

The grade of blasting shall be performed in line with the approved painting scheme. The nature, quality and grain size of abrasives and the parameter of their use are to be chosen to obtain the required surface profile depth and cleanliness. Surfaces prepared for coating shall be coated the same day and before any visible rusting occurs (the time elapsed between blast cleaning and



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POWER PROJECT STAGE III

EPC TENDER SPECIFICATION FOR BTG PACKAGE



commencement of painting shall under no circumstances exceed 4 hours, but in any case must commence before signs of degradation occur).

The grades of surface finish

	ISO 8501-1	SIS 055900	SSPC	NACE
White metal	Sa3	Sa3	SP5	1
Near White metal	Sa 2½	Sa 2½	SP10	2
Commercial Blast	Sa2	Sa2	SP6	3
Brush off blast	Sa1	Sa1	SP7	4

Unless otherwise specified in the documents, the surface shall satisfy the following requirements after blasting

- Blasting according to SIS 055900, Grade Sa 2½
- Primer paint shall be Zinc Silicate of approved brand. Dry film thickness of each primer coat shall be 15-25 µm.

3.2 Manual Rust Removal

Manual rust removal shall be allowed for welded zones and for touching up installed components.

3.3 Cleaning

Removal of impurity

Impurity	Removal
Dust, Loose deposits	Vacuum cleaning, brushing
Adhesive deposits	Power brushing
Oils, greasy impurities	Wet Blasting, Use of Detergent Additives by agreement
Salt deposits	Rinsing
Markings (eg felt up pen)	Organic solvents to manufacturer's specifications eg Trichloro trifluoro ethane and solvents containing acetone (renew solvent and rag frequently)

3.4 Acid Pickling

Prior to galvanizing the surface preparation shall be done by acid pickling as per SSPC-SP-08.

4.0 PROCESSING

4.1. General Application Conditions

The primer shall be applied to properly prepared surfaces only. The specifications of the coating material manufacturers shall be observed. The minimum temperature 0C shall be + 5 and the relative humidity shall not exceed 80%. The temperature of the work piece shall be at least 3C above dew point.



4.2. Application Procedure

The primer shall be applied by means of brush or by spary. The top coats shall be applied by means of brush, roller or spray.

At points where coating application is interrupted, the individual layers shall be adequately stepped to ensure proper layer sequence when coating operations are resumed.

4.3. Touching Up

Before each layer is applied, previous coating shall be touched up where necessary by way of rust removal and cleaning according coating manufacturer's specification. The final top shall be reapplies completely.

4.4. Uncoated Surfaces

Moving parts of machines (e.g stems, shafts, sliding and locating bearings), nameplates, instruments and sealing surface shall not be coated. Welds shall be left free of coating up to a distance of 30 mm on each side of the weld edge until erection and weld examinations, if any, have been completed.

4.5. Bond Strength

The pill off stress determined using the pull off test method for adhesion shall not be less than 1.5 N/mm², according to ISO 4624.

5.0 SURFACE CONDITIONS OF COATING SURFACES

The coating surface shall have a uniform film thickness, shade and gloss and shall be free from inclusions, sags and wrinkles.

6.0 COATING SYSTEMS

6.1 General Requirements for Coating Systems

Coating materials according to SSPC, BS 5493 or DIN 55 928 shall be used. Intermediate coats are to be pigmented with micaceous iron oxide. The materials shall be matched with each other so that they are compatible. Coatings deviating this specification shall be subject to approval. Standards of surface preparation and painting shall give a time to first maintenance of 10 years.

The colour and gloss of top coats shall be in accordance with sub clause suggested colour codes for painting (Sub Clause 6.8)

6.2 Standard Coating System (External Coatings)

(a) Steel Surfaces

- i. All steel structures shall receive two primer coats and two sandwich coat of MIO Epoxy paint and one finish coat of painting. First coat of primer shall be given in shop after fabrication before dispatch to erection site after surface preparation as described below. The second coat of primer shall be applied after erection and final alignment of the erected structures. Two intermediate coats and one finished coat shall also be applied after erection.
- ii. Steel surface which is to be painted shall be cleaned of dust and grease and the heavier layers of rust shall be removed by chipping prior to actual surface preparation. The



surface shall be abrasive blasted as explained in clause 3.1 to Sa 2½ finish as per SIS05-5900. Primer paint shall be Zinc Silicate of approved brand. Dry film thickness of each primer shall be 60 microns.

- iii. Two intermediate MIO Epoxy paint, and one top polyurethane coating of approved brand shall be applied. Dry film thickness of each intermediate coat shall be 90 microns and top polyurethane coating shall be 30 microns. The under coat and finish coat shall be of different tint to distinguish the same from finish paint. The total dry film thickness shall be 330 microns. All paints shall be of approved brand and shade as per owner's requirement.
- iv. Joints to be site welded shall have weldable primer applied within 100 mm of welding zone. Similarly where friction grip fasteners are to be used removable anti corrosive coating shall be provided. On completion of the joint the surfaces shall receive the paint as specified.
- v. Surfaces inaccessible after assembly shall receive two coats of primer prior to assembly. Surfaces inaccessible after erection including top surfaces of floor beams, supporting gratings or chequered plate shall receive one additional coat of finish paint over the above number of coats specified before erection. Portion of steel member embedded/ to be encased in concrete shall not be painted.

(b) Gratings and Step Threads

- i. Surface Preparation
Gratings and step threads shall be cleared by acid pickling as per SSPC-SP-08
- ii. Hot Dip galvanizing
The hot dip galvanizing shall be done as per IS 2629. The average mass of coating shall be 610 gm/m²
- iii. Post Treatment
Immediately after galvanizing post treatment such as chromating shall be applied to retard white rust attack.
- iv. Touch up mechanical damages
The repair of damages coatings shall be done as per the recommended practice ASTM A780.

6.3 Painting of Indoor components such as valves, pumps, motors, electrical parts, tanks etc.

At Works

Surface Preparation

Blasting according to SIS 055900 grade Sa 2½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 25 µm may be used.

Prime Coat

Two (2) layers of Zinc phosphate epoxy, total dry film thickness 75µm.



At Site

Thorough cleaning to remove oil, grease, dirt and any other contaminants. Derusting of all mechanical damages according to SIS 055900 Grade ST3. Touch up with dry film thickness 50 µm.

Finish Coat

Application of two (2) finishing coats of chlorinated rubber paint in approved shades at 30-40 microns DFT each coat in approved shades.

Remarks

Equipment coated with a standard application system can be accepted if the quality of this application system is corresponding with the quality of the above mentioned system.

- 6.4 Painting of Outdoor equipment (external surfaces) such as piping, valves, pumps, motors, electrical parts, tanks etc.

Weather exposure, weather resistance, temperature up to 120°C as per clause 6.1 & 6.3.

Surface Preparation

Blasting according to SIS 055900 grade Sa 2½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Two (2) layers of Zinc phosphate epoxy, total dry film thickness 75µm.

Intermediate Coat

One (1) layer 2 pack high build epoxy polyamide MIO, DFT 100µm.

Finish Coat

Application of two (2) finishing coats of chlorinated rubber paint in approved shades at 50 microns DFT each coat in approved shades.

- 6.5 Special Coating

- (a) Parts exposed to temperatures above 120°C, up to 200°C, not insulated

- i. At Works

Surface Preparation

Blasting according to SIS 055900 grade Sa 2½ and ISO 8501-1:1958. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Inorganic ethyl Zinc silicate, total dry film thickness 75µm.

- ii. At Site

Pre-treatment

Derusting of all mechanical damages, according to ISO 8501-1:1989, grade St 3 touch up with 1 pack inorganic ethyl zinc silicate, dry film thickness 50µm.



Intermediate Coat

1 pack silicon acrylic dry film thickness 35 µm.

Final Coat

1 pack silicon acrylic, dry film thickness as 35µm. Total system dry film thickness 145µm. Final coat according to colour code

(b) Parts exposed to temperatures above 200°C, up to 400°C, not insulated

i. At Works

Surface Preparation

Blasting according to ISO 8501-1:1958 grade Sa-2½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Inorganic ethyl Zinc silicate, total dry film thickness 75µm.

ii. At Site

Pre-treatment

Derusting of all mechanical damages, according to standard Sa 2½ to ISO 8501-1:1988. Touch up with coating system according to manufacturer's recommendations.

(c) Insulated parts continuously exposed to condensing water or parts exposed to temperatures For parts that are provided with insulation on site.

i. Insulated parts exposed to condensing water

At Works

Surface Preparation

Blasting according to Sa 2½ to ISO 8501-1:1988. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm shall be used.

Prime Coat

Inorganic ethyl Zinc silicate, total dry film thickness 75µm

ii. Insulated parts exposed to temperatures

Parts exposed to temperatures up to < 400°C

Surface Preparation

Blasting according to Sa 2½ to ISO 8501-1:1988. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm shall be used. Parts exposed to temperature above 400°C at works (Steam pipes, pressure tubes and parts for the HRSG, such as heating surfaces, heaters and superheaters, reheaters etc)

Temporary Primer

Varnish



- (d) Intermittent exposure due to condensing water/ chemicals (Indoors)
- (i) At Works
- Surface Preparation
Blasting according to Sa 2½ and ISO 8501-1:1988. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.
- Prime Coat
Two layers of Zinc phosphate primer, total dry film thickness 75µm.
- (ii) At Site
- Pre-treatment
Dersuting of all mechanical damages, according to standard Sa3 to ISO 8501-1:1988, touch up with 2 pack high build epoxy with volume solid content of more than 85%, 75µm.
- Intermediate Coat
2 pack high build epoxy, dry film thickness 80 µm.
- Finish Coat
2 pack silicon acrylic, dry film thickness of 50µm. Total system dry film thickness 205µm. When exposed o weathering, weather resistance finish coat shall be applied.
- (e) Water Exposure
- i. At Site/ Works
- Pre-treatment
Removal of all welding pearls. Blasting according to Sa 3 to ISO 8501-1:1988
- Coat
4 coats 2 pack coal tar epoxy, dry film thickness 125 µm each. Total system dry film thickness 500µm Touch up after erection as required.

6.6 Painting of Pipes

6.6.1. Buried Piping Internal surfaces

- i. Surface cleaning by sand blasting.
- ii. Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.
- iii. Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.

The total dry film thickness of 150 microns.

Note: All steel pipes carrying sea water shall be internally coated with corrocoat/ polyurea coating having thickness 1500 DFT.



Tests to be carried out after application : Bond/ Adhesion test, Holiday test

External surfaces

- i. Surface cleaning by Sand Blasting.
- ii. Coal tar primer compatible with coal tar enamel grade. The number of coats shall be two with a DFT of 35 microns each.
- iii. Coal tar enamel shall be applied. A single spiral inner wrap of glass fibre tissues shall be applied overlapping at least 25 mm ensuring impregnation of glass fibre tissues in the first coat. The second coat of enamel and second outer wrap of glass fibre felt, Type – I to IS: 7193-1974 will be applied in the same way confirming to Table – 10 of IS – 10221 – 1982. The total thickness of the coating will not be less than 4.0 mm
- iv. Alternatively Wrapping with coal tar based anticorrosion tape conforming to IS 15337: 2003 is also acceptable in lieu of s.no. (iii) above. Wrapping thickness shall be 4.0 mm. Tests to be carried out after application: Bond/ Adhesion test, Holiday test

6.6.2. Overground Piping

Internal surfaces

- i. Surface cleaning by sand blasting.
- ii. Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.
- iii. Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns. The total dry film thickness of 150 microns.
Note: All steel pipes carrying sea water shall be internally coated with corrocoat/ polyurea coating having thickness 1500 DFT.

External surfaces

- i. Surface cleaning by Sand Blasting.
- ii. Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.
- iii. Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.

6.7 Internal Coatings

6.7.1. Tanks (Internal surfaces) as specified in relevant sections of specification

Industrial deionised, demineralised and potable water up to 60°C pH range 4.5-9.5 Blasting according to Sa 2½ and ISO 8501-1:1988.

Prime Coat

Two layers of Zinc phosphate epoxy primer, total dry film thickness >75µm.

Pre-treatment



Dersuting of all mechanical damages, according to standard Sa3 to ISO 8501- 1:1988, touch up with 2 pack high build epoxy with volume solid content of more than 85%, 75µm.

Intermediate Coat

2 pack high build epoxy, dry film thickness 80 µm.

Finish Coat

2 pack silicon acrylic, dry film thickness of 150µm per coat. In case of service or potable water tanks, the coating material selected shall not taint the water. The paint system shall confirm to regulations issued by Food & drug administration/ National Public Health service/ AWWA/ OSHA and comply with applicable laws, regulations, ordinances etc. of the local authority, state or the nation pertains to work. QA/ QC Procedure including pinhole inspection, shall be submitted for approval by Owner/ Owner's representative.

- 6.7.2. Rubber Lining of Pipes, Valves and Tanks for DM Water
Pre-treatment
Blasting according to Sa 2½ and ISO 8501-1:1988

Rubber Lining

Hard rubber 5 mm for DM water applications as IS – 4682

6.8 Painting for Electrical items

- 6.8.1. All the steel work shall be thoroughly cleaned of rust, scale, oil, grease, dirt and swarf by pickling, emulsion cleaning etc. The sheet steel shall be phosphate/ oven dried and then painted with two coats of zinc rich primer paint. After application of the primer, two coats of finishing epoxy paint shall be applied. The colour of the finishing coats inside shall be glossy white and exterior of the treated sheet steel shall be shade 631 of IS-5/ RAL 7032 for all switchboard/ MCC/ Distribution boards, control panels etc.
- 6.8.2. All electrical equipment shall be given tropical and fungicidal treatment and outdoor equipment shall be provided with rain hood to prevent entry of rain water into the equipment.
- 6.8.3. Painting of I & C equipment: Epoxy coating required for all I & C equipment.

6.9 SUGGESTED COLOUR CODES FOR PAINTING

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
1	Structures, platforms, galleries, ladders and handrails	Dark Admiralty Grey	632	-	-
2	Boiler casing, ducting	Nut Brown	413	-	-
3	Crane				
3.1	Crane structure	Golden Yellow	356	Black	-
3.2	Trolley & hook	Crimson	540	-	-



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SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
4	Fans, pumps, motors, compressors	Light Grey	631	-	-
5	Tanks (without insulation and cladding)				
5.1	Outdoor	Aluminium	-	-	-
5.2	Indoor	Light grey	631	-	-
6	Vessels & all other proprietary equipment (without insulation & cladding)	Light grey	631	-	-
7	Switchgear	Light grey (Powder coated)		-	-
8	Control & relay panels	Light grey (Powder coated)	631/7078 of IS 1650	-	-
9	Turbines	Light grey	631	-	-
10	Generators & Exciter	Light grey	631	-	-
11	Transformers	Aluminium	-	-	-
12	Machinery guards	Signal red	537	-	-
13	Piping (without insulation and cladding)				
13.1	Water System				
a	Boiler feed	Sea Green	217	-	-
b	Condensate	Sea Green	217	Light Brown	410
c	DM Water	Sea Green	217	Light Orange	557
d	Soft Water	Sea Green	217	French Blue	166
e	Bearing Cooling Water	Sea Green	217	French Blue	166
f	Potable & filtered Water	Sea Green	217	French Blue	166
g	Service and clarified water	Sea Green	217	French Blue	166
h	Cooling water	Sea Green	217	French Blue	166
i	Sea Water	Sea Green	217	White	-
14	Ash Transmitting Vessels and pipe lines	Aluminium	-	-	
15	Air System				
15.1	Station air	Sky blue	101	-	-
15.2	Control air	Sky blue	101	White	-



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EPC TENDER SPECIFICATION FOR BTG PACKAGE

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
16	Oil system				
16.1	Fuel oil	Light brown	410	French	166
16.2	Light oil (HSD)	Light brown	410	Brilliant green	221
16.3	Lubricating oil	Light brown	410	Light grey	631
16.4	Transformer oil	Light brown	410	Light orange	557
17	Gas System				
17.1	Carbon dioxide	Canary yellow	309	Light grey	631
17.2	Hydrogen	Canary yellow	309	Signal red	537
18	Fire services	Fire red	536	-	-
19	Effluent pipes	Black	-	-	-
20	Vacuum pipes	Sky blue	101	Black	-

Notes:

1. This colour code basically refers to IS: 2379 for piping with necessary modifications
2. Where band colour is specified, same shall be provided at 30 meter intervals on long uninterrupted lines and also adjacent to valves and junctions.

Bidder shall furnish his painting specification to suit corrosive atmosphere of coastal area along with the bid. The specification shall in general be in line with the above requirements.



1x800 TANGEDCO NORTH CHENNAI TPP

SPECIFICATION No: PE-TS-423-554-A001

SECTION : I

SUB-SECTION : C-3

REV. 01

DATE: NOV 2017

**VENTILATION SYSTEM
TECHNICAL SPECIFICATION
(ELECTRICAL PORTION)**

SECTION: I

SUB-SECTION: C-3

TECHNICAL SPECIFICATION (ELECTRICAL PORTION)

**TAMILNADU GENERATION AND DISTRIBUTION
CORPORATION LIMITED**

**1X800 MW COAL BASED NORTH CHENNAI THERMAL
POWER PROJECT STAGE III**

**VENTILLATION SYSTEM
TECHNICAL SPECIFICATION
(ELECTRICAL PORTION)**



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT,
NOIDA, U.P., INDIA**

	TITLE: ELECTRICAL SPECIFICATION FOR VENTILLATION SYSTEM 1X800MW COAL BASED SUPERCRITICAL NORTH CHENNAI THERMAL POWER PROJECT STAGE III	SPECIFICATION NO.
		VOLUME NO. : II-B
		SECTION: C
		REV NO. : 00 DATE: 27.03.17
		SHEET: 1 OF 1

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TECHNICAL SPECIFICATION FOR
VENTILLATION SYSTEM
(ELECTRICAL PORTION)

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SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

- 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 same shall be provided by the bidder without any extra charge.
- c) Supply of mandatory spares as specified in the specifications of mechanical equipment’s.
- d) Electrical load requirement for **VENTILLATION 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, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.
- h) Motor shall meet minimum requirement of motor specification.
- i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
- j) 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 The electrical specification without any deviation from the technical & quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of confirmation cum compliance sheet & cost of withdrawal sheet as in price schedule.
- 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:

- a) Electrical scope between BHEL & vendor (Annexure –I)
- b) General Technical Requirement for LV Motors.
- c) Datasheets & quality plan for motors.
- d) Electrical Load data format (Annexure –II)



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- e) BHEL cable listing format (Annexure –III)
- f) Sub vendor list for motors (Annexure-IV)
- g) Technical Specification for motors
- h) Technical Specification for actuators
- i) Technical Specification for Cabling
- j) Technical Specification for earthing & lighting protection

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGES : VENTILLATION SYSTEM

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 1x800MW NORTH CHENNAI STAGE-III

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	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	

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGES : VENTILLATION SYSTEM

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 1x800MW NORTH CHENNAI STAGE-III

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
10	Equipment grounding (including electronic earthing) & lightning protection	BHEL	BHEL	Refer note no. 4 for electronic earthing
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:

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGES : VENTILLATION SYSTEM

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 1x800MW NORTH CHENNAI STAGE-III

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.

[illegible]

CABLE SCHEDULE FORMAT

ANNEXURE III

[illegible]

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

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

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

(A) SYSTEM VOLTAGE CODES:

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

(B) CABLE VOLTAGE CODES:

A = 11KV (Power cables)

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

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

(C) CABLE CODES

PVC Copper

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

PVC Aluminium

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

XLPE Copper

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

XLPE Aluminium

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

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

ANNEXURE-IV

SUB-VENDOR LIST

The list of approved make of the LT Motors are as mentioned below:

LV MOTORS (NON FLAME PROOF)	ABB
	BHARAT BIJLEE LTD.
	CROMPTON GREAVES
	GE-POWER
	KIRLOSKAR ELECTRIC CO LTD.
	LAXMI HYDRAULICS PVT. LTD
	MARATHON
	NGEF
	RAJINDRA ELECT INDUSTRIES
	SIEMENS
LV MOTORS (FLAME PROOF)	RAJINDRA ELECT INDUSTRIES

However, the final list of makes for the LT Motors is subjected to BHEL/Customer approval, during contract stage, without any commercial implications.

	TITLE LV MOTORS <u>DATA SHEET-A</u>		SPECIFICATION NO.	
			VOLUME	II B
			SECTION	D
			REV NO. 00	DATE 12.10.17
			SHEET 1	OF 1
1.0	Design ambient temperature	:	50 °C	
2.0	Maximum acceptable kW rating of LV motor	:	Upto 200KW	
3.0	Installation (Indoors/ Outdoors)	:	As required	
4.0	Degree Of Protection	:	IP55	
5.0	Cooling	:	TEFC	
6.0	Details of supply system			
	a) Rated voltage (with variation)	:	415V $\pm$ 10%	
	b) Rated frequency (with variation)	:	50 Hz (Variation: +3% 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 box	:	50 kA for 0.25 sec	
	f) LV System grounding	:	Solidly	
7.0	Class of insulation	:	Class 'F', with temp rise limited to class B.	
8.0	Minimum voltage for starting (As percentage of rated voltage)	:	80% of rated voltage	
9.0	Power cables data	:	Shall be given during Detailed engg.	
10.0	Earth Conductor Size & Material	:	Shall be given during Detailed engg.	
11.0	Space heater supply (30KW & ABOVE)	:	240 V, 1 Φ , 50 Hz	
12.0	Rating up to which Single phase motor	:	Acceptable below 0.20 Kw	
13.0	TYPE OF STARTER PROVIDED IN MCC	:	DOL	
14.0	Locked rotor current			
	a) Limit as percentage of FLC	:	As per IS 12615	
	b) Permissible tolerance, if any	:		
15.0	Additional tests	:	As per QP	
16.0	Flame-proof motor			
	a) Enclosure suitable (As per IS:2148)	:	As per requirement	
	b) Classification of Hazardous area (As per IS: 5572 part-I)	:	As per requirement	
	c) Degree of protection	:	IP65	
17.0	Makes	:	AS PER ANNEXURE-I	
18.0	Terminal box	:	Suitable to rotate at 90 degrees	
19.0	Paint shade	:	RAL 5012	



TITLE

LV MOTORS**DATA SHEET-A**

SPECIFICATION NO.

VOLUME II B

SECTION D

REV NO. 00 DATE 12.10.17

SHEET 2 OF 1

20.0 Efficiency class : **IE3**

NOTE :

1. Also detailed Customer spec. for Motors is to be referred as enclosed with technical spec.



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 : 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 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.

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		VOLUME NO. : II-B
		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 : 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 : 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	

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		VOLUME NO. : II-B
		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.		

	TITLE LV MOTOR DATA SHEET - C	SPECIFICATION NO.
		VOLUME II B
		SECTION D
		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 LV MOTOR DATA SHEET - C	SPECIFICATION NO.
		VOLUME II B
		SECTION D
		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 $\geq 55\text{KW}$)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

		QUALITY PLAN		CUSTOMER :		PROJECT		SPECIFICATION :				
				BIDDER/ VENDOR :		TITLE		NUMBER :				
		SHEET 1 OF 2		SYSTEM		QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01		SPECIFICATION TITLE				
				ITEM AC ELECT. MOTORS BELOW 55KW (LV)		SECTION		VOLUME III				
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	2	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	NOTE -1 & NOTE-3
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1		NOTE -1 & NOTE-3
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	NOTE -1 & NOTE-3
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									

		QUALITY PLAN		CUSTOMER :			PROJECT			SPECIFICATION :		
				BIDDER/ :			TITLE			NUMBER :		
		SHEET 2 OF 2		VENDOR			NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION :		
		SYSTEM			ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION			VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	
NOTES: 1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON 2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. 3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY												
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE			SPECIFICATION : NUMBER :			
				BIDDER/ VENDOR :		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
		SHEET 1 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
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	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	2	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVENT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	2	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVENT IS/	SUPPLIER'S TC	3	-	2	HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	3	-	2	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER :		PROJECT			SPECIFICATION :			
				BIDDER/		TITLE			NUMBER :			
				VENDOR		QUALITY PLAN			SPECIFICATION :			
SHEET 2 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	MFG. DRG. SPEC.	RELEVANT IS	SUPPLIER'S TC	3	-	2	
		3. DIMENSIONS	MA	MEASUREMENT	100%	-DO-	MANUFR'S DRG.	LOG BOOK	3	-	2	
		4.INTERNAL FLAWS	CR	UT	-DO-	ASTM-A388	MANUFR'S SPEC. BHEL SPEC.	-DO-	3	2	1	
1.6	SPACE HEATERS, CONNNECTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUFR'S DRG. SPEC.	MANUFR'S DRG. SPEC.	-DO-	3	-	2	FOR DIA OF 55 MM & ABOVE
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	-DO-	3	-	2	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG./ SPEC.	MANUFR'S DRG. / SPEC.	-DO-	3	-	2	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-DO-	-DO-	INSP. REPORT	3	-	2	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE					BIDDER'S/VENDORS COMPANY SEAL				

		QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
				BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE		
		SHEET 3 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	NO VISUAL DEFECTS	INSPT. REPORT	3	-	2	FOR MV MOTOR INSULATION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT
		2. OTHER CHARACTERISTICS	MA	TEST	SAMPLE	MANUF'S SPEC.	MANUF'S SPEC.	LOG BOOK AND OR SUPPLIER'S TC	3	-	2	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK	3	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG. .	MANUFR'S DRG.	-DO-	3	-	2	
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	-DO-	MANUF'S SPEC./ RELEVANT IS	RELEVANT IS	SUPPLIER'S TC	3	-	2	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	LOG BOOK	3*	-	2*	
		2.ELECT. PROP, & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	RELEVANT IS/ BS OR OTHER STANDARDS	RELEVANT IS/ BS OR OTHER STANDARDS	SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3	-	2	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY BHEL/CUSTOMER.
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE			SPECIFICATION : NUMBER :			
				BIDDER/ VENDOR :		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
		SHEET 4 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.10	BEARINGS	3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2	
		1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG./ APPROVED DATASHEET	MANFR'S DRG./ APPROVED DATASHEET	-DO-	3	-	2	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	2	
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC./ BHEL SPEC.	MANUF'S SPEC./ BHEL SPEC.	-DO-	3	-	2	
		4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	2	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	3	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER :			PROJECT		SPECIFICATION :			
				BIDDER/ :			TITLE		NUMBER :			
		SHEET 5 OF 9		VENDOR			QUALITY PLAN		SPECIFICATION :			
		SYSTEM			NUMBER PED-506-00-Q-007, REV-03		TITLE					
					ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNES	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	2	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	2	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVANT SPEC./ ASTM-E165	MANUF'S SPEC./ BHEL SPEC./	-DO-	2	-	1	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC/BHEL SPEC./ RELEVANT STAND	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	2	-	-	
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	2	-	-	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE			SPECIFICATION : NUMBER :				
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE				
		SHEET 6 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS	
1	2	3	4	5	6	7	8	9	10	P	W	V	11
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-		(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE FOR MV MOTOR THREE DIPS TO BE GIVEN
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-		
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1		
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	-	-		
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-		
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1		
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1		
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-		
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1		
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-		
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-		
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1		
BHEL			PARTICULARS		BIDDER/VENDOR								
			NAME										
			SIGNATURE										
			DATE						BIDDER'S/VENDORS COMPANY SEAL				

		QUALITY PLAN		CUSTOMER :			PROJECT TITLE		SPECIFICATION : NUMBER :				
				BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE				
		SHEET 7 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS	
1	2	3	4	5	6	7	8	9	10	P	W	V	11
2.7	COMPLETE STATOR ASSEMBLY	4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1		VERIFICATION FOR MV MOTOR ONLY
		1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-		
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-		
		2.SOUNDNESS	CR	MALLET TEST & UT	-DO-	-DO-	-DO-	Log Book	2		1		
		3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2		1		
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2		1		
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2		1		
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-		
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-		
		3.AXIAL PLAY	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	1		
		4.DIMENSIONS	MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	2	-	-		
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	-		
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2		1		
BHEL			PARTICULARS		BIDDER/VENDOR								
			NAME										
			SIGNATURE										
			DATE					BIDDER'S/VENDORS COMPANY SEAL					

		QUALITY PLAN				CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
						BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
		SHEET 8 OF 9				SYSTEM				ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)				SECTION	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS			
									P	W	V				
1	2	3	4	5	6	7	8	9	10			11			
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC.	MA	ELECT.TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	2	1*	1	* NOTE - 1			
		2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1\$	1	\$ NOTE - 2			
		3.VIBRATION & NOISE LEVEL	MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1\$	1	\$ NOTE - 2			
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-				
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3			
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1\$	1	\$ NOTE - 2			
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1\$	1	\$ NOTE - 2			
		8. NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1\$	1	\$ NOTE - 2			
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3			
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1\$	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY \$ NOTE - 2			
BHEL			PARTICULARS			BIDDER/VENDOR									
			NAME												
			SIGNATURE												
			DATE												
									BIDDER'S/VENDORS COMPANY SEAL						

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE		SPECIFICATION : NUMBER :			
				BIDDER/ VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE			
		SHEET 9 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P W V		REMARKS
1	2	3	4	5	6	7	8	9	10	11	
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 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, THESE TEST MAY NOT BE REPEATED. 4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY											
BHEL			PARTICULARS		BIDDER/VENDOR						
			NAME								
			SIGNATURE								
			DATE								
										BIDDER'S/VENDORS COMPANY SEAL	

Motors



EPC TENDER SPECIFICATION FOR BTG PACKAGE

2.2.12 MOTORS

2.2.12.1 Design Criteria

- i. For the purpose of design of equipments /systems, an ambient temperature of 50 °C and relative humidity of 95% shall be considered. The equipment shall operate in a highly polluted environment.
- ii. Transient voltage dip on starting of the largest motor with DOL shall be limited to 20% of the nominal system voltage at the voltage terminals.

1. Rating

- i. The motor rating shall be arrived at considering 15% margin over the duty point input or 10% over the maximum demand of the driven equipment, whichever is higher, considering highest system frequency.
- ii. All motors shall be continuously rated (S1 duty). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor.
- iii. Whenever the basis for motor ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings shall be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.

2. Starting Voltage requirement for all motors (except mill motors):

- i. 85 % of rated voltage for motors up to 1000 kW
- ii. 80 % of rated voltage for above 1000 kW and up to 4000 kW
- iii. 75 % of rated voltage for above 4000 kW

For Mill Motors:

- iv. 85 % of rated voltage for motors above 1000 kW
- v. 90 % of rated voltage for motors up to 1000 kW

3. Canopy shall be provided for outdoor motors.
4. Contractor shall provide fully compatible electrical system, equipments, accessories and services.
5. All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations.



EPC TENDER SPECIFICATION FOR BTG PACKAGE

6. Voltage and frequency variations:

- i. Frequency : (+) 3% and (-) 5%
- ii. Voltage :
 - A) AC:
 - a. $\pm 10\%$ for 11 kV/6.6 kV
 - b. $\pm 10\%$ for 415 V

B) DC: +10% to -15% for 220 V DC

- iii. Combined 10 % (absolute sum)

7. All LV motors above 10 kW with S1 duty.

8. Continuous duty LT motors rated above 0.37kW upto 200 KW Output rating (at 50 deg. C ambient temperature), shall be Efficiency class-IE3, conforming to IS 12615, or IEC:60034-30. However this is not applicable for geared motors (motors completely integrated with driven equipment) which are specifically designed to suit the driven equipment duty.

The responsibility of coordination with electrical agencies and obtaining all necessary clearances shall be of the contractor.

9. Type

- i. AC Motors:
 - a. Squirrel cage induction motor suitable for direct-on-line starting.
 - b. Crane duty motors shall be slip ring type induction motor
- ii. DC Motors
 - a. Shunt wound

10. Temperature Rise

- i. **Air cooled** motors - 70°C by resistance method.
- ii. Water cooled - 80° C over inlet cooling water temperature mentioned elsewhere, by resistance Method.

11. Degree of Protection

Degree of protection for various enclosures shall be as follows:

1. Indoor motors	-	IP 54
2. Outdoor motors	-	IP 55



EPC TENDER SPECIFICATION FOR BTG PACKAGE

3.	CW motors (in case of screen prot. Drip proof)	-	IP 23
4.	Cable box – indoor area	-	IP 54
5.	Cable box – outdoor area	-	IP 55

2.2.12.2 Codes and Standards

1. All motors shall confirm to the latest editions including all applicable amendment of relevant IS, IEC and CBIP standards/Publications. In case any other standard is followed that ensures equal or better quality, may be accepted. However the English version of the Standard adopted shall be submitted.
2. Major Standards, which shall be followed, are listed below. Any other applicable Indian standards for any component part even if not covered in the list shall also be followed.
 - i. Three phase induction motors : IS:325, IEC:60034
 - ii. Single phase AC motors : IS:996, IEC:60034
 - iii. Crane duty motors : IS:3177, IEC:60034
 - iv. DC motors/generators : IS:4722
 - v. Degree of protection by enclosures for rotating electrical machines : IS: 4691 , IS: 4728, IS: 6362, IS: 2253
 - vi. Noise levels for rotating electrical machines : IS: 12065
 - vii. Mechanical Vibrations for rotating electrical machines : IS 12075

2.2.12.3 Operational Requirements

1. Starting Time
 - i. For motors with starting time less than 20 secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs more than starting time.
 - ii. For motors with starting time more than 20 secs and up to 45 secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs more than starting time.



EPC TENDER SPECIFICATION FOR BTG PACKAGE

- iii. For motors with starting time more than 45 secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.
- iv. Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.
- v. Motors shall be capable of restarting under full load after a momentary loss of voltage with the possibility of 150 % nominal voltage during fast bus transfer.

2. Torque Requirements

- i. Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.
- ii. Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.

2.2.12.4 Design and constructional features

- 1. Suitable single phase space heaters shall be provided on motors rated 30 kW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided.
- 2. All motors shall be suitable for direct on line starting through any type of breaker.
- 3. All motors shall be either totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. However, motors rated 3000KW or above can be Closed air circuit water cooled (CACW). CW motors can be screen protected drip proof (SPDP) type. Motors located in hazardous areas shall have flame proof enclosures conforming to IS: 2148 as detailed below:
 - a. Fuel oil area : Group - IIB
 - b. Hydrogen generation plant area : Group - IIC

4. Winding and Insulation

Type	Non-hygroscopic, oil resistant, flame resistant
Starting Duty	Two hot starts in succession, with motor initially at normal running temperature.
11 kV / 6.6 kV AC motors	Class F: with winding temperature rise limited to class B. They shall withstand 1.2/50 micro sec switching surges of $4U+5$ KV (U=Line voltage in KV).



EPC TENDER SPECIFICATION FOR BTG PACKAGE

415V AC & 220V DC

The coil inter-turn insulation shall be suitable for 0.3/3 micro sec. surge of 32 KVp and 12 kVp for 11 kV and 6.6 kV system respectively followed by 1 min power frequency high voltage test of appropriate voltage on inter turn insulation

Class 'F' with temperature rise limited to class 'B'

5. Motors rated above 1000 kW shall have insulated bearings to prevent flow of shaft currents.
6. Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature.
7. Noise level and vibration shall be limited within the limits prescribed in IS: 12065 & IS: 12075 respectively. Motors shall withstand vibrations produced by driven equipment.
8. In MV/HV motors, 12 nos. simplex or 6 nos. duplex RTDs (two per phase), each having D.C. resistance of 100 ohms at 0°C, embedded in the stator winding at locations where highest temperatures may be expected, shall be provided. The material of the RTD's shall be platinum. Each bearing shall be provided with dial type thermometer with adjustable alarm contact and resistance type temperature detector. All HV motors shall be provided with shaft grounding rings for bearing protection and earthing shaft current.
9. MV/HV motors shall also be capable of satisfactory operation at full load at a supply voltage of 80% of the rated voltage and shall be capable of either two starts in quick succession with third start after 5 minutes in cold condition or two starts at 15 minutes intervals in hot condition, both cases with voltage and frequency variation within specified limits.
10. Locked rotor current of the MV motors shall be limited to 600% (subject to IS tolerance) of the full load current of the motors and for HV motors (like BFP) shall be limited to 450% (inclusive of IS tolerance) of full load current of the motor. Locked rotor current of the LV motor shall not exceed 600% of full load current inclusive of IS tolerance.
11. MV Motors shall be provided with differential protection. These motors shall be provided with star connected stator windings. The 3 nos. current transformers, one for each phase shall be mounted in a separate compartment in the neutral side terminal box. The three phases shall be connected to form the star point after they pass through the CTs. These differential protection CTs for motors on 11/ 6.6 kV switchgear shall be supplied as loose.



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12. Motor body shall be grounded at two earthing points on opposite sides with two separate and distinct grounding pads complete with tapped holes, GI bolts and washers.
13. HV motors can be offered with either elastimould termination or dust tight phase separated double walled (metallic as well as insulated barrier) cable boxes. In case elastimould terminations are offered, then protective cover and trifurcating sleeves shall also be provided. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided in case of cable boxes.
14. All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.
15. Motors rated 18.5kW and below shall be contactor controlled having MPCB incomers with intelligent controllers. Motors rated 18.5kW and above but below 90 kW shall be contactor controlled having MCCB incomers with intelligent controllers. Motors rated 90 kW and & above up to 200KW shall be ACB controlled with numerical relays. HV & MV Motors rated above 200 KW shall have vacuum breakers. HV motors rated 1000kW and above shall be provided with insulation bearings for avoiding bearing currents. HV Motors rated 1000KW and above shall also have differential protection. Care shall be taken by BTG Bidder to ensure that parameters of the differential CT being supplied along with motors (rated above 1000kW) match with the parameters of the differential CT being supplied by BTG bidder in 11kV Switchgear.
16. The motors shall be suitable for bus transfer schemes provided on the 11 kV, 6.6 Kv and 415V systems without any injurious effect on its life.
17. For motors rated 1000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.
18. All motors shall be provided with an emergency stop push button near the motor as per the Indian Statutory regulations.
19. The motor terminal box shall be suitable for withstanding the maximum system fault current for a duration of at least 0.25 seconds.
20. Neutral in case of HV motors shall be kept accessible.
21. Motors shall be designed to easy access for drilling holes through motor feed of mounting flange for installation of dowel pins after assembly of the motor and driven equipment.



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22. Well spacious working platforms shall be provided around the motor area for carrying out maintenance & testing works. Platform shall be minimum of 300 mm below the level of motor base plate.
23. Flow switches shall be provided for monitoring oil flow of forced lubrication bearings, if used. Alarm switch contact rating shall be minimum 0.5 A at 220 V DC and 10 A at 230 V AC.
24. For bearing temperature measurement, duplex RTDs shall be provided for each bearing and shall be wired up to the terminal box.
25. Lube oil pressure transmitters shall be provided to DCS for remote monitoring. Lube oil pressure very low trip to HV equipment shall be 2 out of 3 logic.
26. Capillary type temperature gauge cum switch shall be provided for DE / NDE of HV Motors.
27. Motors with CACA/CACW heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate the following:
 - a) Hot and cold air temperatures of the closed air circuit for CACA motors.
 - b) Hot and cold, air and water temperatures for CACW motors.
28. The Alarm switch contact rating shall be minimum 0.5 A at 220 V DC and 10 A at 230 V AC.
29. DIRECTION OF ROTATION

As needed by driven equipment. The 3 phase motor shall, however, be suitable for operation in both directions of rotation. A plate showing direction of rotation as determined by the phase sequence on the terminals marking shall be screwed at non-driving end of the body of the motor. If, in the case of HV & MV motors, fan is suitable for only one direction of rotation, the fan shall be so designed that with the slight modification work, it can be made suitable for other direction of rotation also. No extra material shall be required for doing above modification work.
30. BEARINGS

Greased ball, roller and/or sleeve bearing shall be rated for minimum standard life of 40000 hours taking bearing and driven equipment loads into account. Loss of grease shall be scarce and it shall not creep along shaft into motor housing. Bearing shall be effectively sealed against dust ingress and shall be pressure grease gun lubricated.

If the bearings are oil lubricated, a drain plug shall be provided for draining residual oil and oil level gauge shall be provided to show precisely oil level required under standstill and running conditions.



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Unless otherwise approved, bearing lubricating system shall be such that no external forced oil or water is necessary to maintain required oil supply to keep bearing temperature within design limits.

For MV & HV motors rated 1000KW and above, the bearings shall be insulated wherever necessary to prevent damage to motor bearings from shaft current.

When pressure oiling is required for horizontal motors, bearings shall be sleeve type arranged for pressure oiling supplied from lubrication system of driven machine, with ring oiling for starting and emergency duty. Ring oiling system shall be adequate for starting and continuous operation of motor for at least half an hour, without pressure oiling system in operation. Oil sight flow gauges shall be provided to indicate oil flow through each bearing.

Lubricants shall be selected for prolonged storage and normal use of motors in tropical climate and shall contain corrosion and oxidation inhibitors. Greases shall have suitable bleeding characteristics to minimize setting. The selected lubricants shall be indigenously available.

Sleeve bearings for use with motors having flexible coupling with limited end play, shall have adequate axial end play to prevent transmission of thrust from driven equipment to motor bearings.

Bearings shall be of reputed make subject to the approval of the Purchaser/Consulting Engineer.

Large motors shall preferably have spherically seated babitted, ring forced, feed lubricated, water-cooled bearings. If anti-friction bearings are provided, these shall be roller bearings rated for a minimum standard life of 30000 hours taking all bearing and driven equipment loads into account.

31. TERMINAL BOXES

General

- i) Motors shall be provided with separate terminal boxes for main, space heaters, embedded temperature detectors, bearing temperature indicators and moisture detectors terminals, Neutral CT terminals. When it is not possible to provide LT motors with separate terminal box for space heater terminals, space heater terminals shall be adequately segregated from the main terminals in the single box. Terminal boxes shall be weatherproof and water-tight conforming to minimum IP-55 degree of protection with removable front cover for making connections. IP-55 degree of protection shall be achieved without application of compound. Space between and



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around terminals shall be adequate for easily connecting aluminium conductor cables. Terminal box arrangement shall be to the approval of the Purchaser /Consulting Engineer. All terminal boxes shall be suitable for proper termination cable to be finalized during detailed engineering.

- ii) The terminal boxes shall be complete with cable glands and termination accessories as required. Suitable non-magnetic material construction shall be adopted for terminal boxes where single core cables are to be terminated. All HV & MV motors shall be provided with phase segregated terminal box.
- iii) Terminal bushings and clamps shall be non-absorbent, non- inflammable, insulated material for connecting with cable.

Main Terminal Box

- i) LV Motors Main terminal box shall be capable of being turned through 360 degrees in steps of 90 degrees.
- ii) MV & HV Motors shall be provided with two (2) terminal boxes for stator terminals. One (1) terminal box shall be for phase terminals while other one for forming star connection. For motors rated below 1000 KW should be interchangeable to facilitate cable routing.
- iii) Neutral terminal box for HV motors rated 1000 KW and above shall be suitable for mounting of three (3) Nos. wound/bar primary/ring type cast resin insulated current transformers for differential protection. These CTs shall be mounted in the motor neutral terminal box. Stator phase terminal box shall be phase segregated terminal box suitable for both top or bottom entry of cables (i.e. they should be capable of being turned through 180 Degrees). The terminal box shall be designed for termination of XLPE cables using heat shrinkable terminating Kit. Terminal leading shall be stud type or leading wire type.
- iv) Terminal Boxes shall be provided with cable end boxes having cable lugs and cable glands for cables.
- v) The terminal boxes shall be capable of withstanding at the terminals the system fault level (as indicated below) without rupture for a duration of atleast 0.25 seconds.
 - a) Min. fault level for 11kV Motors - 50kA
 - b) Min. fault level for 6.6 kV Motors - 40kA
 - c) Min. fault level for 415V Motors -50kA



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- d) Min. fault level for 220V DC Motors -25kA
- vi) Phase to Phase/ Phase to Earth Air Clearance:-
- a) Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows:-

Motor MCR in KW	Clearance
UP to 110 KW	10mm
Above 110 KW and upto 150 KW	12.5mm
Above 150 KW	19mm

- vii) Terminal Accessories.....Each terminal end shall be furnished with bimetallic washers, spring washers, nuts and crimp type aluminium (preferably tinned) lugs suitable for cables of sizes.

32. TYPE AND SIZE OF CABLES

Space Heaters

- i) For LV Motors: Two point five (2.5) mm², two (2) core copper conductor PVC insulated, armoured and FRLS PVC sheathed heavy duty 650/1100 V grade cable to IS: 1554 (Part-I).
- ii) For MV & HV Motors: Six (6) mm² two core aluminium conductor XLPE insulated armoured and FRLS PVC sheathed heavy duty 650/1100V grade cable to IS: 1554 (Part-I).
- iii) For Embedded Temperature Detectors two sets of six (6) Twisted triad 0.5 mm² ATC copper conductor armoured, shielded cable, 650/1100 V Grade IS: 1554 (Part-I). For bearing temperature, RTDS, two (2) sets of four (4) twisted triad 0.5 mm², ATC copper conductor armoured shielded 650/1100 V Grade, IS: 1554 (Part-I).
- iv) Bearing Temperature Indicators - For each indicator, 0.5 mm² six (6) tarnished triad ATC copper conductor, PVC insulated, shielded armoured and FRLS PVC



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sheathed heavy duty 650/1100 V grade cable as per IS: 1554 Part-I. Two (2) cables one (1) for each bearing temperature indicator.

- v) For Moisture Detectors.....As for space heaters

For Main Terminals:-

- i) LT Motors

- a) Three (3) core cables Stranded aluminium conductor, XLPE insulated, colour coded, laid up, FRLS PVC type ST2 sheathed, GI wire / strip armoured, FRLS PVC type-ST2 jacketed overall, 650 / 1100V grade, heavy-duty cables as per IS: 1554 (Part-I).
- b) Single core cables Stranded aluminium conductor, XLPE insulated, hard drawn aluminium wire/ strip armoured FRLS PVC type ST2 jacketed overall, 1100V grade, heavy duty cable as per IS: 1554 (Part-I).

- ii) HV & MV Motors

Three (3) core cables stranded aluminium conductor, XLPE insulated, screened colour coded, laid up, FRLS PVC type ST2 sheathed, GI wire/strip armoured FRLS PVC type ST2 jacketed overall, 6.6 KV / 11 KV un earthed grade, heavy duty cables as per requirement for unearthed system as per IS: 7098 (Part-II).

33. GROUNDING

General..... Two (2) grounding terminals one (1) on either side at the bottom suitable for connecting mild steel/GI flat/GI wire grounding conductor, size of grounding conductor shall be decided during detailed engineering.

LV Motors.....At each earthing point, two (2) drilled and tapped holes with hexagonal head bolts, plain washers, spring washers and tinned lugs (for motors upto 5.5 KW) for size of conductor specified shall be provided.

HV & MV Motors.....Non-corrodible metallic grounding pad shall be welded or brazed at each earthing point. The size of grounding pad shall be 75x65x25 mm. Grounding pad shall have 40 mm apart two (2) drilled and tapped holes with hexagonal head bolts, plain washers and spring washers for size of conductor



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specified. In addition, one suitable earthing terminal shall be provided inside the stator phase terminal box for earthing metallic shield of XLPE cables.

34. EMBEDDED TEMPERATURE DETECTORS

HV & MV motor shall be provided with four (4) Nos. simplex or two (2) Nos. duplex platinum resistance temperature detectors (RTDs) in each phase embedded in stator winding at locations where high temperatures are expected. In addition one (1) duplex type RTD shall be provided in each bearing. The RTDs shall be 3 wire duplex platinum resistance type having a value of 100 ohms at 0 Deg.C

35. BEARINGS TEMPERATURE INDICATORS

HV & MV motors shall be provided with dial type two (2) bearing temperature indicators and shall have two (2) sets of contacts, each set having 2 NO + 2 NC contacts rated for 5A at 240V AC and 0.5A at 220V DC. One set shall be set to operate at lower value to give alarm and other set at a higher value to trip the motor.

36. SPACE HEATERS

Valve / Damper actuator motors; and Motors 30 KW and above shall be provided with one (1) or two (2) space heaters suitable for 240V, 50 Hertz single phase AC supply and of adequate capacity to maintain motor internal temperature above dew point to prevent moisture condensation or deterioration of insulation during shut down. Heaters shall be mounted inside the motor in accessible locations so that their removal and replacement is simple.

The terminals of space heaters shall be brought out to a separate totally enclosed dust proof and weatherproof terminal box.

The space heater shall be wired to maintain the motor internal temperature above dew point when the motor is in idle condition.

37. HOT AIR TEMPERATURE DETECTOR

If the motor is of CACA or CACW enclosure, dial type temperature indicator shall be provided (one each for hot and cold air temperature monitoring for CACA and CACW and one each for inlet and outlet water temperature monitoring for CACW). If alarm and trip are required for cooling air temperature, temperature switch shall be provided.

38. WATER FLOW INDICATOR



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If the motor is of CACW enclosure a provision shall be made for visual indication of water flow and flow switch shall also be provided with alarm contacts. Thermometers shall be provided in water inlet and outlet circuits.

39. MOISTURE DETECTORS

Motors with type of cooling 1C 81W or 1C 91 W shall be provided with moisture detectors for raising alarm in the event of water tube failure.

40. BED PLATE

Whenever motor is supplied with driven equipment the Supplier shall ensure that bed plate suits both motor and driven equipment and is adequately braced to keep vibration and misalignment within allowable limits to the approval of driven equipment and motor manufacturers.

41. Painting

Motor including fan shall be painted with corrosion proof paints of colour shade RAL 5012.

42. Local Push Button Stations

The LPBS shall be installed near the motors to be controlled. Individual channel supports shall be used for each LPBS. These shall be installed as per approved erection detail drawing. LPBS for hazardous areas shall be CMRS certified and CCE approved.

All LPBS shall have necessary canopies. Wiring of LPBS shall be checked before giving control supply.

Local push button station having only stop push button shall be provided for all the drive motors (HV, MV & LV motors).

The degree of protection of LPBs shall be IP65 with canopy.

All PBs shall be push to actuate type and the stop PB shall be lockable in off position as per the scheme requirement.

Emergency local stop push button should not be lockable. Stop Push buttons shall be mushroom type with latched or stay put feature with protective lid/cover. Start push button shall be self-reset type.



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All push buttons shall be provided with 2 nos. NO and 2 nos. NC contacts for various interlocking purposes. One contact of stop PB shall be directly wired to the switchgear module for direct tripping and another contact to control system.

Terminals to be suitable for 2 cores of 2.5 sq.mm conductors with 20% spare terminals. All LPBs shall be of Di-cast aluminium/ FRP.

LPB shall be of following types:

1. Type-A: With Stop Push Button in FRP enclosure
2. Type-B: With Start & Stop Push Buttons in FRP enclosure
3. Type-C: With Forward, Reverse & Stop Push Buttons in FRP enclosure
4. Type-D: With Stop Push Button in flame-proof enclosure
5. Type-E: With Start & Stop Push Buttons in flame-proof enclosure
6. Type-F: With Forward, Reverse & Stop Push Buttons in flame-proof enclosure

43. OTHER ACCESSORIES

Motor shall be supplied with all accessories and parts other than those, specified above which are necessary and/or useful for efficient operation.

44. NOISE LEVEL

Noise level for all the motors shall be limited to 85dB(A) except for BFP motor for which the maximum limit shall be 90dB(A). at 1m from operating motor measured in accordance with IS: 10265.

2.2.12.5 Documents and Drawings

1. INFORMATION WITH PROPOSAL

AC Motor Data Sheet
Dimension Drawing/Foundation load details of motor and driven equipment.
Manufacturer's catalogue showing constructional details.

2. INFORMATION ON AWARD OF CONTRACT

Motor Data Sheet

Certified binding dimension drawing of motor complete with all accessories and fittings specifically showing terminal boxes, terminal spacing and sizes, earthing connections and sizes thereof, mounting details, lifting lugs, final foundation loads and dimensions with tolerances of centering spigot (where needed), shaft extension and key.



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Following characteristics curves:-

- i) Torque-speed curves for motor at eighty (80), hundred (100) and hundred ten (110) percent rated voltage as well as torque-speed curve for driven equipment except for mill motor. For mill motor torque speed curve for motor at ninety (90) hundred (100) and hundred ten (110) percent rated voltage as well as torque-speed curve for driven equipment
- ii) Current-speed curves at eight (80), hundred (100) and hundred ten (110) percent rated voltage except for mill motor. For mill motor current speed curve for motor at ninety (90) hundred (100) and hundred ten (110) percent rated voltage
- iii) Current-time curves at eighty (80), hundred (100) and hundred ten (110) percent rated voltage except for mill motor. For mill motor current time curve for motor at ninety (90) hundred (100) and hundred ten (110) percent rated voltage.
- iv) Thermal withstand curves for hot and cold at eighty (80), hundred (100) and hundred ten (110) percent rated voltage except for mill motor. For mill motor thermal withstand curve for motor at ninety (90) hundred (100) and hundred ten (110) percent rated voltage.
- v) Efficiency, power factor, current and speed versus power output curves.
- vi) Speed-time curves at eight (80), hundred (100) and hundred ten (110) percent rated voltage except for mill motor. For mill motor speed time curve for motor at ninety (90) hundred (100) and hundred ten (110) percent rated voltage.
- vii) Negative phase sequence current withstand characteristics.

2.2.12.6 List of tests to be conducted for HV, MV and LV Motors

1. Type tests
 - i. No load saturation and loss curves up to approximately 115% of rated voltage.
 - ii. Momentary overload test.
 - iii. Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp., core temp., coolant flow and its temperature shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose.



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- iv. Surge withstand test on the sample coil after placing it in stator core at (4U + 5 KV) and with at least five impulse of 1.2/50 micro sec. wave, for HV motors only, where U is the line to line voltage in kV.
- v. Surge-withstand test with 0.3/3 micro sec. wave on each type of 6.6/11 kV motor coils with at least five such impulses, followed by one minute power frequency high voltage test on turn to turn insulation, after cutting the coil and bringing out the turns suitably. The power frequency test voltage shall be decided during detailed engineering.
- vi. Dimensions (for motors covered by IS 1231:1974 and IS 2223:1983 only).
- vii. Measurement of resistance of windings of stator and wound rotor.
- viii. Reduced voltage running up test at no load (for squirrel cage motors up to 37kw only).
- ix. Full load test to determine efficiency, power factor and slip.
- x. Insulation resistance test.
- xi. Test for vibration severity of motor.
- xii. Test for noise levels of motor.
- xiii. Test for degree of protection by enclosure.
- xiv. Temperature rise test at limiting values of voltage and frequency variations.
- xv. Over speed test.

2. Routine Tests

The following shall constitute the routine tests.

- i. Insulation resistance test
- ii. Measurement of resistance of windings of stator and wound rotor.
- iii. No load test
- iv. Locked rotor readings of voltage, current and power input at a suitable reduced voltage
- v. Reduced voltage running up test (for squirrel cage motor)



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- vi. Open circuit voltage ratio of stator and rotor windings (for slip ring motors); rotor;
- vii. High voltage test

2.2.12.7 Inspection and Testing at site

1. Insulation resistance of 415V motors shall be measured between the winding of the machine and its frame by means of a 500/1000V megger. A minimum value of 1 mega ohm for 415V motors shall be considered a safe value. In case of lower I.R. Value, the insulation value shall be brought up by any of the following methods as desired by the Site Engineer.
 - i. Blowing hot air in case of big motors.
 - ii. Putting the motor in electric oven in case of smaller motors.
 - iii. Placing heaters or lamps around and inside in case of small motors after making suitable guarding and covering arrangements so as to conserve the heat.
2. Site Test
 - i. Measurement of vibration.
 - ii. Measurement of insulation resistance and polarization index.
 - iii. Measurement of full load current.
 - iv. Test running of the motors, checking the temperature rise and identifying the hot spot etc.
3. 6.6 kV motors shall be tested for insulation by 500/1000V megger and its value should not be less than the safe minimum insulation of $\geq 20 \text{ M}\Omega$ resistance at 60 deg. C. In case the insulation is low, the following method of drying has to be adopted.
 - i. By locking the motor so that it cannot rotate and then applying such a low voltage to the stator terminals that full load current flows in the stator, keeping the stator winding temperature below 90 deg. C. In this a close watch shall be kept for any possible overheating and I.R. Values vs. temperature shall be plotted and heating continued till I.R. Value becomes steady.
 - ii. By blasting hot air from external source, Maximum temperature of winding while drying should be 70 deg. C to 80 deg. C. (Thermometer) or 90 deg. C. to 95 deg. C. by resistance method. Heating should be done slowly till steady



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temperature of winding is reached after 4 to 5 hours and for large machines after 10 hours. A record has to be kept for drying process, with half an hour readings and, after steady temperature is reached, at an interval of 2 hours. In case it is essential, the drying process can be supplemented by blower.

Actuators



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2.2.13 ACTUATORS

2.2.13.1 SCOPE

This Specification covers the general requirements of Electric Motor Actuators for valves, dampers and gates.

All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification.

2.2.13.2 CODES & STANDARDS

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

Code	Name of standard
IS: 325	Specification for three phase induction motor
IS: 900	Code of Practice for installation and maintenance of induction motors.
IS: 996	Single Phase AC Motor
IS: 1271	Thermal evaluation and classification of electrical insulation.
IS:2223	Dimensions of flange mounted AC induction motors.
IS: 3043	Code of practice for earthing
IS: 4029	Guide for testing three phase induction motors.
IS: 4691	Degree of protection for enclosures of rotating electrical machinery.
IS: 4722	Specification for rotating electrical machinery.
IS: 4728	Terminal marking and direction of rotation for rotating electrical machinery.
IS: 4889	Methods of determination of efficiency of rotating electrical machines.
IS: 5571	Guide for selection of electrical equipment for hazardous areas.
IS:6362	Designation of Method of Cooling of Rotating electrical machines.
IS: 8789	Values of performance characteristics for three phase



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	induction motors.
IS: 9334	Electrical Motor Operated Actuators
IS: 12065	Noise level of motors.
IS: 12075	Measurement and evaluation of vibration of rotating electrical machines.
IS: 12615	Induction motors-Energy efficient, three-phase, squirrel cage – Specification
IS: 12802	Temperature rise measurement of rotating electrical machines.
IS: 12824	Type of duty and classes of rating assigned.
IEC: 60034-1	Rotating electrical machines
NEMA, MG-1	Motors and Generators

Equipment and material 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 furnished during detail engineering.

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

2.2.13.3 General

- The Actuators shall be integral starters along with overload relays with built in SPP (Single Phase Preventer) with provision for operation from Control room, Local and by wireless set.
- The actuator motors shall be suitable for use on 415 Volt 3 phase 50Hz power supply. The actuator comprising motor, integral reversing starter, local control facilities and terminals for remote control and indication shall be housed within a self contained, sealed enclosure.
- Actuator working platforms shall be provided for maintenance purpose.
- Commissioning tools shall not form an integral part of the actuator and must be removable for secure storage/authorized release. In addition, provision shall be made for the protection of configured actuator settings by a means independent access to the commissioning tool.
- For some specific applications, integral starter shall also be separately mountable



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casting type and plug-in. Such applications shall be decided during detail engineering.

2.2.13.4 Actuator Sizing

The actuator shall be sized to guarantee valve closure at the specified differential pressure. The safety margin of motor power available for seating and unseating the valve shall be sufficient to ensure torque switch trip at maximum valve torque with the supply voltage 10% below nominal. The operating speed shall be such as to give valve closing and opening at approximately 4 to 5 mm per second unless otherwise stated in the job specification. Transient voltage dip on starting of the largest motor with DOL shall be limited to 20% of the nominal system voltage at the voltage terminals.

2.2.13.5 Environmental

Actuators shall be suitable for indoor and outdoor use. The actuator shall be capable of functioning in an ambient temperature ranging from 10°C to 50°C, upto 95% relative humidity. Actuators for explosion-hazardous applications shall in addition be certified Flameproof for Zones 1 and 2 (Divisions 1 and 2 Group gases).

2.2.13.6 Enclosure

Actuators shall be 'O' ring sealed, watertight to IP68 degree of protection. The motor and all other internal electrical elements of the actuator shall be protected from ingress of moisture and dust when the terminal cover is removed at site for cabling.

2.2.13.7 SPECIFIC REQUIREMENT

- i) The actuator shall essentially comprise the drive motor, torque/ Position limit switches, gear train, clutch, hand wheel, position indicator and transmitter, inbuilt thermostat for overload protection, space heater and internal wiring. Actuator shall be integral type. Integral starters shall have facility to hook-up with plant DCS for positioning of limit and torque switches.
- ii) The actuator enclosure shall be totally enclosed, dust tight, weather proof (NEMA-6/IP-68) suitable for outdoor use without necessity of any canopy.
- iii) All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.
- iv) The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.
- v) A lockable local/remote selector switch shall also be provided for selecting mode of operation.



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- vi) Gear Train:-Metal (Fibre gears are not acceptable) self-locking to prevent drift under torque switch (where ever applicable) spring pressure when motor is de-energised.
- vii) Manual Wheel:- Shall disengage automatically during motor operation.
- viii) Duty cycle of actuators shall suit the system requirement. The actuators shall be capable of giving the required torque at the output shaft. The actuators shall be designed to take the full thrust
- ix) The integral starter which shall have sophisticated electronic controls with field programming feature. It shall be designed for remote control from DCS/Respective control system. Required interposing relays for receiving open/close/stop command from DCS/Respective control system shall be provided. Potential free contacts and transducers shall be provided to provide status indication at remote DCS/Respective control system.
- x) A three position selector switch (marked as LOCAL-OFF-REMOTE) and push buttons OPEN-STOP-CLOSE (for local operation) with indication lamps for running OPEN and running CLOSE shall be provided.
- xi) The Remote command signal (OPEN-STOP-CLOSE) from DCS/Respective control system/Control panel shall be isolated from control electronics through opto-isolator.
- xii) The following individual status annunciation LED's (Colour-Green) shall be provided locally (Integral to actuator) to annunciate the following for easy local monitoring.
 - 1. Actuator in local mode
 - 2. Actuator in remote mode
 - 3. Actuator running in OPEN direction
 - 4. Actuator running in CLOSE direction
 - 5. Actuator in inching mode.
 - 6. Actuator in self-retaining mode
 - 7. Limit switch OPEN trip
 - 8. Limit switch CLOSE trip
 - 9. Control voltage availability
- xiii) The following individual fault annunciation LED's (Colour-Red) shall be provided locally. (Integral to Actuator)
 - 1. Torque switch OPEN
 - 2. Torque switch CLOSE
 - 3. Thermo switch trip
 - 4. Electronic overload relay trip
 - 5. Motor single phasing
 - 6. Common fault (Inclusive of any one or combination of above fault)



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- xiv) View port shall be provided on integral starter unit to monitor the above status annunciation and fault annunciation.
- xv) Electronic overload relay shall be provided to trip actuator in case of overload. Plug in connections/design shall be provided between:-
 - 1. Integral starter unit and basic actuator
 - 2. Between external customer connections and actuator
- xvi) OPEN-CLOSE indication /LED shall be provided for indication of full open/close position.
- xvii) Automatic phase correction facility and potential free contact for annunciation of power failure shall be provided.

2.2.13.8 Motor

The electric motor shall be Class F insulated, with a time rating of at least 15 minutes at 50°C or twice the valve stroking time, whichever is more, at an average load of at least 33% of maximum valve torque.

- i) The squirrel cage induction motor shall be designed for full voltage direct-on-line start, with starting current limited to 6 times full-load current. The motor shall be capable of starting at 85% of rated voltage and running at 80% of rated voltage at rated torque and also at 85% of rated voltage at 33% excess rated torque for a period of 5 minutes each. The motors shall otherwise generally conform with technical specification for motors mentioned elsewhere in this specification.
- ii) The actuators shall be sized so as to open or close valves/ dampers at rated speed enclosure shall not be more than 70 degree 'C' over ambient temp. of 70 deg.C as these are subjected to higher ambient conditions due to their vicinity to operate fluid on continuous load operation. The actuators shall be suitable for a relative humidity of 95%. Class of insulation shall be class-F and type of enclosure shall be IP-615.0
- iii) Insulation:- The motor winding shall be insulated with class-F insulation having temperature rise limited to Class-B.
- iv) Performance:-The motor shall be capable of:
 - a) Starting at 85% of rated voltage
 - b) Running at 80% of rated voltage at rated torque for 5 minutes
 - c) Running at 85% rated voltage at 33% excess rated torque for 5 minutes.
- v) Maximum continuous motor rating shall be atleast 10% above the maximum load derived of the driven equipment under entire operating range including voltage & frequency variation.



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Vi) Bearing

The motor bearing shall be double shielded, grease lubricated and antifriction type.

vii) Earthing

At least two earthing terminals shall be provided for the motor body. Separate earthing terminal should be provided for terminal box.

2.2.13.9 Motor Protection

Protection shall be provided for the motor as follows:

- i. The motor shall be de-energized in the event of a stall when attempting to unseat a jammed valve.
- ii. Motor temperature shall be sensed by a thermostat de-energising the motor in case of overheating.
- iii. Lost phase protection.
- iv. Overload protection.
- v. Short circuit protection by suitably rated long acting fuse.

2.2.13.10 Gearing

The actuator gearing shall be totally enclosed in an oil-filled gear casing suitable for operation at any angle. All drive gearing and components must be of metal construction and incorporate a lost-motion hammer blow feature. For rising spindle valves the output shaft shall be hollow to accept a rising stem, and incorporate thrust bearings of the ball or roller type at the base of the actuator. The design should be such as to permit the opening of the gear casing for inspection or disassembling without releasing the stem thrust or taking the valve out of service.

2.2.13.11 Hand Operation

A hand wheel shall be provided for emergency operation, engaged when the motor is declutched by a lever or similar means, the drive being restored to power automatically by starting the motor. The hand wheel or selection lever shall not move on restoration of motor drive. Provision shall be made for the hand/auto selection lever to be locked in both hand and auto positions. It should be possible to select hand operation while the actuator is running or start the actuator motor while the hand/auto selection lever is locked in hand without damage to the drive train.

The hand wheel drive must be mechanically independent of the motor drive and any hand wheel gearing should be such as to permit emergency manual operation in a



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reasonable time. Clockwise operation of the hand wheel shall give closing movement of the valve unless otherwise stated in the job specification.

2.2.13.12 Drive Bushing

The actuator shall be furnished with a drive bushing easily detachable for machining to suit the valve stem or gearbox input shaft. Normally the drive bush shall be positioned in a detachable base of the actuator. Thrust bearings, when housed in a separate thrust base should be of the sealed for life type.

2.2.13.13 Limit Switches

- a) Each motor actuator shall have Six (6) rotary drum position limit switches with two for open each with 2 NO + 2NC contacts and two for close each with 2 NO + 2 NC contacts positions, each with adjustable setting between fully open and fully closed positions. Each rotary drum limit switch shall have two (2) limit switches for intermediate open position each with 2 NO + 2 NC contacts. The limit switches shall have capacity of 5A at 240V AC or 0.5A at 220V DC.
- b) Each motor actuator shall also have two (2) torque limit switches with two (2) normally opened and two (2) normally closed contacts each.
- c) The torque switches shall have a minimum accuracy of 3% of set value. The torque switches shall be provided with calibrated knobs for setting desired torque and separate knobs shall be provided for open and close torque switches. The torque and position limit switches shall be housed in a separate enclosure with protection class as that of actuator.
- d) The motor operators/actuators shall be capable of meeting 150 percent of unseating torque at specified voltage.
- e) The motor actuators shall have 2 nos. potentiometric type transmitters of 100 ohm rating.
- f) Torque switches shall function to stop the motor on closing/opening. Upon actuation by the torque clutch it is restricted its attempt to open or close, thereby causing an overloading torque. Torque switches shall be self-resetting type only (i.e.) once a particular direction torque switch operates, it shall get resetted only when the equipment is operated in other direction.
- g) All six (6) limit switches shall be changeover type and adjustable besides having the snap facility. All limit switches, contacts shall be wired up independently upto the terminal block.

2.2.13.14 Remote Valve Position/Actuator Status Indication



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- iv. Four contacts shall be provided which can be selected to indicate any position of the valve. Provision shall be made for the selection of a normally closed or open contact form. Contacts shall maintain and update position indication during hand wheel operation when all external power to the actuator is isolated.
- v. The contacts shall be rated at 5A for 240V AC, 0.5A for 220V DC.
- vi. As an alternative to providing valve position any of the four above contacts shall be selectable to signal one of the following:
 - a. Valve opening, closing or moving
 - b. Thermostat tripped, lost phase
 - c. Motor tripped on torque in mid travel, motor stalled
 - d. Remote selected
 - e. Actuator being operated by hand wheel
- vii. Position feedback has to be provided for all inching type applications. These shall be interfaced with plant DDCMIS.
- viii. Actuator local and remote indications shall be grouped and taken separately

2.2.13.15 Local Position Indication

The actuator shall include a digital position indicator with a display from fully open to fully close in 1% increments. Red, green and yellow lights corresponding to open closed and intermediate position shall be included on the indicator. End of travel indication colours shall be reversible. The digital display shall be maintained and updated during handwheel operation when all external power to the actuator is isolated. The display shall incorporate valve, actuator and control status indication. Provision shall be made to orientate the display through increments of 90°.

Provision shall be made in the design for the addition of a contactless transmitter to give a 4-20mA analogue signal corresponding to valve travel for remote indication when required.

2.2.13.16 Integral Starter and Transformer

The reversing starter, control transformer and local controls shall be integral with the valve actuator suitably housed to prevent breathing and condensation. The starter shall be suitable for 60 starts per hour and of rating appropriate to motor size. The starter logic shall be microprocessor- based. The controls supply transformer shall be fed from two of the incoming three phases and incorporate overload protection. It shall have the necessary tapings and be adequately rated to provide power for the following functions:



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- i. Energization of the contactor coils.
- ii. DC output where required for remote controls.
- iii. Supply for all the internal electrical circuits.

2.2.13.17 Integral Local Control and Control Mode Selector

The actuator shall incorporate local controls for Open, Close and Stop and a local/ Stop/ Remote mode selector switch lockable in any one of the following three positions: local control only, stop (no electrical operation), remote control plus local stop only. It shall be possible to select maintained or non-maintained local control.

The local controls shall be arranged so that the direction of valve travel can be reversed without the necessity of stopping the actuator.

Provision shall be made to orientate the local controls through increments of 90°.

2.2.13.18 Control Facilities

- i. The necessary wiring and terminals shall be provided in the actuator for the following control functions:
- ii. Open and close external interlocks to inhibit local and remote valve opening and/or closing control. Provision shall be made to configure the interlocks to be active in remote control only.
- iii. Remote controls fed from an internal 24V DC supply and/or from an external supply rated 110V AC to be suitable for any one or more of the following methods of control:

Open, close and stop control :

- a. Open and close maintained or 'push to run' (inching) control
- b. Overriding Emergency Shut-down to Close (or Open) valve from a normally closed or open contact .
- iv. The following individual potential free relay contacts shall be provided in the actuator for remote annunciation to facilitate continuous monitoring of the actuator.
 - a. Actuator in local mode
 - b. Actuator in remote mode
 - c. Actuator (valve) running in OPEN direction.



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- d. Actuator (valve) running in CLOSE direction.
 - e. Limit switch OPEN trip
 - f. Limit switch CLOSE trip
 - g. Actuator in local mode.
 - h. Actuator in inching mode.
 - i. Actuator in self-retaining mode.
 - j. Actuator power switched off /single phasing.
 - k. Torque switch trip, thermo switch trip and overload relay trip (or close)
- v. Automatic phase correction facility and potential free contact for annunciation of power failure shall be provided.
- vi. It shall be possible to reverse valve travel without the necessity of stopping the actuator. The starter contactors shall be protected from excessive current surges during travel reversal by an automatic time delay on energization of the contactor coils.

2.2.13.19 Monitoring Facilities

Facilities shall be provided for monitoring actuator operation and availability as follows:

- i. Monitor (availability) relay, having one changeover contact, the relay being energised from the control transformer only when the Local/Off/Remote selector is in the Remote position to indicate that the actuator is available for remote (control room) operation.
- ii. Where required, it shall be possible to provide indication of Thermostat trip and Remote selected as discreet signals. The actuator shall include a diagnostic module, which will store and enable download of historical actuator operation and torque data to permit analysis of actuator and valve in-service performance. Data download shall be carried out without removing any covers and all shall be available locally to the actuator or remotely via telecom data transfer.
- iii. Diagnostic and configuration software shall be made available in a Lap Top PC for user.

2.2.13.20 Wiring and Terminals

- i. Internal wiring shall be tropical grade PVC insulated stranded cable of appropriate size for the control and 3-phase power. Each wire shall be clearly identified at each end.
- ii. The terminals shall be embedded in a terminal block of high tracking resistance compound.



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- iii. The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight sea land shall be provided with a minimum of 3 threaded cable entries with provision for a minimum of 4.
- iv. All wiring supplied as part of the actuator to be contained within the main enclosure for physical and environmental protection. External conduit connections between components are not acceptable.
- v. A durable terminal identification card showing plan of terminals shall be provided attached to the inside of the terminal box cover indicating:
 - a. Serial number
 - b. External voltage values
 - c. Wiring diagram number
 - d. Terminal layout
- vi. This must be suitable for the contractor to inscribe cable core identification along side terminal numbers.

2.2.13.21 Startup Kit

Each actuator shall be supplied with a start-up kit comprising installation instruction manual, electrical wiring diagram and cover seals to make good any site losses during the commissioning period. In addition, sufficient actuator commissioning tools shall be supplied to enable actuator set up and adjustment during valve/actuator testing and site installation commissioning.

2.2.13.22 Performance Test Certificate

- i. Each actuator must be performance tested and individual test certificates shall be supplied free of charge. The test equipment should simulate a typical valve load, and the following parameters should be recorded:
 - a. Current at maximum torque setting
 - b. Torque at max. torque setting
 - c. Flash test voltage
 - d. Actuator output speed or operating time
- ii. In addition, the test certificate should record details of specification such as gear ratios for both manual and automatic and second stage gearing if provided, drive closing direction, wiring diagram number.

- 2.2.13.23** The following minimum tests/ checks shall be conducted at site. Any other tests/ checks as per the manufacturer's recommendation shall also be carried out.
- a. Measurement of insulation resistance.
 - b. Measurement of full load current.



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c. Test running of the motors.

2.2.13.24 Drawing and Manuals

Following drawings/ data and Manuals to be submitted for approval:-

- i) Instruction manuals on Installation, tests
- ii) Actuator Data sheet.
- iii) Internal wiring diagram and control schematic.
- iv) Torque switch and Limit switch contact development.
- v) QAP for Test reports.
- vi) Manufacturers Catalogue
- vii) Instruction manuals on installation methods. tests etc.
- viii) Motor sizing calculation
- ix) Integral starter details
- x) General arrangement drawings
- xi) Test reports
- xii) Manufacturing quality plan
- xiii) Field quality plan

Cabling System



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2.2.17 CABLING SYSTEM

2.2.17.1 SCOPE OF WORK

The scope of work covers supply, erection, testing and commissioning of complete electrical system including cabling, fire stop mortar seal, fire retardant cable coating system etc. the scope shall broadly cover, but not be limited to:

- i) TG Building & Transformer Yard
- ii) Boiler Area, ESP
- iii) All auxiliary buildings (including electrical rooms of respective buildings) and structures as per details in the general electrical specification/ plot plan & related drawings.
- iv) Service Building
- v) CPU Regeneration
- vi) DG House
- vii) Pipe cum cable rack (within the battery limits).
- viii) Air Washer Units
- ix) All electrical equipment as described in different sections.
- x) As built drawing for all above systems on completion of project.

The scope of work shall also include all civil and structural works necessary for successful installation, commissioning & commercial operation of all electrical equipment to be erected under this specification.

2.2.17.2 SCOPE OF SUPPLY

- 1 The scope of work shall include complete supply, installation, testing, commissioning and putting into successful commercial operation of the cabling system for the entire plant covering all indoor & outdoor areas of BTG area.
- 2 The equipments and materials within the scope of supply shall include but not limited to
 - i. Power & control cabling works (including that of special cables):
Supply and installation of cable and cable trays/raceways, supports, conduits, duce bank, cable accessories such as jointing/termination kits, cable glands, lugs, ferrules, etc. as required for all the systems & equipments.
 - ii. Supply and installation (including laying & termination) of control cables, special cables, instrumentation cables for all equipments and systems.



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- iii. Supply and installation (including laying & termination) of all power cables (HV and LV) of all power cables (HV and LV) for all equipments and systems.
- iv. Cable routing has to be planned such that it shall not cross the steam lines, oil lines.
- v. Fire Sealing Arrangement: All cable entries into the panel (HV & MV & LV SWGR panels) should be provided with fire sealing arrangements.
- vi. Cable/cable tray openings in walls and floors or through pipe sleeves from one area to another or from one elevation to another within the unit shall be seated by a fire proof sealing system (FPSS). The FPSS shall effectively prevent the spread of fire from the flaming to non-flaming side of a fire
- vii. Galvanized steel rigid/ flexible conduits and accessories, ferrules, lugs, glands, terminal blocks, galvanized sheet steel junction boxes, cable fixing clamps, nuts & bolts etc as required.
- viii. All necessary erection materials, consumables and sundry items including arc welding rods to complete the installation for satisfactory and trouble free operation.
- ix. Any item of works or erection materials which have not been specifically mentioned but are necessary to complete the work involved shall be deemed to be included in the scope of this specification and shall be furnished by the Bidder without any extra charge to the purchaser.

2.2.17.3 CODES AND STANDARDS

All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards/ codes as applicable.

IS:513	Cold rolled low carbon steel sheets and strips.



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IS:1079	Hot Rolled carbon steel sheet & strips
IS:1239	Mild steel tubes, tubular and other wrought steel fittings
IS:1255	Code of practice for installation and maintenance of power cables upto and including 33 KV rating
IS:1367 Part-13	Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners).
IS:2147	Degree of protection provided by enclosures for low voltage switchgear and control gear
IS:9537	Conduits for electrical installation.
IS:9595	Metal – arc welding of carbon and carbon manganese steels - recommendations.
IS:13573	Joints and terminations for polymeric cables for working voltages from 3.3kv up to and including 33kv performance requirements and type tests.
BS:476	Fire tests on building materials and structures
DIN 46267 (Part-II)	Non tension proof compression joints for Aluminium conductors.
DIN 46329	Cable lugs for compression connections, ring type ,for Aluminium conductors
VDE 0278	Tests on cable terminations and straight through joints
BS:6121	Specification for mechanical Cable glands for elastomers and plastic insulated cables.
	Indian Electricity Act.
	Indian Electricity Rules.

Equipment complying with other internationally accepted standards such as IEC, BS, DIN, USA, VDE etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Contractor shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards along with copies of all official amendments and revisions in force as on date of opening of bid and shall clearly bring out the salient features for comparison.

2.2.17.4 DESIGN AND CONSTRUCTIONAL FEATURES

1 Inter Plant Cabling



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Interplant cabling for main routes shall be laid along overhead trestles/duct banks. However, from tap-offs, same can be through shallow trenches with sand filling. All the switchgear room shall be provided with cable spreader room at ground floor. The cable trenches are allowed between switchyard control room and transformer yard only. In case of Duct banks, pull-pits shall be filled with sand and provided with a PCC covering.

2 Transformer yard

In transformer yard cables shall be laid in RCC concrete trenches with RCC covers. The main cable routes coming out from Main plant building and crossing the Transformer yard shall be laid in overhead trestles/duct banks. Minimum clear height of trestle shall be 3 m and for Rail/road crossing, it shall be as per rail/road crossing norms. False floors are not to be provided for cabling purpose.

3 Cable entry

Cable entry from outdoor underground/cable routes to the buildings, if any, shall be above the finished floor level of the building.

All Buildings shall have suitable cable spreader rooms /cable vaults.

4 Trenches

PCC flooring of built up trenches shall be sloped for effective drainage with sump pits and sump pumps.

No sub-zero level cable vault/trenches shall be provided below control building/switchgear rooms in main plant areas.

All field switches for equipments corresponding to a stream located within a radius of 4-5 m shall be wired out to a field junction box and from field junction box to control panel/Input – Output cabinet by screened instrumentation cables.

Cable trenches shall be provided in Transformer Yard and Switchgear/MCC rooms. In other areas local cable trenches with length not exceeding 5 metres are allowed just near the equipment.

Cables for one set of auxiliaries such as ID,FD & PA fans & half of the coal mills shall be routed in one route & for through other set of auxiliaries through other route.

Bidder shall provide two independent routes for cables between Switchyard Control Room & Main Plant Control Room. Bidder shall provide the cable trays along with its supporting structure arrangement on the trestle.



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5 Cable Vault:

- i) Cable vault of not less than 3.5 metres clear height shall be provided.
- ii) Clear access passage of at least 750 mm wide & 2.0 Mts clear height shall be provided at entrances & along cable ways. Wherever the passage is through cable routes clear height shall not be less than 1.5 Mts.
- iii) Cable vaults shall be provided with adequate drainage facility for drainage of fire water.
- iv) Each cable vault should have two fire proof doors.
- v) Exit signs shall be provided near doors for personnel escape in case of emergency.

- 6 Major routes in Turbine area (STG Package area) shall be on overhead cable trays either supported from available structures, building structure. Only in specific areas as shall be approved by purchaser/consultant where number of cables are too small compared to the route length and in transformer yard, cable shall be routed in cable trenches.

2.2.17.5 EQUIPMENT DESCRIPTION

Cable trays, Fittings & Accessories

- 1 Cable trays shall be ladder type as specified complete with matching fittings (like brackets, elbows, bends, reducers, tees, crosses, etc.), accessories (like side coupler plates, etc.) and hardware (like bolts, nuts, washers, G.I. strap, hook etc.) as required. Cable tray shall be ladder type for power & control cables and perforated for instrumentation cables.
- 2 These shall be either prefabricated hot dip galvanized sheet steel trays or site fabricated angle iron trays free from flaws such as laminations, rolling marks, pitting etc. These (including hardware) shall be hot dip galvanized as per relevant IS.
- 3 Cable trays shall have standard width of 150 mm, 300 mm & 600 mm and standard lengths of 2.5 metre. Minimum thickness of mild steel sheets used for fabrication of cable trays and fittings shall be 2 mm. The thickness of side coupler plates shall be minimum 3 mm.
- 4 Cable troughs shall be required for branching out few cables from main cable route. These shall be U-shaped, fabricated of mild steel sheets of minimum thickness 2 mm and shall be hot dip galvanized as per relevant IS. Troughs shall be standard width of 50 mm & 75 mm with depth of 25 mm.
- 5 Prefabricated hot dip galvanized sheet steel cable trays shall be used for maximum support span of 2000 mm unless design is approved for larger span. Cable trays shall be suitable for a cable weight of 100 kg/meter running length of tray. Minimum thickness of sheet steel/galvanizing shall be 2mm/86 microns respectively. The



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amount of zinc deposit shall not be less than 610 gm per square meter.

- 6 Cable trays fabricated from standard rolled sections shall be 50x50x6/75x75x6 sections for runners for supporting spans limited to 2000 mm/more than 2000 mm respectively. Cross support shall be 32x6 mm / 50x6 flat for widths up to 500mm/more than 500mm respectively.
- 7 Separate coloured paint strips 2 inch width each numbers equally spaced at 5 metres interval shall be applied for identification of different type of trays depending upon types of usage/applications/area as below:

High/ medium voltage cables:

11kV/6.6kV : red strips

1.1kv power cables : yellow strips

1.1kv control cables : blue strips

Instrumentation cables : green strips

8 Support System for Cable Trays

Cable tray support system shall be pre-fabricated similar or equivalent to "Unistrut make".

Support system for cable trays shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall be of two types:

- (i) C1:- having provision of supporting cable trays on one side and
- (ii) C2:- having provision of supporting cable trays on both sides. The support system shall be the type described hereunder
 - a. Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor plates, all hardware such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc.
 - b. The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardware's fittings and accessories shall be prefabricated factory galvanised.
 - c. The main support and cantilever arms shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hardware etc. to form various arrangements required to support the cable trays. Welding of



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- the components shall not be allowed. However, welding of the bracket (to which the main support channel is bolted) to the overhead beams, structural steel, insert plates or reinforcement bars will be permitted. Any cutting or welding of the galvanized surface shall be brushed and red lead primer, oil primer & aluminium paint shall be applied.
- d. All steel components, accessories, fittings and hardware shall be hot dip galvanized after completing welding, cutting, drilling and other machining operation.
 - e. The main support channel and cantilever arms shall be fabricated out of minimum 2.5 thick rolled steel sheets conforming to IS.
 - f. Cantilever arms of 300 mm, 600 mm and 750 mm in length are required. The arm portion shall be suitable for assembling the complete arm assembly on to component constructed of standard channel section. The back plate shall allow sufficient clearance for fixing bolt to be tightened with tray in position.
 - g. Cable trays in areas subjected to excessive coal dust or mechanical damage shall have hot dip galvanized sheet steel metal trays cover installed on front tray in vertical run and inverted 'V' type on upper tray in horizontal run with consideration for ventilation.

The size of structural steel members or thickness of sheet steel of main support channel and cantilever arms and other accessories as indicated above are indicative only. Nevertheless, the support system shall be designed by the contractor to fully meet the requirements of type tests as specified. In case the system fails in the tests, the components design modification shall be done by the Contractor without any additional cost. The contractor shall submit the detailed drawings of the system offered by him along with the bid.

9 FRP CABLE TRAYS

FRP Cable trays shall be used for areas like intake raw water pump house, Desalination plant, CHP, Battery room, NDCT and chemical house.

Cable trays shall be of ladder / perforated type complete with all necessary coupler plates, elbows, tees, bends, reducers, stiffeners and other accessories. Cable trays of ladder and perforated types and the associated accessories such as coupler plates, tees, elbows, etc. shall be of FRP.

The FRP cable tray shall be ultra violet resistant. FRP cable trays shall be manufactured in accordance with NEMA FG-1-1984-1993 and Standards IS-6746 and ASTM E 84. Manufacturing process shall be pultrusion using automated pultrusion machines. Resin to be used shall be ultraviolet resistant polyester resin.



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All cable trays and accessories shall be corrosion / chemical resistant, weather resistant, easy to drill and cut. Lightweight, high strength and flame retardant in accordance with ASTM E-84-Class 1 Rating and as per IS-6746-Very Low Flammability. An additive material shall be mixed with the FRP to make them resistant to ultraviolet light. The oxygen index shall be minimum 30 as per ASTM-D-2863.

The minimum glass content in the FR material shall be 55%.

The Ladder type trays shall have side rails and horizontal rungs. Both of these shall be of same material i.e. the FRP with additive material. The rungs shall be placed 300 mm apart from each other. The side runner of the Ladder type FRP cable trays shall be pultruded FRP channel of 100 x 35 mm height. The minimum thickness of the tray will remain 4mm. The rungs to side member are connected to the Larger portion of the side rail by using pin made of fiberglass reinforced thermoplastic, and should have both mechanical and adhesive lock.

Minimum thickness of perforated type FRP cable tray shall be 4mm. Minimum thickness of coupler plates shall be 4mm.

HV, MV and LV power single core cable shall be laid in trefoil formation with 2D gap where 'D' is the diameter of cable.

HV & MV cables and LV power cables (95 sq. mm & above) multicore cables shall be laid in touching formation in single layer. 1100V multicore cables below 95 sq. mm shall be laid in two layers. Control and instrumentation cables shall be laid in 3 layers.

- i) Individual tray systems shall be established for the following services: -
 - a) 6.6 kV and higher voltage power cables.
 - b) 415 Volt power cables.
 - c) Special noise-sensitive circuits or instrumentation cables.
 - d) Control cables. (Control cables shall be laid along with LV power cables and instrumentation cables if required for short length near the equipment with GI separators).
 - e) Further subdivision of tray systems shall be provided if required to meet special segregation/separation requirements.
- ii) In areas having coal dust, cable trays shall be run in vertical formation while horizontal trays shall be provided in other areas. Cable depth not to exceed two cables for vertical trays.
- iii) The minimum design vertical spacing for trays shall be 300 mm measured from the bottom of the upper tray to the top of the lower tray. At least a 250 mm clearance shall be maintained between the top of a tray and beams, piping, or



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other obstacles to facilitate installation of cables in the tray. A working space of not less than 600 mm shall be maintained on at least one side of each tray. Tray covers shall be provided on the top most tray of each tier of cable trays.

10 **Pipes, Fittings & Accessories**

Pipes offered shall be complete with fittings and accessories (like tees, elbows, bends, check nuts, bushings, reducers, enlargers, coupling caps, nipples etc.) The size of the pipe shall be selected on the basis of maximum 40% fill criteria

GI Pipes shall be of medium duty as per IS: 1239

Duct banks shall be High Density PE pipes encased in PCC (10% spare of each size, subject to minimum one) with suitable water-proof manholes.

11 **Junction Boxes**

Junction Boxes shall comprise of a case with hinged door constructed from cold rolled sheet steel of minimum thickness 2mm. Top of the boxes shall be arranged to slope towards rear of the box. Gland plate shall be 3 mm thick sheet steel with neoprene/synthetic rubber gaskets. All junction boxes shall be of adequate strength and rigidity, hot dip galvanised as per relevant IS, and suitable for mounting on wall, columns, structures etc. The boxes shall include brackets, bolts, nuts, screws M8 earthing stud etc. required for installation.

Glass Fibre Reinforced Junction Boxes No. of Ways: 12/24/36/48 with 20% spares terminals.

Junction boxes shall be Glass Fibre Reinforced with saturated polyester conforming to standards like DIN 16911 type 803/16913 type 834, 5 self extinguishing in accordance with ASTM D635/UL 94 VO. Junction boxes for use in outdoor or damp locations shall be sturdy construction. Temperature resistance shall be between – 10 to 100°C. Impact resistance shall be greater than 7 Nm, (EN 50014). Protective insulation shall be in line with VDE 0100, dielectric strength shall be greater than 10 KV/mm, halogen free toxicity, the enclosure and door cover shall be painted and electro statically power coated (preferably in RAL7032). Earth connection (studs size shall be M 6) shall be provided on the cover as well as door.

Protection Class

Protection Category shall be IP 66 to EN 60529. There shall be guaranteed perfect seal to meet Protection class IP 66 providing arrangement like highly elastic foamed in special type seal like polyurethane/chloroprene. The sealing rubber shall not have aging effect and shall retain its sealing characteristics for more than 20 years. Contractor shall indicate this in data sheet. The rubber seal should be pasted at its



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place with pasting technology for like more than 20 years (double sealing arrangement is preferred).

Mounting clamps and accessories

Junction boxes shall be suitable for mounting on walls, columns and structure. Brackets, bolts, nuts, screws, glands and lugs required for erection shall be of brass. The accessories like mounting plates etc. of steel shall be powder coated. The support rails for terminal box shall be zinc coated.

General

1. JBs shall have small canopy at the top.
2. There shall be rainwater collection arrangement from top and side of the outer ages to ensure that any leakage into the junction box shall be avoided and it shall fall outside.
3. Cable entry shall be from bottom side only.
4. Ensure gland plate sealing perfect. It shall be of the same quality and arrangement as that of door to cover arrangement.

Steel Junction Boxes

No. of Ways 12/24/36/48 with 20% spares terminals.

Junction boxes shall be designed in accordance with NEC, article 370, paragraph 18, 19 & 20 or equivalent standards.

Enclosure

Junction boxes for use in outdoor or damp locations shall be sturdy steel construction. The enclosure and door cover shall be surface finished clean, degreased, phosphated, deep coated primed (preferably in RAL 7044) and electrostatically powder coated (preferably in RAL 7032). Earth connection (studs size shall be M6) shall be provided on the cover as well as door. The sheath steel thickness shall be more than 2 mm.

Doors

The doors shall be hinged and lockable. The doors shall have industrial heavy duty hinges. The doors shall be easily but firmly lockable with quick release fastener and with integrated viewing window of 3mm resistant plexi glass or equivalent. The doors shall be industrial heavy duty hinges. The doors shall be easily but firmly lockable with quick release fastener.

Junction boxes shall be provided with two nos. earthing terminals (externally available) suitable for connection of 8 SWG G.I. wire. Knockouts shall be provided at bottom and both sides. These shall be provided by fixing plates in order to make



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them detachable type with suitable neoprene gaskets. Bottom and side plates for cable/conduit connection shall be provided. All unused holes shall be sealed with suitable grommets.

Junction boxes shall be provided with external designation label. The label inscriptions shall be informed to the Contractor by the Owner. Junction boxes shall be provided with danger sign in case of 415V circuit.

Junction boxes shall be of two types, viz. One suitable for control cabling and the other suitable for power cabling.

Junction boxes for control cabling shall have 24 way/ 48 way terminal blocks suitable for up to 2.5 sq.mm. Cu. Cable. However, for instrumentation junction boxes there shall be 24/48 ways suitable for terminating cable of 0.5 sq.mm. Cu. Cable.

Junction boxes for power circuit cabling shall be suitable for 1 no. 3 core 16 sq.mm.AL. Incoming cable and 1 no. 3 core 2.5 sq.mm Cu. Outgoing cable.

12 Terminal blocks

Terminal blocks shall be 650 volts grade, rated for 10 Amps and in one piece, rigid, Bakelite moulded, with disconnecting /shorting link. It shall be complete with insulating barriers, Klip-on-type terminals and identification strips, terminal studs, washers, nuts, lock nuts, marking strips etc.

Marking on terminal strip shall correspond to the terminal numbering on wiring diagrams. It shall be Elmex type CSLT-1 with insulating material of Melamine conforming to ESI Standard 12.1 or equivalent. Cage clamp type terminal block suitable for terminating 2 wires of 2.5 sq mm. on both sides arranged to facilitate easy termination shall be provided. 20% spare terminals shall be provided

13 Terminations & Straight through Joints

Termination and jointing kits for 11/6.6 kV grade XLPE insulated cables shall be of proven design and make which have already been extensively used and type tested. Termination kits and jointing kits shall be pre-moulded type, taped type or heat shrinkable type. 11/6.6 kV grade joints and terminations shall be type tested as per IS: 13573. Critical components used in cable accessories shall be of tested and proven quality as per relevant product specification/ESI specification. Kit contents shall be supplied from the same source as were used for type testing. The kit shall be complete with the aluminium solder less crimping type cable lugs & ferrule as per DIN standard.

Straight through joint and termination shall be capable of withstanding the fault level for 33kV, 11 kV and 6.6 kV systems.



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1.1 KV grade straight through joints shall be of proven design.

14 Cable glands

Cable glands shall conform to BS: 6121 and be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating. Rubber components shall be of neoprene and of tested quality. Necessary cable dimensions shall be furnished to the successful contractor.

Cable glands shall be single compression for indoor use, double compression type for outdoor use. Glands for classified hazardous areas shall be double compression type flameproof and weather proof duly certified by CMRS and approved by CCE.

15 Cable lugs/ferrules

The cables lugs shall be conforming to IS: 8309.

Machine ferruling shall be adopted.

Cable lugs for power cables shall be Aluminium solder less crimping type suitable for aluminium compacted conductor cables.

The cable lugs for control/instrumentation/ telephone cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipments.

Cable lugs shall be suitable for termination of different cross-sections of control/instrumentation/telephone cables and shall be of following types.

- i) Copper tubular terminal end for solder less crimping to copper conductors.
- ii) Cable lugs for control cable termination shall be insulated type. These lugs shall be flat type/ring type/U type to suit the terminals provided in the pan
- iii) Pin type lugs shall not used.
- iv) Aluminium tubular terminal ends for solder less crimping of to Aluminium conductor. Solder less crimping of terminals shall be done by using corrosion inhibiting compound. The cable lugs shall suit the type of terminals provided on the equipment. Lugs for control/instrumentation cables shall be PVC insulated/sleeved type.



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16 Cable Clamps & Straps

The cable clamps required to clamp multicore cables on vertical runs shall be made up of Aluminium strip of 25x3 mm size. For clamping the multicore cables on horizontal trays, self-locking, de-interlocking type nylon clamps/straps shall be used. The clamps/straps shall have sufficient strength and shall not get affected by direct exposure to sun rays and outdoor environment.

Trefoil clamps for single core cables shall be pressure die cast aluminum or fibre glass or nylon and shall include necessary fixing accessories like G.I. nuts, bolts, washers, etc. Trefoil clamps shall have adequate mechanical strength to withstand the forces generated by the system short circuit current of 105 KA peak.

17 Galvanizing

Galvanizing of steel components and accessories shall conform to IS: 2629 & IS: 2633. Additionally galvanizing shall be uniform, clean smooth, continuous and free from acid spots

The amount of zinc deposit over threaded portion of bolts, nuts, screws and washers shall be as per IS: 1367. The removal of extra zinc on threaded portion of components shall be carefully done to ensure that the threads shall have the required zinc coating on them as specified.

18 Welding

The welding shall be carried out in accordance with IS: 9595. All welding procedures and welders qualification shall also be followed strictly in line with IS: 9595

2.2.17.6 INSTALLATION

1 Cable tray and Support System Installation

Cables shall run in cable trays mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures. All cable trays shall be in vertical configuration in boiler, CHP & ESP areas. Horizontally running cable trays shall be clamped by bolting to cantilever arms and vertically running cable trays shall be bolted to main support channel by suitable bracket/clamps on both top and bottom side rails at an interval of 1500 mm. For vertical cable risers/shafts cable trays shall be supported at an interval of 1000mm. Fixing of cable trays to cantilever arms or main support channel by welding shall not be accepted. Cable tray installation shall generally be carried out as per relevant Standard. The cantilever arms shall be positioned on the main support channel with a minimum vertical spacing of 300 mm unless otherwise indicated in the relevant



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approved tray layout drawings.

All cable way sections shall have identification, designations as per approved cable way layout as and painted/stenciled at each end of cable way and where there is a branch connection to another cable way. Minimum height of letter shall be not less than 75 mm. For long lengths of trays, the identification shall be painted at every 10 meter. Risers shall additionally be painted/ stenciled with identification numbers at every floor.

In certain cases it may be necessary to site fabricate portions of trays, supports and other non standard bends where the normal prefabricated trays, supports and accessories may not be suitable. In such cases the Contractor shall fabricate at site suitable sections of trays, supports and accessories to make the installation complete for the specific purpose after obtaining owner's prior approval, which shall be neat in appearance and shall match with the prefabricated sections in the dimensions. They shall be applied with one coat of red lead primer, one coat of oil primer followed by two finishing coats of aluminium paint.

2 Conduits/Pipes/Ducts Installation

- (a) The Contractor shall be fully responsible for properly embedding conduit pipe sleeves wherever necessary for cabling work. All openings in the floor/roof/wall / cable tunnel/cable trenches made for conduit installation shall be sealed and made water proof by the Contractor.
- (b) GI pull wire of adequate size shall be laid in all conduits before installation. Metallic conduit runs at termination shall have two lock nuts wherever required for junction boxes etc.
- (c) Conduit runs/sleeves shall be provided with PVC bushings having round edge at each end. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed with Glass wool/Cement Mortar/Putty to prevent entrance of moisture and foreign material.
- (d) Cable routing between lined cable trench and equipment/motors shall be taken through GI pipe sleeves of adequate size. Pipe sleeves shall be laid at an angle of maximum 150 to the trench wall. In case of larger dia cables i.e. 50mm and above, adequately sized pipe with larger bend radius shall be provided for ease of drawing of cable or for replacement. In places where it is not possible, a smaller trench may be provided if approved by Site Engineer.
- (e) Exposed conduit/pipe shall be adequately supported by racks, clamps, straps or by other approved means. Conduits /pipe support shall be installed square and true to line and grade with an average spacing between the supports as given below, unless specified otherwise



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Conduit /pipe size (dia).	Spacing
Up to 40 mm	1 M
50 mm	2.0 M
65-85 mm	2.5 M
100 mm	3.0 M

- (f) In areas like WTP, chemical handling, battery room etc. exterior surface of the conduits shall be further coated with chromate or polymer for better resistance to corrosion.
- (g) All G.I. pipes shall be laid as per approved layout drawings and site requirements.
- 1 Before fabrication of various profiles of pipe by hydraulically operated bending machine (which is to be arranged by the contractor), all the burrs from the pipes shall be removed. The bends formed shall be smooth. GI Pipes with bends shall be buried
 - 2 in oil/concrete in such way that that the bends shall be totally concealed. For GI pipes shall be undertaken well before paving is completed and necessary co- ordination with paving agency shall be the responsibility of Electrical Contractor. The open ends of pipes shall be suitably plugged with G.I. plugs after they are laid in final position. G.I. plugs shall be supplied by the contractor at no extra cost.

3 **Junction Boxes Installation**

Junction boxes shall be mounted at a height of 1200mm above floor level or as specified in the approved drawings or as decided by Owner and shall be adequately supported/mounted on masonry wall by means of anchor fasteners/ expandable bolts or shall be mounted on an angle, plate or other structural supports fixed to floor, wall, ceiling or equipment foundations.

4 **Cable Laying and Installation**

- 1) Cable network shall include power, control, lighting, communication and fire alarm system cables, which shall be laid in trenches, cables trays/conduits as detailed in the approved drawings and cable schedules. Erection of cable trays and aligning and leveling as required shall be the responsibility of the contractor.
- 2) Cable installation shall be carried out as per IS: 1255 and other applicable standards.



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- 3) Cable drums shall be unloaded, handled and stored in an approved manner on hard and well drained surface so that they may not sink. In no case shall be drum be stored flat i.e. with flange horizontal. Rolling of drums shall be avoided as far as possible. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum. In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cables. For unreeling the cable, the drum shall be mounted on suitable jacks or on cable wheels and shall be rolled slowly so that cable comes out over the drum and not from below. All possible care shall be taken during unreeling and laying to avoid damage due to twist, kink or sharp bends. Cable ends shall be provided with sealed plastic caps to prevent damage and ingress of moisture.
- 4) Laying of cables directly buried in ground is not acceptable.
- 5) For coal handling plant the cables shall not be routed along conveyor galleries. The cables shall be routed on independent cable trestles. All tray levels shall be checked after erection and marked in as built drawings. Cable routing given on the layout drawings shall be checked in the field to avoid interference with structures, heat sources, drains, piping, air-conditioning duct etc. and minor adjustments shall be done to suit the field conditions wherever deemed necessary. All tray runs shall be installed parallel to the trench/building walls and floors except otherwise noted in the approved drawings. The contractor shall have to secure rack/tray supports by welding to those inserts or other available building steel surfaces. Outdoor trays shall be installed by welding on the steel/concrete structure with inserts by the contractor. As far as practicable, cable trays shall be supported from one side only in order to facilitate installation and maintenance of cables from the other side.
- 6) While laying cable, ground rollers shall be used at every 2 metre interval to avoid cable touching ground. The cables shall be pushed over the rollers by a gang of people positioned in between the rollers. Cables shall not be pulled from the end without having intermediate pushing arrangements. Pulling tension shall not exceed the values recommended by cable manufacturer. Selection of cable drums for each run shall be so planned so as to avoid using straight through joints. Care should be taken while laying the cables so as to avoid damage to cables.
- 7) All temporary ends of cables must be protected against dirt and moisture to prevent damage to the insulation. For this purpose, ends of all cables shall be tapped with an approved PVC or rubber insulating tape. Use of friction type or other fabric type tape is not permitted.



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- 8) Cables installed above grade shall be run in trays, exposed on walls, ceilings or structures and shall be run parallel or at right angles to beams, walls columns. Cables shall be so routed that they will not be subjected to heat from adjacent hot piping or vessels.

5 Laying of cables in cable trays

- 1) Cables shall be laid on cable trays strictly in line with cable schedule furnished. Where specific cable layouts are not shown on approved drawings, contractor shall route these as directed by the Owner.
- 2) Power and control cables shall be laid on separate tiers. The laying of different voltage grade cables shall be on different tiers according to the voltage grade of the cables. In horizontal tray stacks, H.V. cables shall be laid on topmost tier and cables of subsequent lower voltage grades on lower tiers of trays. Single core cable in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil center lines and clamped at every two metre. All multicore cables shall be laid in touching formation. LT power cables above 95 sq.mm size shall be laid in single layer touching formation in trays while cables upto & including 95 sq.mm shall be laid in maximum of 2 layers. Control and Instrumentation cables can be laid upto a maximum of three layers in each tray.
- 3) All communication cables (telephone, P.A. System) RTD Cables shall run on instrument trays/ducts/trenches. Wherever these are not available, cables shall be taken in a separate trench/trays with a minimum clearance of 600mm away from electrical trench/trays as per the direction of Site Engineer and Communication cables shall cross power cables at right angles
- 4) Power and control cables shall be secured fixed to trays/support with self locking type nylon cable straps with de-interlocking facilities. For horizontal trays arrangements, multicore power cables and control cables shall be secured at every five meter interval. For vertical tray arrangement, individual multicore power cables and control cables shall be secured at every one meter by nylon cable strap. After completion of cable laying work in the particular vertical tray, all the control cables shall be binded to trays/supports by aluminium strips at every five meter interval and at every bend.

Bending radii for cables shall be as per manufacturer's recommendations and IS1255.

- 5) Individual cables or small groups which run along structures/walls etc will



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be clamped by means of 16 SWG GI saddles on 25x6mm saddle bars. The cost of saddle and saddle bars shall be deemed to have been included in the installation of cables. Alternatively small group of cables can be taken through 100mm slotted channel/ISMC 100. They shall be rightly supported on structural steel and masonry, individual or in groups as required, if drilling of steel must be drilled where the minimum weakening of the structure will result.

- 6) Cables shall be supported so as to prevent unsightly sagging. In general distance between supports shall be approximately 300mm for cables upto 25mm diameter and maximum 500mm for cables larger than 25mm dia and cables laid in vertical run of cable trays shall be clamped at an interval of 900mm.
- 7) Where cables cross roads/rail tracks, the cables shall be laid in Hume pipe/PVC pipe.
- 8) At road crossing and other places where cables enter pipe sleeves adequate bed of sand shall be given so that the cables do not slack and get damaged by pipe ends.
- 9) Power and Control Cables, as far as possible, shall be laid in complete, uncut lengths from one termination to the other. Straight through joints in power cable shall be allowed only in nearest of rare situation only after approval of owner.
- 10) Joints for less than 250 Meters run of cable shall not be permitted.
- 11) In each cable run some extra length shall be kept at suitable point to enable one LV/two HV straight through joints to be made, should the cable develop fault at a later stage. Control cable termination inside equipment enclosure shall have sufficient lengths so that shifting of termination in terminal blocks can be done without requiring any splicing.
- 12) Wherever few cables are branching out from main trunk route troughs shall be used.
- 13) Cables shall be neatly arranged in the trenches/trays in such a manner so that criss-crossing is avoided and final take off to the motor/switchgear is facilitated. Arrangement of cables within the trenches/trays shall be the responsibility of the contractor.
- 14) The contractor shall ascertain the exact requirement of cable for a particular feeder by measuring at site and avoiding interference with structure, foundation, pipelines or any other works. Before the start of



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cable laying, cable drum schedule shall be prepared by electrical contractor and get that approved by site engineer to minimize/avoid straight through joints. The actual number of straight through joints required shall be worked out by the contractor. During the erection period the contractor shall furnish a monthly report on cable position in an approved proforma so as to keep the owner apprised of the position.

- 15) The installation work shall be carried out in a neat workman like manner & areas of work shall be cleaned of all scraps, water, etc. after the completion of work in each area every day. Contractor shall replace RCC/Steel trench covers after the Installation work in that particular area is completed or when further work is not likely to be taken up for some time.
- 16) Minimum number of spare cores required to be left for interconnection in control cables shall be as cl.3.07.00, chapter 16.
Electrical cable trays exposed to hazardous process fluid shall be covered with detachable G.I. covers. The covers shall be suitable to resist wind forces.
- 17) For cables laid above ground in cable racks, asbestos sheeting of 3mm thickness shall be provided below the bottom cable tray to protect the cables from fire.
- 18) Supporting steel shall be painted before laying of cables. The painting shall be done with one coat of red lead paint and two coats of approved bituminous aluminium paint unless otherwise specified.
 - a) Separation
 - b) Sufficient spacing not less than 300 mm shall be provided between different tiers of trays and the same shall be maintained to permit adequate access for installation and maintenance of cables.
 - c) At least 300mm clearance shall be provided between HV power & LV power cables, LV power & LV control/instrumentation cables,
 - d) Segregation
 - e) Segregation means physical isolation to prevent fire jumping.
 - f) Cables from two different services viz. supply from Station Board and Unit Board shall be segregated.
 - g) Interplant cables of station auxiliaries and unit critical drives shall be



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segregated in such a way that not more than half of the drives are lost in case of single incident of fire. Power and control cables for AC drives and corresponding emergency AC or DC drives shall be laid in segregated routes. Cable routes for one set of auxiliaries of same unit shall be segregated from the other set.

- h) For Coal Handling Plant all the cables of one stream shall be segregated from the cables of the other stream and shall run on either side of the trestle.

6 Cable fire sealing

- i) Cable/cable tray openings in walls and floors or through pipe sleeves from one area to another or from one elevation to another within the unit shall be sealed by a fire proof sealing system (FPSS). The FPSS shall effectively prevent the spread of fire from the flaming to non-flaming side of a fire.
- ii) Wherever the cables/cable trays pass through walls/floors, fire proof cable penetration seals rated for one hour shall be provided. This shall be by suitable block system using individual blocks with suitable framework or by silicon RTV foaming system. In case foaming system is offered, damming board, if used, shall not be considered for fire rating criteria. Any of the system offered shall be of proven type as per BS: 476 (Part-20) or equivalent standard.
- iii) In order to prevent fire propagation through cable penetrations, after laying, dressing & clamping of cables, all the openings shall be properly sealed by using Fire Stop Mortar Seal and Fire Retardant Cable coating compound. Also the cable runs both before and after the fire scale shall be suitably sprayed with anti-fire propagation liquid.

7 Cable laying in trenches between switchyard and Transformer yard

- 1 RCC cable trenches with removable covers will be provided by the contractor. Cables shall be laid in 3 or 4 tiers in these trenches. Concrete cable trenches shall be filled with sand where specified to avoid accumulation of hazardous gases. RCC covers of trenches in process area shall be effectively sealed to avoid ingress of chemicals etc. Removal of concrete covers for purposes of cable laying and reinstating them in their proper positions after the cables are laid shall be done by the contractor at no extra cost.

For cable trays are laid in trench in more than two tiers a space of minimum 600 mm shall be available for maintenance. In case two or



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more tiers of cable trays are running parallel along both sides of trench walls there shall be space of minimum 600 mm between them.

Cables shall be handled carefully during installation to prevent mechanical injury to the cables. Ends of cable leaving trenches shall be coiled and provided with a protective pipe or cover till such times the final termination to the equipment is completed.

- 2 Prior to laying of cables inside trenches, the contractor shall properly clean inside of those trenches.
- 3 When cables are laid in multiple tiers, spacing between individual tiers shall be as approved by Site Engineer. Space between individual tiers shall be filled and compacted with soil and sand.
- 4 As each row of cables is laid in place and before covering with sand every cable shall be given on insulation test in the presence of Site Engineer. Any cable, which proves defective, shall be replaced before the next groups of cables are laid.
- 5 All wall openings/pipe sleeves shall be effectively sealed after installation of cables to avoid seepage of water inside building/lined trench.
- 6 Where cables rise from trenches to motor, control station, lighting panels etc., they shall be taken in G.I. Pipes for mechanical protection up to a minimum of 150mm above grade.
- 7 Cable ends shall be carefully pulled through the conduit, to prevent damage to these cables. Where required, approved cable lubricant shall be used for this purpose. Where cable enters conduit the cable should be bent in large radius. Radius shall not be less than the recommended bending radius of the cables specified by the manufacturer.
Following guide of the pipe fill shall be used for sizing the pipe size:

1. 1 Cable in pipe - 53% full
2. 2 cables in pipe - 51% full
3. 3 or more cables - 43% full
4. Multiple cables - 40% full.

After the cables are installed and all testing is complete, conduit ends above grade shall be plugged with a suitable weatherproof plastic compound/'PUTTI' for sealing purpose. Alternatively, G.I. Lids or PVC bushes shall be employed for sealing purposes. The cost for the same shall be deemed to have been included in the installation of G.I. pipe and



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no separate payment shall be allowed.

- 8 Where cables pass through foundation walls or other underground structures, the necessary ducts or openings will be provided in advance for the same. However, should it become necessary to cut holes in existing foundations or structures, the electrical contractor shall determine their location and obtain approval of the Site Engineer before cutting is done.

2.2.17.7 CABLE IDENTIFICATION

1. Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry & exit, and at every 20 meters in cable tray/trench runs. Cable tags shall also be provided inside the switchgear, motor control centers, control and relay panels etc. where a number of cables enter together through a gland plate. Cable tag shall be of rectangular shape for power cables and control cables. Cable tag shall be of 2 mm thick aluminum with number punched on it and securely attached to the cable by not less than two turns of 20 SWG GI wire conforming to IS:280. Alternatively, the Contractor may also provide cable tags made of nylon, cable marking ties of 'TY-CAB' or equivalent type with cable number heat stamped on the cable tags.
2. If laying of underground cable is specifically agreed by Owner as a special case then the underground cables shall be provided with identity tags of Stain less steel securely fastened every 30 M of its underground length with at least one tag at each end before the cable enters the ground. In unpaved areas cable trenches shall be identified by means of markers. These posts shall be placed at location of changes in the direction of cables and at intervals of not more than 30 M for straight run and at cable joint locations with additional inscription 'Cable Joint'. For buried cables the marker shall project 150mm above ground.
3. Drum number of each cable from which it is taken shall be recorded against the cable number in the cable schedule.

2.2.17.8 CABLE TERMINATIONS & CONNECTIONS

1. The termination and connection of cables shall be done strictly in accordance with cable termination kit manufacturer's instructions, drawings and/or as directed by Site Engineer. Cable jointer shall be qualified to carryout satisfactory cable jointing/termination. Contractor shall furnish for review documentary evidence/experience reports of the jointers to be deployed at site.



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2. Work shall include all clamps, fittings etc. and clamping, fitting, fixing, plumbing, soldering, drilling, cutting, taping, preparation of cable end, crimping of lug, insulated sleeving over control cable lugs, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job to the satisfaction of the Engineer in charge of TANGEDCO.
3. Responsibility of proper termination shall lie on the contractor. Guarantee for termination shall also have to be given by the contractor.
4. The equipment will be generally provided with undrilled gland plates for cables/conduit entry. The Contractor shall be responsible for punching of gland plates, painting and touching up. Holes shall not be made by gas cutting. The holes shall be true in shape. All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively sealed by 2mm thick aluminium sheets.
5. Contractor shall drill holes for fixing glands wherever necessary at no extra cost. Gland plate shall be of non-magnetic material/aluminium sheet in case of single core cables. If the cable end box or terminal chamber provided on the equipment is found unsuitable and requires major modifications the same shall be carried out by the contractor at the discretion of the Engineer- in-Charge.
6. Control cable cores entering control panel/switchgear/MCC/ miscellaneous panels shall be neatly bunched, clamped and tied with self locking type nylon cable ties with de interlocking facility to keep them in position.
7. The panels where a larger number of cables are to be terminated and cable identification may be difficult, each core ferrule shall include the complete cable number. The ferrules shall be indelible interlocking type and shall fit tightly on cores. Spare cores shall have similarly ferrules with a suffix letter 'S' alongwith cable numbers and coiled up after end sealing.
8. All cable terminations shall be appropriately tightened to ensure secure and reliable connections.
9. It is the responsibility of the Contractor to terminate the cables at motor terminals in correct phase sequence to ensure the proper direction of rotation.
10. All cables upto 1.1KV grade shall be terminated at the equipments by means of compression type cable glands. They shall have a screwed



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nipple with conduit electrical threads and check nut.

11. All cable entries shall be through bottom only and top entry terminations are made only after getting approval of Site Engineer.
12. Power cables, wherever colour coding is not available, shall be identified with red, yellow and blue PVC tapes. Where copper to aluminium connections is made, necessary bimetallic washers shall be used. For trip circuit identification additional red ferrules shall be used only in the particular cores of control cables at the termination points in the Switchgear/Control panels and Control Switches.
13. In case of control cables all cores shall be identified at both ends by their terminal numbers by means of PVC ferrules. Wire numbers shall be as per schematic/ wiring/ inter-connection diagram. Contractors shall have the samples of PVC markers approved before starting the work. All unused spare cores of control cables shall be neatly bunched and ferruled with cable tag at both ends. Control cables shall be neatly bunched and served with PVC perforated tape to keep it in position at the terminal block.
14. Where threaded cable gland is screwed into threaded opening of different size, suitable brass threaded reducing bushing shall be used provided.
15. The cable shall be taken through glands inside the panels or any other electrical equipment such as motors. The individual cores shall then be dressed and taken along the cable ways (if provided) or shall be fixed to the panels with polyethylene straps. Only control cables of single strand and lighting cables may be directly terminated on to the terminals. In case of termination of cables at the bottom of a panel over a cable trench having no access from the bottom, close fit hole should be drilled in the bottom plate for all the cables in one line, and then bottom plate should be split in two parts along the centre line of holes. After installation of bottom plate and cables it should be sealed with cold setting compound. Cables shall be clamped over the open armouring to connect it to earth bus.
16. Cable leads shall be terminated at the equipment terminals by means of crimped type solder less connectors. Crimping shall be done by hand crimping/hydraulically-operated tool and conducting jelly shall be applied on the conductor. Insulation of the leads should be removed immediately before the crimping. Conductor surface shall be cleaned and shall not be left open the terminals.



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17. All cable entry points shall be properly sealed and made dust and vermin proof.
Unusual opening, if any, shall be effectively closed. Sealing work shall be carried out with approved sealing compound having fire withstand capability for at least three hours.

18. **Cable accessories for H.V. Systems**

1. The H.V. cables terminations/joints shall be done by skilled, certified and experienced jointers duly approved by the Site Engineer.
2. The termination and straight through joint kits for use on high voltage system shall be suitable for the type of cables offered by the contractor or the type of cables issued by owner for installation. The materials required for termination and straight through joints shall be supplied in kit form. The kit shall include all insulating and sealing materials apart from conductor fittings and consumable items. An installation instruction shall be included in each kit.
3. The termination kits shall be suitable for termination of the cables to an indoor switchgear or to a weatherproof cable box of an outdoor mounted transformer/motor. The termination kits shall preferably be as of the following types.
 - a. 'PUSH ON' type for LV cables.
 - B Heat-shrinkable sleeve type for LV & HV cables.However, termination kits for HV cables shall be of Heat Shrinkable type of makes with specific approval of owner.
For outdoor installations, weather shields/sealing ends and any other accessories required shall also form part of the kit.
4. The straight through jointing kits shall be suitable for underground buried installation with uncontrolled backfill and possibility of flooding by water. The jointing kit shall be one of the following types.
 - a. 'TAPEX' of M-seal make or equivalent for LV cables
 - b. Heat-shrinkable sleeve type for LV & HV cables.However, termination kits for HV cables shall be of Heat Shrinkable type of makes with specific approval of owner. For outdoor installations, weather shields/sealing ends and any other accessories required shall also form part of the kit.

2.2.17.9 QUALITY ASSURANCE PROGRAMME

Contractor shall furnish detailed Quality Assurance Programme and Quality Plans for all materials and accessories to be supplied and installed under the



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scope of the specification as per General Technical Conditions of technical specification. The Quality Plans shall include all tests/ checks as per relevant National/International Standards and the requirements of this specification including tests listed in this section.

2.2.17.10 LIST OF TESTS TO BE CONDUCTED

1 Type tests on Cable Trays support system

a) Test 1A

On main support channel type-C2 for cantilever arms fixed on one side only.

A 3.5 metre length of main support channel shall be fixed vertically at each end to a rigid structure as per appropriate fixing arrangement. Eight (8) nos. 750 mm cantilever arms shall be fixed to the main channel and each arm shall be loaded over the outboard 600 mm with a uniform working load of 100 kg. Subsequently a point load of 100 kg shall be applied on arm 2. A uniform proof load on all the arms equal to twice the working load shall be then be applied. Deflections shall be measured at the following load intervals and other necessary points:

- a) Working load
- b) Working load + point load
- c) Off load
- d) Proof load + point load
- e) Off load

The deflection measured at working loads shall not exceed 16 mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied.

b) Test 1B: Test 1A shall be repeated with Eight Cantilever arms uniformly loaded and with the same point load on arm 2

On Main support channel type -C2 for cantilever arms fixed on both sides

- a) Test 2A:** A 3.5 m length of main support channel C2 for cantilever arms fixing on both sides shall be fixed at each end to rigid structure as per appropriate fixing arrangement. Six (6), 750 mm cantilever arms shall be attached to each sides and each arm uniformly loaded to a working load of 100 kg over the out board 600 mm. A point load of 100 kg shall than be applied to arm 2, followed by a uniform proof load



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of twice the working load on all the arms; deflection shall be measured at the following load intervals and other necessary points.

- i) Working load
- ii) Working load + Point load
- iii) Off load
- iv) Proof load + Point load
- v) Off load

The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied

- b) Test 2B:** The test 2 A shall be repeated with the assembly but with an asymmetrical load on the C2 column and point load applied to arm 8. The 100 kg and 200 kg uniformly distributed loads shall be applied to the upper three arms on one side and the lower three arms on the opposite side.

- c) Test 3:** Tests on Channel Fixed on Beam/Floor
A length of main support channel section shall be fixed to steel structure/floor and have loads applied as detailed below and other important points not mentioned herein.

- c) Test 3A** A length of steel structure shall be rigidly supported it should be fitted on a metre length of channel section using beam clamps welded/bolted. A point load of 1200 kg shall be applied to the centre point via two brackets. No distortion or pulling of the components shall take place.

- d) Test 3B** With the components assembled as in Test 3A, two perpendicular point loads of 600 kg shall be simultaneously applied at positions 150 mm either side of the centre line, no distortion or pulling of the components shall take place.

- e) Test 3C** With the components assembled as in Test 3A, a perpendicular point load shall be applied at a point 150 mm on one side of the centre line. The load shall be gradually increased to the maximum value that can be applied without causing distortion or pulling of the components. This value shall be recorded.



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- d) Test 4 Channel nut slip characteristics (what ever applicable)

Tests 4A1, 4A2, 4A3:

A length of channel C1 section 200 mm long shall have fitted bracket with the two bolts fixing. With loads applied at the appropriate position nut slip shall be determined with bolt torque of 30 NM, 50 NM and 65 NM. No fewer than three measurements shall be made for each torque setting. A minimum loading of 720 kg shall be obtained before nut slip with bolt torque of 65 NM.

Tests 4B1, 4B2, 4B3:

The length of channel C1 section 200 mm long shall have fitted bracket with the one bolt fixing. With loads applied at the appropriate position, nut slip shall be determined with bolt torques of 30 NM, 50 NM and 65 NM. No fewer than three measurements shall be made for each torque setting. A minimum loading of 350 kg shall be obtained before nut slip with a bolt torque of 6 NM.

Test 5 Weld Integrity Test

After deflection test as per test 1A, 1B, 2, 3 & 4 weld integrity shall be checked by magnetic particle inspection to detect sub-surface cracks developed, if any. Cable termination kit and straight through joints should have been tested as per IS: 13573 for 6.6kV and 11kV class. Fire proof Cable Penetration system should have been tested for the following tests:

- a) Accelerated Ageing test
- b) Water absorption test
- c) Fire rating test
- d) Hose Stream test
- e) Vibration test followed by fire rating test

2 Routine/ Acceptance Tests

Following routine/acceptance tests shall be carried out on all the equipments, devices & materials supplied:

a) Galvanizing Tests

The quality of galvanizing shall be inspected visually and shall be smooth, continuous, and free from flux stains.

- i) Uniformity of coating – The coating of any article shall withstand four 1 minute dips in standard copper sulphate solution without the formation of an adherent red spot of metallic copper upon the basic metal.



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- ii) The quality of cadmium/zinc plating on items with screw threads shall be inspected visually and shall be free from visible defects such as unplated areas, blisters and modules.
- iii) In addition, the plating thickness shall be determined microscopically/chemically or electronically.

3 Welding

The quality of welding shall be visually inspected, particular attention being paid to the following points.

- 1) The welded joints shall be continuous along its length on both sides and of uniform width and thickness. It should be free from blow holes.
- 2) The weld metal shall be properly fused with the parent metal without undercutting.
- 3) The outside surface of the weld shall be clean. All slag shall have been removed. All welding shall be regularly checked for cracking using magnetic particle inspection or their equivalent technique.
 - 1. Physical and dimensional checks for all items.
 - 2. All conduits/pipes, etc. shall be routine/acceptance tested as per relevant standards.
 - 3. All acceptance and routine tests on cable glands as for BS: 6121. Additionally Proof torque test shall be carried out as acceptance on each body group of cable glands.
 - 4. Deflection test cable trays.
 - 5. All acceptance and routine tests on Junction boxes.
 - 6. Following tests shall also be carried out on each type of equipments, devices and materials/items supplied:
 - 1) Physical and Dimensional checks
 - 2) Check/measurement of thickness for Nickel chrome plating for cable glands and tinning for cable lugs.
 - 3) Check chemical composition of brass parts for cable glands.
 - 4) Hardness check on gaskets.
 - 5) Test for uniformity of galvanization.

4 Cable trays / supports and accessories

- 1) Check for proper galvanizing/painting and identification number of the cable trays/supports and accessories.
- 2) Check for continuity of cable trays over the entire route.
- 3) Check that all sharp corners, burrs, and waste materials have been removed from the trays supports.
- 4) Check for earth continuity

Earthing and Lightning Protection System



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2.2.18 EARTHING AND LIGHTNING PROTECTION SYSTEM

2.2.18.1 Earthing System

2.2.18.2 Scope

- ii. The Contractor shall provide all required material and carry out main earth grid, treated earth pits, raisers and inter connections, equipment earthing, interconnection to the existing, BOP area earth mats etc. for the following areas and all areas/buildings/structures including but not limited to:
 - a) Main Plant Building (TG Building)
 - b) Boiler Area, ESP area, Circulating water system, DG room & other electrical systems.
 - c) Service building
 - d) Air washer room
 - e) Transformer yard
 - f) All other miscellaneous building not mentioned herein but in BTG supplier scope.
- iii. Earthing system shall consist of earth grids and electrodes buried in soil in the plant area, embedded in concrete inside the buildings to which all the electrical equipment, metallic structures are connected to have earth continuity for safety reasons. The earthing system shall conform to IS 3043 and Indian Electricity Act/rules.
- iv. The Contractor shall furnish the detailed design, layout and calculations for Owner's approval. Contractor shall obtain all necessary statutory approvals for the system.

2.2.18.3 Codes and Standards

- i. All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards / codes as applicable.
- ii. Equipment complying with other internationally accepted standards such as IEC, BS, DIN, USA, VDE etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed below. In such a case, the Contractor shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards along with copies of all official amendments and revisions in force as on date of opening of bid and shall clearly bring out the salient features for comparison.



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1. IS:513 - Cold rolled low carbon steel sheets and strips
2. IS:802 - Code of practice for the use of Structural Steel in Overhead Transmission Line Towers
3. IS:1079 - Hot Rolled carbon steel sheet & strips
4. IS:1239 - Mild steel tubes, tubular and other wrought steel fittings
5. IS:1367 Part-13 - Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners)
6. IS:2309 - Code of Practice for the protection of building and allied structures against lightning
7. IS:2629 - Recommended practice for hot dip galvanising of iron & steel
8. IS:2633 - Method for testing uniformity of coating on zinc coated articles
9. IS:3043 - Code of practice for Earthing
10. IS:6745 - Methods for determination of mass of zinc coating on zinc coated iron & steel articles
11. IS:9595 - Metal – arc welding of carbon and carbon manganese steels – recommendations
12. IEEE:80 - IEEE guide for safety in AC substation grounding
13. IEEE:142 - Grounding of Industrial & commercial power systems
14. Indian Electricity Act.
15. Indian Electricity Rules.

2.2.18.4 Design Criteria

1. Fault Current & Duration



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Earthing system network/earth mat shall be interconnected mesh of mild steel rods buried in ground in the plant. For earth mat design, the size of earthing conductor shall be calculated considering maximum fault current 50 kA for duration of 1 second and corrosion factor. The maximum permissible step and touch potentials shall be calculated in accordance with the formula, given in IEEE-80.

2. Conductor Material

- i. The earthing system conductors and accessories as proposed are to be as:
 - (a) Conductors above ground level and in trenches : Galvanized steel
 - (b) Conductors buried in ground or embedded in concrete : Mild Steel
 - (c) Electrodes : GS Pipe / Rod
- ii. The contractor shall undertake the soil resistivity measurements at site and shall select suitable type of conductors.
- iii. The earth conductors shall be free from pitting, laminations, rust, scale and other electrical, mechanical defects.

3. Size of Conductors

The minimum sizes of earthing conductors for various electrical equipments shall be as below:

Sl.No	Equipment	Earth Conductor buried in earth	Earth conductor above ground level & in built up trenches
1.	Main earth Grid	40 mm dia. MS Rod	---
2.	Transformeryard	40 mm dia. MS Rod	---
3.	Switchyard	40 mm dia. MS Rod	---
4.	Power Transformer		75 x 10 mm GS Flat
5.	11kV / 6.6 kV / 415 V Switchgear / Equipment	---	75 x 10 mm GS Flat
6.	415 V MCC / Distribution Boards/ Distribuion Transformers	---	75 x 10 mm GS flat
7.	LV motors		
	Above 100 to 200 kW	---	75x10 mm GS flat
	Above 55 KW to 100 KW	---	50x6 mm GS flat



**1X800 MW COAL BASED NORTH CHENNAI THERMAL
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	Above 22 KW to 55 KW	---	50x6 mm GS flat
	Above 5.5 KW to 22 KW	---	25x6 mm GS flat
	Fractional HP LV Motors	---	8 SWG GS Wire
8.	Control panel & Control Desk	---	50x6 mm GS flat
9.	Push Button Station / Junction Boxes	---	8 SWG GI Wire
10.	Column, Structures, Cable tray, fence , gate and busduct enclosures	---	50x6 mm GS flat
11.	Crane, Rail, Rail tracks & other non-current carrying metal parts	---	50x6 mm GS flat

4. Soil Treatment to lower Resistivity

The soil resistivity study shall be carried out by the contractor. In order to reduce the resistivity of the soil the earth pits shall be treated with high purity electrically conductive material having ultra-low resistance value (typically, 0.001 ohm-m). The properties of the material shall be such that it does not require periodic re-watering or recharge of salt or earth enhancing compound during the life of the power plant. The material should be such that it does not reach chemicals into the adjacent soil or underground water channels and should be PH neutral. Earth enhancing material should permanently protect the encased metal components of the earthing systems. Earthing electrodes encased in high strength concrete mixed with the conductive material shall be preferred instead of electrode buried directly in the earth.

5. Rod Electrodes

Galvanized steel pipe/rod electrodes of suitable diameter and length shall be used as per the recommendation of IS-3043. For test pits electrodes shall be heavy duty type (Class – C) GI pipe of suitable diameter with perforations. For treated earth pits, GI pipe shall be provided as per IS 3043 including charcoal, salt etc. Necessary number of treated earth pits shall be provided for UTs, UATs in the transformer yard and other UATs in the main power house building and for all LT transformer Neutral & body earthing. Electrodes installed in the test pits will have disconnecting facilities.

6. Earthing of Electrical equipment on cranes and travelling machines



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- i. Every electrical equipment shall have double earthing. A ring earthing system shall be provided within the crane/machine to which electrical equipment shall be connected at least at two places.
- ii. The earth ring on the crane/machine shall be connected to the plant earthing system through gantry rails. Two sets of earth collector brushes shall be provided on each side of crane/machine to connect its earth ring to the gantry rails. Each end of each gantry rail shall be bonded to the plant earthing system.
- iii. In addition, intermediate earthing bond shall also be provided on the rails at every 60 m in case of longer tracks. Flexible copper bonds shall be provided across any gap in the running gantry rails. For mobile equipment with flexible cables, one separate copper conductor of adequate size shall be provided for earthing.

7. Equipment Earthing Leads

The size of the earthing leads shall be decided based on the type of equipment and structure to be earthed and shall be provided generally as per IS-3043.

2.2.18.5 Earthing System Layout

1. General

- i. Metallic frames of all current carrying equipment, supporting structures adjacent to current carrying conductors, structures in contact with switchyard earth, lightning protection system conductors and neutral points of various systems shall be connected to a single earthing system.
- ii. All the offsite areas shall be interconnected together by minimum two parallel conductors.
- iii. Crane rails, tracks, metal pipes and conduits shall be effectively earthed at two points. Steel RCC columns, metallic stairs, and rails etc. of the building housing electrical equipment shall be connected to the nearby earthing grid conductor by one earthing lead ensured by bonding the different sections of hand rails and metallic stairs.
- iv. For all other equipments, two earthing leads shall be used if rated voltage of equipment is above 250V. In case the rated voltage is 250 V or below, one earth lead can be used. Metallic structures adjacent to electrical equipment shall be earthed by one earthing lead.
- v. Earthing conductors in outdoor areas shall be installed at a minimum depth of 600 mm.



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- vi. Each continuous laid lengths of cable tray shall be earthed at minimum two places by G.S. flats to earthing system, the distance between earthing points shall not exceed 30 metre. Wherever earth mat is not available Contractor shall do the necessary connections by driving an earth electrode in the ground.
- vii. Portable tools, appliances and welding equipment shall be earthed by flexible insulated cable .
- viii. The cable sheaths, screens armour shall be earthed at both ends for multi-core cables. For single core cables the same shall be done at one end (switchgear end) only.
- ix. Electronic earthing shall be provided as per relevant international standard for all control systems (such as DDCMIS,PLC,SAS,EDMS,etc.,). For electronic equipment chemical earthing pit shall be provided. The earth pit shall be tested and type proven and shall be guaranteed for service life of 40 years. The chemical earth pit shall comprise pipe electrode,crystalline conductive mixture, bentonite, etc., constructed in a pit of not less than 4000mm depth. The pit shall be effective in all weather conditions and offer medium resistance. For electronic earthing system, earthing conductor shall be copper.
- x. Neutral of Service transformers shall be earthed through minimum of 400 sq.mm single core cable through two numbers treated earth pit and inturn shall be connected to station earth grid.
- xi. LV Neutral points of the following transformers shall be connected to Neutral Grounding Resistors(NGR). NGR shall be connected to earth through two numbers treated earth pit.
 - a) Unit transformers
 - b) Station Transformer
 - c) Unit , station and other Auxiliary transformers
- xii. Steel to copper connections shall be brazed type and shall be treated to prevent moisture ingress.
- xiii. Metallic sheaths and armour of all multi-core power cables shall be earthed at both equipment and switchgear end, Sheath and armour of single core power cables shall be earthed at switchgear end only.
- xiv. Earthing conductors along their run on cable trench, ladder, walls etc., shall be supported by suitable welding/cleating at intervals of 1000mm. Wherever it passes through walls, floors etc., pipe sleeves shall be provided for the passage of the conductor and both ends of the sleeve shall be sealed to prevent the passage of water through the sleeves.



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- xv. Railway tracks within the plant area shall be bonded across fish plates and connected to earthing grid at several locations.
- xvi. Electronic panels and equipments shall be grounded utilizing an insulated copper ground wire terminated at separate earth electrodes.

2. Earthing Conductor layout

- i. Main earthing conductors shall be laid in the form of a grid. Spacing between conductors, number of parallel conductors, etc., shall be decided such that step and touch potential are within safe limits.
- ii. The maximum permissible step and touch potentials shall be calculated in accordance with the formula, given in IEEE-80.
- iii. Earthing conductors shall be provided around the outside edge of fence at a distance of approximately 6000 mm. This shall be connected to the main earthing grid.
- iv. Grounding conductor around the building shall be buried in earth at a minimum distance of 1200 mm from the outer boundary of the building.
- i. Every alternate post of the fence shall be connected to earthing grid by one GS flat and gates by flexible lead to the earthed post.
- ii. Each of the earth leads of transformer neutral, lightning arrester shall be directly connected to two separate electrodes. Neutral points of HV transformer shall be earthed through NG resistors. The Contractor shall connect the NGR earthing point to earth electrodes by suitable earth conductors. Lightning protection down conductor shall be directly connected to a separate earth electrode.
- iii. All earth electrodes in turn shall be connected to main earthing system. The earth grids of different areas of the plant shall be interconnected through, test pits to enable measurement of earth resistance for each area separately.
- iv. Earthing grid design shall be done in such a manner that the grid resistance is less than one ohm.
- v. Earth pit shall be constructed as per IS: 3043. Electrodes shall be embedded below permanent moisture level. Minimum spacing between electrodes shall be atleast equivalent to twice the length of the electrode.



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3. Earthing Conductors inside the building

- i. Main earthing conductors shall be buried in earth around the building. Minimum two taps-off from this earthing loop shall be taken inside the building and connected to the earthing grid embedded in the floor slab with approximately 50 mm concrete cover. The requirement of electrodes around the building shall be specified.
- ii. In case the building has more than one floor, each floor shall be provided with separate earth grid. These floor earthing grids shall be interconnected.
- iii. Each RCC / Steel column of the building shall be interconnected to the floor earthing grid in the ground floor.
- iv. Instrumentation system and computer system shall be provided with a dedicated earthing system suitable for the equipment. Separate electronic earthing for the PLC equipments, SAS panels and all other equipments wherever necessary shall also be provided.
- v. Earthing grids of all the buildings, outdoor yards shall be interconnected to form a single grid for the plant.
- vi. Earthing grid design shall be done in such a manner that the grid resistance is less than one ohm.
- vii. Suitable earth risers as approved by Owner shall be provided above finished floor/ground level, if the equipment is not available at the time of laying of main earth conductor.
- viii. A minimum earth coverage of 300 mm shall be provided between the ground grid conductor and the bottom of trenches, tunnels, underground pipes, foundations, railway tracks etc. The ground grid conductor shall be re-routed in case it fouls with equipment foundations.

2.2.18.6 Earthing System Installation

- i. The spacing between two electrodes shall be at least equivalent to twice the length of the electrode.
- ii. Earthing conductors along their run on columns, walls, etc. shall be supported by suitable welding / cleating at interval of 1000mm and 750mm respectively. 8 SWG earth wire should be run along with lighting conduits and shall be earthed at both ends. The wire should be suitable clamped with conduit at equal interval at not more than 500 mm.



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- iii. The earthing conductor crossing the road / track shall be laid in hume pipe or laid at a greater depth to avoid damage.
- iv. When earth conductor passes through floors, walls, etc., suitable pipe sleeves shall be provided and the same shall be sealed after installation.
- v. The connection between earthing pads / terminal to the earth grid shall be made short and direct and shall be free from kinks & splices.
- vi. Cable trays, metal pipes / conduits, steel columns, etc., shall not be used as earth continuity conductors.
- vii. Street lighting poles, flood light poles & towers, their junction boxes shall be connected to the earthing conductor to be run along with supply cable. This earth conductor shall be in turn connected to earth grid at two extreme points.
- viii. Flexible earth conductors shall be provided at expansion joints for earthing the gates, operating handles, etc.
- ix. Equipment bolted connection after being checked and tested shall be painted with anti-corrosive paint / compound be welded. For rust protection, the welds shall be treated with zinc chromate primer and coated with zinc rich paint.
- x. Proper earth connections for cable glands, cable boxes, cable armour, screens, etc. to be provided.
- xi. All bimetallic connections shall be treated with suitable compound to prevent moisture ingress.
- xii. The contractor shall demonstrate the effectiveness of earthing system by measurement of earth resistance, step and touch potential at different locations. Earth resistance at earth terminations shall be measured in presence of Owner's representatives. All equipment required for testing shall be furnished by contractor.
- xiii. Connections between earth leads and equipment shall normally be of bolted type. Contact surfaces shall be thoroughly cleaned before connections. Equipment bolted connections after being tested and checked shall be painted with anti-corrosive paint/compound.
- xiv. Connections between equipment earthing leads and between main earthing conductors shall be of welded type. For rust protection the welds should be treated with red lead compound and afterwards thickly coated with bitumen compound. All welded connections shall be made by electric arc welding. The overlapping of earthing conductor in welded joints should be 6 times diameter. Cleats should be



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provided at both sides to increase contact area. Angles/ cleats should be welded at the point of crossing of longitudinal and transverse earthing conductors.

- xv. Resistance of the joint shall not be more than the resistance of the equivalent length of conductors.
- xvi. Back filling material to be placed over buried conductors shall be free from stones and harmful mixtures. Back filling shall be placed in layers of 150 mm. Trenches after laying earth rods should be closed with approved filling materials in layers and not with debris.

2.2.18.7 Other Requirements of Earthing System

Life expectancy	40 years
System Fault level	50kA for one second
Minimum Steel corrosion	0.3mm/year (on dia. of conductor)
Depth of burial of main earth conductor	600mm below grade level; where it crosses trenches, pipes, ducts, tunnels, rail tracks, etc., it shall be at least 300mm below them.
Conductor joints	By electric arc welding, with resistance of joint not more than that of the conductor.

2.2.18.8 Lightning Protection System

- i. The main purpose of lightning protection system are to :
 - Provide protection to structures from lightning strokes.
 - Provide a low resistance-conductive path to lightning discharge.
- ii. Lightning protection system shall be in strict accordance with IS: 2309 for the structures, equipments and buildings within the battery limits.

2.2.18.9 Conductor material

For Lightning protection, material & minimum sizes shall be as follows:

- a. Vertical air termination : 20 mm dia MS rod
- b. Horizontal air termination : 25X6 mm Galvanised steel flats
- c. Down conductor : 25X6 mm Galvanised steel flats
- d. Test link : 150x50x6 mm Galvanised steel Strip with Box
- e. Earth Electrodes : Treated earth pit with pipe electrode as per IS:3043



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The above sizes are indicative only. Actual size shall be arrived at as per design by the Bidder.

2.2.18.10 Lightning System Layout

- i. Lightning system shall comprise of air terminations, down conductors, test links, earth electrode etc.
- ii. Air termination network consisting of vertical or horizontal conductors or combination of both shall be provided for the building. Down conductors shall follow the most direct path possible between the air terminal network and the earth termination network. Each down conductor shall be provided with a test link for testing. An earth electrode shall be connected to each down conductor.
- iii. Suitable lightning protection shall be provided to protect
 - a) Main Power House building as per IS requirement
 - b) Boiler Area, ESP area, DG room, Service building & other electrical systems.
 - c) All other miscellaneous building & electrical systems not mentioned herein but in scope of main plant (BTG) supplier.
- iv. Installation of lightning conductors on the roofs of buildings shall include construction of support, laying, anchoring, fastening and cleating of horizontal conductors, grouting of vertical rods wherever necessary, laying, fastening / cleating / welding of the down comers on the walls / columns of the building and connection to the test links to be provided above ground level.

2.2.18.11 Air Terminations

- i. The vertical air terminal rods shall be installed at the roof of buildings for MCC/Switchgear rooms, ESP Control rooms etc to protect these objects from lightning strokes.
- ii. ii) The projected length of the Air termination rod shall be as required to protect the object (on which the rod is fixed) from lightning stroke.
- iii. The air terminal rod shall be properly fixed on the top of the building/structure to withstand very high wind pressure. In case the air terminal rod is embedded at the top of roof of building, the portion embedded inside the concrete shall not touch the reinforcement bars and shall be duly insulated from them.
- iv. All the vertical air terminal rods shall be electrically connected together by means of horizontal conductors of size 25 x 6 mm galvanized steel flats. Horizontal air



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termination (i.e. G.S. Flat conductor) shall be so laid that no part of the rod shall be more than nine (9) metres from the nearest roof conductor.

2.2.18.12 Shielding Masts

- v. The shielding mast for lightning protection shall be installed at the top of steel columns cap plates of the associated building.
- vi. The shielding mast shall be made of galvanized steel rod and the height of the same shall be decided considering the zones to be protected.
- vii. Each shielding mast shall be connected to grounding grid by a down conductor 50 x 6 mm minimum. Galvanised steel flat run along the building column. In addition all building columns joints shall be electrically bonded.

2.2.18.13 Down conductors

- i. Down conductors shall be as short and straight as practicable and shall follow a direct path to earth electrode.
- ii. Each down conductor shall be provided with a test link at 1000 mm above ground level for testing but it shall be in accessible to interference. No connections other than the one direct to an earth electrode shall be made below a test point.
- iii. All joints in the down conductors shall be welded type.
- iv. Down conductors shall be cleated on outer side of building wall, at 750 mm interval or welded to outside building columns at 1000 mm interval.
- v. Lightning conductor on roof shall not be directly cleated on surface of roof. Supporting blocks of PCC/insulating compound shall be used for conductor fixing at an interval of 1500 mm.
- vi. All metallic structures within a vicinity of two meters of the conductors shall be bonded to conductors of lightning protection system.
- vii. Lightning conductors shall not pass through or run inside GI Conduits.
- viii. Testing link shall be made of galvanized steel of size 25x 6mm.
- ix. Pulser system for lightning shall not be accepted.
- x. Hazardous areas handling inflammable/explosive materials and associated storage areas shall be protected by a system of aerial earths.



EPC TENDER SPECIFICATION FOR BTG PACKAGE

- xi. Lightning protection conductors/ air termination rods and circumferential band provided at the top position of chimney stack shall be lead coated in order to avoid melting by exposure to hot flue gases.
- xii. For tall buildings and structures, early streamer emission (ESE) type, air terminal system is preferred.
- xiii. Horizontal air termination flats provided on top of boilers, main plant building & other buildings shall be laid such that no part of the roof shall be more than 9 metres.
- xiv. Conductors of lightning protection system shall not be connected with conductors of earthing system above ground level.
- xv. Lightning protection shall have as few joint as possible and avoid sharp bends. Down conductors shall have as far as possible, no joint except at test point and end termination.
- xvi. Termination at the metallic equipments on roof should be made by suitable nuts, bolts, pressure washer and bitumen washers with good electrical conductivity.
- xvii. All lightning protection conductors shall be exposed to atmosphere unless specifically mentioned. The lightning protection in the transformeryard shall cover the following equipments in the protection zone.
 - a) Generator Transformer
 - b) Station Transformer
 - c) Unit Transformers
 - d) Auxiliary Transformers
- xviii. All areas of the power station shall be provided with lightning protection. The lightning protection system for buildings shall consist of Air termination network, Down conductors, Test link and earth electrodes.
- xix. Air termination network consisting of vertical or horizontal conductors or combination of both shall be provided for the building. Down conductors shall follow the most direct path possible between the air terminal network and the earth termination network. Each down conductor shall be provided with a test link for testing. An earth electrode shall be connected to each down conductor.
- xx. For lightning protection, material thickness of galvanizing shall be at least 610 gm / sq.mm for all galvanised steel conductor.



EPC TENDER SPECIFICATION FOR BTG PACKAGE

- xxi. The lightning protection system shall not come in direct contact with other equipment / systems such as cables, conduits, electrical equipment, under ground metallic ducts etc., All metallic structures within vicinity shall be bonded to the lightning protection system.
- xxii. All welded / brazed joints shall be coated with anti-corrosive paints for rust protection.
- xxiii. Lightning conductor when used above ground level and shall be connected through test link with earth electrode / earthing system. Down conductors shall be as short and straight as practical and shall follow a direct path to earth. Down conductor shall not be connected to other earthing conductors above ground level.
- xxiv. Each down conductor shall be provided with test link at 1500 mm above ground level for testing. But it shall be in accessible to interference. No connections other than the one direct to an earth electrode shall be made below a test point. All joints in the down conductors shall be welded type.
- xxv. Down conductors shall be cleated on outer side of the building wall / welded to outside building columns at 750 mm interval.
- xxvi. Lightning conductor on the roof shall be cleated on surface of roof using insulated clamps / saddles for conductor fixing at an interval of 1000 mm for horizontal run and 750 mm for vertical run.
- xxvii. Conductor of the lightning protection system shall not be connected with the conductors of the safety earthing system above ground level.
- xxviii. Installation of lightning conductors on the roofs of the buildings shall include construction of supports, laying, anchoring, fastening and cleating of horizontal conductors, grounding of vertical rods wherever necessary, laying, fastening / cleating / welding of the down comers on the walls / columns of the buildings and the connections to the test links to be provided above ground level.

2.2.18.14 Electrodes (for Lightning Protection)

- i. The electrodes shall be 40 mm diameter 3000 mm long mild steel rod. These shall be driven into the ground.
- ii. All the electrodes shall be interconnected by means of one (1) 40 mm dia mild steel rod which shall be laid under ground at a minimum depth of 1000 mm below finished grade level unless stated otherwise. This ground mats/electrode in turn shall be connected to main grounding grid.



EPC TENDER SPECIFICATION FOR BTG PACKAGE

2.2.18.15 Riser (for Lightning Protection)

All risers connected to grounding mat shall be 40 mm mild steel rods and shall be projected 300 mm above grade level unless stated otherwise.

2.2.18.16 Jointing & Connection

- i. All ground conductor connections below ground level shall be done by electric arc welding with low hydrogen content electrode.
- ii. The projected portion of riser above ground shall be coated with two (2) coats of bitumen paints (anti-corrosive paints) with a minimum thickness of 1 mm after connection.
- iii. The joints in the lightning conductors shall be kept to a minimum and there shall be no joint in the underground portions of conductors.
- iv. All the joints shall be done by arc welding process overlapping of the conductors at straight joints shall not be less than 150 mm. The contact surfaces shall be cleaned properly before jointing.
- v. The portion of galvanized steel flats, which undergoes welding at site, shall be coated with two (2) coats of cold galvanizing anti-corrosive paint after welding.
- vi. The bolted joint of the test link shall be covered with thick coating of bitumen paint after successful testing.
- vii. The air terminal rods and shielding mast shall be coated with weather resistant anti-corrosive paint (zinc chromate followed by two coats of aluminium paint).
- viii. The steel to copper connection shall be brazed type.
- ix. The lightning protection of inflammable liquid storage tanks wherever required, shall be provided with horizontal conductors strung between tall poles covering the entire zones or with air terminal rods mounted on top of poles/structure. These horizontal conductors/vertical air terminal rods shall be connected to rod electrodes, which in turn shall be connected to station ground mat.

2.2.18.17 Quality Assurance Program

Contractor shall furnish detailed Quality Assurance Programme and Quality Plans for all



EPC TENDER SPECIFICATION FOR BTG PACKAGE

materials and accessories to be supplied and installed under the scope of the specification. The Quality Plans shall include all tests/ checks as per relevant National/International Standards and the requirements of this specification including tests listed in this section.

2.2.18.18 Inspection and Testing

1. Earth Continuity Checks.
2. Earth resistance of the complete system as well as sub system
3. The earthing and lightning conductors should be type tested as per IS 2669. Following minimum tests shall be conducted.
 - a) Freedom from defects
 - b) Uniformity in thickness
 - c) Mass pf coating
 - d) Adhesion tests
 - e) Any other applicable tests not mentioned in the specification but required.

2.2.18.19 Drawing and Documents

The following drawings and documents shall be submitted for approval during detail engineering stage.

1. Soil resistivity report
2. Design basis report for earthing and lightning protection system
3. Earthing design calculation
4. Typical installation drawings for earthing and lightning protection system
5. Electronic earthing layout and details
6. Earthing layout for Transformer yard
7. Earthing layout for power house building, boiler and ESP.
8. Earthing layout for all auxiliary plant buildings
9. Earthing layout for all non-plant buildings
10. Lightning Protection design calculation and layout



1X800 TANGEDCO NORTH CHENNAI TPP

SPECIFICATION No: PE-TS-423-554-A001

**VENTILATION SYSTEM TECHNICAL
SPECIFICATION
(C&I PORTION)**

SECTION : I

SUB-SECTION : C-4

REV. 01

DATE: NOV 2017

SECTION: I

**SUB-SECTION: C-4
TECHNICAL SPECIFICATION (C&I PORTION)**

**1X800MW COAL BASED SUPERCRITICAL NORTH CHENNAI
TPP
STAGE III IN THE PREMISES OF EXISTING NCTPS
TAMILNADU**

**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
AANCHAL CHOUDHARY	SEEMA KHATRI	SC SHARMA
SR. ENGR. (C&I)	DY. MGR. (C&I)	SR. MGR. (SH-I02,C&I)

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SPECIFIC TECHNICAL REQUIREMENT

Specific Technical Requirements

- 1.0 The control system of Ventilation system shall comprise of DDCMIS based control system (common for both AC & ventilation system). DDCMIS shall be in BHEL's scope with remote I/O panel, hook-up with serial link to main plant DDCMIS for monitoring.
- 1.1 The vendor 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 BHEL shall prevail without any commercial implication
- 1.2 The Air washer units shall be started/stopped by initiation from the local panel and the starting/stopping of fans and pumps shall be automatic upon such initiation.
- 1.3 The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements as per interpretation of BHEL among them are to be complied with.
- 1.4 All instruments shall be terminated on JB/LCP in field and both instrument and JB/LCP are in vendor's scope. Number of junction boxes shall be sufficient and positioned in the field to minimize local cabling (10-12 mtrs) and trunk cables. However, minimum number of Jbs shall be provided by the vendor as indicated in the BOQ of JB attached in the specification.
- 1.5 Local control panels for ventilation system, wherever applicable, shall be provided by the vendor.
- 1.6 Drawings/Documents and data to be furnished after award of the contract as per deliverables list.

- 1.7 All local gauges as well as transmitters, sensors and switches for parameters like pressure, temperature, level, flow etc. as required for the safe and efficient operation and maintenance under the scope of specification shall be provided. The necessary root valves, impulse piping, drain cock, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting / erection of these local instruments shall be furnished even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments; sensors, switches etc. for external connection including spare contacts shall be wired out to suitably located junction boxes. 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.
- 1.8 All field instruments shall be weatherproof, drip tight, dust tight and splash proof suitable for use under outdoor ambient conditions prevalent in the subject plant. All field-mounted instruments shall be mounted in suitable locations where maximum accessibility for maintenance is achieved. The enclosures of all electronic instruments shall conform to IP-65 unless otherwise specified (Explosion proof for NEC article 500, class 1, Division 1 area & flame proof) and an anticorrosive paint shall be applied to the field mounted enclosures / instruments. All the field instruments shall also be provided with SS tag nameplate and double compression type Nickel-plated brass cable gland. Gaskets, Fasteners, Counter and mating flange shall also be included wherever required with the field instruments.
- 1.9 Painting of I & C equipment: Epoxy coating required for all I & C equipment.
- 1.10 All the instruments/equipment /electrical items shall be provided & designed with maximum star rating as available in line with energy conservation policies notified by BEE, GOI at the time of supply.
- 1.11 Each switching element including the limit and torque switches of valve actuators shall be provided with minimum two contacts i.e. 2SPDT OR DPDT.
- 1.12 All transmitters shall be HART compatible.

- 1.13 Signal/Electrical connection shall be screwed connection with double compression type Nickel-plated brass cable glands for Explosion proof area, Flame proof area and high vibration prone area.
- 1.14 For cable scope refer to electrical scope between BHEL and vendor defined in electrical specification.
- 1.15 It is mandatory to use sensors/signals/measurements with 2 out of 3 logic for critical control & protection (Analog & Binary) Application/service and sensors with 1 out of 2 logic for all other control & interlock (Analog & Binary) application/service.
- 1.16 For binary and analog inputs required for other modulating control, protection and interlock purpose of other equipment and other critical monitoring application etc., minimum dual sensors shall be provided. Dual sensors shall be provided for instruments required for auto starting of LT driven pumps or LT driven pump tripping due to very low level of water/discharge pressure very low.
- 1.17 Dual measurement scheme for analog inputs employing two independent transmitters/ temperature element, connected to separate tapping points shall be employed for the remaining measurements used for analog control functions.
- 1.18 All the instruments/sensors/transmitters/switches meant for redundant applications shall have completely separate and independent impulse pipes/ root valves etc. No redundant instrument shall share a single process tapping. There will be separate and independent tapping for every individual instrument.
- 1.19 Temperature transmitters shall be provided for temperature measurements.
- 1.20 Bidder to provide mandatory spares as per mandatory spares list.
- 1.21 Bidder to furnish electrical load/UPS load data during detailed engineering.
- 1.22 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.

- 1.23 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.

General Requirements

Separate emergency local stop push button shall be provided for each pump, compressor, fans etc. of AC system.

Lamps shall be provided for indicating the status of each pump, compressor, fans etc. of AC system in the main and local panel.

All the annunciation related to failure of equipments, tripping of equipments, source of failure / reason due to which the equipment is stopped/tripped, low & high limits of parameters such as level, temperature, pressure drop, pressure etc. shall be provided for each pump, fan, compressor, AHU etc. in the respective panel.

Fully wired, twenty percent (20%) spare annunciation windows shall be provided in all the panels.

Air washer units shall be started/stopped by initiation from the local panel and the starting/stopping of fans and pumps shall be automatic upon such initiation.

The operation of the pumps shall be interlocked with the low level of water in the sump. High level of the sump shall be annunciated. The standby pump shall be started automatically when the working pump is tripped.

Auto/manual selector switches and working/standby selector switches for the pump shall be provided in the panel.

A selection switch enabling the running of AWU fan or pump alone shall be provided.

Separate emergency local stop push button shall be provided for each pump, fans etc.

Lamps shall be provided for indicating the status of each pump, fans etc. in the main and local panel.

All the annunciations related to failure of equipments, tripping of equipments, source of failure/ reason due to which the equipment is stopped/ tripped, low and high limits of parameters such as level, temperature, pressure, pressure drop etc. shall be provided for each pump, fan, AWU etc. in the respective panel.

Both supply and exhaust fans shall be operated locally.

Fully wired, twenty percent (20%) spare annunciation windows shall be provided in all the panels.

BOQ OF JB

SYSTEM :	NO OF WAYS	QUANTITY
VENTILATION SYSTEM :		
AJB :	24	1 Nos.
	48	2 Nos.
BJB :	24	2 Nos.
	48	1 Nos.

NOTES:

1. All instruments shall be terminated on JB/LCP in field and both instrument and JB/LCP are in vendor's scope. Number of junction boxes shall be sufficient and positioned in the field to minimize local cabling(10-12 mtrs) and trunk cables .

JB Classification :

- a) AJB- for ANALOG SIGNALS
- b) BJB- for BINARY SIGNALS

LIST
OF
C&I DOCUMENTS/
DELIVERABLES

C&I DELIVERABLES LIST

C&I DELIVERABLES LIST FOR VENTILATION SYSTEM		
SI.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE
1	PE-V9-423-553-I911	CONTROL & OPERATIONAL WRITE-UP FOR THE SYSTEM
2	PE-V9-423-553-I912	CONTROL SCHEME/LOGIC DIAGRAM(TO BE IMPLEMENTED IN DDCMIS)
3	PE-V9-423-553-I913	HMI PICTURES/PLANT SCHEMATICS
4	PE-V9-423-553-I914	INSTRUMENT SCHEDULE with set points
5	PE-V9-423-553-I915	I/O LIST (ANALOG & BINARY)
6	PE-V9-423-553-I916	DRIVE LIST/SOLENOID/ACTUATOR VALVE LIST WITH LOCATION DATA
7	PE-V9-423-553-I917	ANNUNCIATION & SOE LIST
INSTRUMENTATION		
1	PE-V9-423-553-I901	INSTRUMENT DATA SHEETS
2	PE-V9-423-553-I902	BOQ
3	PE-V9-423-553-I903	INSTRUMENT QP / CHECK LIST
Local Control Panel		
1	PE-V9-423-553-I950	LOCAL CONTROL PANEL DATA SHEET
2	PE-V9-423-553-I951	WIRING DIAGRAM
3	PE-V9-423-553-I952	PANEL EXTERNAL GA DRAWING (INCLUDING FOUNDATION DETAILS & FLOOR CUT-OUT)
4	PE-V9-423-553-I953	PANEL INTERNAL GA DRAWING
5	PE-V9-423-553-I954	PANEL FRONT VIEW DRAWING
6	PE-V9-423-553-I955	LIST OF SIGNAL EXCHANGE WITH DDCMIS
7	PE-V9-423-553-I956	BILL OF MATERIAL
8	PE-V9-423-553-I957	LOCAL CONTROL PANEL QUALITY PLAN
9	PE-V9-423-553-I958	LOCAL CONTROL PANEL O & M MANUAL

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.

FIELD & MEASURING INSTRUMENTS

|



CHAPTER-3

FIELD AND MEASURING INSTRUMENTS

2.3.3 Field & Measuring Instruments (Primary & Secondary Instruments)

2.3.3.1 General requirements

Instruments, control devices and other equipment accessories covered under this specification shall be furnished in accordance with I&C specification sheets and drawings enclosed herewith and the requirements of all applicable clauses of this specification.

The instrumentation and control equipment shall conform to all applicable codes and standards including those referred in Cl. no. 2.3.1.6 in this Volume. All equipment and systems shall also fully comply with the design criteria stated in chapter-2 of this part.

The instrumentation/control equipment and accessories shall be from the latest proven design for which the performance and high availability have been demonstrated by a considerable record of successful operation in power station service for similar applications. The bidder shall furnish sufficient evidence to fully satisfy the Owner in this regard.

For plug in type instruments, the plug & sockets shall be polarized to prevent wrong connections and have facility for secure coupling in plug-in position to prevent loose connections.

Signal/Electrical connection shall be screwed connection with double compression type Nickel-plated brass cable glands for Explosion proof area, Flame proof area and high vibration prone area.

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

All field instruments shall be weatherproof, drip tight, dust tight and splash proof suitable for use under outdoor ambient conditions prevalent in the subject plant. All field-mounted instruments shall be mounted in suitable locations where maximum accessibility for maintenance is achieved. The enclosures of all electronic instruments shall conform to IP-65 unless otherwise specified (Explosion proof for NEC article 500, class 1, Division 1 area & flame proof) and an anticorrosive paint shall be applied to the field mounted enclosures / instruments. All the field instruments shall also be provided with SS tag nameplate and double compression type Nickel-plated brass cable gland. Gaskets, Fasteners, Counter and mating flange shall also be included wherever required with the field instruments.

Following minimum requirement of field instruments shall be fulfilled by Bidder (In addition, Redundancy criteria for field instruments shall be as specified elsewhere in specification): -



**1X800 MW COAL BASED NORTH CHENNAI THERMAL
POWER PROJECT STAGE III**



EPC TENDER SPECIFICATION FOR BTG PACKAGE

- a. Level switches / pressure switches / flow switches/any other process switches etc. for OLCS / Alarms / Interlocks / Protection. Pressure switches at inlet, outlet of individual pumps and discharge header of pumps for protection and auto start / stop & alarms.
- b. Level switches (Type as per Owner approval) for sump/tank level high/normal/ low/very low interlocks.
- c. Level Transmitters (Type as per Owner approval) for open sump/ tank/bunker/vessel/heaters.
- d. Stand pipes on both side of tank for all level instruments (LT, LS & LG).
- e. Flow elements (Type as per Owner approval) with flow transmitter & Flow meter for flow measurement of process medium like Steam, Water, Air, Flue Gas, Fuel oil, open channel liquid, solid fuel, ash flow, DM water, Raw water, Instrument and Service air etc. as decided by owner.
- f. Pressure gauges and temp. Gauges at inlet and outlet of each heat exchanger and cooler.
- g. DPG, DPT & DPS across the filters/strainers.
- h. Tapping points/test points shall be provided.
- i. All primary Instruments, hardwares & JBs etc. used for measurement for HFO, LDO & Turbine Lube Oil system shall be flame proof (IEC-79.1, Part I). All primary Instruments, hardwares & JBs etc. used for measurement for Hydrogen shall be intrinsically safe and explosion proof as per NEC article 500, class 1, Division 1 area I.
- j. All Thermocouples & RTDs (Type as per Owner approval) shall be Duplex. Thermocouples shall be provided for Services with Temperature > 200 deg C.
- k. All Field Instruments used in acid or alkaline atmosphere shall be with standard Anti corrosion coating i.e. the combination of Polyurethane and epoxy resin baked coating (ANSI/ISA-71.04).
- l. All primary instruments installed at "Minus level or Floor" shall be with protection class of IP 68.
- m. Transmitters (all type) for monitoring & controls purpose.
- n. Bidder shall provide electronics weighing in motion system as per IS-11547, hermitically sealed load cell of precision strain gauge type, 100% over load protection of cell and 250% overload protection for the construction; one calibrator attachment with two Weigher.
- o. All field mounted push button, selector switch etc. shall be as per IEC or NEMA 4X protection.



**1X800 MW COAL BASED NORTH CHENNAI THERMAL
POWER PROJECT STAGE III**



EPC TENDER SPECIFICATION FOR BTG PACKAGE

- p. All limit switch shall be conform to IEC-60947-5-1 and shall have minimum 2SPDT/DPDT contacts.
- q. ~~At APH, temperature measuring device of different lengths forming grid shall be provided to have average temperature for variable flow of flue gas, secondary air and primary air. These temperatures may be connected to nearest remote I/O panel.~~
- r. ~~On both left and right sides of furnace, separate lines shall be laid and provided with furnace pressure transmitters having wide range than the furnace pressure transmitters used for modulating control.~~
- s. Temp. Transmitters are envisaged with RTD & Thermocouples for monitoring services / application only. However any RTD & Thermocouples are used for control, interlock & protection application, same shall be directly wired to DDCMIS/DCS using instrumentation & Extension cables respectively.
- t. ~~As for the water flow/ steam flow measurements, necessary flow elements/ transmitters are chosen in the process line and supplied such that their algebraic summation shall be mass balanced for calculating the system efficiency.~~
- u. Non-contact type electronic 2-wire position transmitters shall be provided for all inching type motorised valves and dampers.
- v. ~~For CW sump level, Turbine oil tank, Ash Silo, LDO/HFO tank, DM water tanks, CS tank, Acid and alkali applications, only noncontact type level transmitters like Acoustic, Ultrasonic, and Radar based (Type as per Owner approval) shall be provided by bidders as specified in Tender Specification and as approved by owner.~~
- w. ~~For Turbine oil, HFO/LDO applications & H₂ Gas application, Zener protection on power supplies shall be included.~~
- x. ~~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. For HFO, LFO Applications, SS capillary with thin wafer element with ANSI RF flanged ends are to be provided. For hazardous area, explosions proof enclosure as described in NEC article 500 shall be provided.~~
- y. ~~Considering the type of application, wireless technology to bring signals to DDCMIS may be adopted by interfacing with OPC gateway to avoid cabling for smart level transmitters specified above at sr. no. xxi, in case used for monitoring only. However Wireless technology as adopted by Bidder shall be reliable and field proven in power plants and same shall be approved by Owner. Wirelss transmitters shall have the same minimum specification/ parameters as mentioned for wired transmitters.~~

- z. Gauges (all type) for local monitoring in field.
- aa. Each switching element including the limit and torque switches of valve actuators shall be provided with minimum two contacts i.e. 2SPDT OR DPDT.
- bb. All instruments should be supplied with valid calibration and test certificates provided by OEM.
- cc. Canopy/Enclosure shall be provided for field instruments like transmitters, switches & flow meters, etc and any other equipment to protect from direct sun light, lightning & rain.

Field instruments shall be supplied & offered as per data sheets specified below:

2.3.3.2 Transmitters, Switches, Gauges and Panel Mounted Instruments

i) Pressure, Differential Pressure, DP type Level and Flow Transmitters (PT, DPT, LT & FT)

Smart Transmitters of the electronic type shall be furnished. All Transmitter shall be installed in closed LIE in the boiler area. Similarly transmitter for TG shall also be in LIE except the transmitters located in covered area on TG floor and these shall be mounted in LIR. Transmitters shall be equipped with mounting brackets suitable for a mounting in transmitter enclosures.

In general, Transmitters are envisaged to be grouped at several places as to be decided during detailed engg. Stage. For this purpose, suitable enclosures complete with all tubing, fittings, purge meters, loop cable trays etc. shall be provided.

S.No	Features	Essential / Minimum Requirements
1	Type/Construction	Sealed capacitance/ Inductance/ Silicon resonance type
2	Material	
	Body	Die cast Aluminium with epoxy coating for air & flue gas, SS316 for other services
	Diaphragm	SS316 With Teflon seal for process requirement/process media for other services
	Measurement element	316 SS (Suitable material/coating for Hydrogen pressure transmitters/Differential pressure transmitters) the suitable material/coating shall be chosen as per the suggestion of transmitter manufacturer.
	Valves	Carbon steel for non-corrosive applications & SS316 for corrosive applications
3	Output Signal	4 to 20 m Amp. DC (Two wires) HART Compatible
4	Local Indicator	LCD indicator (5 digit) with scale of Engg. unit
5	Overall Accuracy	± 0.04% or better of Span for BTG package ± 0.065% or better of Span for BOP packages ± 0.2% or better of span for remote seal type transmitter.
6	Turn down ratio	100:1 in general

S.No	Features	Essential / Minimum Requirements
		10:1 for vacuum/very low pressure applications. 10:1 for very high pressure application. 30:1 for other applications.
7	Stability	+ 0.15% of URL for 5 years.
8	Response time	150 msec.
9	Power supply	24V DC nominal
10	Load Impedance	500 Ohms (min.)
11	Drive capability	600 Ohms nominal
12	Enclosure Class	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
13	Span and Zero	Locally adjustable, non-interacting
14	Zero suppression / elevation	At least 100% of Span
15	Connection	
	Process	Half (1/2) inch NPT (F) Quarter (1/4) inch NPT with / without oval flanges
	Electrical	Suitable for Plug in type connection (Both side of transmitter), unused entry with blind plug.
16	Accessories	
	For Absolute Pressure Transmitters	Two (2) valve SS316 manifold
	For Gauge & Vacuum pressure transmitter	Three (3) valve SS316 manifold
	For DP, level & flow transmitter	Five (5) valve SS316 manifold
	For oil and corrosive liquids	Separator diaphragm seals
	For all transmitters	Mounting bracket
	Steam Service	Syphon
	Pumps Discharge service	Snubbers
17	Adjustment / calibration From hand held calibrator / centralized OWS based system / maintenance (as applicable).	From hand held calibrator/centralized OWS based system
18	IBR Requirement	For high pressure service, Process tapping and root valves are as per IBR rules and regulations

Manifold should not be mounted on the transmitter, Manifold shall be non integral and standalone type. Snubbers/Pulsation dampners shall be used where the process media is unstable for measurement such as the discharge of a pump. Over range protection shall be used where necessary. The coil syphons & condensate pots shall be used for steam services. Transmitters shall be provided with suitable drain & vent points.

~~Transmitters, smart positioner & other HART based instruments shall be supplied along with 4 Nos. of universal type hand held/portable calibrators. Temperature transmitters shall be supplied along with 4 Nos. of hand held/portable mV source generators/signal reader.~~

~~If one type of hand held type calibrator is not suitable for communicating with all types of transmitters then separate hand held calibrator will be provided.~~

Following minimum accessories shall be provided with each set:-

- a) Soft carrying case with adjustable shoulder straps & lead compartments.
- b) HART lead set.
- c) Rechargeable batteries.
- d) Battery charger.
- e) Power adaptor.
- f) Universal plug kit for power adaptor.
- g) Load resistor.
- h) Interfacing cables of each type as per requirements.
- i) Protective boot.
- j) Standard banana jack.
- k) Operation manual & software CD.
- l) Analysis & Diagnostic Software.

For flanged remote seal diaphragm:

- a) Maximum pressure rating : To meet 200 percent of process pressure
- b) Availability of seals : for both high and low pressure sides with capillary connection in case of differential pressure transmitters and
- c) Single Capillary connection for pressure transmitters.
- d) Capillary length : 6.0 m
- e) Fill fluid : Suitable oil
- f) Process connection size : 1 inch
- g) Flange size and Accessories : As per process requirement. Flange pressure rating : Required Class (ANSI)
- h) Process liquid : Sea water, Ash water, chemical, hydrogen gas, sealoil etc.,
- i) Process fluid temperature : 25°C to 60°C
- j) Diaphragm and wetted part material : Suitable for sea water, ash water and chemical applications.(offered material to be specified)
- k) Flushing option : To be made available with 1/4 inch (necessary drain and gasket suitable for sea water application to be provided)

ii) Pressure Switches (PS) & Differential Pressure Switches (DPS)

S.No	Features	Essential / Minimum Requirements
1	Applicable Standards	IS3624 - 1966/ISA-RP-8.1 except as modified in spec.
2	Materials	
	Bellows	316SS
	Bourdon tube	316SS
	Movement	316SS
	Enclosure	Die-cast aluminium with stoved enamel black finish. Epoxy coating shall be provided for corrosive atmosphere.
3	Type/Construction	Bourdon/Sealed Diaphragm Piston Actuated preferable. Indicators with contacts are not acceptable.
4	Protective Diaphragm	Teflon
5	Accuracy	± One (1) percent or better of full range

S.No	Features	Essential / Minimum Requirements
6	Repeatability	± 0.5(half) percent or better of full range
7	Setting & Differential	Adjustable
8	Contact	
	Number	DPDT /2 SPDT
	Type	Auto reset with internal Adjustable snap action micro switch
9	Rating	5 Amp, 240V AC / 0.2 Amp, 220V DC
10	End connection	½" NPT (F) / Manufactures Standards
11	Connection - instrument	Half (1/2) inch NPT Male Process
12	Electrical	Suitable for Plug in type connection. All the switches are internally connected and brought to the surface with Amphenol male/female connection. Cabling need not terminated inside the switch. Cable ends are to be soldered in connector and to be inserted for easy maintenance.
13	Over range protection	One Fifty (150) percent of full scale
14	Enclosure Class	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)
15	Dead band adjustment	Adjustment up to 10% at set points.
16	Accessories	
	3 / 5 valve manifold	As applicable for all switches
	Self cleaning type pulsation dampners / Snubbers (Material SS316)	Pump and compressor
	Syphon	For all steam lines
	Protective separating diaphragm	For fuel oil & corrosive liquid lines.
	Mounting	Local (in LIE/LIR for BTG package)
17	IBR Requirement	For high pressure service, Process tapping and root valves are as per IBR rules and regulations

iii) Pressure & Differential Pressure Gauges (PG & DPG)

S.No	Features	Essential / Minimum Requirements
1	Applicable Standards	IS:3602-1966, IS/3624, ASME B 40.1
2	Type / construction	
	760 mm to 1.0Kg/cm ²	Bellows/Diaphragm
	Above 1.0Kg/cm ²	Bourdon Tube
	Suction side of pumps	Compound gauge
3	Materials	
	Bellows	316SS
	Bourdon tube	316SS
	Movement	316SS
	Case Enclosure	SS 316 / Die-cast aluminium with stoved enamel black finish. Epoxy coating shall be provided for corrosive atmosphere.
4	End connection	½" NPT (M)
5	Protective Diaphragm	Teflon
6	Dial Size	150mm with shatter proof glass

S.No	Features	Essential / Minimum Requirements
7	Scale Details	Graduations in black lines on white dial, on white dial, 270 Deg. pointer deflection scale provided with glass cover. Smallest scale division shall be one (1) percent of full scale value or smaller. Pointer stop for all gauges.
8	Range Selection	Cover 125% of max. of scale
9	Accuracy	± One (1) percent or better
10	Instrument process connection	½" NPT Male (Back Entry)
11	Mounting Type	Local / 1/2 inch NPT Male (Back entry) mounted on local gauge board.
12	Protection Class	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)
13	Accessories	
	3 way needle valve / manifolds	For all gauges
	Self cleaning type	Pump and compressor discharge (Pulsation dampener / Snubbers (S316) lines
	Syphon	For all steam lines
	Protective separating	For fuel oil and corrosive liquid lines
14	Other Particulars	
	External Zero adjustment / Safety device	For all gauges
	Ranges 5 to 20 Kg/cm ²	Rubber blow out disc with open front construction.
	Ranges above 20 Kg/cm ²	Neoprene safety diaphragm at the back with solid front construction.
16	Over range protection	One Fifty (150) percent of full scale
17	Over Range Test	Test pr. For the assembly shall be 1.5 to the max. Design pr. At 38°C
18	Other Requirements	Movement mechanism shall be glycerine filled for oil services & vibration prone area. For Fuel oil & corrosive liquid lines diaphragm type sensors required. Armoured capillary of 10 M for Fuel oil & Corrosive liquid service. Contact type pressure gauges are not acceptable for interlock & protection. For condensate storage tank the pressure gauge in terms of 0-10000 mmwcl or suitable range having dial size of 300mm or bigger size shall be provided.
19	IBR Requirement	For high pressure service, Process tapping and root valves are as per IBR rules and regulations

2.3.3.3 Temperature Related Instruments

a) Temperature Transmitters (TT)

S.No	Features	Essential / Minimum Requirements
1	Type	SMART type configurable from control room through HART protocol (HMS System).
2	Display type	Indicating type (5 digit LCD Display),
3	Accuracy	±0.10%,

S.No	Features	Essential / Minimum Requirements
4	Ambient temperature error	0.1% per 10°C change
5	Input	Same transmitter shall be capable to handle Pt- 100 RTD, Thermocouples –K&R types (input type to be selectable at site through HART terminal)
6	Output	4-20 mA DC (2 wire system) HART compatible signals for analogue monitoring inputs to the distributed control system (DDCMIS), DCS & PLC.
7	Isolation	Min. 500 V AC
8	EMC compatibility	as per EN 61326
9	Operating ambient temperature	0 to 85 deg C (without indicator) 0 to 70 deg C (with indicator)
10	Protection class	NEMA 4 / IP66 or equivalent degree of protection for enclosure)/ (Explosion/Flameproof for NEC Class-1, Division 1 area)/flame proof (IEC-79.1, Part I). As applicable).
11	Material of accessories	SS316
12	Stability	± 0.1 % or ± 0.1 deg C of reading (whichever is great) for 2 years in case of RTD inputs and for 1 year in case of Thermocouples inputs.
13	Operating Voltage	16 – 48 V DC
14	Calibration	As per NIST monograph 125 for T/C & European Curve Alpha = 0.00385 for RTD.
15	Ref. Junction compensation	Provided
16	Span/zero adjustment	Locally adjustable, Non interacting
17	Auto calibration	Provided
18	Burn out protection upscale	Provided
19	Input - output isolation	Provided
20	Circuit ungrounded	Provided
21	Accessories	Mounting arrangements including Clamps etc.
22	Composite Accuracy	For head mounted and DIN-rail mounted type RTD =<0.4% of 0-250 deg C span For dual-input type: RTD =<0.25% of 0-250 deg C span
23	For head mounted and DIN-rail mounted type RTD =<0.4% of 0-250 deg C span For dual-input type: RTD =<0.25% of 0-250 deg C span	Temperature transmitters of this category shall be field mounting type & shall be capable of withstanding operating ambient temperature up to 70 deg C. These modules shall be connected to DDCMIS through field bus such as Profibus, Foundation Field bus etc. directly from the transmitter. Maximum Number of inputs per such temperature transmitter shall be eight. These shall be mounted in cabinets in non-AC areas. As an alternate, these signals from temperature transmitters can be connected to DDCMIS through standard remote I/O modules of the DCS, in which case, the temperature transmitter signals will be acquired through 4-20mA input modules in the remote I/O cabinet for connecting to DDCMIS through remote I/O bus.



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Any RTD or Thermocouples shall be directly wired to DDCMIS/DCS/PLC for metal temperature application, bearing & winding temp application only.

The Temperature transmitter shall accept Universal dual inputs of all types of thermocouples & RTD, 0-5V input signals etc.

Temp. Transmitter shall be extremely stable against ambient temp variation, the accuracy figure shall be inclusive of effect due to ambient temperature variation.

For BFPs' differential temperature protection by 2 out of 3 logic, DTT shall be employed to deliver 4-20 mA output to DDCMIS using suction & discharge temperature measurements.

Temperature Transmitters shall not be used for CLCS, OLCS, interlock & protection services anywhere in the plant with RTD & Thermocouples. However RTD & Thermocouples are used for control, interlock & protection application, same shall be directly wired to DDCMIS/DCS/PLC using instrumentation & Extension cables respectively.

These transmitters shall be connected with duplex sensors and shall have bump less change over facility to second sensor in case first sensor fails .This change-over is to be alarmed.

Considering the monitoring application & distance involved for monitoring parameters wireless technology shall be adopted by interfacing with DDCMIS through OPC connectivity. However Wireless technology as adopted by Bidder shall be reliable and field proven in power plants and same shall be approved by Owner. Wireless transmitters shall have the same minimum specification/parameters as mentioned for wired transmitters.

b) Resistance Temperature Sensors (RTD) with Thermo wells

S.No	Features	Essential / Minimum Requirements
1	Applicable Standard	ASME PTC 19.3 - Latest Revision DIN EN 60751:1996, BS EN/IEC60751: 2008
2	Element	Platinum, R0=100 ohm 4-wire, Duplex for Process Temp. Measurement Platinum, R0=100 ohm 3-wire Duplex for Bearing & Winding Temp. Measurement
3	Sheath Material/ Insulation	316SS/Compacted Magnesium Oxide (Purity above 99.4%)
4	Sheath O D	8 MM
5	Gauge	18 AWG
6	Terminals	Spring loaded high temperature ceramic base with silver plated brass for high vibrating locations.
7	Calibration	As per DIN Standard – 43760/IEC 60751, Class A
8	Head	Hex Head, Die Cast Aluminium (Screwed) with galvanized SS chain
9	Response Time	6-10 Sec bare & 30 Sec. With protective sheath/thermo well
10	Accuracy	± 0.35 degree C or Class-A whichever is better.



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S.No	Features	Essential / Minimum Requirements
11	Electrical connection	Gold plated Plug in type. Double entry – one unused entry with blind plug
12	Enclosure Class	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)
13	Response Time	Repeat and contradictory.
14	Accessories	i. Adjustable nipple-union-nipple with thermo well ii. Compression fittings/unions Flanges etc. (for flanged connections only) iii. SS 316 forged thermo well as per ASME PTC
	THERMOWELL	
15	Applicable Standard	ASME PTC 19.3 TW - 2010
16	Construction	Tapered drilled from Bar stock (Straight for Air & Gas systems)
17	Material	316 SS/F11/F22/F91 - water and steam Services depending upon process parameters. Inconel for air & flue gas services For furnace zone, impervious ceramic protecting tube of suitable material along with Incoloy supporting tubes and adjustable flanges. For Mill classifier outlet long life solid sintered tungsten carbide material or better of high abrasion resistance. Bidder shall provide calculation for thermo well as per ASME – PTC-19.3 2010. “All Thermo wells in high velocity steam service shall be checked for Strouhal’s frequency limit to arrive at a safer size and design of Thermo wells”.
18	Process Connection	(i) M 33 x 2 (ii) SS316 Flanged, for Air & Gas systems, with mating flanges, fasteners, gaskets etc.
19	Extension	Threaded union (SS316) 1/2" NPT (F) with two nipples of SS 316 having 1/2"NPT(M) threads at both ends
20	Immersion length	Within ± 10 mm of centre line of pipe and as per ASME – PTC-19.3 - 2010
21	Extension neck length	Minimum 100 mm above insulation of pipe and Minimum 160 mm when there is no insulation on pipe.
22	IBR Certification	For high pressure service, Steam Temp., Fuel oil temp. measurement as per IBR rules and regulations
23	Note : Extension /Compensating/paired cable exposed to atmosphere in the conventional method melts away due to high temperature or the head shall be more than 300 mm above the top of mill or due to coal burning. Hence The terminals of temperature sensors shall not be at the top of mills itself. The temperature sensors wires are to be laid up to JB though SS tube of required diameter and the head shall be placed nearer to the JB. In case, Duplex RTDs are not provided by bidder due to system/equipment limitation, two no. simplex RTD shall be provided instead of Duplex RTD. Both Simplex RTD shall be terminated at local JB/Termination Box.	



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c) Thermocouples (T/C with T/W) With Thermo wells

S.No	Features	Essential / Minimum Requirements
1	Applicable standard	ASME PTC 19.3- Latest Revision ANSI-MC 96.1 – 1982, IEC 584-2
2	Element	Duplex
3	Sheath	8 MM OD
4	Sheath Material	316 SS
5	Spring Loaded	Yes
6	Nipple/Union	Yes
7	Packed connector	Compacted magnesium Oxide ungrounded
8	Type	i. Type K (Chromel - Alumel) ii. Type S/R (Platinum Rhodium-Platinum) iii. Type T (Cu-CuNi) with special limits to the standards
9	Gauge	16 AWG
10	Head	Die Cast Aluminium
11	Electrical connection	one unused entry with blind plug
12	Enclosure Class	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)
Thermo well		
13	Construction	Tapered Drilled from Bar stock (Straight for Air & Gas systems)
14	Material	316 SS/F11/F22/F91 - water and steam Services depending upon process parameters. - Inconel for air & flue gas services - For furnace zone, impervious ceramic protecting tube of suitable material along with Incoloy supporting tubes and adjustable flanges. - For Mill classifier outlet long life solid sintered tungsten carbide material or better of high abrasion resistance. Bidder shall provide calculation for thermo well as per ASME – PTC-19.3 2010. “All Thermo wells in high velocity steam service shall be checked for Strouhal’s frequency limit to arrive at a safer size and design of Thermo wells”.
15	Process Connection	SS316 Flanged, for Air & Gas systems, with mating flanges, gaskets, fasteners etc.
16	Extension	Threaded union (SS316) 1/2" NPT (F) with two nipples of SS 316 having 1/2"NPT(M) threads at both ends
Accuracy (Special Class as per IEC-751/ANSI-C-96.1)		
17	(For Type K T/C)	± 1.1 deg.C (for 0 to 277 deg.C) ± 0.4 percent (for 277 to 1280 deg.C) Class-A
18	For Type S & R T/C	± 0.6 deg.C or ± 0.1%
19	For Type T T/C	± 0.5 deg.C or ± 0.4%
20	Accessories	Bolts, nuts and gaskets for flanged connections.



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S.No	Features	Essential / Minimum Requirements
	Response Time (Bare Thermocouple)	
21	For SH & RH Temp. Control	4-6 Sec.
22	All other applications	10 Sec.
23	Immersion length	Within + 10 mm of centre line of pipe and as per ASME – PTC-19.3 - 2010
24	Extension neck length	Minimum 100 mm above insulation of Pipe and minimum 160 mm when there is no insulation on pipe.
25	IBR Certification	For high pressure service, Steam Temp., Fuel oil temp. Measurement as per IBR rules and regulations.
26	Note Extension/Compensating cable exposed to atmosphere in the conventional method melts away due to high temperature or the head shall be more than 300 mm above the top of mill or due to coal burning. Hence The terminals of temperature sensors shall not be at the top of mills itself. The temperature sensors wires are to be laid up to JB though SS tube of required diameter and the head shall be placed nearer to the JB. CJC Boxes are not required, Thermocouple cables shall be directly terminated at Thermocouple I/P cards only. Bidder may also provide Triplex Thermocouples as per process requirements.	

Thermocouples provided for steam services like super heater / de super heater area, where the process pipe is inside the insulation of boiler penthouse, Thermo wells are inaccessible and terminal head and connecting cable cannot withstand high temperature, for such services thermocouples shall be provided with flexible extension SS316 Sheath of 10-15 meters.

d) Metal Temperature Thermocouples (MTE)

S.No	Features	Essential / Minimum Requirements
1	Measuring Medium	Metal Temperature
2	Material of Thermocouple	Chromel Alumel Type K
3	Type of Thermocouple	Duplex with separate hot junctions, ungrounded
4	Insulation	Mineral Insulation Magnesium Oxide.
5	Thermocouple wire gauge	16 AWG
6	Protective sheath	SS 321
7	Protective sheath dia	8 mm O.D
8	Characteristics of Thermocouple	Special limits of error as in ANSI thermocouple MC 96.01.1975
9	Mounting accessories	½" BSP SS Sliding end connector, weld pad, clamps of heat resistant steel SS310
10	Cold end sealing	SS pot seal with color coded PTFE headed sleeve insulated flexible tails. Sealing compound Epoxy resin
11	Minimum bending radius	30 mm
12	Length of T/C	30 Mtr. (minimum)



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S.No	Features	Essential / Minimum Requirements
13	Enclosure Class	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)

e) Temperature Switches (TS)

S.No	Features	Essential / Minimum Requirements
	Type / Construction	
1	Switch	Industrial type inert gas filled with capillary and separable thermo well and contacts directly connected to Bourdon element/vapour pressure sensing, gas filled bellows type preferred.
2	Thermo well	Bar stock
a	Enclosure Class	IP 65 or better/ (Explosion/Flame proof for NEC Class 1/2, Division 1 area)/ flame proof (IEC-79.1, Part I). As applicable.
	Material	
3	Bulb	316 SS
4	Capillary	Armoured Stainless Steel
5	Bourdon	316 SS
6	Bourdon Movement	SS 316
7	Casing	Die-cast aluminium with stoved enamel black finish Epoxy coating shall be provided for corrosive atmosphere.
8	Setting and Differential	Adjustable
9	Accuracy	± One (1) percent of setting and differential
10	Repeatability	One half (1/2) percent of setting.
	Contacts	
11	Number	DPDT/2 SPDT
12	Type	Auto reset with internal Adjustable snap action micro switch
13	Rating	5 Amp, 240V AC / 0.2 Amp, 220V DC
14	Pipe Connection	M33 x 2
15	Extension	Threaded union (SS316) 1/2" NPT (F) with two nipples of SS 316 having 1/2"NPT(M) threads at both ends
16	Thermo well	To suit Temp. switch with same design criteria as specified for RTDs.
17	Electrical	Suitable for Plug in type. All the switches are internally connected and brought to the surface with Amphenol male/female connection. Cabling need not terminated inside the switch. Cable ends are to be soldered in connector and to be inserted for easy maintenance.
	Other Particulars	
18	Capillary length	As per requirement (min 10 meters)
19	Immersion Length	Within + ten (10) mm of centre line of pipe with adjustable nuts.
20	Extension neck length	Minimum 50 mm above insulation of pipe /As per approved hook up drawings



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S.No	Features	Essential / Minimum Requirements
21	Packing glands	Yes
22	IBR Certification	For high pressure service, Steam Temp, Fuel oil temp. measurement as per IBR rules and regulations
23	N.B	Switches designed for cross ambient operation shall be used in applications where the ambient temperature will approximate or exceed the switch set point.

f) Temperature Gauges (TG)

S.No	Features	Essential / Minimum Requirements
1	Applicable Standard	IS : 3602, BS:5235 ISA:RP:8.1 except as modified in this specification
	Type/Construction	
2	Thermometer	Industrial type, Gas in Filled type with separable thermo well
3	Thermo well	Bar stock
	Material	
4	Bulb	316 SS
5	Capillary	Armoured SS (Applicable for capillary Type)
6	Casing	SS 316/ Die-cast aluminium with stoved enamel black finish. Epoxy coating shall be provided for corrosive atmosphere
7	Dial Size	150mm with shatter proof glass
8	Scale Details	270 degree dial rotation/deflection. Graduations in black lines on white dial provided with glass cover. Smallest scale division shall be one (1) percent of full scale value or smaller .Pointer stop for all gauges
9	Accuracy	± One (1) percent or better
10	Response time	Maximum 15 seconds without thermo well and 30 seconds with thermo well
	Connection	
11	Pipe	M33 x 2
12	Thermo well	To suit instrument with same design criteria specified for RTDs.
13	Process Connection	M 33 x 2 (ii) SS316 Flanged, for Air & Gas systems, with mating flanges, fasteners, gaskets etc.
14	Extension	Threaded union (SS316) 1/2" NPT (F) with two nipples of SS 316 having 1/2"NPT(M) threads at both ends
15	Other Particulars	
16	Capillary length	5Meters/10 Meters as required
17	Immersion Length	Within + ten (10) mm of centre line of pipe with adjustable nuts.
18	Extension neck length	Minimum 50 mm above insulation of pipe /As per approved hook up drawings.
19	Stop at Maximum value	For all gauges of scale
20	Pointer	i) Externally adjustable



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S.No	Features	Essential / Minimum Requirements
		ii) In general, Contact type Temp. gauges are not acceptable for interlock & protection. iii) Contact type Temp. gauges are acceptable for interlock & protection in case of bearing temp. Only.
21	Over range protection	150 percent (%) of full scale
22	IBR Certification	For high pressure service, Steam Temp., Fuel oil temp. measurement as per IBR rules and regulations
23	Enclosure Class	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)

g) Test Thermo wells (TW)

S.No	Features	Essential / Minimum Requirements
1	Applicable Standard	ASME PTC 19.3 TW-2010
2	Type/Construction	Machined from Bar stock
3	Material	316 SS/F11/F22/F91
	Connection	
4	Pipe	M33 x 2
5	Test Instrument	To suit test instruments
6	Accessories	Plug with chain
7	IBR Certification	For high pressure service, Steam temperature Fuel oil temperature measurement as per IBR rules and regulations. Bidder shall provide calculation for thermo well as per ASME – PTC- 19.3 TW - 2010.

Test wells shall be provided on main steam, reheat steam, extraction steam, feed water, condensate, spray water lines and other piping as required to meet ASME test requirements.

2.3.3.4 Level Instruments

a) Direct mounted level transmitter (LT)

Displacer type level transmitter shall not be used in the process anywhere in the plant.

b) Ultrasonic Level Transmitter (for Water sump/Tank level measurements)

S.No	Features	Essential / Minimum Requirements
1	Principle of Operation	Detection of reflected ultrasonic pulse
2	Measuring Ranges	Up to 30 meters (typical)
3	Signal Processing	Microprocessor Controlled Signal Processing
4	Operating Freq.	10 KHz to 50 KHz (typical)
5	Display	Head mounted alpha-numeric back lit LCD/LED
6	Calibration & Configuration	Accessible from front of panel & HART calibrator.
7	Diagnosis	On-line
8	Status	For power, Hi / Lo / V. Hi / V. Lo- level indication, fault etc.



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S.No	Features	Essential / Minimum Requirements
		operation.
5	Casing	IP-65.
6	Accessories (as required)	a) Air lock relay b) Hand wheel. c) Air filter regulator with gauge. d) Volume Booster. e) Limit Switches. f) Positioner with Input, Output and supply pressure gauges. g) Pilot Solenoid Valve (Double Coil type) h) Position Transmitter (4-20 mA DC linear output, LVDT or non-contact type).
7	Fail-safe operation	Stay put, open or close position on pneumatic / electrical power supply failure as per process safety criteria.
8	Repeatability	Better than 0.5% of full travel.
9	Hysteresis	Less than 1% of full travel.
10	Material	Internal part's material and material of accessories shall be SS316 only.
	In case of loss of mA signal. Manual adjustment shall be made through available manual knob and locked at required position for sufficient required process fluid flow.	

2.3.3.11 Non - Nucleonic (Vibration) type Density Meter (For DM Plant)

S.No	Features	Essential / Minimum Requirements
1	Type	Non - Nuclear type radiation
2	Application	Liquid Density measurement
	Detector	
3	Orientation	As per requirement
4	Case Material	SS 316/ Cast Aluminium alloy
5	Wetted part material	SS 316
6	Operating Principle	Vibration Density measurement
	Convertor	
7	Output	4-20 mA DC Isolated.
8	Electrical Connection	½" NPT
9	Enclosure Class	IP 65
10	Local Display	Digital 5 digit, density display with temp. Compensation.
11	Accuracy	+/- 1%
12	Response time	< 1 minute
13	Power Supply	240 V AC, +/- 10%, 50 Hz. From UPS

2.3.3.12 Junction Box

S.No.	Features	Essential/Minimum Requirements
1	Type of Enclosure	Dust tight, Flame Proof / Weatherproof and Waterproof, generally conforming to IP 65.



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S.No.	Features	Essential/Minimum Requirements
2	Material	16 SWG sheet steel hot-dip galvanized / Cast aluminium LM6.
3	Type of Cover	Solid unhinged with retention chain
4	Mounting	Indoor / Outdoor
5	Cable Entry	Downwards
6	Cable Glands	Double compression type – Nickel plated brass with PVC hoods.
7	Terminals	Phoenix / Wago (screw less cage clamp type spring loaded)
8	Gasket	Neoprene
9	Grounding	Two terminals for body and shield ground
10	Number of Drain Holes	Two at bottom capped.
11	Door	Hinged, lockable type
12	Color	In General same as provided for control panels, and for special services, To be decided during detailed engineering & subject to owner's approval.
13	Note: i. Suitable mounting clamps and other accessories shall be in scope of bidder. ii. The brackets, bolts, nuts, screws, glands, lugs required for erection shall be of brass, included in bidder scope of supply. High voltage & insulation resistance test shall also be conducted. iii. M6 Ni plated Brass earthing stud shall be provided (external 2 nos. internal 1 no.) iv. Gasket (Normal)- Neoprene thickness 6.0 mm	

2.3.3.13 Interposing Relays (IPR)

Electromagnetic type IPRs with modular design, plug-in type connections, suitable for channel/DIN rail mounting in cabinets; coil rating 24V D.C; 2 set of silver plated change over contacts rated for 0.5A 220 V DC/8 A 240 V AC. Freewheeling diode across relay copper coil and self reset type status LED indicator flag (electronic) shall be provided. Manual forcing/override facility is required. The test voltage for relay shall not be less than 4 KV with operating temperature from as per ambient temperature condition at site. The relay shall have the necessary approvals like V0 inflammability class in accordance with UL94", IEC60664/IEC60664A/DIN VDE 0110. Facility to stimulate IPR manually shall be provided. The VA burden of relays shall be suitable to match the capacity of output modules. Interposing relay & sockets for mounting the interposing relay shall be of same make only.

The operating temperature of the Relay & Sockets shall be from –20 deg. C to 60 deg. C. The operating/release time of the relay shall not be more than 10/5 ms respectively.

The relay and DIN Rail sockets shall have the necessary approvals like UL/VDE and V0/V2 inflammability class in accordance with UL94", IEC60664/IEC60664A/ DINVDE0110.

Facility to stimulate IPR manually shall be provided. The VA burden of relays shall be suitable to match the capacity of output modules. Interposing relay & sockets for mounting the interposing



**1X800 MW COAL BASED NORTH CHENNAI THERMAL
POWER PROJECT STAGE III**



EPC TENDER SPECIFICATION FOR BTG PACKAGE

relay shall be of same make only and sockets shall have the plug in RC circuits/Varistors, required for EMI suppression.

2.3.3.14 Recorders (Chartless)

S.No.	Features	Essential/Minimum Requirements
1	Type	Micro-processor based, Digital TFT display type
2	No. of Channels	Six (6) Points & Forty Eight (48) point).(Simultaneous parameter display preferred)
3	Input Signal	Fully configurable multi range (Programmable) universal (input)
4	Recording method	Continuous with different colour, for each channel
5	Display colour	Desired display color using RGB value
6	Bar graph facility	To be provided
7	Digital indication	To be provided
8	Accuracy	+/- 0.1 % for reading for DCV Input And 0.1 Deg for TC/RTD input
9	Programmability	Front key board
10	Data Storage	hard disk/ Flash Memory
11	Data Retrieval	Compact 4 GB flash Memory card and USB port with 8 GB USB drive.
12	Scan rate	< 100 m second or less for individual channel. Selection of scan time for individual channel is required.
13	No. of Alarm relays with change over Contacts	6 Nos
14	Backup Battery	To be provided.
15	Communication	Ethernet connectivity for remote viewing in PC & file transfers to PC
16	Software to be supplied along With instrument	Software required for data archives from chartless recorder though Ethernet, remote viewing in PC through Ethernet, file transfer through Ethernet to PC.
17	External Storage media	Compact USB flash drive & Compact flash memory card with high capacity to be provided.
18	Math Function	General Arithmetic function, Summation for each channel and group of channels, Statistical operations like Average Maximum, Minimum etc.,
19	Ethernet Cable with Connectors	50 metres for each recorder
20	For virtual memory of chartless recorder	Provision of Modbus Protocol and its communication interface card in Chartless recorders for reading/writing of measurements/data from third party system/ electronic modules through digital communication. The recorder shall carry 48 or More channels of virtual measurements through data communication from third party system/ electronic modules
21	Color laser Multi function printer	1 No. A3 size color laser Multi Function printer for Print, Scan & Copy for complete set. 1 No. lap top computer with necessary CR application software to integrate with CR

2.3.3.33 Push buttons (PB)/ ILPBs for ON/OFF, OPEN/CLOSE, START/STOP

S.No.	Features	Essential/Minimum Requirements
1	Type	Momentary/Miniaturized Suitable for mosaic grid 24x48 Mm with 2 PB and 3 coloured LED
2	Contact Configuration	2 NO + 2 NC
3	Contact Material	Hard Silver Alloy
4	Contact Rating	500V / 10 A
5	Insulation Voltage	2 KV for 1 minute between terminals and earth
6	Lamp Rating :- a) Voltage b) Watt	240 V AC 2 Watt (approx.)
7	Colour	
	i. Red	ON/Start/Open ILPB, energized, running, Start, valve open LED/Lamp, OFF/Stop/Close PB, Emergency trip push buttons with red flap / hinged Transparent acrylic cover.
	ii. Green	OFF/Stop/Close ILPB, de-energized, stopped, valve closed LED/Lamp, ON/Start/Open PB
	iii. Light yellow	Abnormal, discrepancy LED/Lamp

2.3.3.34 Push Button for Control DESK

Momentary mosaic grid mounted 24x48 mm size, single PB 18x40 mm Colours for DESK RELEASE - Yellow, Desk Lamp test - Blue, Desk Acknowledgement – Green

2.3.3.35 Push Button for Sequence Start/Release

Momentary (Miniaturised) suitable for mosaic grid 24x48 mm3 PB + 5 LED

2.3.3.36 Push buttons for annunciation

S.No.	Features	Essential/Minimum Requirements
	Contacts	
1	Number & Type	As per requirement
2	Breaking capacity	1 Amp, 220V DC 10 Amp, 600V AC Different colours for Accept/Ack. - Green, reset Grey, Lamp test – Blue, System Test – Yellow & Audio Ack. - Black.

2.3.3.37 Hydrogen Gas System Instruments / Analysis

i) Hydrogen Gas Hygrometer

S.No.	Features	Essential/Minimum Requirements
A	Performance	

- l) At CW & ACW pump discharge headers flow transmitters shall be provided (Non Contact ultrasonic Type are preferable). In addition flow measurement shall also be provided for CW water used anywhere except condenser service.
- m) Flow transmitters for general applications shall be of the differential pressure type
- n) Flow switches for OLCS / Alarms / Interlocks / Protection.
- o) Lubricating oil Flow transmitter/meter with switch shall be provided for Bearing systems of APH, FD, PA, etc.,
- p) Sight glasses flapper indication type shall be provided on lube oil cooling water piping as required to ensure indication of fluid flow.
- q) On line Fuel flow & velocity measurement facility in each Pulverized Fuel (PF) pipe for each coal pulveriser shall be provided by bidder for accurate, absolute and simultaneous measurement of coal velocity, coal density, coal mass flow rate and air-to-fuel ratio. The equipments shall comprise of sensors working on micro wave technology.
- r) In addition to the conventional triple DP measurement techniques involving venturi/Aerofoil for secondary air flow measurement, One number Flow measurement system each on Left side and Right side shall be provided as redundant/checking measurement for secondary air flow which could be used in the optimization package.
- s) On line secondary air flow & velocity measurement facility in each on left side & right side shall be provided by bidder for accurate, absolute and simultaneous measurement of air velocity & flow rate. The equipments shall comprise of sensors working on tribo-electric (Correlation technique) technology.
- t) Any other flow element/meter required for system shall be finalised as per system requirement and as per approved drawings/documents by owner.

5. Process Connections

- a) The type of instrument source connection shall depend upon the process parameters and the tapping size. The source connection drawings shall be finalised during the engineering stage.
- b) Size of tapping point stub, number and size of root valves for different types of measurements are as follows:

S.No.	Quantity of root valves	Size of stub and root valve	Service Condition
Pressure and Differential Pressure Measurement			
(i)	2	25NB	$\geq 40 \text{ bar (g) OR } 425^{\circ}\text{C}$
(ii)	1	15NB	$< 40 \text{ bar (g) AND } 425^{\circ}\text{C}$
Level Measurement			
(a)	Level Gauge & Switch		
(i)	2	25NB	$\geq 40 \text{ bar(g) OR } 425^{\circ}\text{C}$
(ii)	1	25NB	$< 40 \text{ bar(g) AND } 425^{\circ}\text{C}$
(b)	Level transmitter (displacement type)		
(i)	2	40NB	$>40 \text{ bar(g) OR } 425^{\circ}\text{C}$
(ii)	1	40NB	$<40 \text{ bar(g) AND } 425^{\circ}\text{C}$
(c)	Stand pipe for level measuring instrument		
(i)	2	80 NB	$\geq 40 \text{ bar(g) OR } 425^{\circ}\text{C}$
(ii)	1	80 NB	$< 40 \text{ bar(g) AND } 425^{\circ}\text{C}$
Flow Measurement			
(i)	2	25NB	$\geq 40 \text{ bar(g) OR } 425^{\circ}\text{C}$
(ii)	1	25NB	$< 40 \text{ bar(g) AND } 425^{\circ}\text{C}$
Sampling system measurement (Steam and Water Service)			
(i)	2	25 NB	$\geq 40 \text{ bar(g) OR } 425^{\circ}\text{C}$
(ii)	1	25 NB	$< 40 \text{ bar(g) AND } 425^{\circ}\text{C}$

LOCAL PANEL



SPECIFICATION FOR LOCAL PANELS

SPECIFICATION NO.: PE-SS -999- 145 -054A	
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1.0 SCOPE

This specification covers the Design, Manufacture, Inspection and Testing at the manufacturer's works, proper packing for transportation and delivery to site, supervision, erection, and commissioning at site of Local Panels required for control and monitoring of the Auxiliary Plant & Equipment.

2.0 CODES AND STANDARDS

2.1 All the equipments specified herein shall comply with the requirements of the latest issue of the relevant National and International standards.

2.2 As a minimum requirement, the following standards shall be complied with:

- a) IS-6005 : 1998 : Code of practice for phosphating of iron and steel.
- b) IS-5 : 2007 : Colors for ready mixed paints and enamels.
- c) IS-1248:2003 : Direct Acting Indicating Analog Elec Measuring Instruments.
- d) IS/IEC 60947:Part 1:2004 : Low Voltage switchgear & control gear: Part-I (General Rules)
- e) IS-8828:1996 : Circuit breaker for household and similar installations.
- f) IS-13947 (Part-I):1993 : Low Voltage switchgear & control gear : Part-I (General Rules)
- g) ISA-18.1:1979 : Annunciator Sequences and Specification
- h) NFPA-496:2003 : Purged & Pressurised Enclosure for Electrical Equipment in Hazardous Locations.

3.0 TECHNICAL REQUIREMENTS

3.1 Panel Construction

3.1.1 The local panels shall house the secondary instruments, annunciation system, Single loop controller, Control switches / push buttons, indicating lamps/LED cluster, relays, timers and other devices required for operation and monitoring of the equipment locally.

3.1.2 The panels shall be of free standing type either welded construction on angle iron (minimum section of 50 x 50 x 4 mm) structure or folded construction by sheet metal formation depending upon the equipments to be mounted on it. The panels shall be robustly built and stiffeners as necessary shall be provided.

3.1.3 The panel shall be suitably reinforced to ensure adequate support for all instruments mounted thereon. All welds on exposed panel surfaces shall be ground smooth.

3.1.4 The salient features of construction shall be:

Sheet material: Cold rolled sheet steel

Frame thickness: Not less than 3.0mm

Enclosure thickness: Not less than 2.5 mm for load bearing sections (Mounted with instruments)
1.6 mm for doors and Not less than 2.0 mm for others

Panel Height: As Required

Gland plate thickness: 3.0mm

Base channel: ISMC 100 with anti-vibration mounting & foundation bolts.

3.1.5 The panel shall be provided with rear doors with integral lockable handle. The door when locked shall be held at minimum three places. The door width shall not be more than 550mm. The doors shall be provided with suitable stiffeners to prevent buckling. The handle shall be on the right side of the door. The door shall be removable type with concealed hinges to facilitate maintenance work. Suitable pocket inside the door shall be provided for keeping the drawings / documents. Double door shall be provided with suitable glass windows, as per the requirement.

3.1.6 Suitable neoprene gasket shall be provided on all doors and removable covers. Suitable ventilation system along with louvers shall be provided at bottom and top of the doors covered with removable wire mesh.



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- 3.1.7 The class of protection shall be in accordance with IP-42 unless otherwise specified in the data sheet – A (No. PES-145-54A-DS1-0).
- 3.1.8 All steel surfaces shall be cleaned by sand / pellet blasting, treated for pickling, degreasing and phosphating etc. by seven tank method. The panel shall have a high quality finish and appearance. The panel shall be painted with two coats of primer followed by two coats of epoxy / synthetic enamel based final paint of color shade and finish as given in data sheet-A (No. PES-145A-DS1-0). Minimum thickness of the paint shall be 85 microns for external paint and 70 microns for internal paint.
- 3.1.9 The cable glands of the required size and type as given in data sheet-A (No. PES-145A-DS1-0) shall be supplied alongwith the Panel.
- 3.1.10 All operable and indicating devices shall be mounted on the front of the panel while aux. Relays / timers MCBs etc. required for realization of control logics shall be mounted on a mounting plate inside the panel. Auxiliary relays and timers etc. shall be grouped according to the control function. No operable or indicating devices shall be mounted below 750 mm and above 1800 mm (w.r.t. finished ground level). The devices shall be located in such a way so as to ensure easy access for operation / maintenance.
- 3.1.11 Single / dual control power supply feeders of voltage class as specified in data sheet-A (No. PES-145A-DS1-0) shall be provided by the purchaser. In case redundant power supply feeders are provided then auto changeover unit shall be mounted on the panel are in the panel supplier's scope. Where DC control power supply is specified an additional 240V, 50 Hz AC supply feeder for powering of space heater and lighting shall be provided by the purchaser. Suitable arrangement shall be provided inside the panel to receive and terminate the power supply feeder(s). For this purpose MCBs of suitable current rating shall be provided by the vendor. A supervisory relay along with a pilot lamp to indicate control supply 'ON' shall be provided on the panel. Any other power supply required for the operation of the devices mounted in the panel shall be arranged by the vendor.
- 3.1.12 The internal wiring shall be carried out with 1100 volt grade PVC insulated copper multi strand wire / flexible of 1.5mm² size. AC & DC wires shall be kept separate from each other. Separate coloured wires to be used for AC and DC circuits. All wires shall be properly numbered and identified with ferrules as per the Control scheme / wiring diagram. Wires shall be routed and run through PVC troughs.
- 3.1.13 Terminal blocks shall be clip on type, 1100 volts grade. Separate terminal blocks shall be used for AC & DC circuits. The terminals shall be suitable for terminating 0.5 mm² to 2.5mm² external cables. The TB points in terminal block shall be cage clamp type / screw type. The terminal for ammeters shall be provided with removable links for shorting CTs. Each terminal strip shall be provided with identification strip. The terminal shall not be mounted below 250 mm height from finished floor. The panel shall have ten (20) percent spare terminal.
- 3.1.14 The interior of each panel shall be suitably illuminated through fluorescent lamps / tube lights with shrouded cover of minimum 15W operable on 240V 50 Hz AC power supply through panel door switch. A 15 Amp. 3-pin Power receptacle shall be provided.
- 3.1.15 Suitable space heaters operable on 240 Volts 50 Hz AC power system shall be provided at the panel bottom. These shall be designed to maintain the panel temperature five (5) deg. C above the ambient temperature during maintenance shutdown. Suitable isolating and control devices comprising of MCB, thermostat etc. shall be provided for the space heater.
- 3.1.16 The panel shall be provided with a copper earth bus of 25 x 6 mm size running throughout the width of the panel. It shall be terminated internally with 10 mm bolts at extreme ends for connection to; main station earth. The panel mounted equipments / devices shall be connected to earth bus through green coloured PVC insulated stranded copper conductor of 2.5 mm² size.
- 3.1.17 Local Panel shall be provided with main name plate of 150 mm x 40 mm size having inscription of 20 mm height. The individual devices on the panels shall be as provided with separate name plate with inscription of 3 mm height. The instrument / devices shall be provided with stick on label plates inside the panel. The material of the main and individual labels shall be three (3) ply 3 mm thick Traffolyte



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Sheet / 2 mm Anodised Aluminium Plate. The inscription shall be with white letters on black background on traffolyte sheet. The labels shall be fixed by self tapping non-rusting screws.

3.1.18 Vendor shall furnish electric load and heat load list (in case panel is to be placed in ac environment) of each panel.

3.2 Hazardous Area Panel Requirement

3.2.1 The Local Panel located in hazardous area shall be pressurized as per NFPA-496 requirements to render it non-hazardous. Alarms shall be provided for local and remote annunciation when pressurisation falls below 2.5 mm of water column. Protection shall be of type Z of NFPA-496. It shall not be possible to switch ON the power of purged section unless it is purged as per the recommendation of NFPA-496. Vendor must provide a protective device on the panel to protect the panel from over pressurisation.

3.2.2 Vendor shall supply pressurisation kit consisting of valves, restriction orifices, dual filter regulation, pressure gauges, pressure switches, rotameter etc. Pressurisation kit shall be surface mounting on a metal board and located outside the local panel. Pressurisation kit shall further consist of solenoid valve flow switch, timer blow off safety device etc., so as to make purging fully automatic. However final start shall be manual. Panel protection against over pressure to be provided as per NFPA-496.

3.2.3 Pressurised local control panel pressurization kit assembly design shall provide minimum leakage flow through the Local Control Panel. Panel venting shall be as per NFPA-496.

3.2.4 All components in the local panel like indicating instruments, push buttons switches, lamps etc., which are required to be energized without panel pressurization or before completion of purge cycle shall be explosion proof as per NEMA-7 & suitable for area classification.

3.2.5 All push buttons etc. requiring frequent operation during machine running shall have good positive sealing. Weatherproof housing or cover to be provided wherever necessary. Vendor shall provide pressurisation bypass switch outside explosion proof enclosure of pressurized panel with lamp indication. This shall be used only during maintenance. All hinges, screws, other non-painted metallic parts shall be of stainless steel material.

3.2.6 Provision to switch off manually all types of power shall be provided in the panel. In addition, it shall also be possible to switch off power circuits / components which are powered from motor control centre or control room manually in case of pressurization failure. All such cables from MCC and main control room shall be terminated in explosion proof boxes (NEMA-7).

3.3 Control & Monitoring devices

3.3.1 Instruments like Indicators, recorders, single loop controllers etc. as applicable and specified elsewhere for the plant / equipment shall be supplied and mounted on the panel.

3.3.2 Alarm Annunciator System

It shall be solid state discrete facia type having a sequence of ISA-S18.1A or as specified, opaque facia windows of 70 mm x 50 mm size, having two (2) lamps per window, and hooter of 10W, and provision for repeat group alarm at remote. The annunciator shall be provided with ten (10) percent spare windows or minimum two (2) windows along with electronics.

3.3.3 Relays

The relays shall be electromagnetic type suitable for specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable. There shall be ten (10) percent spare contacts.

3.3.4 Timers

The timers shall be electronic type suitable for specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However, minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable.



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3.3.5 Control / Selector Switches

Switches shall be Rotary Cam type with minimum of 5 Amps AC & 2 Amp DC continuous current rating. Selector switches shall be stay put type while control switches shall be spring-return-to-neutral type. Contact configuration and rating shall be as per the control function requirement. The switches shall be lockable type wherever specified. Each switch shall be provided with engraved plates indicating the switch position / functions.

3.3.6 Push Buttons / Indicating Lights

The push buttons shall be momentary action self-resetting type, however stop P.B. for unidirectional drives shall be provided with manual reset facility. Its contact configuration & rating shall be as required for the control function but minimum 2 NO + 2 NC of 5 Amp. AC rating. It shall have round coloured projecting tab and engraved escutcheon plate / inscription plate. Colour coding of push buttons shall be as under:

RED	Motor OFF / Valve CLOSE	YELLOW	Alarm acknowledge	Left Hand Side
GREEN	Motor ON / Valve OPEN	BLACK	Lamp test	Right Hand Side

Indicating lights shall be suitable for direct connections across specified power supplies. It shall be fitted with built in resistance to prevent circuit tripping on shorting of lamp filament. It shall be fitted with LED cluster type lamp replaceable from front.

GREEN	Motor OFF / Valve CLOSED condition	AMBER	Motor tripped	Left Hand Side
RED	Motor ON / Valve OPEN condition	WHITE	Normal / healthy	Right Hand Side

3.3.7 Ammeters

Ammeter shall be 96 x 96 mm size, 90 deg. deflection, 1.5% accuracy, 1 Amp. CT operated or with 4-20mA input and Flush mounting type as called for in the data sheet-A (No. PES-145-54A-DS1-0). Ammeters for motors shall have six (6) times folded scale at upper end to enable motor starting current indication

3.3.8 Miniature Circuit Breaker (MCB)

These shall be instantaneous magnetic trip type for short circuit in addition to current time inverse delayed thermal trip feature for over current protection. The housing of MCB shall be made of non-ignitable, high impact material. It shall have minimum short circuit rating of 9 KA for AC Voltages and 4 KA for DC Voltages.

3.3.9 Makes of various instruments / devices shall be as given below

1.	Alarm Annunciators	:	Procon / IIC
2.	Ammeters	:	AEP / IMP
3.	Control / Selector Switches	:	Alsthom / Kaycee / Siemens / L&T
4.	Push Buttons / Indicating Lamps	:	Siemens / L&T / Teknic / Alsthom
5.	Auxiliary Relays	:	Jyoti / Siemens / L&T / OEN
6.	Timers	:	L&T / Alsthom / Bhartiya Cutler Hammer
7.	MCBs	:	S&S Power Engg. / Indo Asian / MDS
8.	Terminal Blocks	:	Jyoti / Elmex

4.0 TESTING AND INSPECTION

4.1 The bidder shall adopt suitable quality assurance program to ensure that the equipments offered will meet the specification requirements in full.

4.2 BHEL's standard Quality Plan for LCP is enclosed with the specification. The bidder shall furnish his acceptance to BHEL's QP and submit the signed and stamped copy of QP along with the offer.



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4.3 The vendor shall conduct the following tests as a minimum requirement:

4.3.1 Routine Tests

1. High Voltage (H.V.)
2. Insulation Resistance (I.R.)
3. Functional

4.3.2 Type Tests

1. Enclosure Class Test



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5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

The bidder shall supply all commissioning spares and consumables 'as required' during Start-up, as part of the main equipment supply.

5.2. Mandatory Spares

The bidder shall offer alongwith main offer, the Mandatory Spares as specified elsewhere in the specification. The Mandatory Spares offered shall be of the same make and type as the main equipment.

5.3. Recommended Spares

The bidder shall furnish a list of Recommended Spares indicating the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation alongwith unit rate against each item to enable BHEL/BHEL's Customer to place a separate order later, if required.

6.0 DRAWINGS AND DOCUMENTS

6.1 The bidder shall furnish the following documents in required number of copies along with the bid :

1. Data Sheet no. PES-145A-DS1-0
2. General Arrangement Drawing.
3. Catalogue and technical information for instruments and devices.
4. Quality Plan.

6.2 The vendor shall furnish the following documents in required number as agreed after the award of contract:

1. Data Shee No. PES-145A-DS2-0
2. GA Drawing indicating layout of instruments, construction details, foundation details, cable gland plate alongwith cable glands and all details mentioned in this specification.
3. Control Schematic Diagram along with grouping of different terminals for various functions.
4. Catalogue and technical information for instruments and devices with selected options clearly marked.
5. O&M Manuals.
6. "As Built" Drawing.
7. CDs.

7.0 MARKING AND PACKING

7.1 Panel with all instruments / devices mounted on it shall be suitably packed & protected for the entire period of despatch, storage and erection against impact, abrasion, corrossion, incidental damage due to vermin, sunlight, high temperature, rain moisture, humidity, dust, sea-water spray (where applicable) as well as rough handling and delays in Transit and storage in open.

8.0 APPLICABLE DATA SHEET FORMS

This document shall be read with one or more of the following data sheet forms :

- Data sheet A&B for Local Panels	:	Data sheet no. PES-145A-DS1-0
- Data sheet C for Local Panels	:	Data sheet no. PES-145A-DS2-0



DATA SHEET FOR LOCAL PANELS

SPECIFICATION NO.: PE-SS-999-145-054A

VOLUME

SECTION

REV. NO.

02

DATE: 16.09.2013

SHEET

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OF

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TAG No. Qty.....

Data Sheet No.: PES-145A-DS1-0

Data Sheet A & B

DATA SHEET-A FOR LOCAL PANEL
(TO BE FILLED BY PURCHASER)

DATA SHEET-B
(TO BE FILLED-UP BY
BIDDER)

GENERAL

MANUFACTURER

CONSTRUCTION

☐ FOLDED ☐ WELDED
(As per requirement EDN)

ENCLOSURE SHEET THICKNESS

FRONT

☐ 2.0 mm

OTHER

☐ 2.0 mm

DOOR

☐ 1.6 mm

HEIGHT

☐ 2365 mm for stand alone panels. ☐ Other

OTHER

☐ Load bearing sheet front shall have 3mm thickness

TECHNICAL

INPUT POWER SUPPLY *

(ANY OTHER POWER REQUIREMENT
TO BE DERIVED FROM THIS SUPPLY ONLY)

☐ 240V 50 Hz AC ☐ 220V DC
☐ 415V 3 PHASE 3W ☐ 415V 3 PHASE 4W

NO. OF FEEDERS

☐ ONE ☐ TWO

STARTER WITH MCC

(CHECK WITH MAUX/ELEC)

☐ REQUIRED ☐ NOT REQUIRED

IPR POSITION

☐ MCC ☐ RELAY PANEL

CONTACT RATING OF RELAY

☐ 5 Amp, 230 V AC ☐ 0.25 Amp, 220V DC

CONTROL SUPPLY

☐ 110V AC ☐ 220V AC
☐ 220V DC ☐ Other.
(As per requirement)

ALARM ANNUNCIATOR WINDOW

(EXCLUDING SPARES)

____ NOS. (AS REQUIRED)

TEMP SCANNER

(IF REQUIRED –NO. OF CHANNELS TO BE
SPECIFIED UNDER SEC-C)

☐ REQUIRED ☐ NOT REQUIRED

PAINT TYPE

☐ EPOXY ENAMEL
☐ EPOXY POWDER COATED

MIMIC (TYPE OF MIMIC- MATERAIL, THICKNESS
TO BE SPECIFIED DURING DETAILED ENGG.)

☐ REQUIRED ☐ NOT REQUIRED

PANEL COLOUR (EXTERNAL)

☐ LIGHT GREY (Shade 631 IS-5)
☐ OPALINE GREEN (Shade 275) .

FINISH (EXTERNAL)

☐ MATT
☐ GLOSSY ☐ SEMI GLOSSY

PANEL COLOUR (INTERNAL)

☐ WHITE ☐ CREAM
☐ OFF WHITE

FINISH (INTERNAL)

☐ MATT
☐ GLOSSY ☐ SEMI GLOSSY

CLASS OF PROTECTION

☐ IP-42 (FOR INDOOR SERVICE)
☐ IP-55 (FOR OUTDOOR SERVICE) ☐ ANY
OTHER

CONTROL HARDWARE

☐ RELAY BASED

	DATA SHEET FOR LOCAL PANELS		SPECIFICATION NO.: PE-SS-999-145-054A	
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TAG No. Qty.....			Data Sheet No.: PES-145A-DS1-0	
Data Sheet A & B				
DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
	FOUNDATION ARRANGEMENT		☐ FOUNDATION BOLTS ☐ ANCHOR FASTENERS	
	WEIGHT OF PANEL (Kg.)		(Vendor to specify)	
	PANEL TYPE		☐ PRESSURISED ☐ UNPRESSURISED As per Requirement	
	CABLE GLAND		☐ DOUBLE COMPRESSION	
	AMMETER (TYPE OF INPUT) *		☐ 1 Amp CT ☐ 4-20 mA	
	SCOPE OF SUPERVISION FOR ERECTION & COMMISSIONING		☐ APPLICABLE ☐ NA	
	* TO BE CO-ORDINATED WITH PEM ELECTRICAL			
NAME DESIGNATION SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL NAME: SIGNATURE: DATE:
	AANCHAL CHOUDHARY	SACHIN SRIVASTAVA	MA MANSOORI	
	SR.ENGR	DY.MNGR	D. GM	
	16.09.2013	16.09.2013	16.09.2013	



DATA SHEET FOR LOCAL PANELS

SPECIFICATION NO.: PE-SS-999-145-054A

VOLUME

SECTION

REV. NO.

02

DATE: 16.09.2013

SHEET

3

OF

3

TAG No. Qty.....

Data Sheet No.: PES-145A-DS1-0

Data Sheet C

DATA SHEET-C FOR LOCAL PANEL
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

GENERAL	MANUFACTURER				
	CONSTRUCTION		☐ FOLDED ☐ WELDED (As per requirement EDN)		
	ENCLOSURE SHEET THICKNESS	FRONT			
		OTHER			
		DOOR			
		HEIGHT			
OTHER					
TECHNICAL	INPUT POWER SUPPLY				
	NO. OF FEEDERS				
	CONTACT RATING OF RELAY				
	TEMP SCANNER				
	CONTROL SUPPLY				
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)				
	PAINT TYPE				
	PANEL COLOUR (EXTERNAL)				
	FINISH (EXTERNAL)				
	TYPE OF MIMIC				
	MATERIAL OF MIMIC				
	THICKNESS OF MIMIC				
	PANEL COLOUR (INTERNAL)				
	FINISH (INTERNAL)				
	CLASS OF PROTECTION				
	CONTROL HARDWARE				
	FOUNDATION ARRANGEMENT				
	WEIGHT OF PANEL (Kg.)				
	PANEL TYPE				
	CABLE GLAND				
	AMMETER (TYPE OF INPUT)				
	SCOPE OF SUPERVISION				
NAME SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL NAME: SIGNATURE: DATE:	
	AANCHAL CHOUDHARY	SACHIN SRIVASTYAVA	MA MANSOORI		
	16.09.2013	16.09.2013	16.09.2013		

Interposing relay panels for the system shall be supplied for mounting interposing relays & terminating all cables originating from the DO cards in case of solenoid valves, and other required services etc. IPR panels shall be placed in CER and LCR.

Interposing relay shall be mounted in respective SWGR / MCC / integral starter required for commands signals of HT / LT unidirectional drives and bidirectional drives, breakers, isolators & bus couplers etc. from DDCMIS / DCS or any control system. Terminal blocks shall be located inside the cabinets on support wings fabricated of metal plates. Similarly suitable lockers (min. 8 nos in each control room) shall be provided in BOP package / BTG offsite control rooms shall be provide by bidder.

The plug socket shall be mounted on hinged plates to provide an access to the rear pins of the plugs. General features of termination cabinets and accessories shall conform to the general design and construction specification of panels. Terminal blocks shall be Rail mounted Terminal blocks (Screw less cage clamp type) with markers.

2.3.6.5 Constructional Features of Panels, Consoles, Control Desk, Cubicles & Enclosures

All panels, cubicles, consoles, SOV panels and enclosures furnished as per this specification shall be of free standing type and shall be constructed of specified gauge of steel plates. The panel sheet thickness shall be not less than 2mm unless otherwise specified herein.

The panels, consoles / desks shall be reinforced as required to ensure true surfaces and adequate support for instruments mounted thereon. All instrument cut outs, mounting studs, and support brackets shall be accurately located. All welds on the exposed panel surfaces shall be ground smooth. Finished panel surfaces shall be free from waves, bellies, or other imperfections. Unless specified, otherwise, panel doors shall be 4 points hinged and shall have turned back edges and additional bracing where required to ensure rigidity. Door hinges shall be of the concealed type. Door latches shall be of the three-point type to ensure tight closing. Door locks shall be furnished which will allow actuation of all locks by a single master key. All panels shall have removable lifting eyebolts for safe lifting from top during storage and installation handling.

Cabinet doors shall be hinged and shall have turned back edges and additional bracing where required ensuring rigidity. Hinges shall be of concealed type. Door latches shall be of three / four-point type to assure tight closing. Detachable lifting eyes or angles shall be furnished at the top of each separately shipped section and all necessary provisions shall be made to facilitate handling without damage. Front and rear doors shall be provided with locking arrangements with a master key for all cabinets. If width of a cabinet is equal or more than 800 mm, double doors shall be provided.

All panels shall be mounted on vibration dampers, which are secured to channels mounted on the floor. The channels shall be field welded to steel plates set into the concrete flooring. The steel plates shall be located such as to approximate the outline of panel bases. The exact mounting details shall be as approved by the owner during detailed engineering stage. All panels shall be provided with adequate ventilation and packaging density of components shall be restricted so as to limit the

temperature rise above ambient to 10°C under the worst conditions. All panels shall have auto on/off switch for internal lighting. All the power supply circuit for control panels shall be provided with auto changeover circuitry.

In each panel / cabinet, a 24 VDC Voltmeter digital type shall be provided to check the Field Interrogation voltage.

Exhaust Fans with louvers & filters shall be provided on door's (front & Rear) upper side to remove hot air in all consoles, control desk and panels.

~~Fire / Smoke detectors shall be provided inside the Control room mounted system / control cabinets.~~

UPS, 24V DC & non UPS's Feeder failure / healthy indication shall be provided in each cabinet & remote indication shall be hooked up to DDCMIS / DCS / annunciation & suitably grouped.

All the panels shall be equipped with Antivibration pad of min. 15 mm size. Cable gland plate thickness shall be 3 mm.

Doors shall be provided with neoprene / polyurethane gasket only.

All the cable entries shall be at the bottom of electronic cubicles / control panels. Protection class of panels shall be as specified at Vol. II, chapter 2.

a) Operator Control Desk

In CCR, Operator work station consoles / desk shall be of granite top of curved nature with powder coated frame. OWS consoles shall be provided with the facility for locating the CPU, document etc. with all required utilities.

Unit In charge desk / consoles shall be of granite top of curved nature with powder coated frame. OWS consoles shall be provided with the facility for locating the CPU, document etc. with all required utilities.

Station In charge desk / consoles shall be of granite top of curved nature with powder coated frame. OWS consoles shall be provided with the facility for locating the CPU, document etc. with all required utilities.

Engineer work station and all other consoles / desk shall be ergonomically designed industrial grade type with swivel chairs for use at the various Programming stations and all other plant locations. All the equipment like Programmers stations, PC's, various peripherals & similar devices shall be complete with desks and they shall be of industrial grade stands and other mounting accessories and the same shall be completely erected & commissioned by the bidder. Details for other operating and engineering stations shall be as below:

1. Operator Control desk shall be free standing table top type with doors at the back and

shall be constructed of 3 mm thick CRCA steel plates. It shall have concealed cable & wire way management system. The top surface of control desk shall be 30mm thick with the top 12mm of acrylic solid surface and the remaining 18mm of laminated medium density fibre board. Control desk shall consist of vertical, horizontal and base supports with their coverings for work surface, keyboard trays, Mouse pads, Monitor shelf and concealed cable and wire way management, perforated trays with covers in both horizontal & vertical directions.

2. To achieve durable & water resistant finish, a sheet of "plastic PVC membrane" on the surface of control desks shall be provided. Final paint finish with proper smoothening is to be ensured. Final finish of CD should be in line with relevant International standards. For more durability, the membrane sheet of the Control desk should extend 200 mm more into the underside of the desk. The cabling / wiring between OWS & CPU's, power supply cables etc. shall be aesthetically routed and concealed from view.
3. All the control desk shall be equipped with Anti vibration pad of min. 15 mm size. Cable gland plate thickness shall be 3 mm.
4. Doors shall be provided with neoprene / polyurethane gasket only.

b) Surface Preparation and Painting

All panel exterior steel surfaces shall be ground smooth, and painted as specified below: Suitable filler shall be applied to all pits, blemishes and voids in the surfaces. The filler shall be sand blasted so that surfaces are level and flat, corners are smooth and even. Exposed raw metal edges shall be ground burr free. The entire panel surface shall be sand blasted to remove rust and scale and all other residue due to the fabrication operation. Oil grease and salts etc. shall be removed from the panels by one or more solvent cleaning methods. Alternatively 7 tank process shall be followed.

Two spray coats of inhibitive epoxy primer surface shall be applied to all exterior and interior surfaces, each coat of primer surface shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final finish colour (Catalysed epoxy finish) shall be applied to all surfaces of dry film thickness 2.0 mil. The finish colours for exterior and interior surfaces shall conform to the following shades:

- a. Exterior - RAL 7032 / RAL 7035.
- b. Interior - Glossy white two coats / RAL 7035 with fire resistant paint

One uniform colour shade as finalized shall be applicable for complete plant. Paint films, which show sags, checks, blisters teardrops, fat edges or other painting imperfections, shall not be acceptable and if any such defects appear, they shall be repaired by and at the expenses of the Bidder.

c) Panel Wiring

Interconnecting wiring shall be provided between all electrical devices mounted in the panels, and between the devices and terminal blocks if the devices are to be connected to equipment outside the panels by cabling and through pre-fabricated plug in cables. All alarm contacts located within a panel shall be wired to terminal blocks. Thermocouple and other special circuits shall be field wires direct to instrument terminal blocks without the use of panel wiring.

All control and instrument wiring used within the panels shall conform to NEC and NEMA standards and shall be factory installed and tested at the works of a qualified manufacturer. All interior wiring shall be installed neatly and carefully, and shall be terminated at suitable terminal blocks. Sufficient clearance shall be provided for all control and instrumentation leads, and all incoming and outgoing leads shall be connected to terminal blocks suitably located for connecting external circuits.

All panel wiring shall have appropriate ferruling for clear identification. Interior wiring shall be so arranged that the external connections can be made with only one wire per terminal point. Any common connections shall be made internal side of the terminal blocks. Common connections shall be limited to two wires per terminal. Instrumentation cable shield wires shall be connected to separate terminal at the terminal block. Signal circuit shields shall be grounded separately.

All internal wiring (except low level instrument wiring) shall be National Electric Code Type SIS, Plyometric / Elastomeric insulated, tinned copper stranded conductor, switchboard wire, or owner approved equal.

Panel wiring shall have a flame resistant insulation with adequately sized 650 / 1100 V grade tinned copper stranded conductor based on current carrying capacities as etc. forth by the National Electric Code. Wire sizes shall be as specified herein and suitable for intended applications.

Wiring to door mounted devices shall be provided with (49 strand minimum) adequate loop lengths of hinge wire so that multiple door openings will not cause fatigue braking of the conductor.

Wiring shall be arranged to enable instruments or devices to be removed and / or serviced without unduly disturbing the wiring. No wire shall be routed cross the face or rear of any device in a manner, which will impede the opening of covers or obstruct access to leads, terminals or devices.

Panel wires shall be identified with wire number and each termination by means of action craft products split sleeve or Borden Chemical Co. indelible tubing markers or owner approved equal. Corrections and modifications of all panel wiring shall be Bidder's sole

responsibility. Any corrections / modifications required at site for successful commissioning shall be done by the Bidder without any additional costs. Terminal lugs furnished must be of the compression, insulated sleeve, half ring tongue type. Open ended terminal lugs will not be accepted. Wires shall not be looped around the terminal screws or studs. Wires shall not be tapped or spliced between terminal points.

Panels, cabinets, consoles / desks will be provided with removable, gasketed cable gland plates and cable glands, for all floor slots used for cable entrance. Split type grommets shall be used for prefab cables.

Internal wiring in factory prewired electronic systems cabinets may be installed according to the Bidder's standard as to wire size, insulation, and method of termination on internal equipment except that insulation for all wiring power supply wiring, and interconnecting cables between devices shall pass the following tests.

- 1) Flammability test IEEE 383 / 1974
- 2) When tested under UITPP test method or ASTM 2893 / 77 light transmittance of 80%.
- 3) When tested under IEC 754-1 maximum acid gas generation shall be 2% by weight
- 4) Oxygen index not less than 30 as per ASTM D 2863.

All terminations for intra panel wiring inter panel cabling and connecting the Bidders panels, PB stations, control stations etc. shall be with cage clamp Screwed less connections. Soldered connections are not acceptable. All field side or external input connections shall also preferably of Cage clamp / Spring Clamp / Screwed less connection.

Conductor clamping shall also confirm to Standard IEC – 60947-1 & IEC-60947-7-1. Identification of conductors may be done by insulation colour coding identified on drawings or by printed wiring lists. Terminal blocks for connection of external circuits in to factory prewired electronic system cabinets shall meet all the requirements as described elsewhere in the specification. For all multicore cables, the outer sheath shall satisfy the properties identified above. However, for panel wiring, the wiring insulation shall also satisfy the properties identified above. The internal wiring shall be done in coloured wiring.

Following Wire size shall be utilized for internal wiring:

S.No	Nature of signals	Wire size
1	Current (4-20 mA), Low voltage signals (AI / AO & DI signals)	0.75 sq.mm
2	DO signals, Ammeter / voltmeter circuit, control switches, indicator, recorder	1.5 sq.mm
3	Internal Illumination	2.5 sq.mm

S.No	Nature of signals	Wire size
4	Size of Power supply cables shall be as below:- i. 1 to 16 Amp. ii. 17 to 20 Amp. iii. 21 to 32 Amp. iv. 33 to 40 Amp. v. 41 to 60 Amp. vi. Power earth	2.5 sq. mm 4 sq. mm 6 sq. mm 10 sq. mm. 16 sq. mm 4 sq. mm

d) Instruments Mounting

Instruments and relays mounted on the panels shall be easily accessible for repair and replacement without disturbing other equipment their connected wiring. No special tools shall be needed for the purpose.

e) Panel Illumination

Panels shall be provided with LED based illuminating lamps with door switch and six (6) point 6 / 16A, 240V AC universal type power sockets with switch for maintenance purposes. These switches shall be with quick make and break mechanism. 100 % spare LED lamps shall be provided with each panel, these are in additional to mandatory spares.

f) Fuse Blocks

Where fuse blocks rated 30 amp. 250 Volts are required by the specifications or the manufacturer's design, they shall be modular type with Bakelite frame and reinforced retaining clips. Blocks shall be class H.2 pole, screw terminal fuse blocks. Blocks for other current and voltage ratings shall be similar in construction.

g) Fuses & MCB

All fuses shall be fast acting semiconductor types for AC supply and compatible to the UPS fuses. For all DC Powered devices, similarly the fuses shall be fast acting compatible to

DCDB fuse provisions. All the AC power supplies shall be provided with the protection of Fast acting semiconductor fuses & 2 P thermomagnetic type MCB. Make of Fuses shall be GE or Siemens. For all the DC power supply circuits, electronic type DC MCB shall be used only. Make of DC MCB shall be Siemens, Phoenix contacts, Murr, Weidmuller, or Lutze. 50 % spare fuses shall be provided with each panel, these are in additional to mandatory spares.

h) Moulded Case Circuit Breakers

Moulded case circuit breakers used in equipment covered under these specifications shall have not less than 5000 amp. Interrupting capacity at 220 Volts DC 10,000 Amp. Symmetrical interrupting capacity at 240 Volts AC. MCCB shall be provided at each main feeder line like ACDB & DCDB main feeders, PLC main feeder, control panels, UPS circuits etc.

i) Grounding

All panels and cabinets shall be provided with a continuous bare copper ground bus of minimum 6 mm x 25 / 50 mm cross section. The ground bus shall be bolted to the panel structure and effectively ground the entire structure. Each Ground bus shall have provision at each end for connection of ground leaks (6 mm x 50 mm GI Flats) by suitable bolting. All system cabinets shall be brought to a common system ground by the bidder. Electronic earthing resistance shall be < 0.5 ohms.

Each circuit requiring grounding shall be individually and directly connected to the panel ground bus by ring tongue type compression lugs. For electronic system cabinets the system ground bus shall be insulated from the cabinet enclosure and shall be separately connected to the system ground. All system cabinets shall be brought to a common system ground by the bidder.

The Bidder shall furnish his recommendations regarding grounding requirements for all equipment / systems and shall specifically indicate the deviations if any from the above requirements as a part of his proposal.

j) Terminal Blocks

For all inputs to the system emanating from the field or other systems, the bidder shall furnish terminals suitable for correct size of field cables.

All outputs going to MCC / SWGR terminal blocks, shall be rated 600 volts minimum and shall have strap screw less terminals suitable for connection of wires with ring tongue type lugs. Standard terminal blocks shall be screw less cage clamps type. Terminal blocks shall be approximately sized for larger wire size of higher voltage insulated incoming conductors as necessary. All the TBs used shall be 6.6 polyamide to withstand corrosion and the metallic portion shall be coated against rust / corrosion. All metal parts should be nonferrous in nature.

Terminal blocks shall be provided with white marking strips and re permitted by the safety codes and standards shall be without covers.

Fuses shall not be mounted on terminal blocks. Neither step type terminal blocks nor angle mounting of terminal blocks will be acceptable.

At least 20 per cent spare unused fully wired terminals shall be provided on each terminal block for circuit modifications and for termination of all conductors in a multi-conductor control cable with each panel, enclosure, cubicle, SOV Boxes etc.

k) Name Plates and Labels

Name plates of adequate size shall be provided for each panel on front and rear of the panel. Instruments / other accessories mounted inside the panels shall have identification marking clearly visible from inside.

Devices to be mounted on the panels shall also be labelled on the panels shall also be labelled on the outside of the panel. Name plates shall be of polyamide sheets with black letters on white background. Name plates shall be attached to the boards by means of stainless steel pan head screws. Fuses provided for protection of various boxes shall be accessible for replacement. Fuse boxes shall be provided with circuit label and fuse rated current and voltage.

l) Markings / Labels

All markers / labels shall be made of halogen & silicon free polyamide material with inflammability class V2 as per UL 94, ensuring scratch proof printing with the use of environment friendly solvent free ink & latest BLUEMARK UV technology so as to comply the WIPE RESISTANCE according to DIN EN 61010-1 / VDE 0411-1.

2.3.6.6 Local Instrument Racks & Enclosure

Transmitters and switches located in the field shall be grouped together and shall be installed in the enclosure (closed transmitter racks) in case of outdoor area such as Boiler area etc. And in open type Rack in case of covered area. Racks shall be factory prefabricated & painted and complete with internal tubing, manifold valve, isolation valves, integral junction boxes with outside access door, illumination etc. Racks used for furnace, flue gas and air application shall be provided with intermittent & continuous air purging.

i) Closed Type Instruments / Transmitter Racks

- a)** Required number of Instruments / transmitter racks shall be furnished to house transmitters, switches and converters by grouping them suitably, area wise / function-wise.
- b)** The transmitter enclosure shall be constructed of 3 mm thick steel plate. The enclosures shall preferably be of modular construction and with two end plate assembly bolted to the frame.
- c)** The enclosure shall approximately be 1200 millimetres wide, 1000 millimetres deep and 2200 millimetres high to allow easy access to the internals. Racks shall be reinforced as required to ensure true surfaces and to provide adequate support for instruments and equipment mounted therein. Double interlocking doors with three point locking arrangement shall be provided and shall be arranged for maximum possible access to the interior. Centre posts or any member which would reduce access shall not be provided.

- b) Since nowadays the reliability and availability of control system is enhanced due to the redundancy path, backup panel with mosaic and vertical type (not L type) is to be provided with as minimum as possible for safe guarding the main equipments BTG and auxiliaries.
- c) Hence in addition to the LVS and OWS, a limited operation from backup unit control vertical panel with mosaic is envisaged for emergency operation and to provide safe shut down of plant/equipments. The backup Unit control vertical panel with mosaic shall be housed Conventional Push-button (ILPB) stations, Console inserts (SG & TG), Trip Push Buttons, Ammeters, CCTV for Furnace Flame, chartless recorders & digital display units for Boiler, Turbine & Generator Process/electrical parameters. Also bidder to refer details in Chapter 6.
- d) Back up panel system shall be designed for handling the situation in clause 2.3.2.17 for failure of HMI.
- e) For electrical layout, complete backup panel with mosaic shall have to be provided for complete on/off operations with necessary meters, DDUs, synchronoscope etc. as specified elsewhere in specification.

2.3.2.11.1 Unit Control And Monitoring Philosophy

The main equipments namely SG & Auxiliaries, TG & auxiliaries , Power cycle / LP piping, Equipments cooling area system and Circulating water system CW etc for this project is envisaged to be controlled from the operator workstations (OWS) mounted on the Unit control Desk (UCD) in association with Large Video Screens (LVS) and backup panels in the Unit Control Room (UCR) under all regimes of operation i.e. start up, shutdown, load maneuvering, load throw off & emergency handling. All the information required for safe and efficient operation of the plant shall be displayed on OWS MONITORS at high speed and accuracy in specially designed displays suitable for Power plant operation .The quantity of OWS stations and LVS are shown in the configuration diagram and elsewhere in the specification.

It may be noted that the plant operation in all regimes even in case of emergency operation is envisaged through LVS and OWS MONITOR only. However Hardwired PB Stations / TPL switches and supervisory/monitoring instruments are envisaged for utmost emergency or the contingency and in case non availability of both i.e. operators' workstations & LVS so as to bring the unit or equipment to safe shutdown without damaging plant/equipment.

Control panel cum desk with HW annunciation windows, ILPBs, Ammeters, PBs, voltmeters, indicators, mimic, recorders etc. shall be provided as Control System Philosophy.

2.3.2.12 Protection, class of cabinets / panels, enclosures etc.

- a) All panels, desks cabinets, consoles & enclosures furnished at least comply with the requirements of protection classes as indicated below.

Ambient Temperature (outside cabinets)	Atmosphere & Pressure	Relative Humidity (RH)	Required Protection Class
Outdoor Locations			
55 degree C max.	Dirty Air @ Atmospheric Pressure	100 % Max.	IP 66***
4 degree C min.	Dirty Air @ Atmospheric Pressure	5 % Min.	IP 66***
Indoor Locations			
55 degree C max.	Air @ Atmospheric Pressure	95 % Max.	IP 54**
4 degree C min.	Air @ Atmospheric Pressure	5 % Min.	IP 54**
Air Conditioned Areas			
24±5 degree C (normal)	Air @ Atmospheric Pressure	95 % Max.	IP 32
50 degree C max.*	Air @ Atmospheric Pressure	5 % Min.	IP 32
* During air conditioning failure.			
** For non-ventilated enclosures. For ventilated enclosures, protection class shall be IP 42.			
*** With a suitable canopy at the top to prevent ingress of dripping water.			

- b) Distribution boxes, junction boxes, cold junction compensation boxes, terminal boxes and all other field mounted equipment to be furnished as per this specification shall have weather protection conforming to IP 65.
- c) The design of panels, cabinets, enclosures and packaging density of components mounted therein shall be such that the temperature rise does not exceed 10 deg. C above the ambient under the worst conditions.
- d) The panels housing electronic hardware shall be provided with flame and smoke detectors by bidder.
- e) Enclosures for peripheral equipments like printers, etc. shall take care of noise and shall ensure minimum possible noise disturb to the working personnel.
- f) For Hazardous areas the protection class shall be in accordance with the requirements of the relevant NEC code for the location.
- g) ~~Workstations, OWS, EWS, Servers, Network Switches, Printers, and other peripherals, maximum temperature limit shall be 40 deg. C. For LVS the same shall be around 30 deg. C.~~
- h) ~~For remote I/O cabinets mounted in non-AC areas, panel redundant AC shall be provided.~~
- i) Specific requirements due to corrosive applications and corrosive environment at project site shall also be considered by bidder.
- j) Delivery of all electronic panels from the manufacturer's works are subject to readiness of respective work fronts or readiness of fully covered stores.

Guards, barriers and access doors, covers of plates shall be marked to indicate the hazard, which may occur upon removal of such devices. Danger or caution signs shall be used to warn of specific hazards such as voltage or current. The marking shall be permanently affixed to the equipment.

2.3.2.13 System Documentation

Master document/drawing list along with dates within 3 months shall be submitted by bidder after award of contract for each package for approval of owner. The Bidder shall provide drawings, system overview & description, hardware/software details, Technical literature, functional & hardware schemes, bill of material, parts list, Inter connection diagrams, data sheets, erection / installation / commissioning procedures, Instruction/operating manuals, etc. for each of the C&I system/sub-systems/equipment, supplied under this package. The documentation shall include complete details of the C&I systems/sub-systems/equipment to enable review & approval by owner during detailed engineering stage and to provide information to plant personnel for Operation & Maintenance (including quick diagnostics & trouble shooting) of these C&I systems/sub-Systems/equipments at site. Following minimum documents shall be submitted by bidder during detailed engineering for review and approval:

DATA / DETAILS TO BE FURNISHED		
S.No	Description	Category
1	C&I System Design Basis Report incorporating Control philosophy / Operation philosophy / Design philosophy / Redundancy philosophy.	A
2	Codes and application standard followed for the project.	A
3	Process & Instrumentation Diagrams (PID) indicating local gauges, Transmitters, analysers for (alarm, control etc.)	A
4	Engineering documents for DDCMIS / DCS based control systems: a. Bill of Quantity for DDCMIS / DCS based system b. I / O Assignment for DDCMIS / DCS based control system including nest loading. c. Instrument Schedule with set points d. I / O List e. Drive List / Solenoid Valve List f. Annunciation List g. SOE list. h. Process mimics / graphics indicating Analog and digital parameters i. List of logs with point assignment j. Time Synchronisation System k. Historical Storage and Retrieval (HSR) system details. l. List of Displays m. Plant Performance Calculation & Optimisation package Details n. Controller partitioning Diagram o. Data sheet for HART management system p. Drive Control Philosophy & MCC Interface diagrams	A

QUALITY ASSURANCE PLAN

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PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.: **PE-QP-999-145-I056**

VOLUME IIB

SECTION D

REV. NO. **01** DATE: **22-02-2008**

SHEET 1 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks
									P	W	V	
1.0	INCOMING Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	IS:1079 IS:513	IS:1079 IS:513	Test Certificate	3	---	2	
		2. Bend Test	CR	Mech. test	Sample	IS:1079 IS:513	IS:1079 IS:513	Log Book	2	---	---	
		3. Surface finish	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---	
		4. Waviness	MA	Visual	100%	Factory Standard	No Waviness	Log Book	2	---	---	
		5. Thickness	MA	Measurement	100%	BHEL Spec.	BHEL Spec.	Log Book	2	---	---	
		6. Mill marking	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	1	
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	IS:2062	IS:2062	Log Book	2	---	---	
		2. Surface Defects	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---	
		3. Straightness	MA	Measurement	100%	Factory Std.	Factory Std.	Log Book	2	---	---	
		4. Mill marking	MA	Visual	100%	IS:2062	IS:2062	Log Book	2	---	1	
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		2. IR and HV	MA	Electrical	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics

^{\$} P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor

 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL						STD QUALITY PLAN NO.: PE-QP-999-145-I056				
								VOLUME IIB				
								SECTION D				
								REV. NO. 01 DATE: 22-02-2008				
								SHEET 2 OF 7				
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
		3. Conductor a) Resistance b) Size c) Sheet colour	MA MA MA	Electrical Measurement Visual	100% 100% 100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	3	---	2	
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type 2. Verification of Test Certificates 3. Operation / Functional check 4. I.R. 5. H.V. 6. Calibration 7. Pick up / Drop off Voltage	CR CR CR MA MA MA MA	Visual Scrutiny of Type / Routine T.Cs. Electrical Electrical Electrical Electrical	Sample 100% Sample+ 100% 100% 100% 100% 100%	BHEL Spec. and BOM Relevant IS Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue	BHEL Spec. and BOM Relevant IS Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue	Log Book Log Book Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2 2 2	--- --- --- --- --- --- ---	--- --- --- --- --- 1 ---	+ for relay & contactors only @ for all components except relays & contactors.
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics ^s P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test. 1 - BHEL 2 - Vendor 3 - Sub-vendor												

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks	
									P	W	V		
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---		
		2. Surface defects	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---		
		3. IR / HV on Terminal Blocks	MA	Electrical	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---		
6.0	IN PROCESS Blanking / Bending / Forming	1. Dimensions	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---		
		2. Surface defects after bending	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	---		
7.0	Nibbling / Punching	1. Cutout Sizes	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---		
		2. Deburring	MA	Visual	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---		
8.0	ASSEMBLY Frame Assembly & Sheet fixing	1. Dimensions	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2		
		2. Alignment	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2		
		3. Welding Quality	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2		
		4. Surface defects	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2		
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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		3. Dipping / Removal Time	MA	Measurement	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		4. Surface quality after every dip	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		5. Primer after phosphating	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		6. Putty Application & Rubbing after primer	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		7. Paint first coat	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks
									P	W	V	
10.	Panel Wiring	1. Wiring Layout	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		2. Wiring Termination (Crimped Lugs)	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		3. Ferrule numbers	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		4. Colour of wiring	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
		5. Size of Conductor	MA	Measurement	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
11.	Component Mounting	1. Correct components	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
		2. Fixing	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
12.	FINAL Final Inspection	1. Workmanship	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.
		2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		3. Components identification Marking / Name plates	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
		5. Dimensions	MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.
		6. Door functioning	MA	Functional	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		7. Paint Shade	CR	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		8. Paint Thickness	CR	Measurement	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		9. Workmanship of Gaskets	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	
		10. Wiring Layout	MA	Visual	100%	BHEL approved drg.	BHEL approved drg.	Inspection Report	2	1	1	
		11. Wire Termination	MA	Pulling manually	Sample	-----	Firm termination	Inspection Report	2	1	1	
		12. Continuity	MA	Electrical	100%	-----	Continuity OK	Inspection Report	2	1	1	

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	Type Test Certificate	3	---	1	
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant IS.	BHEL approved spec., drg., BOM & relevant IS.	Test Report	2	1	1	
15	FUNCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		2. Instrument Calibration	CR	Electrical	10%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		3. Temperature rise	CR	Electrical	100%	BHEL approved spec/drg. & relevant IS.	BHEL approved spec/drg & relevant IS.	Inspection Report	2	1	1	

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2.5.3.6 Calibration of Instruments

The Bidder shall carry out the calibration of instruments as indicated below by submitting the test procedure and quality assurance plan for the Owner's approval. Bidder shall also prepare detailed checklist/calibration sheets for each of the systems/equipment clearly indicating the step-by-step procedures to be carried out for calibration pre commissioning, loop checking, powering and commissioning.

The calibration of all instruments shall be checked and calibration records prepared for the Owner's use. If the instruments require recalibration, Bidder shall recalibrate the instruments and revise the calibration records and submit to the Owner.

2.5.3.7 Tests to be performed for Field Instruments

S.No	Tests to be performed
1.	Pressure Gauges
	Calibration Hydro test (1.5 times max. pr.)
2.	Pressure switches
	Calibration test / Hydro test / Contact rating test / Accuracy test / Repeatability
3.	Differential Pressure Gauges
	Calibration test / Hydro test / Leak test / Over range test / Accuracy test / Repeatability test.
4.	Differential Pressure Switches
	Calibration test / Hydro test / Contact rating test / Leak test / Accuracy test / Repeatability test.
5.	Thermometers
	Calibration / Material test / Accuracy test / Bore concentricity : $\pm 5\%$ of wall thickness / Hydrostatic test for TW (1.5 times max. pr.)
6.	Temperature switch
	Calibration / Material test / Accuracy test / Bore concentricity: 1.5% of wall thickness / Hydrostatic test for TW (1.5 times max. pr.) / Contact rating test.
7.	Resistance temperature detector assembly.
	Calibration / Material test / Bore concentricity test / Insulation test ($\leq 500 \text{ M}\Omega$ at 500V DC) As per ISA, Hydro test for TW. Bore concentricity: $\pm 5\%$ of wall thickness, Accuracy test.
8.	Thermocouple assembly
	Calibration / Material test, Insulation test ($\geq 500 \Omega$ at 500 V, DC) as per ISA, Hydro static test (1.5 times max. pr.), Bore concentricity: $\pm 5\%$ of wall thickness.
9.	Thermo wells
	Material test / Bore concentricity: $\pm 5\%$ of wall thickness / Hydrostatic test for TW (1.5 times max. pr.)
10.	Level Gauges

S.No	Tests to be performed
	Hydrostatic test / Material test / Seat leakage test / Ball check test.
11.	Level switches (Magnetic)
	Material test / Contact rating test / Hydro test / Calibration test.
12.	Flow Switch
	Material test / Hydro static test (1.5 times max. pr.) / function test.
13.	Flow glasses
	Material test / Hydrostatic test (1.5 times max. pr.) / function test.
14.	Variable area flow meters
	Calibration test / Material test / Hydrostatic test (1.5 times max. pr.)
15.	Flow element
	100% Radiography test / Hydro test / Calibration test, IBR Certificate.
	Calibration test for flow element shall be witnessed by Owner.
16.	Control valves / Pneumatic block valve / Pressure regulating valve – Refer chapter 10.
17.	Position transmitters
	Calibration / hysteresis and Accuracy test
18.	Electro Pneumatic Convertors
	Calibration test / Accuracy test
19.	Solenoid valves
	Hydro test / Seat leakage test / CV test / Coil insulation test
20.	Air filter regulators
	Calibration test / Accuracy test
21.	Junction Boxes
	Test for degree of protection / Material test
22.	Tests for terminal blocks
	Test for moulding for flame resistant, Non-hygroscopic and Decarbonised / Insulation test between terminals / Insulation between terminal block and frame.
23.	Thermocouple extension cable
	Thermo-e.m.f characteristic / Continuity test / Measurement on capacitance, inductance and loop resistance / Insulation resistance / High voltage test as per latest IS / Tensile and elongation test / Oxygen index test / Any other test applicable.
24.	Mass flow meter
	Performance test / Calibration test / Hydrostatic test.
25.	Boiler Level Gauge
	Hydrostatic test / Material test / Seat leakage test / IBR Certificate
26.	pH / Conductivity measurement / Silica / Dissolved oxygen analysers:
	Calibration test, Accuracy test
27.	Sample cooler :

S.No	Tests to be performed
	Hydro test, IBR Certificate
28.	Sampling racks :
	Hydro test, IBR Certificate for tubes and fittings.
29.	SO₂ / NO_x analyser / SPM analyser:
	Calibration test, accuracy test
30.	Interposing relay
	Functional test, temperature rise test, H.V test, Insulation test
31.	Transmitter Racks :
	Hydro test, air leak test for piping / tubing and fittings. IBR certification as required for tubing / piping and fittings.
32.	Pressure Transmitter
	Calibration test / Hydro test / Leak test / Over range test / Accuracy test / Repeatability test.
33.	Differential pressure transmitter
	Calibration test / Hydro test / Leak test / Over range test / Accuracy test / Repeatability test.
34.	Temperature Transmitter
	Calibration test / Accuracy test / Ambient temperature error test
35	Pneumatic Block Valves
	a) IBR certificate form III C b) Hydrostatic test : ANSI B 16.34 c) Seat leakage test : As per ANSI B 16-104 d) CV test: As per ISA procedure e) Magnetic particle test ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 Deg.C) f) Liquid penetration test: ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 Deg.C) g) Radiography test: ANSI B 16.34 special class h) Calibration and Hysteresis test i) Actuator leakage test
36.	Pressure Regulating Valve
	a) IBR certificate form III C b) Hydrostatic test : ANSI B 16.34 c) Seat leakage test : As per ANSI B 16-104 d) CV test: As per ISA procedure e) Magnetic particle test ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 Deg.C) f) Liquid penetration test: ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 Deg.C) g) Radiography test: ANSI B 16.34 special class h) Calibration and Hysteresis test i) Actuator leakage test
37.	Local Panels :
	Visual inspection, wiring & continuity check, H.V. and I.R. tests on panels, checking of bill of materials, functional tests.
38	Wiring Termination & Accessories

S.No	Tests to be performed
	Routine test: Conductor resistance test / High voltage test / Impulse dielectric test / insulation test / Humidity test / Temperature rise test on power circuits / short time current test on power circuits.
	Type test: Annealing test / Test for insulation and sheath / Flame retardency test - a) Oxygen index, b) Flammability / Test for acid gas generation / test for water absorption / wet dielectric test
39	Marshalling / System cabinets
	Verification of degree of protection / Electrical tests as detailed under wiring Termination & accessories / Type test and routine test as per relevant Indian standards.
	Notes:
	1. Test Certificates in addition to inspection at manufacturers works shall be furnished for all the instruments for Owner's review. 2. Above Test to be witnessed shall be finalized by Owner. 3. In addition to above test, test as per approved QAP shall also be witnessed by owner

i) Testing Types

The BIDDER shall furnish the Type test reports of all type tests as per relevant standards and codes. As well as other specifics test indicated in the specification. A list of such test are given for various equipment in table titled, Type Test Requirement for C&I System and under the item special requirement for solid state requirements/systems. For the balance equipments/instruments type test may be conducted as per manufacturer standards or if required by relevant standards.

- 1) Out of these test listed, the bidder / sub vendor / manufacturer is required to conduct certain type test specifically for this contract (and witnessed by employer or his authorized representative). Even if the same have been conducted earlier as clearly indicated subsequently such tests.
- 2) For the rest, submission of type test, results, and certificates shall be acceptable provided following points
 - a) The same have been carried out by the bidder/ sub vendor on exactly the same model/rating of equipment. (For control valves this shall be same size, type & design).
 - b) There has been no change in the components from the offered equipments and tested equipments.
 - c) The test has been carried out as per the latest standards along with amendments as on the date of bid opening.
- 3) In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the bidder/sub-vendor within the quoted price and no extra cost will be payable by the owner on this account.

As mentioned against certain items, the test certificates for some of the items shall be reviewed and approved by the main bidder or his authorized representative and balanced have to be approved by the employer. The schedule of conduction of type test/submission of reports shall be submitted and finalized during preaward discussion.

For the type test to be conducted, bidder shall submit detailed test procedure for approval by owner. This shall clearly specify test setup, instruments to be used, procedure, and acceptance norms (wherever applicable). , recording of different parameters, intervals of recording precaution to be taken etc. for the test to be carried out.

ii) **Special Requirements for Solid State Equipments /Systems**

The minimum type test report, over and above the requirements of above clause which are to be submitted for each of the major C&I systems like DDCMIS, DCS etc. shall be as indicated below:

Surge Withstand Capability (SWC) for solid state equipments/equipments

1. All solid state systems/equipments shall be able to withstand the electrical noise and the surges as encountered in actual service conditions and inherent in the power plant. All the solid states systems /equipments shall be provided with all required protection that needs the surge withstand capability as defined in ANSI 37.90.1/IEEE 472. Hence, all front end cards which receive external signals like analog input and output modules, Binary input and output modules etc. including power supply, data highway, data links shall be provided with protection that meets the surge withstand capability as defined in ANSI 37.90.1/IEEE 472. Complete details of the features incorporated in the electronic system to meet this requirement the relevant test carried out, the test certificates, etc. shall be submitted along with the proposal. As an alternative to the above, suitable class of EN 61000-4-12 which is equivalent to ANSI 37.90.1/IEEE 472 may also be adapted for SWC test.
2. The dry heat test as per IEC 68-2-2 or equivalent
3. Damp heat test as per IEC 68-2-3 or equivalent
4. Vibration test as per IEC 68-2-6 or equivalent
5. Electrostatic Discharge test as per EN 61000-4-2 or equivalent
6. Radio frequency immunity test as per EN 61000-4-6 or equivalent
7. Electromagnetic Field Immunity test as per EN 61000-4-3 or equivalent

Test listed at Item no 5, 6, 7 above are applicable for electronic cards only as defined under item no. 1 Above

iii) **Type Test Requirements for C&I Systems**

S.No	Item	Test Requirement	Standard	Test to be specifically conducted	Owners approval required on test certificate

S.No	Item	Test Requirement	Standard	Test to be specifically conducted	Owners approval required on test certificate
1	Electrical metering instruments	As per standards	IS 1248	No	Yes
2	Thermocouple	Degree of Protection Test	IS - 13947	No	No.
3	Junction Box	Degree of Protection Test	IS - 13947	Yes	Yes
4	RTD	As per standards	IEC-60751	No	No
5	Electronic Transmitter	As per standards	BS 6447 / IEC 60770	No	Yes
6	E / P convertor	As per standards	Manufacturing standard	No	Yes
7	Instrumentation cable (Twisted and shielded) (Refer Vol. II, Chapter 8)				
8	Battery	As per standard	IS 10918	Yes	YES
9.	Voltage stabiliser	Over load test	Approved procedure	No	YES
		Temp. rise test without redundant fans	Approved procedure	No	YES
		Input voltage variation test	Approved procedure	No	YES
10	DDCMIS				
	CLCS system	Model Test	Approved procedure	No	No
	BMS & MFT	Safety requirement	VDE0116, SEC 8.7	No	YES
11	Conductivity type level switch	Degree of protection test	IS 13947	No	No
12	Local gauges	Degree of protection test	IS 13947	No	No
13	Process actuated switches	Degree of protection test	IS 13947	No	No
14	Control valves	CV test	ISA 75.02	No	YES
15	LIE / LIR	Degree of	IS 13947	YES	YES
16	Flue gas O2 analyser, other Flue	Degree of protection test	IS 13947	No	YES
17	Flow nozzles & Orifice plates	calibration	ASMEPTC BS 1042	YES	YES

Note:

VENDOR LIST

PEM REGISTERED VENDOR

Package Code	Package Name	Vendor Name	Vendor Address
145-45000-A	INSTRUMENT FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA-UTTAR PRADESH-INDIA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
145-45000-A	INSTRUMENT FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI-MAHARASHTRA-INDIA Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
145-45000-A	INSTRUMENT FITTINGS	HP VALVES & FITTINGS INDIA PVT. LTD.	S. Harichandran/P.S. Pandi B-11, Mugappair Industrial Estate, CHENNAI-Tamilnadu-INDIA Phone- 044 26252537 Pincode : 600037 Email : sales@hpvalvesindia.com
145-45000-A	INSTRUMENT FITTINGS	Perfect Instrumentation Control (India) Pvt. Ltd.	MD Hussain Shaikh/Shahanawaz Khan Gala No. 168, Loheki Chwal,216/ 218, Maulana Azad Rd. Nagpada Junction Mumbai-Maharashtra-INDIA Phone- 91-9324383121 Pincode : 400008 Email : shahanawaz.khan@perfectinstrumentation.com
145-45000-A	INSTRUMENT FITTINGS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai,-Maharashtra,-India, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,
145-45000-A	INSTRUMENT FITTINGS	Comfit & Valve Pvt. Ltd.	Mr. Jeetu Jain/Mr. Vinay Sosa Survey No. 23/1, Part 2, Ahmedabad-Mehsana Highway Laxmipura, Nandasan-Gujarat-INDIA Phone- 02764-267036/37 Pincode : 382705 Email : marketing@com-fit.com
145-45000-A	INSTRUMENT FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI-DELHI-INDIA Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
145-45000-A	INSTRUMENT FITTINGS	Arya Crafts & Engineering Pvt. Ltd.	Mr.Sanjay Brahman/Mr.Shyam Vazirani 102, Vora Industrial Estate No.4 Navghar, Vasai Road (E) Dist.Thane, Mumbai-Maharashtra-INDIA Phone- +91-250-2392246 Pincode : 401210 Email : arya@aryaengg.com

145-45000-A	INSTRUMENT FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI- MAHARASHTRA-INDIA Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
145-45000-A	INSTRUMENT FITTINGS	FLUIDFIT ENGINEERS PVT. LTD.	Mr. Abbas Bhola Potia Building No. 2, Office No. 3,292, Bellasis Road,Mumbai Central (East) Mumbai-Maharashtra-India Phone- 9920044113 Pincode : 400008 Email : ab@fluidfitengg.com
145-38000-A	INSTRUMENTS PIPE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI- MAHARASHTRA-INDIA Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
145-38000-A	INSTRUMENTS PIPE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI-DELHI- INDIA Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
145-38000-A	INSTRUMENTS PIPE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI-MAHARASHTRA- INDIA Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
145-38000-A	INSTRUMENTS PIPE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA-UTTAR PRADESH-INDIA Phone- +91- 9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
145-32000-A	INSTRUMENTS TUBE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA-UTTAR PRADESH-INDIA Phone- +91- 9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
145-32000-A	INSTRUMENTS TUBE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI-MAHARASHTRA- INDIA Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
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145-32000-A	INSTRUMENTS TUBE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI-MAHARASHTRA-INDIA Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
145-25000-A	JUNCTION BOX	FLEXPRO ELECTRICALS PVT. LTD.	Mr. Dineshbhai Zaveri C-1/ 27&37, GIDC, Kabilpore, Navsari-Gujarat-India Phone- 02637-265140,265003 Pincode : 396424 Email : flexpro@flexproltd.com
145-25000-A	JUNCTION BOX	AJMERA INDUSTRIAL & ENGINEERING WORKS	JIGNESH MAHENDRA AJMERA DENA BANK BLDG.,SHREE NAGESH INDL. ESTATE,STATION ROAD, MUMBAI-MAHARASHTRA-INDIA Phone- 022 67973578 Pincode : 400 088 Email : ajmera@ajmera.net, jmajmera@yahoo.com
145-25000-A	JUNCTION BOX	K.S.INSTRUMENTS PVT.LTD.	S Raghavan No. 72, 3rd Main, 1st Stage Industrial Suburb, Yeshwanthpur Bangalore-Karnataka-India Phone- 9880385770 Pincode : 560022 Email : sales1@ksinstruments.net
145-25000-A	JUNCTION BOX	SUCHITRA INDUSTRIES	NO-2,OPP-27 AECS LAYOUT 2ND STG REJAMAHALVILAS EXTN 2ND STG BANGALORE - Phone- Pincode : Email : suchitra.industriesblr@gmail.com
145-25000-A	JUNCTION BOX	Shrenik & Company,	Mr. Mitesh Shah/Mr. Pulin Shah 39 A/3 ,Panchratna Industrial Estate, Sarkhej-Bavla Road Ahmedabad-Gujarat-India Phone- 9825024921 Pincode : 382213 Email : sales@pustron.com, pulin@sumip.com
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.- MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI- Maharashtra-INDIA Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai,-Maharashtra,-India, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,

145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA-WEST BENGAL-INDIA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE-KARNATAKA-www.hgurusouth.com Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	FORBES MARSHALL (HYD) LTD.	MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD-TELANGANA-INDIA Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	BOSE PANDA INSTRUMENTS PVT.LTD.	Mr. Partha Bose 44, Saheed Hemanta Kumar Bose, Sarani, Kolkata-West Bengal-India Phone- +91 33 2548 7220 Pincode : 700074 Email : parthabosebpi@gmail.com; bosepanda@vsnl.net
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol-Gujarat,-INDIA Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA-WEST BENGAL-INDIA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol-Gujarat,-INDIA Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Barksdale GmbH, Germany	Michael Weileder Dorn Assenheimer, Strasse 27 Reichelsheim--Germany Phone- +91-9999107840 Pincode : D-61203 Email : msingh@barksdale.de
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	DRESSER INDUSTRIES INC.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol-Gujarat-India Phone- 02764-233682 Pincode : 382729 Email : Nishit.patel@ashcroftindia.com

145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS (INDIA) LIMITED	MR.L.C.VENKATRANGAN/MR.B.KANNAN New No.17, II Floor, Adwave Towers, Dr.Sevalia Shivaji Salai, T.Nagar Chennai-TamilNadu-INDIA Phone- +91 44 24353407 Pincode : 600017 Email : delhi@indfos.com
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	GENERAL INSTRUMENTS CONSORTIUM	Mr. Amarendra Kulkarni 194/195, Gopi Tank Road, Off. Pandurang Naik Marg, Mahim Mumbai-Maharashtra-India Phone- 9323195251 Pincode : 400016 Email : amarendra@general-gauges.com
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Kaustubha Udyog,	S.No. 36/1/1, Sinhgad Road, Vadgaon Khurd, Near Lokmat Press, Pune,-Maharashtra,-India, Phone- 020-24393577, Pincode : Email : pressure@vsnl.com,
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS INDUSTRIES LIMITED	B-20-21, INDUSTRIAL AREA, MEERUT ROAD, GHAZIABAD-UP-INDIA Phone- 0120-2712016 Pincode : Email : mktg@indfos.com
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SWITZER PROCESS INSTRUMENTS PVT. LTD.	B Kannan/V S Jayaprakash 9, SOUTH BOAG ROAD, II FLOOR, PB NO-1423, T.NAGAR, CHENNAI-TAMIL NADU-INDIA Phone- 044-24340999 / 24344 Pincode : 600017 Email : marketing@switzerinstrument.com
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA-KANSAS-USA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,
145-14000-A	TRANSMITTERS	Honeywell Automation India Limited	Mr. Ritwij Kulkarni 917, INTERNATIONAL TRADE TOWER, NEHRU PLACE, NEW DELHI-DELHI-INDIA Phone- 9890200584 Pincode : 110019 Email : rajesh.chaudhary@honeywell.com
145-14000-A	TRANSMITTERS	V. AUTOMAT & INSTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI-DELHI-INDIA Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com
145-14000-A	TRANSMITTERS	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhupura, Ajmer,-Rajasthan,-India, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,
145-14000-A	TRANSMITTERS	YOKOGAWA INDIA LIMITED,	PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, BANGALORE,-KARNATAKA,-INDIA, Phone- 080-41586000, Pincode : Email : uday.shankar@in.yokogawa.com,

145-14000-A	TRANSMITTERS	SIEMENS LIMITED	Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai-Maharashtra-INDIA Phone- 0124 383 7377 Pincode : 400018 Email : ankit.varshney@siemens.com
145-14000-A	TRANSMITTERS	EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	Mr. Amit Paithankar/Vikram Raj Singh 206-210,BALARAMA BUILDING 2ND FLR. BANDRA EAST MUMBAI-MAHARASHTRA-INDIA Phone- 9619121500 Pincode : 400051 Email : vikramraj.singh@emerson.com
145-14000-A	TRANSMITTERS	SMART INSTRUMENTS LTD, BRAZIL	Agents: Digital Electronic Ltd. 74/11 'C' Cross Road MIDC Andheri (East) MUMBAI-MAHARASHTRA-INDIA Phone- 28208477 Pincode : 400093 Email : corp@delbby.rpgms.ems.vsnl.net.in
145-14000-A	TRANSMITTERS	SBEM PVT. LTD.	MR.N.K. BEDARKAR/MR. VISHWANATH KARANDIK 39, ELECTRONIC CO.OP. ESTATE, PUNE SATARA ROAD PUNE,-MAHARASHTRA-INDIA Phone- 912041030100 Pincode : 411009 Email : newdelhi@sbem.co.in
145-14000-A	TRANSMITTERS	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune-Maharashtra-INDIA Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com
145-14000-A	TRANSMITTERS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai,-Maharashtra,-India, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,
145-14000-A	TRANSMITTERS	NIVO CONTROLS PVT. LTD.	Mr. Praveen Toshniwal 104-115, Electronic Complex, Indore-M.P.-India Phone- 0731-4081305 Pincode : 452010 Email : sales@nivocontrols.com
145-14000-A	TRANSMITTERS	Moore Industries International Inc.	Leonard.W. Moore/ Matt Moren 16650 Schoenborn St. North Hills-CALIFORNIA-USA Phone- +1 818 830 5548 Pincode : 91343 Email : mmoren@miinet.com
145-14000-A	TRANSMITTERS	ABB LIMITED	MR. RAJIV GOVIL 14, MATHURA ROAD, FARIDABAD-HARYANA-INDIA Phone- 09971085678 Pincode : 121003 Email : vipin.swami@in.abb.com
145-14000-A	TRANSMITTERS	Endress + Hauser (India) Pvt. Ltd.,	Mr. Prakash Vaghela 215-216, DLF Tower 'A', Jasola District Centre, New Delhi,-New Delhi,-India, Phone- 9717593001, Pincode : 110025, Email : prakash.vaghela@in.endress.com,

SI No.	Package Name	Vendor Name	LOCATION
1	LOCAL CONTROL PANELS	C and S ELECTRIC LTD.	New Delhi
		PYROTECH ELECTRONICS PVT. LTD.	Udaipur
		PROCON INSTRUMENTATION PVT. LTD.	Chennai
		INDUSTRIAL CONTROLS & APPLIANCES PVT LTD	Mumbai
2	ANALYSERS (ALL TYPES)	ABB INDUSTRIES AG	SWITZERLAND.
		ROSEMOUNT ANALYTICAL INC	IRVINE
		ENDRESS + HAUSER INDIA PVT. LTD.	MUMBAI
		HACH LANGE S.A.R.L CH-1222,	VESENAZ
		SWAN Analytische Instrumente AG, CH-8340	Hinwii
		METTLER-TOLEDO INDIA PVT. LTD.,	MUMBAI
		THERMO ORION INC	BEVERLY
3	UPS	EMERSON NETWORK POWER,	AMBERNATH
		EMERSON NETWORK POWER	PUNE
		HITACHI-HIREL,	GANDHINAGAR
		KELTRON,	TRIVANDRUM
		CONSUL NEOWATT POWER SOLUTIONS,	PUNE
5	MOTORISED ACTUATOR	ROTARK	UK
		AUMA	Bengaluru
		WEIR BDK VALVES	Hubli
		LIMITORQUE	Faridabad
6	AIR FILTER REGULATOR	PLACKA	Chennai
		SHAVO-NORGREN	Mumbai
		SCHRADER SCHORILL DUNCAN LTD.	Mumbai
		FAIRCHILD	USA
		SMC PNEUMATICS	Noida
7	SOLENOID VALVE	ASCO	USA
		ROTEX	Vadodra
		SCHRADER	Pune
		AVCON	Mumbai
		HERION-NORGREN	Germany
		IMI-NORGREN	Germany
		JAFFERSON	Argentina

Notes :-

1) The above sub-vendor list is tentative & reference only. However sub-vendor list is subject to BHEL/end user approval without any commercial/delivery implication.

2) New subvendor, if proposed by vendor during contract stage shall be subject to BHEL/end user approval without any commercial implication.

MANDATORY SPARES

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1X800MW NORTH CHENNAI SUPERCRITICAL THERMAL POWER PROJECT
STAGE III IN THE EXISTING PREMISES OF NCTPS

ANNEXURE IV
MANDATORY SPARES

III. MANDATORY SPARES (C & I):

S No	Name/ Description of Spares	Unit	Qty
	The quantity of following spares includes a minimum of 20 % spares for replacement of each type of lamps, PBs, ILPBs, fuse, MCB, MCCB used in the equipment/system offered by him even if this is not detailed below.		
i)	Measuring Instruments - Indicators, Recorders, Electrical Metering and Skid Mounted Instruments	Lot	1
1	10% of the number of indicators, recorders and meters offered from each model for the project or a minimum of one number per model, whichever is more. These instruments shall be supplied with three sets of blank scales.		
2	For skid mounted instruments (if any) - 10% of total number of instruments for each model and type for the project or a minimum of one number for each model and type, whichever is more.		
ii)	Temperature Elements and Thermowells	Lot	1
1	10% spare thermocouple/RTD elements, suitable for replacement for each type and length of element furnished with thermocouple/RTD assemblies, or a minimum of one number of each type & length, whichever is more.	%	10%

1X800MW NORTH CHENNAI SUPERCRITICAL THERMAL POWER PROJECT
STAGE III IN THE EXISTING PREMISES OF NCTPS

ANNEXURE IV
MANDATORY SPARES

S No	Name/ Description of Spares	Unit	Qty
2	10% thermo wells for each type of temperature sensors or a minimum of one for each type, whichever is more	%	10%
3	Temperature Transmitters and Electronic Transmitters (For Pressure, DP, Temp, Flow, Level), Temperature, Pressure, Flow & Level Switch, safety switches, Gauges, meters, Transducer or any other instrument etc.		
	10% of total number of instruments/transducers offered for each model and type for the project or a minimum of one number, whichever is more.	Lot.	1
iii)	Flue Gas Analyzers & CEMS	Lot	1
	Spare parts shall be furnished in accordance with manufacturer's recommendations for five years continuous operation or minimum quantities indicated as below (whichever is more)		
1	One set of electronic modules comprising of at least one number of each type of module for each analyzer type.		
2	A spare cooling and purging air blower unit and set of air filters shall be furnished for each stack analysis system.		
3	One set of light source and detector unit for smoke density analyzer.		

1X800MW NORTH CHENNAI SUPERCRITICAL THERMAL POWER PROJECT
STAGE III IN THE EXISTING PREMISES OF NCTPS

ANNEXURE IV
MANDATORY SPARES

S No	Name/ Description of Spares	Unit	Qty
9	Three (3) No of each type Primary coolers/secondary coolers.		
vi)	Relay Based Control Panels	Sets	1
1	10% LEDs for indicating lights shall be furnished.		
2	Three times, the one hundred percent (300% of installed) spare replacement control circuit fuses/MCB/MCCB of each current rating required shall be furnished.		
3	20% spare replacement relays modules & contactors of each type.		
vii)	Alarm Annunciation System	Sets	1
1	20% spares of each type installed shall be provided for logic modules, group card modules, power supply modules, Hooters and any other electronic module.		
2	5% spares of each size shall be provided for un-engraved window boxes complete with LED etc.		
3	20% of installed LEDs for annunciation facia windows and LEDs box assemblies offered for the project shall be provided as mandatory spares.		
4	One (1) spare annunciator hooter of each type.		
viii)	Erection hardware	Sets	1
1	Ten (10) percent of each type & Size installed instrument valve, manifold for each type, rating, model number and size of devices supplied for the project.		
2	Ten (10) percent of total number of condensate pots or four numbers whichever is higher of each type & Size installed.		
3	Ten (10) percent of each type & Size installed Fittings		
iv)	LVS	Sets	1
1	20% spare LEDs of each type & size		
2	50% spare or min 6 nos. LVS Filters		

1X800MW NORTH CHENNAI SUPERCRITICAL THERMAL POWER PROJECT
STAGE III IN THE EXISTING PREMISES OF NCTPS

ANNEXURE IV
MANDATORY SPARES

S No	Name/ Description of Spares	Unit	Qty
	Bidder to supply 10% or 1 no. (whichever is more) of each type of sensor/instrument, analyzers /special instruments/Electronic card, instrumentation/mechanical fittings etc. for any other electronic system, feeder control cabinets, hydra step (EWLI), Vibration Monitoring System, CCTV, C&I Lab Instruments, On line Carbon in Ash analyzer system, On line Coal mass flow/speed measurement system, On line secondary air flow measurement system Mass Flow meter, Solid flow meter, 3 D Acoustic type level transmitters, Nucleonic & non nucleonic density transmitter etc.		
xvii)	Other Related Control and Instrumentation Systems/Equipments		
	Other SG related sub-systems		
1	Flame Monitoring System	Lot.	1
(i)	Complete Flame Scanner Assembly including scanner head assembly, scanner housing, and fiber optic cables.		20% or 4 nos. whichever is more.
(ii)	Flame Scanner Lens.		100%
(iii)	Electronic cards for scanners		10% or 2 nos. of each type whichever is more.
(iv)	Power Supply Modules		10% or 2 nos. of each type whichever is more.
2	Coal Feeders	Lot.	
(i)	Calibration Motor		10% or 2 nos. whichever is more.

INSTRUMENT INSTALLATION DRAWING

|

A

B

C

D

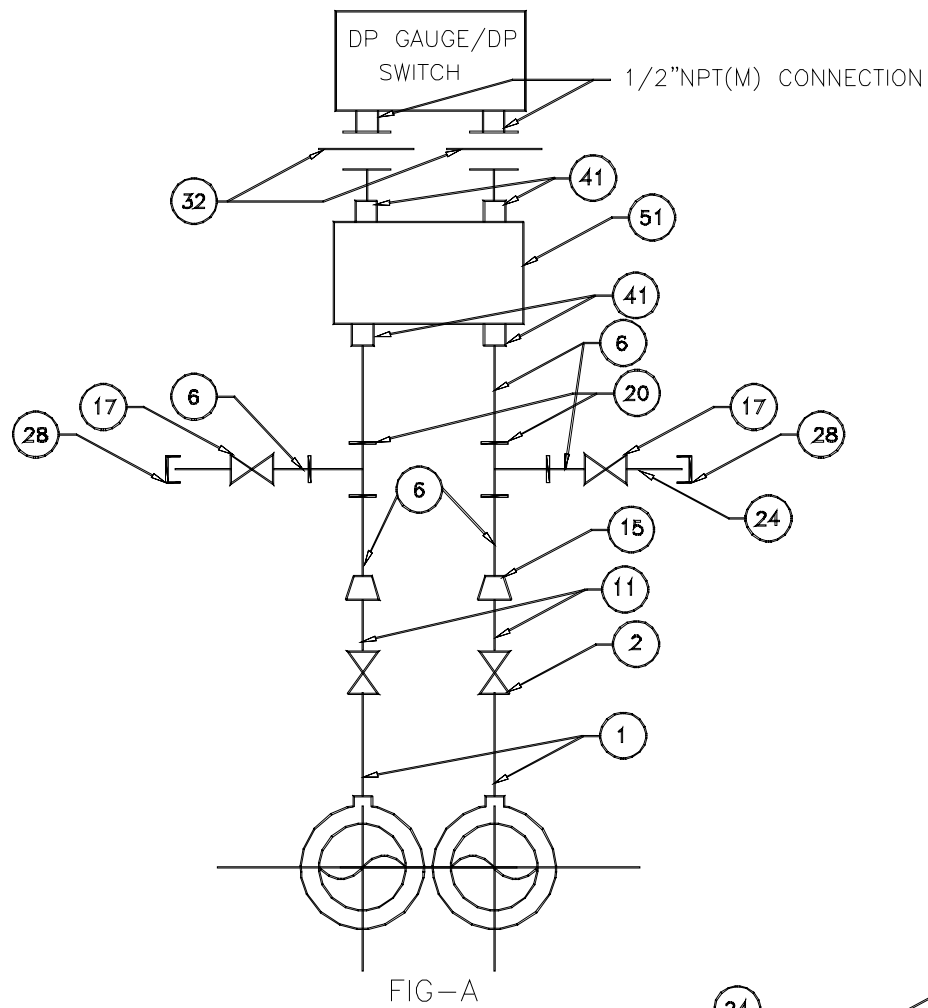


FIG-B

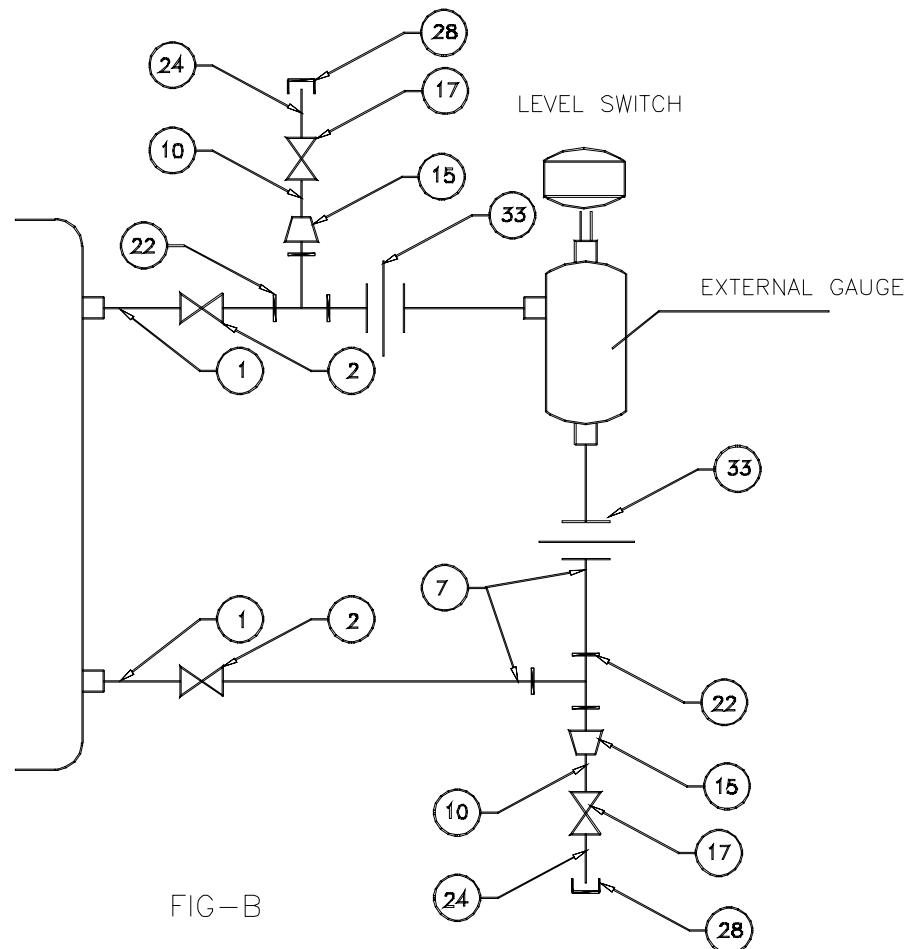
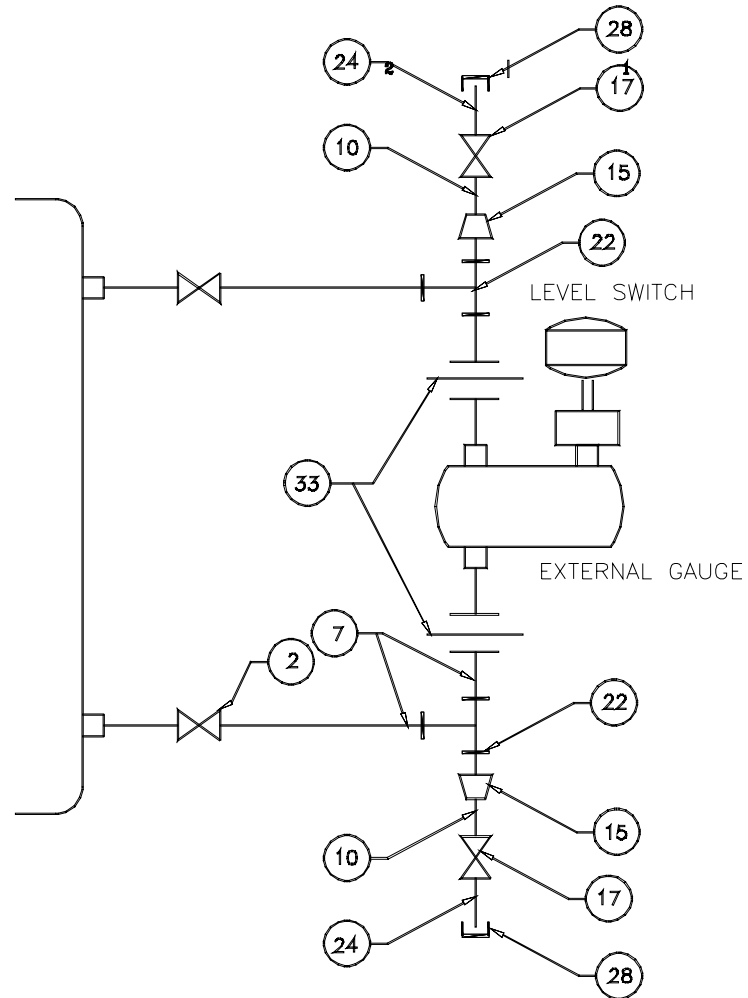


FIG-C



NOTE

TAG NO.	DESCRIPTION	QTY.		
		A	B	C
78	1/2"NPT(F)X1/2"NPT(M) SNUBBER/ PULSATION DAMPER	1	-	-
38	3-WAY GAUGE VALVE WITH 1/2" NB SW	1	-	-
32	1/2"NPS, 3 PIECE PIPE UNION WITH 1/2"NPT(F) SCREWED	1	-	-
28	1/2"NPT (f) CS CAP	1	2	2
24	1/2"NPS, SCH-80/160 X 1/2"NPT(M) CS/AS NIPPLE	1	2	2
20	1/2"SW EQUAL TEE, CS/AS	1	-	-
17	1/2"SW CS/AS GLOBE VALVE	1	2	2
1	1/2"/ 3/4"/ CS/AS NIPPLE OF MTL. SAME AS THAT OF MAIN PIPE(AS PRE PROCESS REQ.)	AS REQ.		
15	1"TO 1/2"SW REDUCER	1	2	2
11	1"NPS SCH-80/160 CS/AS PIPE	1	-	-
6	1/2"NPS. SCH-80/160 CS/AS PIPE	AS REQ.		
2	1/2"/3/4"/1"ROOT VALVE - SW GLOBE VALVE	2	2	2
33	1"SW EQUAL PIPE UNION	-	2	2
22	1"SW EQUAL TEE CS/AS	-	1	2
10	1/2"NPS, SCH 80/160 CS/AS NIPPLE	-	2	2
7	1"NPS, SCH 80/160 CS / AS PIPE	AS REQ.		
33	1"SW EQUAL PIPE UNION	2	2	2

NOTE:-

WITH VALVE SIZE 1/2"SW NIPPLE PIECE IS NOT REQUIRED

X	XX.XX.2015	XXX	XXX	XXX	XXX	PRELIMINARY ISSUE			
REV. No.	DATE	MECH.	CIVIL	ELEC.	C&I	DESCRIPTION			
						CHECKED			



TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED



LAHMEYER INDIA

LAHMEYER INTERNATIONAL (INDIA) PVT. LTD.
CONSULTING ENGINEERS, GURGAON, INDIA

CONTRACT NO :			PROJECT :		
PREPARED	NAME	DATE	1 X 800MW - NCTPP - STAGE - III		
DRAWN BY	--	--	ENNORE & PUZHUVAKKAM VILLAGE, CHENNAI, TAMILNADU		
DESIGNED BY	--	--	DRAWING TITLE :		
CHECKED BY	--	--	INSTRUMENT DRAWING FOR DP GAUGE/		
APPROVED BY	--	--	SWITCH & LEVEL SWITCH		
SHEET SIZE	A4		DRAWING NO :		REV.
SCALE	1:1		LII-GEOE15066-I-45786-013		00
					SHEET
					1 OF 1

Protection mark DIN 34 - 1 - E:
Copying of this drawing, and giving it to others and the use or communication of the contents thereof, are forbidden without express authority. Offenders are liable to the payment of damages. All rights are reserved in the event of the grant of a patent or the registration of a utility model or design.



Protection mark DIN 34 - 1 - E:
Copying of this drawing, and giving it to others and the use or communication of the contents thereof, are forbidden without express authority. Offenders are liable to the payment of damages. All rights are reserved in the event of the grant of a patent or the registration of a utility model or design.



1X800 TANGEDCO NORTH CHENNAI TPP

SPECIFICATION No: PE-TS-423-554-A001

**VENTILATION SYSTEM TECHNICAL
SPECIFICATION
(MATERIAL HANDLING PORTION)**

SECTION : I

SUB-SECTION : C-5

REV. 01

DATE: NOV 2017

SECTION: I

**SUB-SECTION: C-5
TECHNICAL SPECIFICATION (MATERIAL HANDLING PORTION)**



**TECHNICAL SPECIFICATION
ELECTRIC HOISTS & CHAIN PULLEY BLOCKS
1X800 MW NORTH CHENNAI TPP STAGE III**



Material Handling Equipments



**TECHNICAL SPECIFICATION
ELECTRIC HOISTS & CHAIN PULLEY BLOCKS
1X800 MW NORTH CHENNAI TPP STAGE III**



1.0 ELECTRIC HOIST AND MANUAL HOIST (CHAIN PULLEY BLOCK)

Required number of electric hoist / manual hoist of adequate capacity, to meet the erection and maintenance requirements are to be provided for the various areas.

Manual hoists (hand operated) shall be designed to duty class 2 as per IS 3832 and electric wire rope hoist shall be designed as per IS: 3938 (latest).

The stipulations of all statutory codes like Indian Electricity Act, Indian Electricity Rules, Factory Acts, Local Municipality act etc. shall however prevail over the specification requirements, in case any conflict arises between this specification and the statutory codes.

Maintenance tools and tackles shall be as per data sheet attached.

DESIGN CRITERIA

For items weighing 500 kg and above, hoists and trolleys along with monorails shall be provided throughout the plant where crane cannot be utilized. For items weighing less than 1000 kg, manual hoists shall be provided. For items weighing 1000 kg and more, electric hoists (lift & travel) shall be provided. In case the lifting height is more than 10m, electric hoist (lift & travel) shall be provided irrespective of the weight. All hoists shall be provided with trolleys.

Capacity of electric and manual (Chain pulley block) hoists shall be decided keeping 25% margin over equipment to be handled.

For hand operated hoists, the hoists shall be suitable for operation from floor level. Hand chain shall be provided for long travel of trolley and the Hoisting mechanism. The operator shall be able to control the movement of the electrical/ manual hoist with the help of floor operated pendant

MINIMUM LIFTING REQUIREMENT

S.N.	AREA DESCRIPTION	QTY (nos)	CAPACITY(T)	TYPE
1	LIST TO BE MENTIONED AS APPLICABLE			
2				
3				

Note:

1. Area, type, capacity mentioned are minimum requirement and shall be finalised during detail engineering without any commercial implication
2. Travel and Lift are layout dependent and shall be finalised during detail engineering without any commercial implication
3. Additional electric/manual hoist required during detail engineering shall be provided as per design criteria given above without any commercial implication.

2.0 SCOPE OF SUPPLIES

Equipment and services to be furnished by the bidder for the ELECTRIC HOIST/ MANUAL HOIST with accessories as per the details given in the technical specification and data sheet A. Any equipment / accessories not specified in the specification but required to make the ELECTRIC HOIST/ MANUAL HOIST complete and efficient operation shall also be under the bidder's scope of work.

Compliance with this specification shall not relieve the bidder of the responsibility of furnishing material and workmanship to meet the specified working/duty conditions.



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- 2.1.0 Electric hoist shall include but not be limited to the following: -
- a. Hoisting and CT drive arrangement
 - b. All electrical equipment including cables (as per electrical scope matrix) and panels.
 - c. PVC insulated shrouded bus bar DSL
 - d. Earthing arrangement.
 - e. Initial fill of lubricant.
 - f. Painting of electric hoist and accessories.
 - g. Maintenance Tools & Tackles (as per attached list at SI No-11 below)
 - h. Erection & Commissioning spares
 - i. Isolating switch in enclosure at operating floor for disconnecting supply to DSL while maintaining the electric hoist.
- 2.2.0 Erection and Commissioning spares (ELECTRIC HOIST)
The Bidder shall also supply erection & commissioning spares along with his main equipment as per his experience, for replacement of damaged or unserviceable parts during the execution of the project at site, to avoid delay in the project schedule. This shall form part of the main equipment supply. The Purchaser shall retain the unutilized commissioning spares. The initial fill of lubricants, oil etc. shall also be supplied by the bidder.
- 2.3.0 Services to be provided by the bidder
Packing, forwarding and transportation to site, storage and handling at site.
- 2.4.0 Erection and Commissioning
- 2.5.0 Functional test (Overload testing, load testing at rated speed, travel and hoisting motion checks as per relevant Indian standards)
- 2.6.0 Obtaining clearance and acceptance certificate from the concerned competent authority after site test as applicable. Necessary fees/expenditure as required shall be borne by the supplier.

3.0 Inspection and Testing

As per enclosed reference quality plan and as per IS 3938 (latest revision). Prime inspection agency shall be Consultant/ End Customer. Equipment supplied shall be strictly in accordance with nomenclature & technical specification. Any additional testing requirement/CHP (Customer Hold Point) at any stage of inspection deemed necessary by Consultant/ End Customer during detailed engineering shall be carried out without any commercial or technical implication.

4.0 Works Excluded

Supply of ISMB monorail.

5.0 PAINTING SPECIFICATION

As per painting details specified elsewhere in specification.

6.0 PACKING

In general packing shall be wooden box packing.

7.0 TESTING AT VENDOR'S WORKS

Hoist along with its drives, controls and other accessories shall be demonstrated for the rated capacity against the rated speed of motions and for the service conditions specified as specified in QAP and as per IS 3938 for electric hoist and IS 3832 for manual hoist.

The bidder shall have the full responsibility for the safe and efficient operation of the hoist with associated accessories as a single unit.

If the shop performance tests indicate the failure of any of the components to achieve the guaranteed



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performance, the deficiency shall be made good at bidder's cost.

Demonstration tests shall be carried out each time after the rectification /modification is carried out.

8.0 MAKE OF SUB - VENDOR ITEMS

Makes of bought out items will be as per list specified in the specification. No other make will be acceptable, until and unless specifically got it approved by the purchaser/ end client. (Refer annexure-I)

9.0 TESTING AT SITE

A) ELECTRIC HOIST:

As required for statutory clearance for operating at site i.e., overload test, load test and other tests as per IS 3938.

Test for Operation -After the supply has been connected, tests shall be carried out to prove the following:

- a) The satisfactory operation of each controller, switch, contactor, relay and other control devices and in particular the correct operation of all limit switches under the most unfavorable conditions;
- b) The correctness of all circuits and interlocks and sequence of operation; and
- c) The satisfactory operation of all protective devices.

Overload Test -After test but before the hoist is put into service, it shall be tested with overload relays appropriately set, to lift and sustain a test load of 125 percent of the working load. During the overload test, the hoist shall sustain the load under full control. The specified speeds need not be attained but the hoist shall show itself capable of dealing with the overload without difficulty.

B) MANUAL HOIST:

As required for statutory clearance for operating at site with following minimum test i.e., overload and load test.

10.0 TECHNICAL DATA SHEET:

A) Technical data sheet-A for ELECTRIC HOIST:

Sl.no	DESCRIPTION	TECHNICAL PARTICULARS
1.0	Type	Steel wire electric hoist with electrically operated trolley
2.0	Scope (Qty., Capacity, Lift, Travel Length)	Refer the separate Annexure A.
3.0	Type of service	Indoor
4.0	Overload test	125% of SWL
5.0	Design Ambient temperature	50° C
6.0	General Design	As per IS: 3938 / 1983 or latest, Class-II duty
7.0	Operating speed	
7.1	Hoisting speed/ Creep speed (thru' VVVF drive)	3 Mtr per min/ creep speed 10% of main speed.
7.2	Trolley speed	6 Mtrs per min
8.0	Type of transmission	Through Electric motor and gear box.
9.0	Wire Rope	



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9.1	Construction / core	6 x 36 or 6 x 37 construction, steel core
9.2	Code	IS:2266
9.3	Number of falls	Min. 4
9.4	Factor of safety	Not less than 5
10.0	Load Hook and block	NORMALISED HOOK ONLY
10.1	Type of load hook	Plain shank trapezoidal section with safety latch.
10.2	Load hook Code	IS: 15560
10.3	Load hook Material	Alloy steel/carbon steel as per IS:15560
10.4	Hook suspension	Thrust bearing
10.5	Material of block suspension	Fabricated from steel plate, Material: IS: 2062
11.0	Gearing	
11.1	Type	Spur / Helical, hardened and tempered with machine cut teeth
11.2	Gear material	Forged steel as per IS 3938
11.3	Lubrication	Oil splash/ grease lubricated
11.4	Bearing type	Antifriction Ball / Roller
12.0	Trolley drive	
12.1	Wheel	Single flange taper thread
12.2	Wheel conform to (Std. / code)	IS: 3938
12.3	Wheel material	Heat treated carbon steel/ low alloy steel, graded cast iron.
12.4	Bearing type	Antifriction Ball / Roller
12.5	Trolley type	Rolled structural steel with side plates extended beyond wheel flanges to protect wheels.
12.6	Hardness	Max hardness 200 BHN
13.0	SHEAVE	
13.1	Material	Cast steel or mild steel.
13.2	Bearing type	Antifriction Ball / Roller.
14.0	BRAKE (HOIST)	
14.1	Type	DC EM brakes disc type (fail to safety).
14.2	Capacity	As per IS 3938.
14.3	Number	One number for each motor.
15.0	BRAKE (TROLLEY)	



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15.1	Type	DC EM brakes disc type (fail to safety).	
15.2	Capacity	As per IS 3938.	
15.3	Number	One number for each motor	
16.0	ROPE DRUM		
16.1	Material	Cast steel or mild steel.	
16.2	Flange / Flangeless	Flanged	
16.3	Type of groove	As per manufacturers standard to suit the layout requirement.(Shall be decided during detail engineering)	
17.0	TYPE OF DSL		
17.1	CT travel	PVC shrouded Cu conductor bus bar	
18.0	MOTORS		
18.1	Type	Sq. Cage induction, TEFC, S4 duty, 60% CDF.	
18.2	Number of start	300starts / hr, Motors shall be suitable for direct on-line (DOL) starting	
18.3	Voltage , Phase and Frequency	415V $\pm$ 10%, 3 phase, 50 Hz	
18.4	Class of insulation	Class "F" and temperature rise limited to class B.	
18.5	Type of enclosure	TEFC	
18.6	Degree of protection provided for enclosure	IP-55	
18.7	Margin	10% over maximum continuous load demand of driven equipment under entire operating range including voltage and frequency variation.	
19.0	LIMIT SWITCHES	Hoisting	Trolley
19.1	Type	Snap action, self actuating type	One (1) no. two way limit switch
20.0	Control panel	* Fabricated from CRCA sheet steel not less than 2 mm thick * Degree of protection shall be IP 54. * Power on indicating lamps shall be provided * Panel illumination lamps operated by door switch. * 2 nos earthing terminals on panel. * 20 % spares terminals (clip on type) shall be provided. * Power and control terminals (clip on type) shall be on separate channels. * Gland plate thickness shall be minimum 3mm. * Gland plate shall be double brass compression type.	
20.1	Qty	1 No.	
21.0	Pendent Push buttons	Up /down / forward / Reverse push buttons. Indicative marking for easy operation shall be provided.	
22.0	Power cables	Copper material, minimum size : 6 mm sq ,FRLS insulated, multi strand Copper PVC sheathed armoured	



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		cable(for fixed cable) and EPR insulated CSP sheathed cable (for flexible cable)
23.0	Control cable	Control cables shall have stranded copper conductor, Minimum size 2.5 mm sq. FRLS—insulated, multi strand Copper PVC sheathed armoured cable(for fixed cable) and EPR insulated CSP sheathed cable (for flexible cable) Minimum size 1.5 mm sq.
24.0	Control Voltage	110 V

B) MANUAL HOIST (CHAIN PULLEY BLOCK):

DATA SHEET-A

- 1.00.00 Type : Chain pulley block with/ without travelling trolley
- 2.00.00 Area : **As per requirement**
- 3.00.00 Design : IS: 3832, IS: 2429, IS 15560, IS 210, IS 4367, IS 6216, IS: 4460. (All standards shall be of latest revision)
- 4.00.00 Duty Class as per IS:3832 : Class –II
- 5.00.00 Hoisting Mechanism
- a) Type : Hand operated gear transmission
- b) Type of gear : Spur / Helical
- c) Load Chain :
i) Type : Link type
ii) Material : Alloy steel grade 80 as per IS: 6216
iii) Conforms to (Std./Code) : IS: 6216
- d) Hand Chain :
i) Type : Link type
ii) Material : Mild steel (grade 30) as per IS 2429 Part II
- e) Load Hook & Hook Block :
i) Type of load hook : Plain shank- Trapezoidal section
ii) Load hooks conform to : IS: 15560
/ Material
iii) Type of hook suspension : Swivelling
iv) Type of make of bearing : Thrust ball bearing of hook suspension
- f) Gears/pinion :
i) Type : Spur/ Helical
ii) Material : Alloy steel / Carbon Steel
iii) Type of bearing used : Antifriction ball bearing / Roller
- g) Sprockets



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- i) Type of bearings used : Antifriction ball bearing / Roller
- h) Method of lubrications Used
- i) Bearings : Grease
 - ii) Gearing & Pinions : Grease
 - iii) Sprockets : Grease
- i) Brakes
- i) Type : Ratchet and pawl arrangement along with screw and friction disc type
- 6.00.0 Trolley & Bridge Drive
- a) Trolley
- i) Type : Geared (Manually operated)
 - ii) Material of frame : Rolled structural steel (IS:2062 Grade A or B)
- b) Drive Chain
- i) Type : Link type
 - ii) Material : Steel Gr.30
- c) Trolley Wheel
- i) Number of pairs of wheel : Two/four
in each trolley/bridge
 - ii) Flange : Single flanged
 - iii) Wheel material : As per IS 3832
 - iv) Type of bearings need : Antifriction
- d) Gears
- i) Type : Spur / helical
 - ii) Material : Alloy/ Carbon steel/ High graded cast iron (Material confirming to IS 3832)
 - iii) Type of bearings used : Antifriction
- e) Method of lubrication for
- i) Bearings : Grease
 - ii) Sprockets : Grease
- f) Load chain wheel (Load chain wheel shall be part of hoisting mechanism)
- i) Material : SG iron/ Steel casting/IS 3832
- g) Hand chain wheel
- i) Material : SG iron/ Steel casting/Grey iron
Casting./IS 3832

11.0 Maintenance Tools and Tackles

One (1) complete unused new set of special purpose tools, tackles and accessories along with detailed instructions and maintenance manual shall be supplied. Tools shall be of suitable sizes for maintenance of electric hoist of each type and capacity. Each tool and wrench shall be stamped so as to be identified easy for its use. The tools shall be supplied in steel toolbox and with a copy of instruction manual. The items supplied shall be of the best quality, specially protected against rusting. The following shall be provided as minimum requirement:

S-No.	Description	Qty.
1	Complete set of ring spanners (Indicate the sizes offered)	1 Set
2	Complete set of screwdrivers (Indicate the sizes)	1 Set
3.	Adjustable Spanner	1 No.



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4. Insulated plier	1 No.
5. Grease gun	1 No.
6. Oil gun	1 No.
7. Line tester	1 No.

Note: -The tools shall be supplied in one tool box. Bidder shall ensure that the tools & tackles mentioned in above list are sufficient to handle all sizes/capacities of hoists & in case any other /additional tool is required for handling/maintenance any size/capacity of hoist the same shall be included in this list.

12.0 DRAWING/DOCUMENT SUBMISSION

The successful bidder shall submit the following drawings / documents during detail engineering for customer's approval /information:

A) ELECTRIC HOIST

SI. No.	BHEL DRG.NO	DRAWING TITLE
1	PE-V0-423-553-A100	Manufacturing Quality Plan with Sub vendor list
2	PE-V0-423-553-A101	GA Drawing for Electric Hoist, DSL arrangement and painting details
3	PE-V0-423-553-A102	Schematic Circuit Diagram
4	PE-V0-423-553-A103p	Mechanism Sizing Calculation
5	PE-V0-423-553-A104	Detailed BOM/BOQ for crane
6	PE-V0-423-553-A105	O & M Manual
7	PE-V0-423-553-A107	Erection procedure

B) MANUAL HOIST (CHAIN PULLEY BLOCK):

SI. No.	BHEL DRG.NO	DRAWING TITLE
1	PE-V0-423-553-A200	Manufacturing Quality Plan
2	PE-V0-423-553-A201	GA Drawing for Chain Pulley Block with detail BOM with painting details
3	PE-V0-423-553-A202	O & M Manual

Notes:

1. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order.
2. Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.
3. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.:
 - a) All drawings and documents shall indicate the list of all reference drawings including general arrangement.
 - b) All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.



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- c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.
- d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.
- e) Drawings/ documents to be submitted for purchasers review/ approval shall be under Revision A, B, C... etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3 etc.

13.0 MANDATORY SPARES: No Mandatory Spares are applicable for Electric Hoist and Chain Pulley Blocks.

14.0 MAKES: Following makes of Electric hoists & Chain Pulley Blocks are acceptable:

CHAIN PULLEY BLOCK	TUOBRO FURGUSON (INDIA) PVT LTD	Approved
	TRACTEL TIRFOR INDIA PVT. LTD.	Approved
	HERCULES HOISTS LTD.	Approved

ELECTRIC HOIST	Alpha Services	Submit Credentials
	Grip Engineers Pvt. Ltd.,	Submit Credentials
	ARMSEL MHE PVT. LTD	Submit Credentials
	Mangla Hoists Pvt Ltd	Submit Credentials
	CONSOLIDATED HOISTS PVT LTD	Approved
	LIFTING EQUIPMENTS and ACCESSORIES	Submit Credentials
	REVA INDUSTRIES LTD.	Approved
	TUOBRO FURGUSON (INDIA) PVT LTD	Approved
	EDDY CRANES PVT. LTD.	Approved
	CENTURY CRANE ENGINEERS PVT. LTD.	Submit Credentials
	HERCULES HOISTS LTD.	Approved

ANNEXURE-I

MAKES OF SUB VENDORS ITEMS AS APPLICABLE TO ELECTRIC HOIST:

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
1.	STEEL	SAIL		
		TISCO		
		JINDAL		
		ESSAR		
2.	HOOKS	STEEL FORGING & ENGG. CO.,	KOLKATA	
		SIMRITI FORGING		



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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		KARACHIWALA		UP TO 25T CAPACITY
3.	GEAR COUPLINGS	ALLIANCE		
		FLEX-TRANS (formerly known as HICLIFF)		
		SAHARA		
		NUTECH		
		OEM		
4.	WIRE ROPE	USHA MARTIN		
		FORT WILLIAMS		
		BHARAT WIRE ROPES		
5.	BEARINGS	SKF		
		FAG		
		TATA		
		NBC		
6.	MOTORS	SIEMENS		
		NGEF (up to 15KW)		
		CROMPTON		
		KIRLOSKAR		
		BHARAT BIJLI		
		MARATHON		
		ABB		
		LHP		
7.	BRAKES	ELECTROMAG		
		SPEED-O- CONTROL		
		BCH		FOR DCEM BRAKES ONLY
		KAKKU		
		PETHE		
8.	CONTACTOR	SIEMENS		
		L&T		
		SCHNEIDER (Earlier TELE MECHANIQUE)		
		BCH		
9.	OVER LOAD RELAYS	SIEMENS		
		L&T		
		ABB		
		SCHNEIDER (Earlier TELE MACHANIQUE)		
10.	HRC FUSES	SIEMENS		
		L&T		
		ENGLISH ELECTRIC		
		GE POWER		
		EATON (BUSSMANN)		
		ABB		
11.	ISOLATING SWITCH	SIEMENS		
		L&T		
		CONTROL & SWITCH GEAR		



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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		ABB		
12.	SWITCH FUSE UNITS	SIEMENS		
		L&T		
		CONTROL & SWITCH GEAR	-	
		ABB		
13.	TIME DELAY RELAYS	SIEMENS		
		L&T		
		ABB		
		BCH		
		SCHNEIDER (Earlier TELE MACHANIQUE)		
14.	TRANSFORMERS	INDCOIL		
		LOGICSTAT		
		KAPPA		
		AUTOMATIC ELECTRIC		
		PRECISE ELECTRICALS		
		SILKAAN ELECTRIC MFG. CO. LTD.		
		SOUTHERN ELECTRIC		
		NEC		
15.	CABLE LUGS (HEAVY DUTY)	DOWELLS		
		UML ENGINEERS	KOLKATA	
		JAINSON		
16.	PVC POWER CABLES	APAR INDUSTRIES LTD.	MUMBAI	
		CORDS CABLE INDUSTRIES LTD.	NEW DELHI	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GOYOLENE FIBRES (INDIA) PVT.LTD	MUMBAI	
		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	
		KEI INDUSTRIES LTD.	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		MANSFIELD CABLES COMPANY LTD.	NOIDA	
		NICCO CORPORATION LTD.	KOLKATA	
		PARAMOUNT COMMUNICATIONS LTD.	NEW DELHI	
		POLYCAB WIRES PVT. LTD.	MUMBAI	
		RADIANT CORPORATION PRIVATE LIMITED	HYDERABAD	



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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD.	VADODARA	
		SRIRAM CABLES PVT. LTD.	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD.	SOLAN	
		SAM CABLES & CONDUCTORS (P) LTD	UDHAM SINGH NAGAR	
		THERMO CABLES LTD	HYDERABAD	
17.	PVC CONTROL CABLES	ADVANCE CABLE TECHNOLOGIES (P) LTD	BANGALORE	
		APAR INDUSTRIES LTD., CMI LTD	MUMBAI	
		CMI LIMITED	FARIDABAD	
		CORDS CABLE INDUSTRIES LTD	NEW DELHI	
		CRYSTAL CABLE INDUSTRIES LTD	KOLKATA	
		DELTON CABLES LTD	NEW DELHI	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		ELKAY TELELINKS LTD	NEW DELHI	
		GEMSCAB INDUSTRIES LTD	NEW DELHI	
		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	
		INCOM CABLES (P) LTD	NEW DELHI	
		KEI INDUSTRIES LTD	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		MANSFIELD CABLES COMPANY LTD	NOIDA	
		NICCO CORPORATION LTD	KOLKATA	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SPECIAL CABLES PVT. LTD	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD	SOLAN	
		SAM CABLES & CONDUCTORS (P) LTD	UDHAM SINGH NAGAR	
		SPM POWER & TELECOM PVT. LTD	HYDERABAD	
		TORRENT CABLES LTD	AHMEDABAD	



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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		THERMO CABLES LTD	HYDERABAD	
		TIRUPATI PLASTOMATICS PVT. LTD	JAIPUR	
		UNIVERSAL CABLES LTD	SATNA	
18.	TRAILING CABLES	NICCO	KOLKATA	
		UNIVERSAL	SATNA	
		INCAB		
		ICL	NEW DELHI	
		APAR INDUSTRIES LTD	MUMBAI	
		CMI LTD	FARIDABAD	
		KEI INDUSTRIES LTD	NEW DELHI	
		SUYOG ELECTRICALS LTD	VADODARA	
19.	XLPE POWER CABLES	APAR INDUSTRIES LTD	MUMBAI	
		CORDS CABLE INDUSTRIES LTD	NEW DELHI	
		CRYSTAL CABLE INDUSTRIES LTD	KOLKATA	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GEMSCAB INDUSTRIES LTD	NEW DELHI	
		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	
		KEI INDUSTRIES LTD	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		MANSFIELD CABLES COMPANY LTD	NOIDA	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SPECIAL CABLES PVT. LTD	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD	SOLAN	
		SRIRAM CABLES PVT. LTD	NEW DELHI	
		TORRENT CABLES LTD	AHMEDABAD	
		THERMO CABLES LTD	HYDERABAD	
		TIRUPATI PLASTOMATICS PVT. LTD	JAIPUR	
20.	XLPE CONTROL CABLES	APAR INDUSTRIES LTD	MUMBAI	
		CABLE CORPORATION OF INDIA LTD	MUMBAI	
		CRYSTAL CABLE INDUSTRIES	KOLKATA	



**TECHNICAL SPECIFICATION
ELECTRIC HOISTS & CHAIN PULLEY BLOCKS
1X800 MW NORTH CHENNAI TPP STAGE III**



SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		LTD		
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GEMSCAB INDUSTRIES LTD	NEW DELHI	
		HAVELLS INDIA LIMITED	NOIDA	
		KEI INDUSTRIES LTD	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RADIANT CORPORATION PRIVATE LIMITED	HYDERABAD	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SRIRAM CABLES PVT. LTD	NEW DELHI	
		TORRENT CABLES LTD	AHMEDABAD	
		UNIVERSAL CABLES LTD	SATNA	
21.	CABLE GLAND	COMMET		
		SUNIL&CO		
		ARUP ENGINEERING		
		JAINSON		
		DOWELL		
22.	PUSH BUTTONS	SIEMENS		
		L&T		
		BCH		
		SCHNEIDER		
23.	LIMIT SWITCHES	SPEED-O-CONTROL		
		ELECTROMAG		
24.	PENDENT PUSH BUTTON STATION	OEM		
25.	INDICATING LAMPS	TECKNIC		
		BCH		
		SIEMENS		
		STANDARD		
26.	MCB	MDS		
		INDO COPP		
		STANDARD		
		SIEMENS		
		L&T		
		ABB		
		SCHNEIDER		
27.	PANELS	OEM		



**TECHNICAL SPECIFICATION
ELECTRIC HOISTS & CHAIN PULLEY BLOCKS
1X800 MW NORTH CHENNAI TPP STAGE III**

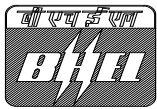


SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		RITTAL		
		PYROTECH		
		ENAPROS		
		OEM		
		SAFEX FIRE SERVICES LTD		
		UNITED FIRE EQUIPMENTS PVT. LTD		
		ZENITH FIRE SERVICES (INDIA) PVT LTD		
		YASKAWA		
		ABB		
		SIEMENS		
		SCHNIEDER		
		FUJI ELECTRIC		
		MITSUBISHI ELECTRIC		
		SUSHEEL		
		STROMAG		
		IPA		
		SARTORIUS		
		OEM		
		ELECON ENGINEERS		
		SHANTI GEARS		
		PBL *		
		NAW*		
		NORD*		
		SEW*		
		BONGFILIOLI*		
				* = Applicable for Geared Motors only

NOTE:

- THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL.

BIDDER TO PROPOSE SUB VENDOR WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED.
- DEALERS ARE NOT ACCEPTABLE FOR ANY ITEM OF THE PACKAGE. BIDDER SHALL PROCURE ALL ITEMS INCLUDING PLATES, STRUCTURAL, FLANGES; COUNTER FLANGES ETC. FROM APPROVED SUB VENDOR ONLY.
- THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER.

	TECHNICAL SPECIFICATION ELECTRIC HOISTS & CHAIN PULLEY BLOCKS 1X800 MW NORTH CHENNAI TPP STAGE III	

MAKES OF SUB VENDORS ITEMS AS APPLICABLE TO CHAIN PULLEY BLOCKS:

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
1.	STEEL	SAIL		
		TISCO		
		JINDAL		
		ESSAR		
2.	HOOKS	STEEL FORGING & ENGG. CO.,	KOLKATA	
		SIMRITI FORGING		
		KARACHIWALA		UP TO 25T CAPACITY
		NASHIK FORGE		

NOTE:

- THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL.

BIDDER TO PROPOSE SUB VENDOR WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED.

- DEALERS ARE NOT ACCEPTABLE FOR ANY ITEM OF THE PACKAGE. BIDDER SHALL PROCURE ALL ITEMS INCLUDING PLATES, STRUCTURAL, FLANGES; COUNTER FLANGES ETC. FROM APPROVED SUB VENDOR ONLY.
- THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER.



**TECHNICAL SPECIFICATION
ELECTRIC HOISTS & CHAIN PULLEY BLOCKS
1X800 MW NORTH CHENNAI TPP STAGE III**



PAINTING SPECIFICATION

1. Painting specification for steel structures:-

Surface preparation: De greasing and Mechanical cleaning with wire brush or blasting according to SIS 055900, Grade 2 ½ .

Primer : Zinc Silicate of approved brand. - 2 coat, DFT 60 µm per coat.

Intermediate : MIO Epoxy paint- 2 coat, DFT 90 µm per coat

Finish Coat : Polyurethane coating- 1 coats, DFT 30 µm per coat.

Total DFT : 330 µm

2. Painting specification for Indoor components such as motors, electrical parts etc:-

Surface preparation: blasting according to SIS 055900, Grade 2 ½ . Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 25 µm may be used.

Primer : Zinc phosphate epoxy - 2 coat, Total DFT 75 µm.

Finish Coat : Chlorinated rubber paint- 2 coats, Minimum DFT 30-40 µm per coat.

Total DFT : 135 – 155 µm

3. Color Shade:

SL. No	Item Description	Color Shade	Remarks
1	Crane Structure	Golden Yellow shade 356 as per IS-5	Colour band-Black
2	Trolley and hook	Crimson shade 540 as per IS-5	
3	Motors	Light Gray shade 631 as per IS-5	
4	Control Panels	Light Gray (Powder coated) as per IS-5	

		MANUFACTURERS NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT			1X800 MW NORTH CHENNAI TPP STAGE III			
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE		ELECTRIC WIRE ROPE HOIST				
						REV	0	CONTRACT No						
						DATE	Mar, 2017	CONTRACTOR		BHEL-PEM				
						PAGE	1 of 4							
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS	
									D*	M	C	N		
1	2	3	4	5	6	7	8	9		**	10		11	
1.0	RAW-MATERIALS													
1.1	a) STRUCTURAL MATERIAL b) RAW MATERIAL FOR HOIST AND GEAR BOX HOUSING, TROLLEY PLATE, ROPE DRUM IF FABRICATED ETC	CHEM & MECH PROPS	MA	Lab analysis	1 SAMPLE PER LOT%	IS 2062 /APPD. DRG./ DATA SHEET		MTC/IR	√	P/V	V	V	Test shall be carried out in absence of mill TC or non-correlation of TC with material.BHEL to identify Samples for testing. Test to be carried out at NABL accredited Lab. Reports to be submitted for verification during inspection.	
		NDT	MA	UT	100%	ASTM A388-2004	NOTE 1	IR	√	P	V	V	For dia / plate thickness above 25 mm	
1.1 A	SEAMLESS PIPE FOR ROPE DRUM	CHEMICAL , MECHANICAL	MA	Lab analysis	1 SAMPLE /pipe	Approved drg/ASTM A 106 Grade A or B		MTC/IR	√	P/V	V	V	Test shall be carried out in absence of mill TC or non-correlation of TC with material.BHEL to identify Samples for testing. Test to be carried out at NABL accredited Lab. Reports to be submitted for verification during inspection	
		Flattening & Acid Etching test	MA	PHYSICAL & METALLOGRAPHY	1 SAMPLE /pipe	No cracks, pitting, rusting , damage etc		IR	√	P	V	V		
		SURFACE DEFECTS	MA	Visual	100%									
1.2	FORGINGS FOR GEARS BLANKS ,PINIONS, SHAFT/AXLES, WHEELS , STEEL CASTINGS	MECH , CHEM. PROPS	MA	Lab analysis	100%	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET / IS:3938	LAB. REPORT / MANUFACTURER'S TEST CERTIFICATE	√	P	V	V		
		NDT	CR	UT	100%	ASTM A 388	NOTE 1	INSPN. REPORT	√	P	V	V	IF DIA or THK > 50mm	
		Hardness , surface defects after hardfacing and machining/grinding	MA	DPT/MPI	100%	ASTM E -165 /E-709, No linear indication		MTC	√	P	V	V		
1.3	WIRE ROPE	Dimensional, type, constrcution ,	MI	measurement	100%	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET	MFRS' TEST CERT.	√	P	V	V		
		EXAMINATION OF REPORT OF BREAKING LOAD CAPACITY	CR	Review of TC	100%	IS: 2266		MFRS' TEST CERT.	√	P	V	V		
1.4	HOOKS	MECH. , CHEM. PROPS.	MA	Lab analysis	100%	APPROVED DRG/DATA SHEET IS:15560		MFRS' TEST CERT.	√	P	V	V		
		U.T IF SHANK DIA > 50mm	CR	NDT	100%	ASTM A 388	NOTE 1	INSPN. REPORT	√	P	V/W	V	SHANK PORTION ONLY	
		Dimension & PROOF LOAD TESTING	CR	Measurment , PROOF LOAD TEST	100%	APPROVED DRG/DATA SHEET / IS:3938 / IS:15560		QCR	√	P	V/W	V	IF REQUIRED BY END CUSTOMER.	
		DPT AFTER PROOF LOAD	CR	NDT	100%	ASTM E-165	NO CRACKS	INSPN. REPORT	√	P	V/W	V		
1.5	SHEAVES	MECH	MA	Tensile & hardness	1/lot	Approved drgs		MTC/IR	√	P	V	V		

		MANUFACTURERS NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT		1X800 MW NORTH CHENNAI TPP STAGE III			
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE		ELECTRIC WIRE ROPE HOIST			
						REV	0	CONTRACT No					
						DATE	Mar, 2017	CONTRACTOR		BHEL-PEM			
						PAGE	1 of 4						
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY		REMARKS	
								D*	M	C	N		
1	2	3	4	5	6	7	8	9		**	10		11
1.6	CASTING FOR BEARING PLATED, ROPE GUIDES, PULLEYS ETC	CHEMICAL & MECHANICAL	MAJOR	LAB ANALYSIS	1/LOT	APPROVED DRG/MFG STANDARD	APPROVED DRG/MFG STANDARD	LAB REPORT	√	P	V	V	
2.0	IN-PROCESS												
2.1	Welding process capability and welder skill	WPS,PQR & WPQ	MA	Welding procedure approval and Welder performance qualification in accordance with ASME Section IX	100%	ASME Section IX		WPS,PQR & WPQ		P	V	V	In case approved WPS/PQR/WPQ from BHEL/NTPC/EIL/LLOYDS/TPL available, then documents/records to be submitted for verification during inspection, else, Vendor shall get the approval of Welding Procedure / Welder from the identified agency
2.2	Welding of trolley, rope drum etc	Fillet weld	MA	DPT	10%	ASTM E165 or Eq/ No cracks or linear indication		INSPN. REPORT	√	P	V	V	
		Butt welds	MA	RT, DPT	100%	ASME SEC VIII, DIV 1, UW 51/52		RT FILM & REPORT	√	P	V	V	100% RT for butt weld in tension and 10 % in compression. 100% RT on butt weld of rope drum
		DPT AFTER STRESS RELIEVING OF ROPE DRUM	MA	NDT	100%	ASTM E-165	NO CRACKS	INSPN. REPORT	√	P	V	V	
2.3	NDT OF LOAD BEARING BUTT WELDS (IF ANY)	WELD QUALITY OF BUTT WELDS IN TENSION	CR	PT & RT	100%	ASME SEC. VIII DIV. I	ASME SEC. VIII DIV. 4 . CLUW-51 FOR RT APPENDIX -8 FOR PT	INSPN. REPORT ND FILM	√	P	W	V/W	FILMS TO BE REVIEWED BY BHEL & END CUSTOMER/THIRD PARTY. DPT SHALL BE CHP .
2.4	GEAR BOXES												
	COMPLETE ASSEMBLY	OVERALL DIMENSIONS. LEAK TEST, REDUCTION RATIO, BACK LASH AND CONTACT PATTERN	MA	MEAS./VISUAL	100%	MFG. DRG./KERSON E TEST	MFG. DRG./NO LEAKAGE WHEN FILLED	INSPN. REPORT	√	P	V		
	NO LOAD RUN TEST FOR 4 HRS	CHECK FOR OIL LEAKAGE, VIBRATION, NOISE ,TEMP. RISE. REDUCTION RATIO, BACKLASH , CONTACT PATTERN	MA	PERFORMANCE	100%	APPROVED DRGS /No leakage,Noise 85dbA max at 1 mtrs, vibration 75 microns max, oil temp rise 20 deg above ambient max		- DO -	√	P	V	V	
3.0	ELECTRICALS												
1	MOTORS & CABLES	Make, type , rating	MA	Visual /measurment	100%	Apprvd drg	IS 325 / IS:3938	IR, MTC	√	P	V	V	For motor refer Note: 2
		ROUTINE TESTS											
3	LIMIT SWITCHES,SFU, ISOLATOR/ O/L RELAY, MCB, FUSES,PUSH BUTTONS,CONTACTOR, INDICATING LAMPS etc	Make , type , rating, functional, Continuity	MA	Review of TC	100%	Approved drgs		IR	√	P	V	V	
4	BRAKES	Make , type , rating, HV/IR, Functional test	MA	Review of TC	100%	Approved drgs		IR, MTC	√	P	V	V	
5	DSL	Make , type , rating, dimension	MA	Review of TC	100%	Approved drgs		IR	√	P	V	V	
6	Control transformer	Make , type , rating, input/output	MA	Review of TC	100%	Approved drgs		IR	√	P	V	V	

बी.एस.एल. 		MANUFACTURERS NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT				1X800 MW NORTH CHENNAI TPP STAGE III			
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE				ELECTRIC WIRE ROPE HOIST			
						REV	0	CONTRACT No							
						DATE	Mar, 2017	CONTRACTOR				BHEL-PEM			
						PAGE	1 of 4								
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY				REMARKS	
									D*	M	C	N			
1	2	3	4	5	6	7	8	9		**	10		11		
-	CONTROL PANEL, PENDANT SWITCH	* FIXING OF COMPONENTS WIRING MARKING CONTINUITY * FUNCTIONAL TEST * IR & H.V. TEST * IP - PROTECTION TEST * PAINT SHADE, THICKNESS, SHEET THICKNESS, ADHESION TEST	MA	VISUAL/MEASUR	100%	APPD.DRG. WIRING DIAGRAM,	APPD. DRG. WIRING DIAGRAM,	IR	√	P	V	V			
8	VVVF DRIVES (IF APPLICABLE)	MAKE , TYPE , RATING , ROUTINE TESTS	MA	VISUAL/ VERIFY	100%	APPROVED DRAWINGS	APPROVED DRAWINGS	MTC	√	P	V	V			
4.0	FINAL INSPECTION														

		MANUFACTURERS NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT		1X800 MW NORTH CHENNAI TPP STAGE III			
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE	ELECTRIC WIRE ROPE HOIST				
						REV	0	CONTRACT No					
						DATE	Mar, 2017	CONTRACTOR	BHEL-PEM				
						PAGE	1 of 4						
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	D*	M	C	N	REMARKS
1	2	3	4	5	6	7	8	9		**	10		11
4.1	COMPLETELY ASSEMBLED HOIST	1. COMPLETENESS, CORRECTNESS, WELD QUALITY, OVERALL DIMENSIONS	MA	VISUAL, MEAS	100%	APPD. DRG.	APPD. DRG.	MNFRS' TEST CERT.	√	P	W	W	CHP
4.2	ASSEMBLED HOIST PERFORMANCE WITH ACTUAL CONTROL PANEL, AND PENDENT PUSH BUTTON	1. LOAD TEST	CR	LOAD TEST at SWL	100%	IS:6547 / IS:3938	IS:6547 / IS:3938	MNFRS' TEST CERT.	√	P	W	W	CHP
		2. HOISTING & LOWERING SPEED, PERFORMANCE OF CONTROLLERS SWITCHES CONTACTORS, RELAYS AND OTHER CONTROL DEVICES CORRELATIONS OF CIRCUITS AND INTERLOCKS AND SEQUENCES OF OPERATION, CURRENT MEASUREMENT, LIMIT SWITCH OPERATION	CR	MEAS & VISUAL	100%	IS:3938, TECH SPEC.	TECH SPEC.	MNFRS' TEST CERT.	√	P	W	W	CHP
		3. OPERATION OF ALL PROTECTIVE DEVICES	CR	VISUAL	100%	TECH SPEC	TECH SPEC.	MNFRS' TEST CERT.	√	P	W	W	CHP
4.3	OVER LOAD TEST	OVER LOAD TEST INCLUDING HOLDING CAPACITY OF BRAKES, LIFTING LOAD FROM MID AIR, SOUNDNESS OF WELD AFTER OVERLOAD	CR	TEST AT 125 % OF-SWL	100%	IS:3938	IS:3938	INSPN. REPORT	√	P	W	W	CHP
5	PAINTING												
5.1	PRIMER & FINISHING AND SHADE	Examination - Shade, DOP by paper insertion method	MI	visual	100%	DRG. & DATA SHEET & RELV. IS SPEC.		MNFRS' TEST CERT.		P	V		
		DFT	MA	measurement	Sample					P	V		
6	PACKING	STURDINESS, PROTECTION MARKING	MA	VISUAL	100%	MFG STD	MFG STD			P			
NOTE:													
1	When back wall echo is set to 100% in sound area then a) defect echo shall not exceed 20% b) Back echo shall be minimum 80% in any area.												
2	Less than 30 KW. Acceptance of motor less than 30 KW is based on COC of the manufacturer & the contractor confirming as follows : It is hereby confirmed that the above mentioned motor/motors was/were manufactured taking care of specific requirement regarding ambient temp, voltage & frequency variation, hot start, pull out torque, starting KVA/KW, temp rise, distance between center of stud and gland plate and tested in accordance with approved drawing/data sheet.												
		LEGND											
		* RECORDS IDENTIFIED WITH 'TICK' SHALL BE ESSENTIALLY INCLUDED BY MANUFACTURER IN QA DOCUMENTATION.											
		** M: MANUFACTURER/SUBCONTRACTOR											
		C: BHEL/BHEL NOMINATED THIRD PARTY INSPECTION AGENCY											
MANUFACTURER/ SUB CONTRACTOR		N: CUSTOMER/CUSTOMER'S CONSULTANT/CUSTOMER'S APPOINTED THIRD PARTY											
		"P"- PERFORM", "W"- WITNESS AND "V"- VERIFICATION											
SIGNATURE		" CHP" CUSTOMER HOLD POINT					REVIEWED BY		NAME & SIGN OF APPROVING AUTHORITY & SEAL				

	MANUFACTURER'S NAME & ADDRESS :	<u>MANUFACTURING QUALITY PLAN</u> ITEM : Chain Pulley Block QP No.: REV.:0, Date.: , PAGE: 1 OF 4	PROJECT : 1X800 MW NORTH CHENNAI TPP STAGE III PACKAGE : CHAIN PULLEY BLOCK

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLAS S	TYPE OF CHECK	QUANTU M OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
					M	C/N				M	C	N	
					6.					10.			
1.	2.	3.	4.	5.			7.	8.	9.				11.

1	<u>RAW MATERIAL & B/OUT ITEMS:</u>												
1.1	HOOKS	CHEMICAL & MECH MARK & IDENTIFICATION INTERNAL DEFECTS PROOF LOAD TEST NDT AFTER PROOF LOAD TEST	MA MA MA MA MA	LAB ANALYSIS VISUAL UT REVIEW DPT	ONE SAMPLE PER HEAT 100% 100% 100% 100%	MATERIAL SPECIFICATION AS PER APPROVED DRAWINGS. HOOK TC FROM COMPETENT AUTHORITY ASTM A-388 (REFER NOTE I) IS 15560 ASTM E-165		MTC. TC IR TC TC	✓ ✓ ✓ ✓ ✓	P P P P P	V V V V V	V V V V V	ON SHANK PORTION
1.2	LOAD CHAIN	- DIMENSIONS - BREAKING STR & % ELONGATION - PROOF LOAD -HEAT TREATMENT -GRADE	MA MA MA MA MA	MEASUREMENT -TENSILE TEST -TENSILE TEST REVIEW REVIEW	100% 1/LOT 100% 100% 1/BATCH	APPD. DRGS -DO- -DO- -DO- -DO-	APPD. DRGS. -DO- -DO- -DO- -DO-	IR MTC MTC HT CHRT MTC	✓ ✓ ✓ ✓ ✓ ✓	P P P P P P	V V V V V V	V V V V V V	

MANUFACTURER / CONTRACTOR	LEGEND: ** M : MANUFACTURER / SUB-SUPPLIER C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER/ NOMINATED INSPECTION AGENCY. INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION	FOR CUSTOMER USE	
SUB-CONTRACTOR		REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL
SIGNATURE			

	MANUFACTURER'S NAME & ADDRESS :	MANUFACTURING QUALITY PLAN ITEM : Chain Pulley Block QP No.: REV.:0, Date.: , PAGE: 2 OF 4	PROJECT : 1X800 MW NORTH CHENNAI TPP STAGE III PACKAGE : CHAIN PULLEY BLOCK

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLAS S	TYPE OF CHECK	QUANTU M OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
					M	C/N				M	C	N	
					6.					10.			
1.	2.	3.	4.	5.			7.	8.	9.				11.

1.3	RAW MATL. (BAR /FORGING) FOR GEAR BLANKS/SHAFTS/ PINIONS/AXLE/ RATCHET PAWL / RATCHET WHEEL & PLATES FOR FABRICATION ETC	CHEMICAL COMPOSITION MECHANICAL INTERNAL DEFECTS NDT AFTER MACHINING	MA MA MA MA	Review Review UT DPT	ONE SAMPLE PER HEAT 100% 100%	Material specification as per approved drawings. ASTM A-388 REFER NOTE 1 ASTM E-165 NO RELEVANT INDICATION		MFR' S TC IR TC	✓ ✓ ✓ ✓	P P P P	V V V V	V V V V	TC or inspection report for components shall be given. For rounds ≥50mm and plates ≥25 mm.
1.4.	LOAD CHAIN WHEELS	- CHEMICAL & MECHANICAL PROPERTIES	MA	CHEMICAL MECHANICAL PROPERTIES	ONE SAMPLE PER LOT	APPD. DRG.	APPD. DRG.	MTC	✓	P	V	V	
1.5	BEARINGS	MAKE, TYPE, CATALOGUE NO.	MA	VISUAL	RANDOM	APP DRG / MFR'S CATALOGUE	APP DRG / MFR'S CATALOGUE	IR	✓	P	V	V	
1.6	HAND CHAIN WHEEL	CHEMICAL MECHANICAL PROPERTIES	MA	CHEMICAL MECHANICAL PROPERTIES	ONE SAMPLE PER LOT	AS PER DRAWING	AS PER DRAWING	MTC	✓	P	V	V	
1.7	HAND CHAIN	GRADE/ DIMENSION	MA	GRADE DIMENSION	100%	AS PER DRAWING	AS PER DRAWING	MTC	✓	P	V	V	

	LEGEND:	FOR CUSTOMER USE	
MANUFACTURER / CONTRACTOR	** M : MANUFACTURER / SUB-SUPPLIER C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER/ NOMINATED INSPECTION AGENCY. INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION		
SUB-CONTRACTOR			
SIGNATURE		REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL

	MANUFACTURER'S NAME & ADDRESS :	MANUFACTURING QUALITY PLAN ITEM : Chain Pulley Block QP No.: REV.:0, Date.: , PAGE: 3 OF 4		PROJECT : 1X800 MW NORTH CHENNAI TPP STAGE III PACKAGE : CHAIN PULLEY BLOCK

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLAS S	TYPE OF CHECK	QUANTU M OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
					M	C/N				M	C	N	
					6.					10.			
1.	2.	3.	4.	5.			7.	8.	9.				11.

1.8	TROLLEY GEARS, PINION,WHEELS, AXLE	CHEMICAL & MECHANICAL	MA	LAB ANALYSIS,	100%		APPVD DRGS	APPVD DRGS	IR/TC	✓	P	V	V	
2	IN PROCESS													
2.1	RATCHET PAWL / RATCHET WHEEL	-HARDNESS -SURFACE CRACK	MA MA	HARDNESS DPT	100% 100 %		IS:3832/ APPD DRG. ASTM E165	IS:3832/ APPD. DRG. NO DEFECT	IR IR	✓ ✓	P P	V V	V V	
2.2	COMPONENTS AFTER HARDFACING & MACHINING	HEAT TREATMENT SURFACE HARDNESS SURFACE CRACK DIMENSION	MA MA MA MA	HT CHART HARDNESS DPT FOR SURFACE CRACK MEASURE	100% 10% 100% 10%		IS 1875/IS 4367/IS 3832 --DO-- ASTM E 165	NO DEFECT	IR IR IR IR	✓ ✓ ✓ ✓	P P P P	V V V V	V V V V	
3.0	FINAL INSPECTION													
3.1	COMPLETE ASSEMBLY	OVERALL DIMENSION ENDURANCE TYPE TEST OPERATIONAL PROOF LOAD & LIGHT LOAD TEST, EFFORT. HEIGHT OF LIFT	CR MA CR MA	MEASUREMENT TYPE TEST LOAD TEST VISUAL	100 % 1 PER SIZE 100% 100 %		IS:3832 /APPD DRG IS 3832 -DO- -DO-	IS:3832 /APPD DRG IS 3832 -DO- -DO-	IR TC IR IR	✓ ✓ ✓ ✓	P P P P	W V W W	V V V V	

MANUFACTURER / CONTRACTOR SUB-CONTRACTOR SIGNATURE	LEGEND: ** M : MANUFACTURER / SUB-SUPPLIER C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER/ NOMINATED INSPECTION AGENCY. INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION	FOR CUSTOMER USE REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL

	MANUFACTURER'S NAME & ADDRESS :	MANUFACTURING QUALITY PLAN ITEM : Chain Pulley Block QP No.: REV.:0, Date.: , PAGE: 4 OF 4	PROJECT : 1X800 MW NORTH CHENNAI TPP STAGE III PACKAGE : CHAIN PULLEY BLOCK

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLAS S	TYPE OF CHECK	QUANTU M OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
					M	C/N				M	C	N	
					6.					10.			
1.	2.	3.	4.	5.			7.	8.	9.				11.

		SWIVELING OF HOOK	MA	VISUAL	100%	APPROVED DRG	APPROVED DRG	IR	✓	P	W	V	
		EFFORT	MA	PULL ON CHAIN	100%	-DO-	-DO-	IR	✓	P	W	V	
3.2	PAINTING	-CLEANING - SHADE & DFT OF PAINT	MA MI	VISUAL VISUAL	AT RANDOM AT RANDOM	APPROVED DRAWING/ SPECIFICATI ON	APPROVED DRAWING/ SPECIFICATI ON	IR IR		P p	--- W	--- ---	
3.3	NAME PLATE	VERIFICATION	MA	VISUAL	100%			IR		P	V	---	
3.4	PACKING	-VERIFICATION	MI	VISUAL	100%	SPECS.	SPECS.	IR		P	---	---	
3.5	REVIEW OF QA DOCUMENTATION	VERIFICATION	MA	VISUAL	100%	APPD. QP	APPD. QP		✓	V	V	V	
CR – CRITICAL, MA – MAJOR , MI – MINOR													

NOTE 1: WHEN BACK WALL ECHO (BWE) IS SET AT 100% OF FULL SCREEN HEIGHT (FSH) IN DEFECT FREE AREA THEN

(A) DEFECT ECHO SHALL NOT EXCEED 20% OF FSH &

(B) BWE SHOULD BE MINIMUM 80% OF FSH IN ANY AREA.

NOTE 2: RECORDS IDENTIFIED WITH TICK SHALL BE ESSENTIALLY INLCUDED IN QA DOCUMENTATION.

	LEGEND: ** M : MANUFACTURER / SUB-SUPPLIER C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER/ NOMINATED INSPECTION AGENCY. INDICATE “P” PERFORM “W” WITNESS AND “V” VERIFICATION	FOR CUSTOMER USE	
MANUFACTURER / CONTRACTOR			
SUB-CONTRACTOR			
SIGNATURE		REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL



TITLE: ELECTRICAL EQUIPMENT SPECIFICATION FOR EOT CRANES / ELEVATORS / ELECTRIC HOISTS SYSTEM (ELECTRICAL PORTION) 1X800 MW NORTH CHENNAI TPP STAGE III	SPECIFICATION NO. PE-TS-323-A001
	VOLUME NO. : II-B
	SECTION: C
	REV NO. : 0 DATE: 31.01.17
	SHEET: 1 OF 2

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) Erection and Commissioning spares.
- e) Erection & Maintenance tools & tackles.
- f) Electrical load requirement for ~~EOT CRANES / ELEVATORS /~~ ELECTRIC HOISTS System.
- g) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
- h) 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.
- i) 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.
- j) Motors shall meet minimum requirement of Electric motor specification.
- k) All routine tests and type tests reports as per applicable standards shall be furnished at contract stage.
- l) Purchaser will furnish data sheets to the vendor after award of contract. Vendor shall furnish filled in data sheets meeting the specification requirements.
- m) LV Power Cables and Control Cables shall be as per cable annexure.
- n) Cable trays shall be as per attached Cable Tray Annexure.
- o) Panel shall be as per attached Panel Annexure.
- p) Technical requirements shall be as per specifications listed in Clause 4.1 to 4.9. In case of any discrepancy between Basic technical Particulars for HT or LT motors and BHEL standard specification, Basic technical particulars for HT or LT motors shall prevail.

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 line with this, the bidder as technical offer shall furnish two signed and stamped copies of the following:

- a) A copy of this sheet "Electrical Equipment Specification for ~~EOT CRANES /~~ ~~ELEVATORS /~~ ELECTRIC HOISTS System and sheet "Electrical Scope between BHEL and Vendor" with bidder's signature and company stamp.
- b) List of Erection and Commissioning spares.
- c) List of Erection & Maintenance tools & tackles.



TITLE:
ELECTRICAL EQUIPMENT SPECIFICATION
FOR EOT CRANES / ELEVATORS / ELECTRIC HOISTS
SYSTEM
(ELECTRICAL PORTION)
1X800 MW NORTH CHENNAI TPP STAGE III

SPECIFICATION NO.
PE-TS-323-A001
VOLUME NO. : **II-B**
SECTION: **C**
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SHEET: **1** OF **2**

- d) Electrical load requirement.
- 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 Technical specification – Specification for Electric Motors/Actuators
- 4.3 Basic Technical Particulars of HT/LT motors.
- 4.4 Testing Requirements.
- 4.5 Quality Plan for LV Motors.
- 4.6 Load Data Format.

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE: **ELECTRIC HOISTS**SCOPE OF VENDOR: SUPPLY, **ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT**

PROJECT :

<u>S. NO</u>	<u>DETAILS</u>	<u>SCOPE SUPPLY</u>	<u>SCOPE E&C</u>	<u>REMARKS</u>
1	Isolating Switch	Vendor	Vendor	BHEL will provide one number 415 V(3ph, 4W) supply feeder only up to isolating switches for cranes/hoists. Any other voltage level (AC/DC) required will be derived by the vendor. Motor starter shall be part of crane/ hoist control panel.
2	Power cables, control cables, screened control cables and any special cables (if required) between equipment supplied by vendor.	Vendor	Vendor	Cable from supply feeder to isolating switch shall be in BHEL scope.
3	Cabling material (cable trays, accessories, cable tray supporting system, conduits etc).	Vendor	Vendor	
4	Equipment Earthing	BHEL	BHEL	All equipment metallic enclosures / frames, metal structure etc. shall be grounded at two points each to the nearest grounding points / risers provided by BHEL
5	Motors	Vendor	Vendor	
6	Cable glands and lugs 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 & control cables.
7	a) Input cable schedules (C & I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
8	Equipment layout drawings	Vendor	-	
9	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.



1X800 TANGEDCO NORTH CHENNAI TPP

**VENTILATION SYSTEM
STANDARD TECHNICAL SPECIFICATIONS**

SPECIFICATION No: PE-TS-423-554-A001

SECTION : I

SUB-SECTION : D

REV. 01

DATE: NOV 2017

SECTION: I

SUB-SECTION: D

STANDARD TECHNICAL SPECIFICATIONS



**STANDARD TECHNICAL SPECIFICATION
FOR
AIR WASHER**

SPECIFICATION NO.PES-554-01

VOLUME II B

SECTION D

REV. 00

DATE: NOV 2012

SHEET 1 OF 3

**STANDARD TECHNICAL SPECIFICATION
FOR
AIR WASHER**

	STANDARD TECHNICAL SPECIFICATION FOR AIR WASHER	SPECIFICATION NO.PES-554-01	
		VOLUME II B	
		SECTION D	
		REV. 00	DATE: NOV 2012
		SHEET 2 OF 3	
1.	GENERAL		
1.1.1	This specification covers the design, manufacture, construction features, installation, commissioning and conducting performance test at site.		
2.	CODES AND STANDARDS		
	The design/manufacture and performance of air washer shall comply with all currently applicable statutes, regulations and safety codes in the locality where the air washer is installed. The equipments shall also conform to the requirements of the latest editions of applicable Indian/British/US standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. In particular the equipments shall conform to the latest editions of the following standards:-		
2.1.1	IS:277: Galvanised steel sheets		
2.1.2	IS:1239: Mild steel tubes		
2.1.3	IS: 2062:		
3.	DESIGN/CONSTRUCTION FEATURES		
3.1	GENERAL		
3.1.1	The air washer shall be designed for max. air velocity of 2.8M/sec. Circulating water quantity shall be 1.0 CMH for every 1000 CMH of air flow, unless otherwise stated in data sheet A. The minimum saturating efficiency of air washer shall not be less than 90% Minimum length of air washer shall be 2500 mm.		
3.2	TANK (SUMP)		
3.2.1	The air washer tank shall either be masonry or metallic construction as specified in data sheet A. Masonry tank shall be provided by purchaser whereas metallic tank shall be of welded construction, fabricated from not less than 6mm thick MS plates, and inside, outside surfaces shall be provided with anti corrosive paint (Zinc sprayed to coating thickness of 75 micron min.).		
3.2.2	The air washer tank shall have a minimum depth of 600mm and tank construction shall be such that the suction screen can be replaced while the air washer is under operation. The inlet and outlet ends of tank shall be suitably constructed to accommodate distribution plates and eliminator plates.		
3.3	DISTRIBUTION PLATE		
3.3.1	The distribution plate shall be fabricated from minimum 18 gauge thick GSS and shall have minimum 50% free area. The angles used for supports shall be galvanised.		
3.3.2	The distribution plate shall be built up of number of sections for easy handling.		
3.4	HEADERS AND STAND PIPE		
3.4.1	The air washer shall be of two bank construction (one cross flow and other unit flow). The piping up to and including 100mm dia meter shall be of galvanised steel and above 100mm dia shall be black steel (subsequently spray galvanized to coating thickness as per approved TDS). All piping shall be adequately supported.		

	STANDARD TECHNICAL SPECIFICATION FOR AIR WASHER	SPECIFICATION NO.PES-554-01	
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3.5	SPRAY NOZZLES
3.5.1	Spray nozzles shall be made of HDP (High density polyethylene) and shall be self cleaning type. The nozzles shall be designed to produce fine atomised spray and shall be spaced to give, uniform coverage of the air washer section. The pressure drop through the nozzle shall be in the range of 1.4 kg/cm2 g to 2.4 Kg/cm2g
3.6	ELIMINATOR PLATE
3.6.1	Eliminator plate shall be fabricated from 22 gauge thick GSS (Zinc coating thickness as per approved TDS).The eliminator section shall have minimum 6 bends. Spacer bars, tie rods and supports shall be of galvanised steel construction. Eliminator box shall be complete with suitable drop tray and drain pipe.
3.7	SUCTION SCREENS
3.7.1	Suitable no. of suction screens shall be provided by vendor and one set of spare screens shall be furnished along with each air washer.
3.8	INSPECTION DOOR AND MARINE LIGHT
3.8.1	Air tight inspection door of 600x700mm, metallic construction shall be provided. The air washer shall be equipped with marine light as required.
3.9	MAKE UP, DRAIN AND QUICK FILL CONNECTION
3.9.1	The air washer shall be provided with quick fill and make up connection. The quick fill valve shall be a globe valve. Float valve for making connection shall be backed up by a gate valve. Drain connections complete with isolating valves shall be provided for both suction and main tank. Over-flow pipe shall be provided for main tank and shall be connected to drain pipe, before the isolating valve or drain. In case of masonry tanks suitable pipe pieces with stiffener plates shall be provided by Vendor for use during casting of masonry tank.
4.	DATA TO BE FURNISHED BY VENDOR AFTER AWARD OF CONTRACT
4.1.1	Performance curve for air washer
4.1.2	GA drg.
4.1.3	Foundation drag. weight, dynamic loading etc.
4.1.4	O&M manual



**AIR WASHER
DATA SHEET - A**

VOLUME II-B

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SHEET 1 OF 2

S.No. DESCRIPTION

DETAILS

GENERAL

1.	Designation	Air washers for power house building.
2.	Nos. required	Refer Section-C of Specific Technical Requirement
3.	Service	Evaporative Cooling of TG Hall & electrical bay
4.	Location	As per section-C/ Tender Layout Drg.

DESIGN DATA

5.	Type	Sheet metal type, as per schedule of Ventilation system.
6.	Capacity M3/hr	Refer Section-C of Specific Technical Requirement
7.	Inlet air temperature	(Refer design data.)
8.	Saturation Efficiency (min).	To achieve saturation efficiency of 90%
9.	Allowable Pressure drop through Spray nozzle	2.4 Kg/cm ² (g) max.
9.	Pressure drop across Spray chamber	15 to 20 mm WG.

MATERIALS

11.	Moisture Eliminators plates	24 SWG Galvanized Sheet (Vertical and brake type). / 100% Virgin PVC of minimum finished thickness of 2 mm.
12.	Moisture Eliminators Frame	22 SWG G.I. Sheets.
13.	Distribution plates	18 G GSS to have 50% free area.
14.	Tank	MS
15.	Casing	Black M.S. (10 SWG min.)
16.	Louvers	20 G GSS sheet & frame of 18 G galvanized steel angle. Louvers with Bird screen of galvanized wire mesh of 10 mm square.
17.	Piping	MS Heavy Class Galvanized to IS: 1239 Part I, OR IS –3589 depending upon size.



**AIR WASHER
DATA SHEET - A**

VOLUME II-B

SECTION D

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SHEET 2 OF 2

18.	Suction Screen Water	Brass (40 mesh size 2 nos for each air washer)
19.	Spray nozzles	Brass/Bronze with chrome plating or suitable plastic material (Nylon/Polymer) and shall be self cleaning type.
20.	Flooding Nozzles	Nylon/Polymer.
21.	Banks	Two spray banks each connected to individual header

EQUIPMENT SELECTION CRITERIA

22.	Face Velocity through louver.	Not to exceed 2.5 m/s
23.	Max. Pressure drop	Not to exceed 6.5 mm Wg when clean
24.	Saturation efficiency	Not less than 90%.
25.	Face velocity of air through spray chamber.	Not to exceed 2.5 m/s.
26.	Allowable pressure drop for washing chamber.	15 to 20 mm Wg.

NOTE:

- 1) All parts coming in contact with moisture for air washer shall be spray galvanized/epoxy painted
(2 coat of rust preventing epoxy primer & 2 coat of finished paint from both sides.)
- 2) Moisture eliminator shall have bends at 30 Degree with the direction of air flow & shall have effectively hooked edges for trapping the water.



**STANDARD TECHNICAL SPECIFICATION
FOR
VENTILATION FANS**

SPECIFICATION NO.PES-554-03

VOLUME II B

SECTION D

REV. 02

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**STANDARD TECHNICAL SPECIFICATION
FOR
VENTILATION FANS**

	STANDARD TECHNICAL SPECIFICATION FOR VENTILATION FANS	SPECIFICATION NO.PES-554-03	
		VOLUME II B	
		SECTION D	
		REV. 02	DATE: NOV 2012
		SHEET 2 OF 4	
1.	GENERAL	This specification covers the design, manufacture, testing of performance at manufacturer's/sub-contractors works, delivery at site, handling at site, erection and commissioning of ventilation fans.	
2.	CODE AND STANDARDS	The design, manufacture and performance of equipment shall comply with all currently applicable statutes, regulations and safety codes in the locality where it is to be installed. The equipment shall conform to latest edition of applicable Indian Standards or their equivalent standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. In particular the equipment shall conform to the latest editions of the Following standards.	
2.1.1	IS:4894	-Centrifugal fans	
2.1.2	IS:3588	-Electric Axial Flow fans	
2.1.3	IS:2312	-Propeller type A.C. ventilation fans	
2.1.4	IS-3963	-Roof extractor units	
2.1.5	BS:848	-Method of performance test for fans.	
2.1.6	AMCA publication 99 standards handbook		
2.1.7	AMCA standard 210, Test code for air moving devices.		
3.	DESIGN AND CONSTRUCTION		
3.1	THE ENCLOSED DATA SHEET A GIVES THE NECESSARY DETAILS FOR CENTRIFUGAL/AXIAL/ROOF EXTRACTOR UNITS ETC.		
3.2	WELDING PROCESS AND WELDERS EMPLOYED FOR FABRICATION SHALL BE QUALIFIED AS PER ASME SEC. IX		
3.3	CASING		
3.3.1	The centrifugal fans casing shall be of welded construction fabricated with heavy gauge material (min 3 mm) with flanges (min. 5 mm) on inlet and out let side for direct connection and shall be rigidly reinforced and supported by structural angles. The seams shall be permanently sealed airtight. Horizontal Split casings shall be provided on large size fans. Casing drain (at bottom) with threaded plug/ with valve shall be provided, as required. All mounting/ connecting holes shall be drilled off centre.		
3.3.2	The axial flow casing for supply fans/roof extractors shall be of heavy gauge construction (min 3 mm) properly reinforced for rigidity and shall be complete with suitable supports. Access doors with suitable locking arrangement shall be provided in the casing for easy access to the motor and impeller. External junction box/ Terminal box on casing with IP-55 protection shall be provided, if required. Wiring for motor from external junction box/ Terminal box shall be through flexible conduit.		
3.3.3	Suitable motor brackets designed for rigid mounting of motors, shall be provided for roof extractors and wall mounted exhaust/ supply fans.		

	STANDARD TECHNICAL SPECIFICATION FOR VENTILATION FANS	SPECIFICATION NO.PES-554-03	
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3.4	IMPELLER
3.4.1	Centrifugal fan impeller shall have die formed, aerofoil or laminar blades welded to the rim and back plate and shall have non-overloading, self cleaning characteristics. Rim shall be spun to have smooth contour. If required, intermediate stiffening rings shall be provided. Shaft sleeves shall be furnished, if specified. The impeller, pulley and shaft sleeve shall be secured to the shaft by key and/or nuts (threaded opposite to direction of rotation of impeller). The impeller shall be statically and dynamically balanced.
3.4.2	The axial fan impeller shall be of high efficiency aerofoil design. The blades shall be mounted on a streamlined hub and the impeller shall be mounted directly on the motor shaft. Impeller shall be in one piece however; fabricated blades will be acceptable up to 450 mm impeller diameter.
3.4.3	Roof ventilator impeller may either be centrifugal or axial type. Backward inclined blades shall be provided for centrifugal impellers. Blades may be die-formed or cast. Axial flow impeller shall be directly mounted to motor shaft whereas centrifugal impeller may either be direct-driven or belt-driven. The shaft of belt-driven centrifugal fan shall be solid cold rolled carbon steel, ground and polished. However, direct mounted impellers are preferred.
3.5	BEARINGS:
3.5.1	The centrifugal fan bearing may be ball, roller or sleeve bearings of self-aligning heavy duty type with adequate capacity and life. Make of Bearings to be specified. Bearings shall be oil/grease lubricated and provided with fittings for lubrication from outside and shall be located in easily accessible position to facilitate maintenance.
3.6	INLET CONES AND GUARDS
3.6.1	Centrifugal fans inlet shall be spun to have a smooth contour. Inlet screen, if provided, shall be galvanised wire mesh of 25 mm square with wire thickness of min. 1.5 mm.
3.6.2	Inlet cone, outlet bell and suitably designed guards shall be provided.
3.7	GUIDE VANES:
3.7.1	In case of vane axial fans guide vanes shall be provided on discharge side.
3.8	BASE PLATE AND VIBRATION ISOLATORS
3.8.1	Base plate and vibration isolators, which may be double deflection rubber in shear or rubber in compression type or spring type shall be provided. With each fan rubber bushes, washers wherever needed for vibration isolator in sufficient nos. shall be included, as required, to ensure isolation of foundation from vibration of equipment. For roof ventilators suitable mounting arrangement shall be provided such that there is no ingress of rain water into the building.
3.9	HOOD AND COWL
3.9.1	Roof exhaustors shall be provided with hinge type hood providing easy access to motor and impeller. Weather proof lockable type disconnect switch shall be provided such that hood can open only when the disconnect switch is in 'off'

	STANDARD TECHNICAL SPECIFICATION FOR VENTILATION FANS	SPECIFICATION NO.PES-554-03	
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position. On larger size of roof ventilators hoods may be of split construction. 15 mm mesh galvanised bird screen shall be provided.

3.9.2 Rain protection cowls shall be designed to suit wall exhausters/supply fans for protecting fans from rain. The cowls shall be provided with bird screen of heavy gauge expanded metal netting.

3.10 SPEED

3.10.1 The speed of axial flow fans/roof ventilators shall not exceed 960 RPM for impeller dia exceeding 450 mm and shall not be greater than 1440 with impeller dia less than 450 mm.

4. MOTORS

Drive motors shall be of totally enclosed type, suitable for horizontal/vertical mounting as applicable and shall comply with the requirments of the specifications furnished elsewhere for motors.

5. ACCESSORIES

Accessories as specified in Data sheet-A and as required for satisfactory trouble free & safe operation of fans shall be provided.

TESTING AND INSPECTION

List of TCs arranged as per Approved Quality Plan shall be furnished along with copy of TCs at the time of inspection by BHEL

- Visual inspection of sheets/plates, angles, channels etc. – Pitting, lamination in sheets/ plates, angles and channels shall be avoided.- visual inspection by main contractor of BHEL.
- Sheets/ Plates - Test certificate shall be furnished for physical and chemical properties for sheets / plates- for review by BHEL
- Shaft: Mechanical and chemical— review by BHEL
- Motors (of approved make): Routine TC ,FLP TC if applicable
- Workmanship and dimensional check as per manufacturing drg. and approved Drgs.- by main contractor of BHEL.- Shall be checked by BHEL/ Customer during final inspection.
- Balancing of impellers- Dynamic balancing certificates shall be furnished –grade 6.3 or better to ISO-1940. Balancing weights shall be positively locked/ welded to avoid loosening. - witness by manufacturer - TC to be furnished for review by BHEL(consisting of weight of impeller, radius of correction and balancing rpm). For spare impellers Dynamic Balancing shall be witnessed by BHEL.
- Performance test of one Centrifugal fan or Axial Fan /per type/per size as per applicable standard – by BHEL.

Centrifugal/ Axial fans 100% run tested by main contractor of BHEL. Run test by BHEL/Customer may be at random or 100%- Vibration shall be within satisfactory zone of VDI 2056 (group- G) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient



CENTRIFUGAL FAN
DATA SHEET - A

VOLUME II-B

SECTION D

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SHEET 1 OF 3

No. Particulars

Data

1 General Information

1.1 Fan Designation/application.
system/

Refer schedule of Ventilation
Air washers & UAF Units.

1.2 Nos. required/capacity
Technical

Refer Section-C of Specific
Requirement

1.3 Location

Refer layout drg. Attached.

2.0 Design Data

2.1 Type

DIDW for Air Washer and SISW for
UAF

2.2 Type of blades

backward curved

2.3 Arrangement

To suit application as per layout.

2.4 Discharge direction

To suit application as per layout.

2.5 Duty

Continuous

2.6 Capacity at site (Cubic Meter/hr) & static pressure.
Technical

Refer Section-C of Specific
Requirement

2.7 Suction pressure (mm Wg)

As per system requirement.

2.8 Fluid

Atmospheric Air.

2.9 Suction Temperature

Refer weather data attached.

2.10 Suction humidity

Refer weather data attached.

3.0 Materials

3.1 Fan Scroll

Heavy Gauge Mild Steel to IS: 2062
with galvanised

3.2 Fan Casing (side plates & stiffeners)

Heavy Gauge Mild Steel to IS: 2062 /
IS: 1079 / Eq. Minimum 3 mm thick
casing.

3.3 Impeller

Mild Steel/plate to IS: 2062

3.4 Impeller hub

Mild Steel/plate to IS: 2062

3.5 Impeller back plate blade & shroud

Mild Steel to IS: 2062 / IS: 1079 / Eq.



**CENTRIFUGAL FAN
DATA SHEET - A**

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SHEET 2 OF 3

3.6	a) Shaft b) Shaft sleeve	EN-8 or eqv. -do-
3.7	Support frame and structure.	Mild Steel to IS: 2062
3.8	Flexible connection at outlet impregnated canvas with MS Flanges and cleats (3mm thick).	Fire resistant type plastic
3.9	V Belt	ISI marked (Reinforced rubber section to IS: 4776)
3.10	V Pulley per	Cast Iron multi groove to grade FG 20 as IS: 210. Having taper lock type M.S./C.I.
3.11	Slide rails	G.I. according to supplier's design
3.12	Connection pieces	M.S. Galvanized / Epoxy painted.
3.13	Bolts & nuts	Hard synthetic rubber
3.14	Vibration isolating pads, washers and spring if any.	
4.0	<u>ACCESSORIES</u>	
4.1	Common base plate	Required.
4.2	Anchor bolts	-do-
4.3	Vibration Isolators	Hard synthetic rubber
4.4	V-belt pulleys	-do-
4.5	V-belts	Reinforced rubber of appropriate section
4.6	Belt guard	Required.
4.7	Outlet damper	Required(M.S. Heavy Gauge)
4.8	Inlet guard	Required.
4.9	Inlet Vane (variable)	Not required.
4.10	Drain valve	Required.
4.11	Acoustic silencers	Not required.
5.0	<u>Motor</u>	
5.1	Motor by	Bidder



**CENTRIFUGAL FAN
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5.2 Starter by

BHEL

6.0 Painting of fans including base frame

Galvanized / epoxy painting (as per
Section-C & painting specifications)

NOTE:

- 1) Motors shall have 15 % margin on duty power point.
- 2) Fan shall be designed to operate with in 9% and 25% of system throttling line.
- 3) Opposed Multiple louvers damper shall be provided at fan outlet. Louvres shall be of 2 mm thick MS (galvanized). Casing shall be of 3.15 mm thick MS (galvanized).



VENTILATION FAN (R.E.UNIT)
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General Information

1)	Designation	Roof extractor Units for areas as per schedule of ventilation system.
2)	Nos. required	As per schedule.
3)	Service	Continuous
4)	Location	Roof of respective areas.
5)	Area	As per schedule

Design Data

6)	Type	axial flow type.
7)	Air delivery capacity system.	as per schedule of ventilation
8)	Fluid	Atmospheric Air.
9)	Temperature	50 Deg. C
10)	Static Pressure required	As per Section 'C' schedule of ventilation system.
11)	Outlet air velocity	Not more than 12 m/sec.

Materials

12)	Casing/cowl/hood	M.S. Sheet to IS: 2062 /IS: 1079/Eq.
13)	Impeller 617	Cast Aluminium alloy to A-6M IS- Grade LM6
14)	Support frame and structure. 2062).	M.S. of adequate thickness (IS-

ACCESSORIES

15)	Vibration isolating pads	Yes.
16)	Base frame for mounting	Yes.
17)	Wire Guard at inlet.	Yes.
18)	Disconnect switch	Yes.



VENTILATION FAN (R.E.UNIT)

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19) Gravity damper at outlet

Yes

Motor

20) Motor by

Bidder

21) Starter by

Bidder

22) Type of motor

Conforming to IS: 325 latest/as per specification.

23) Free delivery test

Yes.

24) Performance test at specified duty point.

Yes

25) Speed

Not more than 1500 RPM

NOTE:

1. Motors shall have 15% on duty power Point.



VENTILATION FAN (R.E.UNIT)

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Ventilation Fan (Axial Flow Type)

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No. Particulars

Data

General Information

1) Designation

Supply/Exhaust Fans.

2) Nos. required in

Refer schedule of Ventilation system section-C under specific technical requirement.

3) Service air.

To exhaust warm air/to supply fresh

4) Location

Wall mounted.

5) Area

Same as above in 2.

Design Data

6) Type supply

Axial fans suitable for 415V/3 phase for Motor.

7) Air delivery capacity system.

As per schedule of ventilation

8) Fluid

Atmospheric Air.

9) Temperature

Refer Section of specific technical requirement

10) Static Pressure required

As per Section 'C' schedule of ventilation system.

11) Outlet Air Velocity

Not more than 12 m/sec.

Materials

12) Casing

M.S. (IS-2062)

13) Impeller 617)

Cast Aluminium. (Alloy A-6M, IS-

14) Hub

Al Alloy.

15) Support frame and structure. (Galvanized/

M.S. of adequate thickness Painted) IS-2062.

16) Neoprene rubber pads

As required.



Ventilation Fan (Axial Flow Type)

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17)	Coned inlet for wall exhausters/supply fans	MS (IS-2062)
18)	Supporting frame for mounting.	Required.
19)	Protective screen at inlet.	Yes (Min 14 SWG Galvanized wire knitted in 1" square mesh.
20)	Rain Protection Cowl	Aluminum or hot dip Galvanized after fabrication from M.S.

Motor

21)	Motor by	Bidder
22)	Starter by	BHEL

NOTE:

- 1) For Battery Room, motor for fan shall be of flame proof type & fan of spark proof construction with Epoxy painting.
- 2) Gravity type damper shall be provided at the outlet of axial fan for exhaust application.
- 3) Motor shall have 15% margin over Duty Point.



Ventilation Fan (Axial Flow Type)

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**STANDARD TECHNICAL SPECIFICATION
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LOW PRESSURE AIR DISTRIBUTION SYSTEM**



TECHNICAL SPECIFICATION
LOW PRESSURE AIR DISTRIBUTION
SYSTEM

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1. GENERAL

This specification covers the design, manufacture, construction features, installation, inspection testing and air balancing of air distribution system upto a total pressure of 95mm w.g. The specification is intended to cover the air distribution for air conditioning system and ventilation system not involving localised exhaust.

2. CODES AND STANDARDS

2.1.1 The design, construction and performance of complete system shall conform to all currently applicable statutes, regulations, safety codes in the locality where the equipment are to be installed.

2.1.2 Unless specified otherwise the equipments shall generally conform to latest applicable Indian Standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. In particular the equipment shall generally conform to latest editions by the following standards:-

- a) IS: 655 - Specifications for metal air ducts
- b) IS:277 - Specifications for galvanised steel sheets
- c) IS:737 - Specification for wrought aluminium and aluminium alloy sheet and strip.

3. MATERIAL

3.1.1 Metal air ducts shall be either of galvanised steel sheets or aluminium sheets, as indicated in data sheet-A.

3.1.2 The rolled steel sheets before galvanising shall be properly annealed or normalised so as to allow fabrication of ducts without developing cracks. Zinc coating on the steel shall be as per IS 277 Gr. 275 / as specified in Data Sheet A.

3.1.3 The aluminium sheets shall be of grade S1C or NS3 and shall be suitable for duct fabrication work as per IS-737 latest.

4. CONSTRUCTION/FABRICATION

The thickness of sheets, the type of bracing and other fabrication details shall generally conform to requirements given hereunder unless specified otherwise in data sheet A and/or indicated on drawings.

4.1 RECTANGULAR DUCTS

4.1.1

S.No.	Max Side	Sheet Thickness		Type of transverse Joint connections	Bracings
		(mm) GI	(mm) Al		
a)	Up to 600	0.63 (24G)	0.80	S-drive, pocket or bar slips or flanged joints on 2.5m centres	None
b)	601 to 750	0.63	0.80	S-drive, 25mm pocket or	25x25x3 mm MS



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		(24G)		25mm bar slips or flanged joints on 2.5m centres	angles, 1.2m from joints
c)	751 to 1000	0.80 (22G)	1.00	S-drive, 25mm pocket or 25mm bar slips or flanged joints on 2.5m centres	25x25x3 mm MS angles, 1.2m from joints
d)	1001 to1500	0.80 (22G)	1.00	40x40x3mm MS angle, flanged connections or 40mm pocket or40mm bar slips with 35x3mm bar reinforcing on 2.5m centres	40x40x3 mm MS angles, 1.2m from joints
e)	1501 to2250	1.00 (20G)	1.50	40x40x3mm MS angle, flanged connections or 40mm pocket or40mm bar slips, 1M maximum centres, with 35x3mm bar reinforcing	40x40x3 mm diagonal angles or 40x40x3mm angles, 600mm from joints
f)	2251 & above	1.25 (18G)	1.80	50x50x3mm MS angles,connections or 40mm pocket or 40 mm bar slips, 1M maximum centres with 35x3mm bar reinforcing.	50x50x3mm diagonal angles or 50x50x3mm angles 600 mm from joints.
g)	No bracing is required if transverse joints are less than 600mm apart				
h)	For ducts larger than 2250mm, special handling and supporting methods shall be provided as per the approval of Purchaser				

- 4.1.2 All rectangular ducts having either dimension larger than 450mm shall be cross broken except these ducts which are insulated with sand cement plaster. Air outlet connections on ducts need not be cross broken.
- 4.1.3 The seams on duct cones shall be of Pittsburgh type. Longitudinal seams shall be smooth inside the ducts.
- 4.1.4 The flanges used for transverse joints shall be joined together with GI bolts (grade 4.6) and nuts spaced at 125mm centres as per following:
- Upto 1000mm - 6 mm dia GI bolts
 - 1001 to 1500 - 8 mm dia GI bolts
 - 1501 and above - 10mm dia GI bolts
- 4.1.5 The MS angle flanges shall be connected to ducts with rivets at approx. 100mm centres. The flanged joints shall have 6mm thick felt packing stuck to flanges with shellac varnish. The holes in the felt packing shall be burnt through. The ducts are to be tapped 6mm across the MS flanges.
- 4.1.6 MS angles used for bracings shall be tack welded to the ducts or rivetted at 125mm centres, as applicable.



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4.2 ROUND DUCTS

4.2.1

S.No.	Duct dia-mm	Sheet Thickness		Reinforcing
		(mm) GI	(mm) Al	
a)	Up to 150	0.63 (24G)	0.80	None
b)	151 to 600	0.80 (22G)	1.00	None
c)	601 to 1000	1.00 (20G)	1.50	40x40x3mm girth MS
d)	1001 to 1250	1.00 (20G)	1.50	40x40x3mm girth MS angles at 2.0 meter centres
e)	1251 & above	1.25 (18G)	1.80	40x40x3mm girth MS angles at 1.2m centres

4.2.2 The seams on round ducts may be continuously welded or grooved longitudinal seam. In case of welding of GI sheet, zinc rich paint shall be applied on the welded zone.

4.2.3 Round ducts shall either be joined by welding or the ducts shall be swedged 40mm from the ends such that larger end will butt against the swedge and is held in place with sheet metal screws.

4.3 DUCT SUPPORTS

Unless specified otherwise on drawings, rectangular ducts with larger side of 2250mm or above shall be supported by 15mm MS rods and 50x50x3mm and MS angles while those below 2250 mm shall be supported by 10mm MS rods and all angles shall be given a coat of primer paint. The duct supports shall be at a distance not exceeding 1800mm. The MS rods shall be fixed to MS angle cleats, which in turn are fixed to ceiling slab by suitable anchor fasteners. All anchor fasteners, MS angle cleats, coach screws, hooks and other supporting material required shall be provided by vendor.

However, If ducts are thermally insulated, the MS angles and supports shall not be in direct contact with ducts, for which purpose wooden pieces/ Resin bonded fibre glass sheets (50 mm thick) shall be used in between.

4.4 FLEXIBLE CONNECTIONS

Wherever the sheet metal ducts connects to intake or discharge of fan units a flexible connection of at least 150mm width made by closely woven double layer Fire resistant or canvas shall be provided. The same shall be attached to angle iron frames on equipment and to similar frame on duct or casing by means of a steel band or collar fitting over the end of the flexible connection and bolted through angle iron frame so as to clamp securely between the band and the angle frame.

4.5 TRANSFORMATIONS AND BREACHES

All curves, bends, offsets and other transformations shall be made for easy and

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noiseless flow of air. The throat of every branch duct shall be sized to have a velocity not exceeding that in the main duct to which the branch is connected.

4.6 CAULKING

Wherever duct passes through wall, the opening between masonry and duct work shall be neatly caulked or sealed to prevent movement of air from one space to adjoin by space with a rated fire resistant material.

4.7 EASEMENT

Normally pipe hangers, light fitting rods etc. shall not be allowed to pass through the ducts. Wherever, It becomes absolutely essential to pass these hangers/rods etc. Through the ducts, prior approval of purchaser shall be taken and light streamlines easement around the same shall be provided to maintain smooth air flow.

4.8 ACCESS DOORS

Access doors shall be provided in ducts, plenums etc. on both sides to allow access and servicing of equipment viz. pipes, dampers, coils, valves, heaters etc.

All access doors shall be adequately sized and lined suitably with felt to prevent air leakage. The doors shall be of built-up construction, structurally strong and shall have at least two hinges each, and shall be with two rust proof window sash locks of approved type. All doors shall be so set as to flush with outer finish of duct insulation etc.

4.9 DAMPERS AND SPLITTERS

4.9.1 Dampers and splitters shall be provided at suitable points for proportional volume control of the system. Splitters and dampers shall be made of minimum 18 gauge GSS of quadrant type with locking device mounted outside the duct at accessible location.

4.9.2 Fire Dampers

Fire dampers/fire doors shall be provided as specified in Data Sheet -A and shall be installed at locations indicated on drawings and/or as required/approved by purchaser, including all openings in passage of duct work through fire walls and floors etc. The fire damper shall be of electrical type with damper motor actuated by thermal sensor or fusible link type.

4.9.3 Gravity operated back draft dampers shall be provided to ensure pressurisation of rooms as specified. These dampers shall be designed such as not to allow infiltration of outside air while forced exit of air shall be achieved through this damper. The louvres shall be freely mounted on spindles to allow the dampers to open with the pressure developed by the fan. The dampers shall be provided with flange at inlet.

4.9.4 Vanes

Unless otherwise shown in the drawings all elbows shall be such that the throat radius is 75% of the duct width. In case throat radius is smaller, suitable single thickness vanes of approved details shall be provided.

4.9.5 Flashing

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For the ducts penetrating roofs or outside walls, provision of flashing shall be made by the ducting vendor.

4.10 DIFFUSERS AND GRILLS

The type and quantity of diffusers and grills is indicated on enclosed drawings/data sheet A. The size/quantity of diffusers/ grills indicated in the drawing/data sheet is indicative and is for vendor’s reference purpose only. Vendor shall ensure that the diffusers/grills offered are of requisite capacity, throw and terminal velocity. The pressure drop and noise levels shall be as per data sheet. A enclosed. The diffusers/grills shall be approved by purchaser.

Unless specified otherwise the diffusers/grills shall be of mild steel land painted with two coats of primer paint. Supply air grills shall be complete with volume control dampers. Supply air grills shall be double deflection type while Return Air grills can be single deflection type. Ceiling outlets/diffusers shall have volume control dampers, fixed grids and blanking baffles. All volume control dampers shall be operated by a key from the front of grills/diffusers.

Suitable vanes shall be provided in duct collars to have uniform air distribution. Blank-off baffles wherever required, shall also be provided.

4.11 PLENUMS AND RA BOXING

All plenum chambers and/or connections to fans, dampers etc. shall be constructed in 18 gauge GI sheet. supported on 40x40x6mm MS angle frames. All vertical angles shall be riveted at appox. 125mm. centres to the casing. Suitable caulking compound (Pecora or equivalent) shall be inserted between the base of the angle and all masonry construction to which angles are fastened.

Return air boxing requirements if any are indicated in data sheet-A and the same shall be provided by vendor. The return air box shall be fabricated out of GI sheets shall be insulated with 25mm thick fibre-glass.

4.12 ACCOUSTIC LINING

The ducts shall be lined acoustically from inside as given in data- sheet A and/or section C of the specification.

4.13 PAINTING

Wherever specified the ducts shall be painted or lined with suitable anti-corrosive paint/ lining as per approval of purchaser. In particular the ducts coming in contact with acid fumes shall be epoxy coated, inside and outside.

4.14 THERMAL INSULATION

Thermal insulation shall be as per data sheet - A and the insulation shall conform to enclosed spec. no. PES-553-08.

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5.	INSPECTION AND TESTING
5.1	INSPECTION & TESTING DURING FABRICATION–BY MAIN VENDOR
5.1.1	Visual inspection of GI sheets and angles, channels etc. – dents, black spots, chipping of zinc coating, white dust on galvanised sheets shall be avoided. Pitting , lamination in angles and channels shall be avoided.- visual inspection by Main Vendor.
5.1.2	Galvanised sheets - Test certificate shall be furnished for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating –review of TC by BHEL/Customer
5.1.3	Check for dimensions & mass as per latest IS-277.
5.1.4	Check for defect, twists, ungalvanised spots as per IS-2629.
5.1.5	Bend test & wrapping test as per IS-277.
5.1.6	Zinc coating test on samples as per IS-6745.
5.2	INSPECTION & TESTING AT SITE.
5.2.1	The duct branches, elbows etc. shall be inspected and the joints and connections etc, are to be checked before they are assembled in position.
5.2.2	After completion, all duct systems shall be checked and tested for air leakage, tightness, velocity, pressure drop, vibration and noise etc.
6.	BALANCING
6.1.1	The entire air distribution system shall be balanced by vendor to supply the air quantities as required in various rooms so as to maintain the requisite temperature and air flow in the conditioned spaces. The final balance of air quantities through each grill/diffuser etc. shall be recorded and submitted to purchaser for approval. Proper steps shall be taken to have a uniform temperature in all enclosures, with utmost care for noise level to be within tolerance limit
6.1.2	All instruments required for testing/balancing etc. of the air distribution system shall be provided by vendor.
7.	DATA TO BE FURNISHED BY VENDOR AFTER THE AWARD OF CONTRACT
7.1	Fabrication drawings of ducts and grilles, louvers, dampers, etc, including typical details of grilles dampers etc.
7.2	Test certificates in line with scope of inspection.
7.3	Other dimensional drawings & documents as may be required by purchaser for better understanding of the system & for preparation of operation, maintenance & instruction manual.



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1)	General (List of areas)	As per schedule/tender drgs of Ventilation system.
2)	i) GSS Duct Work	
	a) Type	Zinc coating (Refer Section-C of Specific Technical Requirement)
	b) 1.25 mm thk ducting	Bidder to estimate as per Drawings/sketch
	c) 1.0 mm thk ducting	Separately for Ventilation system.
	d) Any other size	(area wise)
	e) Battery Room ducting. sides.	MS with epoxy painting on both sides.
3)	Special painting epoxy	MS Ducts in Battery Room to be painted. Both interior & exterior)
4)	Thermal Insulation	Required in duct for vent. System exposed to Sun only (furnished by Cement sand plaster)
5)	SA grilles (for each size) (SQ.M) schedule/tender	To suit airflow as per drgs.
6)	Exhaust Gravity/Manual relief dampers (for each size & to maintain a slight positive pressure inside.)	-do-
	a) Frame	1.6mm M.S.
	b) Louver	0.8mm Al.

NOTE:

- 1) Ducting shall be as per IS-655 standard.
- 2) Opposed blade type volume control damper (gang operated) shall be provided at each supply air grilles.
- 3) Bidder to provide suitable gasketing at each duct flange.(Asbestos shall not be used).
- 4) Supply Air Grills shall have 2 (two) set of adjustable louvres.
- 5) Bidder to indicate unit rates for variable items like ducting, grilles with & without volume control damper, gravity damper, thermal insulation, etc.
- 6) Grilles, frames & louvres shall be of at least 18 SWG sheet and 20 SWG MS respectively.



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- 6) Fire damper shall be solenoid operated in accordance with NFPA. The solenoid shall be charged during open condition and shall be de-energising to close.
- 7) Access door in ducting system shall be provided as required.
- 8) MS Angle (painted) shall be used only as duct supports.
- 9) Velocity thru duct shall not exceed 12 M/sec for Ventilation system.
- 10) All exhaust/return air grilles shall have one set of louvres in the front or thick rat-proof wire net guards.



**STANDARD TECHNICAL SPECIFICATION FOR
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**STANDARD TECHNICAL SPECIFICATION
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CENTRIFUGAL PUMPS**



STANDARD TECHNICAL SPECIFICATION FOR CENTRIFUGAL PUMPS

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1.0 GENERAL

This specification covers the design, material, constructional features, manufacture, assembly, inspection and testing at manufacturer's or his subcontractor's works, suitable painting requirements of centrifugal pumps and drives complete with all accessories as specified hereinafter.

2.0 CODES AND STANDARDS

2.1 The design, manufacture, inspection, testing & performance of the pumps as specified hereinafter, shall comply with the requirements of the latest revision of the following standards as indicated below (as applicable):

- a) IS-1520 :Horizontal centrifugal pumps for clear, cold and fresh water
- b) IS-5120 :Technical requirements - Rotodynamic special purpose pump
- c) IS-1710 :Vertical turbine pumps for clear, cold and fresh water
- d) Hydraulic Institute Standards of USA
- e) BS - 599 :Method of testing Pumps
- f) PTC - '6' :Centrifugal Pumps Power test code
- g) API - 610

Wherever standards for certain aspects materials etc., not mentioned, the same shall be as per the applicable Indian or International standards.

2.2 In case of any conflict between the above codes/standards and this specification, the later shall prevail and in case of any further conflict in this matter, the decision of Purchaser's engineer shall be final and binding.

3.0 DESIGN REQUIREMENTS

3.1 The pumps shall be of heavy duty suitable for long periods of uninterrupted service and shall be standard product of the manufacturer thoroughly proven for satisfactory performance and reliability

3.2 The materials of construction of various components shall be as indicated under Data Sheet-A and where not specified to the applicable Indian/British/American standards.

3.3 All pressure containing components including the pump casing, nozzles and stuffing box housing shall be designed, fabricated and tested in accordance with applicable Indian standards if not specified otherwise.

3.4 The pump shall be suitable for handling the fluid as specified in Data Sheet-A

4.0 CONSTRUCTIONAL FEATURES

4.1 Pump Casing

4.1.1 Pump casing may be axially or radially split or barrel type construction as specified in the pump data specification sheet. The casing shall be designed to withstand the maximum pressure developed by the pump at the pumping temperature.



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4.1.2 Pump casing shall be provided with adequate number of vent and priming connections with valves, unless the pump is made self venting & priming. Casing drain, as required, shall be provided complete with drain valves.

4.1.3 Pump shall preferably be of such construction that it is possible to service the internals of the pump without disturbing suction and discharge piping connections.

4.1.4 Under certain conditions, the pump casing nozzles will be subjected to reactions from external piping. Pump design must ensure that the nozzles are capable of withstanding external reactions not less than those specified in API-610.

4.2 Impeller

Unless specifically indicated under Data Sheet-A enclosed, the pump impellers shall be of closed vane type. The impellers shall be secured to the shaft and shall be retained against circumferential movement by keying, pinning or lock rings. Impellers shall be statically and dynamically balanced individually. The assembled rotor shall be dynamically balanced and checked for eccentricity.

4.3 Wearing Ring

Renewable wearing rings for the casing and/or the impellers and renewable shaft sleeves, shall be provided for all pumps. Length of the shaft sleeves must extend beyond the outer faces of gland packing or seal and plate so as to distinguish between the leakage between shaft & shaft sleeve and that past the seals/gland.

4.4 Shaft

Shaft size selected shall take into consideration the critical speed which shall be away from the operating speed as recommended in applicable Code/Standard. The critical speed shall also be at least 10% away from runaway speed.

4.5 Bearings

Bearings and hydraulic devices (if provided for balancing axial thrust) of adequate design shall be furnished for taking the entire pump load arising from all probable conditions of continuous operation throughout its Range of Operation and also at the shut off condition. The bearing shall be designed on the basis of 20,000 working hrs minimum for the load corresponding to the duty point. Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing-lubricating element does not contaminate the liquid being pumped. Where there is a possibility of liquid entering the bearing, suitable arrangement in the form of deflectors or otherwise shall be provided ahead of bearing assembly. Bearings shall be easily accessible without disturbing the pump assembly.

4.6 Stuffing Boxes

Packed type stuffing boxes of adequate depth with lantern rings shall be provided to minimize the leakage. In all cases where the pump suction is below atmospheric pressure, the shaft packing shall be sealed by the liquid pumped by tapping off from the pump discharge itself and all pipes, valves, fittings etc., required for this shall be furnished by the manufacturer.

4.7 Shaft Couplings



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The pumps shall be directly coupled to their drives through heavy duty flexible coupling. Suitable coupling guards shall be provided along with the coupling. The pump and its drive motor shall be mounted on a common base plate.

4.8 Base Plate and sole Plate

Unless otherwise stated the data specification sheet, a common base plate mounting both for the pump and drive shall be furnished. The base plate shall be of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the pumping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, hydraulic piping thrust, etc. Suitable drain taps and drip lip shall be provided.

If required in the data specification sheet, steel sole plates shall be provided, below the base plate.

4.9 Prime Mover

The drive motor selected shall conform to the requirements of the enclosed motor specifications.

4.10 Lifting arrangement

Each pump and motor shall incorporate suitable lifting attachments e.g. lifting lugs or eye bolts etc., to facilitate erection and maintenance.

5.0 Performance Requirements

5.1 The pump shall be designed to have best efficiency at the specified duty point. The pump set shall be suitable for continuous operation at any point within the Range of Operation as stipulated in the data specification sheets.

5.2 Pump shall have a continuously rising head capacity characteristics from the specified duty point towards shut off point, the maximum being at shut off. Power capacity characteristic will be non-overloading type i.e. 110% of the design flow the power required to drive the pump will be practically the same as that at the design flow.

5.3 Wherever specified in data sheet, pumps of each category shall be suitable for parallel operation. The head vs capacity, input power vs. capacity characteristics, etc., shall match to ensure equal load sharing and trouble free operation throughout the range.

5.4 The pump motor set shall be designed in such a way that there is no damage due to the reverse flow through the pump which may occur due to any malfunction of the system.

6.0 Drive Rating

6.1 The power rating of the drive shall be selected such that a minimum margin of 15% is available over the pump input power required at the rated duty point. However, the drive rating shall not be less than the maximum power requirement at any point within the 'Range of Operation' specified.



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6.2 In cases where parallel operation of the pumps are specified the actual drive rating is to be selected by the bidder considering overloading of the pumps in the event of tripping of one of the operating pumps.

6.3 The bidder under this specification shall assume full responsibility in the operation of the pump and the drive as one unit.

7.0 SCOPE OF INSPECTION AND TESTING

7.1 Castings

7.1.1 Witnessing pouring and thereafter physical testing of castings of 'Critical' nature such as casings, impellers, diffusers.

7.1.2 Identification and correlation with test reports for all tests as per the relevant material specifications for castings of 'Major' nature such as suction bell, discharge elbow, stuffing box, gland, wearing rings, shaft sleeves etc.

7.1.3 Foundry's conformity certificate for castings of 'Minor' nature such as base plates, covers etc.

7.1.4 Verification of heat treatment charts (as applicable)

Note: Casting defects shall not be filled by any method until and unless approved by BHEL/their customer

7.2 Forgings and

7.2.1 Identification and correlation with mill test certificates for all tests as per the relevant specifications for important forgings like casings, stage bodies, diffusers, shaft material.

7.2.2 Verification of heat treatment charts (time temperature) (as applicable).

7.3 Fabricated items

7.3.1 Identification and correlation with mill test certificates for material of items such as discharge bellows, column pipes etc.

7.3.2 Approval of welding procedure specifications and qualifications of weld procedures and personnel.

7.3.3 Dye penetrant tests of weldment as per ASTM E-165 and acceptance norm as per ASME Sec.VIII, Div.1, Appendix 8

7.3.4 Verification of heat treatment charts (time temperature), (as applicable)

7.3.5 Hydro test as per para 7.5.1 below.

Note: For para 7.1.2, 7.2.1 and 7.3.1 above; in case correlating test certificates are not available, material shall be identified by BHEL and physical tests conducted by the supplier in the presence of BHEL



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7.4 In process Inspection and Testing

7.4.1 Dye penetrant testing after machining for impellers including vanes, pump shaft, diffusers as per applicable code; in absence of which, as per ASTM E - 165. No defect shall be permitted on moving parts. On static parts acceptance norms are as per ASME Sec.III NB 2546.

7.4.2 Ultrasonic testing of dynamic duty component, i.e. pump shafts (50mm dia and above) and static duty forgings i.e. Barrel, casting (15mm and above wall thickness) as per applicable code, in absence of which as per ASTM E388 and acceptance norms as stipulated hereunder.

7.4.3 Acceptance norms for UT for dynamic duty components. the following defects are unacceptable :

- Cracks, flakes, seams and laps
- Defects giving indications longer than that from a 4mm equivalent flaw.
- Group of defects with maximum indications less than that from a 4mm equivalent flaw, which cannot be separated at testing sensitivity, if the back echo is reduced to less than 50%.
- Defects giving indications of 2 to 4mm dia. equivalent flaw separated by distance less than four times the size of the larger of the adjacent flaw.

7.4.4 For static duty components - as per NB 2542.2 of ASME Sec. III.

7.4.5 Hydro tests of all pressure parts such as casings, column pipes, discharge elbows etc., at two times duty point pressure or 1.5 time shut off pressure, whichever is higher for 30 min., without any leakage.

Note : In case the pump is required to boost certain pressure, the inlet pressure head shall also be taken into consideration to compute test pressures.

7.4.6 Static and dynamic balancing of individual impellers and also assembled rotors as per V.D.I. 2060 Q 6.3 or ISO 1940 G 6.3.

7.5 Performance Test

7.5.1 Pump testing with unit supply motor as per specifications and acceptance norms cited elsewhere, in absence of which as per IS 5120 latest edition. Performance shall be checked for minimum of 7 points (including shut off head and over load) following characteristics shall be checked:

Capacity V/s Head

Capacity V/s Power absorbed by pump

Capacity V/s pump efficiency

Note : For pump of fire protection system, performance test shall be conducted up to 150% of rated capacity

7.5.2 NPSH test in case specifically mentioned elsewhere



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7.5.3 Vibration and noise level measurement. Acceptance norms shall be as per manufacturers standards.

7.5.4 Overall dimensions as per GA drawings

7.5.5 Examination after selective opening up after running for pumps operating at speed over 1800 rpm and capacity exceeding 68M3/hr.

7.5.6 Painting and packing as per technical specification.

7.6 Test at site

The pumps will be tested at site by the purchaser to verify their performance. If the pumps fail to operate smoothly or within the required performance all such deficiencies shall be rectified by the manufacturer by making suitable alternatives in the pump set and additional tests required to show the effect of such alterations shall be performed by him.

7.7 Performance Guarantee

The vendor shall guarantee the material and workmanship of all components as well as the operation of the pump as per requirement of this specification.

The vendor shall also guarantee for each pump the total dynamic head at the specified rated capacity and also corresponding efficiency, brake horse power and shut off head.

8.0 CLEANING, PROTECTION & PAINTING

Before shipment of the equipment to be supplied under this specification the necessary cleaning, flushing etc., as per manufacturers standard shall be done to remove all dirts, scales etc. Shop coats of rust inhibiting paints, lacquers etc., shall be applied to various parts as necessary. Flanges, inlet and outlet pipe, etc shall be protected.

9.0 DRAWINGS, TECHNICAL DOCUMENTS AND OTHER INFORMATION REQUIRED WITH THE PROPOSAL

9.1 Fully dimensioned outline GA drawings of the pump motor assembly unit for each type and size offered. This drawing should include:-

- i) Foundation base plate and sole plate details as applicable
- ii) Civil foundation and anchor bolts details and loading data
- iii) Minimum submergence required for the pump (if applicable)

9.2 Cross sectional drawing of the equipment showing the details of assembly of components and their material of construction with standard applicable codes.

9.3 Performance characteristics (Discharge capacity vs head, BHP and efficiency of the pumps.



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- 9.4 Motor speed torque curve superimposed on pump speed torque curve. Required NPSH of pump.
- 9.5 Experience list about the supply and successful operation of similar pumps for similar application.
- 9.6 A comprehensive write up or brochure on the details of manufacturing and testing facilities in the shop of the manufacturer.
- 9.7 Quality plan for the equipment being offered, in BHEL format as practiced in the manufacturer's works and Field Quality Plan for receipt, storage erection, commissioning & testing at site.
- 9.8 Data sheet-B with all the particulars filled in.

10.0 DRAWINGS AND DATA AFTER AWARD OF CONTRACT

The vendor shall furnish the drawings and other technical documents as required in Data Sheet-C enclosed with this specification

10.1 MANUFACTURERS NAME AND TAG. PLATES

Each pump shall have a permanently attached brass/metal tag on the body indicating the following information both in Hindi and English.

- a) Manufacturer's name and trade mark
- b) Design Capacity and Head
- c) Design
- d) Purchaser's tag no. as furnished during the contract. The purchaser's tag no. will be indicated by the Purchaser on the drawing submitted for approval by the vendor.

11.0 DRAWINGS/DOCUMENTS TO BE FURNISHED BY VENDOR AFTER THE AWARD OF CONTRACT.

- 11.1 Certified GA drawings of pump motor assembly weights, crane
- 11.2 Detailed cross sectional drawings of the pump and motor assembly and all equipment & accessories supplied under the this specification along with details of material of construction with applicable standard codes
- 11.3 Foundation drawings with details of foundation pocket indicating static as well as dynamic load and other data with dimensions.
- 11.4 Certified characteristics curves (discharge capacity vs. head, BHP and efficiency) of each type of pump and motor.
- 11.5 Material and other test certificates as required by the application clauses of this specification.
- 11.6 Motor speed torque curves super imposed on pump speed torque curves.
- 11.7 Quality plan along with complete details of testing and inspection requirements of centrifugal pumps in BHEL format. Vendor shall also furnish Field Quality Plan.



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11.8 Installation , operation and maintenance manual.

11.9 Other drawings and data, if necessary.



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<u>S.No.</u>	<u>DESCRIPTION</u>	<u>DETAILS</u>
1)	Designation	Air washer Pumps.
2)	Type	Horizontal Centrifugal Type.
3)	Quantity	As per section-C
4)	Installation	On floating type foundation inside Air
Washer		Room
5)	Fluid to be handled	Filtered Water.
6)	Temperature of Fluid	To suit.
7)	Capacity Cum/Hr TDH at	To suit system requirements however head shall Not be less than 35 MWC.
8)	Duty	-----Continuous (24Hr./day)-----
9)	Suction condition	-----Flooded-----
10)	Type of drive	Direct (flexible coupling)
11)	Type of prime mover	LV Ac Motor.
12)	Maximum speed	Not more than 1500 RPM
13)	Type of lubrication	Grease Lubrication

MATERIALS OF CONSTRUCTION

<u>S.No.</u>	<u>DESCRIPTION</u>	<u>DETAILS</u>
a)	Impeller	Bronze
b)	Pump Shaft	Carbon Steel C-45, IS-1570 or class-IV, IS- 1875
c)	Casing	Cast Iron, grade-20, IS- 210
d)	Wearing ring	Bronze
e)	Shaft Sleeve	Bronze
f)	Base Plate/frame	Cast Iron to Grade FG-200 IS-210/fabricated Mild steel



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g)	Counter Flanges	Mild Steel
h)	Stuffing box bush	Deep Bronze packing to be renewable with Case.
i) not	Stuffing box gland	Flexible graphite or PTFE (Asbestos shall be used)
j)	Pump Motor Coupling	Pin & Bush type (Flexible)
k)	Bolt and Nuts	MS

15) ACCESSORIES REQUIRED

The following accessories shall be provided by the bidder for each pump.

a)	Priming funnel	Yes
b)	Drain piping upto Common drain point.	Yes
c)	Vent	Yes
d)	Suction & Discharge Pressure gauges	Yes
e)	Companion flanges	Yes
f)	Common base plate	Yes
g)	Suction strainer.	Yes
h)	Isolating valve.	Yes
i)	NRV at pump outlet at inlet/outlet	Yes
j)	Any special requirements	Yes
k)	Inspection & Testing	Yes



**STANDARD TECHNICAL
SPECIFICATION
FOR
AIR FILTER**

SPECIFICATION NO.PES-554-04

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**STANDARD TECHNICAL SPECIFICATION
FOR
AIR FILTER**



**STANDARD TECHNICAL
SPECIFICATION
FOR
AIR FILTER**

SPECIFICATION NO.PES-554-04

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SECTION D

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1. GENERAL

This specification covers the design, manufacture, inspection and testing at manufacturer's work or his sub-contractor's works of Air filters to be used for air-conditioning and ventilation system:

2. CODES AND STANDARDS

This design, manufacture and performance of AIR FILTERS shall comply with all currently applicable statutes, regulation and safety codes in the locality where the equipment will be installed. The equipment shall also conform to latest applicable Indian/British/USA standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. The following standards, in particular, shall be applicable for certified ratings of filters and for conducting performance test, if required.

a) BS EN - 779 -Methods of test for air filters used in air conditioning and general ventilation.

3. GENERAL

The enclosed Data sheet A gives the type and other particulars of filters required.

3.1 POLY FIBRE AIR FILTERS

Filtering media shall consist of a suitable fibrous material (e.g. polyethylene extruded sections coir etc.) packed into a 20 gauges GSS framework, complete with handles etc. The filter element shall be supported by galvanised steel wire mesh of 10mm. sq. on either side, Velocity across the filters shall not exceed 2.5 M/sec. Average efficiency Em (%) shall be ≥ 80 as per BS EN - 779..

3.2 DRY FABRIC AIR FILTERS

Filter element shall be pressed felt filter fabric or suitable material recommended by the manufacturer, stitched on to galvanised wire gauge support and crimped to form deep folds. Suitable aluminium spacers shall be provided to ensure uniform distribution of air flow through filters. Filter casing shall be provided with neoprene sponge rubber sealing, The filter shall have Average efficiency Em (%) of ≥ 95 as per BS EN - 779.

3.3 PANEL TYPE METALLIC FILTERS (DRY/VISCOUS)

Filter shall consist of V-fold galvanised wire mesh interspaced with flat layers of galvanised wire mesh. The density of media shall increase in the direction of air flow. Edges of wire mesh shall be suitably hemmed to prevent abrasion during handling. The media shall be supported on either side by galvanised expanded metal casing. The framework shall be at least 18 gauge GSS. Filter shall be either dry or wetted type as per data sheet=A. The oil shall be mineral oil of approved quality and make. As a the filter frame made of Aluminium alloy conforming to IS:737 can be considered unless use of aluminium is prohibited otherwise due to site conditions being saline/corrosive.

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All filters shall be capable of being cleaned of their accumulated dust by tap water flushing. The dry metallic filter shall have Average arrestance Am (%) shall be ≥ 90 . However oil wetted air filters shall have Average Efficiency Em (%) ≥ 90 as per BS EN - 779..

3.4

ABSOLUTE FILTERS (HEPA)

Filters shall be constructed by pleating a continuous sheet of filter medium into closely spaced pleats separated by heavy corrugated aluminium spacers. They shall be individually tested and certified to have an efficiency of not less than 99.97% when tested with 0.3 micron dioctylphalate smoke as per IS:2831. The clean filter initial static pressure drop shall not be greater than 25mm WC at rated capacity. A neoprene sponge rubber sealing shall be provided on either face of filter frame.

3.5

WATER REPELLANT NYLON FILTERS

This shall be constructed of water repellent nylon fabric with continuous water spraying on it from a header for keeping it clean. Efficiency of this filter shall be 85% down to 10 microns. This filter shall be used for unitary air filtration system only.

4.

INSPECTION & TESTING

The scope of inspection for air filters shall be as below:

List of TCs arranged as per Approved Quality Plan shall be furnished along with copy of TCs at the time of inspection by BHEL.

4.1.1

Dimensional inspection of frame & filter media – TC from Manufacturer- review by BHEL/Customer.

4.1.2

Witnessing by BHEL/Customer of type tests on one per type per size air filters for the following properties.

a)

Gravimetric efficiency.

b)

Pressure drop in clean & dirty (choked - %age to be specified) condition.

c)

Efficiency as per BS EN - 779.

4.1.3

Verification of type test certificates for similar type & size of filters for sodium flame test as per BS-3928 (if applicable- refer data sheet) - by BHEL/Customer

5.

DATA TO BE FURNISHED BY VENDOR AFTER AWARD OF CONTRACT

5.1.1

GA Drawing

5.1.2

Drawing showing material/construction detail

5.1.3

Installation and\service manual

5.1.4

Rating curves/charts

5.1.5

Test certificates

Elect. diagrams (when automatic cleaning type)



AIR FILTER DATA SHEET - A

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Description

Data

1) General

1.1	Service	Ventilation system .
1.2	Location	Main power house bldg. & Blower room of both the unit.
1.3	Nos.	Refer Section 'C' of Specification.
1.4	Total air flow/type	Refer Section 'C' of Specification.
1.5	Temperature	As per project information.
1.6	Relative Humidity	100%
1.7	Gas Composition	Atmospheric Air (Dusty) as prevalent in power station.
1.8	Filter Media	Synthetic non woven
1.9	Efficiency	Average arrestance efficiency of 65-80 % for Dry panel filter (pre-filters) and average arrestance efficiency of 80-90 % for fine filters.
1.10	Allowable pressure drop	2.5 mm & 6.5 mm in clean and dirty condition respectively for dry panel filters (pre filters). 12 mm in clean condition for fine filters.
1.11	Frame Work	18 G, GSS.
1.12	Mounting	Ladder Type M.S Angles (galvanised)
1.13	Size	600 x 600 mm

Note:-

- 1) Face velocity of air across the filters shall not exceed 2.5 m/sec.



**STANDARD TECHNICAL
SPECIFICATION
FOR
THERMAL INSULATION FOR COLD
SURFACES**

SPECIFICATION NO. PES-554-06

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**STANDARD TECHNICAL SPECIFICATION
FOR
THERMAL INSULATION FOR COLD SURFACES**



TECHNICAL SPECIFICATION
THERMAL INSULATION FOR COLD SURFACES

SPECIFICATION NO.PES-554-06
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SECTION D
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1. SCOPE

This specification covers design, manufacture, testing at manufacturers works, supply, application & finishing of insulation for cold piping, air conditioning ducting & equipment for low temperature service.

2. CODES & STANDARDS

The design, manufacture and performance of materials covered under this specification shall comply with all currently applicable statues, regulations & safety codes in the locality where the equipment/material are to be installed. The material shall also conform to the latest applicable Indian/British/American codes & standards. Nothing in this specification shall be construed to relieve the vendor of his responsibility. In particular, the material shall conform to the latest editions of the following standards :-

2.1.1	IS:3069 :	Glossary of terms & symbols & units relating to thermal insulation materials.
2.1.2	IS:4671 :	Expanded polystyrene for thermal insulation purposes.
2.1.3	IS:3677 :	Mineral wool for thermal insulation
2.1.4	IS:8183 :	Resin bonded mineral wool
2.1.5	IS:702	

3. DESIGN REQUIREMENTS

3.1.1	The insulating material as well as protective covering shall be new & unused, non-corrosive, vermin/rodent proof and shall be guaranteed to withstand continuously & without deterioration the maximum/minimum temperatures to which they may be subjected to, under specified site conditions.
3.1.2	The insulation material must be light weight, strong, free from shots & coarse fibre & shall provide high insulation efficiency at low weight & coat. It should be non-hygroscopic & should not rot. It shall not settle or shake down even when subjected to prolonged vibrations.
3.1.3	The insulation material, density and thickness etc. Shall be as specified in DATA SHEET A.

4. APPLICATION DETAILS

4.1.1	The surface to be insulated shall be thoroughly cleaned and allowed to dry. Pressure/hydrostatic tests, if any, shall be carried out before application of insulation.
4.1.2	A layer of solvent free, anticorrosive paint shall be applied & allowed to dry.
4.1.3	Hot industrial bitumen of grade 85/40 or 85/25 conforming to latest IS:702 shall be uniformly applied @ 1.5 kg/sq.m on the surface to be insulated. A similar layer shall also be applied on the inside surface & edges of the insulation. A suitable cold adhesive compound may also be used in place of bitumen.

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4.1.4	Insulation in the form of pipe sections/rolls slabs of specified density & thickness shall be stuck to the coated surface with joints staggered & well butted & secured. The adjoining sections shall be tightly pressed together. All the joints shall be sealed with bitumen/equivalent adhesive. Voids if any shall be packed with suitably cut pieces of insulation material.		
4.1.5	In case of double layer application both circumferential & longitudinal joints shall be suitably staggered.		
5.	VAPOR SEALING & INSULATION FINISH The insulation shall be treated for vapor sealing & weather proofing & finished as specified in DATA SHEET A The acceptable types of finishes are outlined below:-		
5.1	FINISHING SYSTEM I: EXTERNAL INSULATION WITH PLASTER FINISH		
5.1.1	A thick vapor seal of hot bitumen @ 2.5 kg/Sqm shall be applied on the outer surface of insulation & allowed to dry.		
5.1.2	The surface shall then be wrapped with 20mm (3/4"_ hexagonal mesh of 24 SWG GI wire, butting all the joints & laced down with 22 SWG GI lacing wire.		
5.1.3	12.5mm (1/2 inch) thick sand cement plaster in the ratio of (1:1) shall be applied in two layers, the second layer being brought to a smooth finish. A water proofing compound shall be added to the cement before its application.		
5.2	FINISH SYSTEM II: EXTERNAL INSULATION WITH PLASTER FINISH OVER POLYTHENE.		
5.2.1	The insulation shall be covered with 500 g polythene/polythene bonded Hessians (PBH) with 50mm overlap on longitudinal & circumferential joints. Overlaps shall be sealed with synthetic adhesive in case o-f polythene & liberal coat of bitumen in case of PBH:		
5.2.2	The surface shall then be wrapped with 20mm (3/4") mesh of 24 SWG GI wire butting all the joints & laced down with 22 SWG GI lacing wire.		
5.2.3	12.5mm thick (1/2 inch) sand cement plaster in ratio of(4:1) shall be applied in two layers, the second layer being brought to a smooth & even finish similarly as described above.		
5.3	FINISH III:EXTERNAL INSULATION WITH SHEET METAL FINISH		
5.3.1	The insulation shall be covered with 500g polythene with 50mm overlaps at joints which shall be sealed with synthetic adhesive or equivalent compound.		
5.3.2	The polythene shall be covered with 24 gauge GI/aluminum sheet		
5.3.3	25mm wide x 22 SWG GI/aluminum peripheral straps shall be fixed over the GI/aluminum sheet at 300mm centres to secure.		
5.4	FINISH IV: EXTERNAL INSULATION WITH PLASTER & WATER PROOFING COMPOUND For ducts & piping exposed to atmosphere, the finish shall be as follows:		

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5.4.1

A thick vapor seal of hot bitumen at 2.05 kg/sq.m shall be applied on the outer surface of insulation & allowed to dry.

5.4.2

The surface shall then be wrapped with 20mm (32/4") hexagonal mesh of 24 SWG GI Wire butting all the joints & laced down with 223 SWG GI lacing wire.

5.4.3

12.5mm thick (1/*2 inch) sand cement plaster in ratio of (4:1) shall be applied in two layers, the second layer being brought to a smooth finish with water proofing compound added to the cement.

5.4.4

3mm (1/8") thick coat of water proofing compound shall be applied & wrapped with fibre glass RP tissue. A final coat of 3mm thick water proofing compound shall then be applied over the fiberglass RP tissue & allowed to dry. Alternatively, in place of water proofing as desired above, tar felt type 3 grade 1 of IS 1322 with joints overlapped by 75mm shall be fixed & sealed with bitumen & over this 24 SWG. 25mm hexagonal GI mesh shall be fixed with 22 swig. GI lacing wire & finally bitumen paint shall be applied over wire netting.

6.

INSULATION OF PUMPS & VALVES

For all inspection covers & hatches on equipment, pump casing & valve bodies, flanges etc. the insulation shall be applied such as to facilitate removal with minimum damage to the insulation. This shall be achieved by encasing the insulation in 22 gauge aluminum sheet metal boxes, which shall be bolted together around the equipment to permit easy removal & replacement. Proper care shall be taken to maintain continuity of vapor seal between the static & removable partitions of the insulation.

The tenderer may offer thickness of insulation & finishes other than that specified in DATA SHEET A. However, calculations/reasons in support of alternative proposal shall be furnished for purchaser’s approval.

7.

INSPECTION & TESTING (REFER SPEC. NO - PES-553.00)

All necessary tests, as required to ensure that the material supplied conform to the requirements of applicable codes & standards, shall be carried out at manufacturer’s works & test certificates including these for material/accessories shall be furnished for purchasers approval.

8.

PAINTING

8.1.1 Pipe work having insulation & cladding shall be provided with color identification for the fluids handled and for indicating direction of flow.

8.1.2 Equipment surfaces having insulation and cladding shall also have identification numbers and any other relevant data provided on the insulated surface.

8.1.3 All painting for insulated surfaces shall conform to the requirement specified elsewhere.

9.

DATA TO BE FURNISHED AFTER AWARD OF CONTRACT

9.1.1 Final version of data sheet ‘B’ incorporating changes if any along with design data.

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9.1.2	Test certificates/reports giving result of insulation to ensure conformance to applicable codes & standards & in particular the following :- i) Thermal conductivity test ii) Sound absorption coefficient test iii) Corrosion test iv) Sulphur content, moisture content, shot content, moisture absorption etc. v) Compressive strength & cross breaking strength test.		
9.1.3	Sketches/technical literature/sectional drgs. indicating insulation materials finish and method of application etc.		
9.1.4	Manual dealing with safety aspects & instructions for combating fire arising out of insulation work		
9.1.5	Instructions on maintenance of insulation work.		



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INSULATION MATERIAL :

Insulation	Code	Thermal Conductivity MW/cm °C	Density Kg/m ³
Resin bonded mineral wool / glass wool	IS:8183	0.49 at 50 °C	At least 24 (For Thermal Insulation) 48 for Acoustic insulation
Mineral Wool Pipe Section (min. Gr.2)	IS:9842	0.43 at 50 °C	At least 81
Expanded Polystyrene	IS:4671	0.37 at 50°C	At least 15

TYPE OF INSULATION :

S.No.	Surface	Insulation Material	Insulation Form	Thickness (mm)
i)	Supply & Return air duct for air-conditioning system	Resin bonded Glass Wool (IS:8183)	Roll / Slab	50
ii)	Refrigerant Piping	a) Expanded Polystyrene or b) Mineral Wool	Pipe Section Pipe Section	75 75
iii)	AHU drain pipe (Suction & Liquid line)	a) Expanded Polystyrene or b) Mineral Wool	Pipe Section Pipe Section	25 25
iv)	AHU casing and condensate pan	a) Expanded Polystyrene or b) Mineral Wool	Slabs Slabs	25 25
v)	Chilled water piping, valves & specialties	a) Expanded Polystyrene or b) Mineral Wool	Pipe Section Pipe Section	75 75
vi)	Chiller	a) Expanded Polystyrene or b) Mineral Wool	Slabs Slabs	100 100
vii)	Chilled Water Pumps	a) Expanded Polystyrene or b) Mineral Wool	Slabs Slabs	50 50
viii)	Expansion tank with pipe	a) Expanded Polystyrene or b) Mineral Wool	Slabs/Pipe Section Slabs/Pipe Section	50 50



INSULATION
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DATE : NOV 2012

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ix) Acoustic insulation of Duct

Glass Wool

Slab

25



VENTILATION SYSTEM

LIST OF MAKES OF SUB-VENDOR ITEMS

LIST OF MAKES OF SUB-VENDOR ITEMS



VENTILATION SYSTEM

LIST OF MAKES OF SUB-VENDOR ITEMS

SL No	ITEM	VENDOR
1	AIR WASHER & UAF*	HYDERABAD POLLUTION CONTROL
		SK SYSTEM
		ADVANCE VENTILATION
		DRAFT AIR
		BLUE STAR
		VOLTAS
		STERLING WILSON
		ROOTS COOLING SYSTEM
		C DOCTOR
		TAP
		PACK PLAST
		INDUSTRIAL PROJECTS AND PRODUCTS
2	CENTRIFUGAL FAN	FLAKT
		KRUGER
		DRAFT AIR
		HYDERABAD POLLUTION CONTROL
		ADVANCE VENTILATION
		PATEL AIR
		NICOTRA
		SK SYSTEM
		MARATHON
		CB DOCTOR
		SARLA
		COMEFRI
3	FRESH AIR/ SUPPLY/ EXHAUST/ RE UNIT FANS / PROPELLAR	HYDERABAD POLLUTION CONTROL
		SK SYSTEM
		ADVANCE VENTILATION
		KRUGER
		NICOTRA
		MARATHON
		FLAKT
		CB DOCTOR
		SARLA (SITAL)
		PATEL AIR
		KHAITAN
4	PUMPS	BEST & CROMPTON
		JYOTI
		SAM TURBO
		KBL
		KSB



VENTILATION SYSTEM

LIST OF MAKES OF SUB-VENDOR ITEMS

		M&P
		VOLTAS
		BEACON-WEIR
		WORTHINGTON
		FLOWMORE
		SULZER PUMPS INDIA LTD.
		BHARAT PUMPS & COMPRESSORS LTD
		FLOWSERVE INDIA CONTROL PVT LTD
		V-FLOW PUMPS & SYSTEMS CO
		KISHORE PUMPS
5	LV MOTORS (FLAME PROOF)	SIEMENS
		ABB
		CGL
		MARATHON
		KEC
		BHARAT BIJLEE
		BHARAT ELECTRIC
		NGEF
		JYOTI
		LHP
6	LV MOTORS (NON FLAME PROOF)	SIEMENS
		ABB
		CGL
		MARATHON
		KEC
		BHARAT BIJLEE
		BHARAT ELECTRIC
		NGEF
		JYOTI
		LHP
7	AIR FILTER	PUROLATOR
		FMI
		ANFILCO
		TENACITY
		JOHN FOWLER
		SPECTRUM
		AIR TECH
		PUROMATIC
8	INSULTATION MATERIAL	BEARDSHEL
		K-FLEX
		PARAMONT
		ARMAFLEX



VENTILATION SYSTEM

LIST OF MAKES OF SUB-VENDOR ITEMS

		SUPREME
		LLOYDS
		UP TWIGA
		AEROCELL
9	FIRE DAMPER	TSC
		CARRYAIRE
		RAVISTAR (SYSTEM AIR)
10	BUTTERFLY VALVES	AUDCO
		FOURESS ENGG
		INTER VALVE
		BDK
		WEIR BDK
		TYCO
		CRANE PROCESS
		KEYSTONE
		FLUIDLINE
		INSTRUMENTATION LTD
		R AND D MULTIPLES (METAL CAST) PVT LTD
		SURYA VALVES AND INSTRUMENTS MFG CO
		PENTAIR VALVES AND CONTROLS INDIA PRIVATE LIMITED
		UPADHAYA VALVES MANUFACTURERS PRIVATE LIMITED
		VENUS PUMPS AND ENGG. WORKS
11	NON RETURN VALVE	LEADER VALVES
		H SARKAR
		FLUIDLINE
		HI-TECH
		CRESCENT VALVES
		A V VALVES
		BANKIM
		SHIVADURGA
		SURYA VALVES AND INSTRUMENT MANUFACTURING
		ATAM VALVES
		GM DAULI & SONS
		KBL
		VENUS PUMPS AND ENGINEERING WORKS
12	STEEL GATE/GLOBE/NR VALVES(WATER SYSTEM)	CRESCENT VALVES
		BDK
		AUDCO
		FOURESS ENGG



VENTILATION SYSTEM

LIST OF MAKES OF SUB-VENDOR ITEMS

		KIRLOSKAR BROTHERS LTD.
		SANT VALVES
		BOMBAY METAL & ALLOYS
		BANKIM
		LEADER VALVES
		H SARKAR
		AV VALVES
		VENUS PUMPS
		FLUIDLINE
		HI –TECH
		SHIVADURGA
		SURYA VALVES AND INSTRUMENT MANUFACTURING
		ATAM VALVES
		GM DAULI & SONS
		KBL
13	Pipes (MS/GI) - ERW	SURYA ROSHNI
		TISCO
		DADU PIPES
		INDUS TUBES
		WELSPUN
		TATA
		BST
		JINDAL
		SAIL
		PSL
		LALIT PROFILE
		SAMSHI PIPE INDUSTRIES
		S MUKUT PIPES
		MANN INDUSTRIES
		SURENDRA ENGINEERING
		PRATIBHA PIPES AND STRUCTURES PVT LTD
		JCO GAS PIPES
		NUKAT TANK AND VESSELS
		GOODLUCK TUBES
		ADVANCE STEEL TUBES
		BIHAR TUBES
		HITECH PIPES
		RATNAMANI
		MAHARASHTRA SEAMLESS
14	GI SHEETS FOR DUCTING	TISCO
		INDIAN IRON & STEEL CO



VENTILATION SYSTEM

LIST OF MAKES OF SUB-VENDOR ITEMS

		RASHTRIYA ISPAT NIGAM LIMITED
		ESSAR
		ISPAT INDUSTRIES
		JSW
		LLOYDS
		BHUSHAN STEELS
		TATA
		SAIL
		JINDAL
15	GRILL/DIFFUSER/VOLUME CONTROL DAMPER	AIR FLOW
		TSC
		AIR MASTER
		CARRYAIRE
		RAVISTAR (SYSTEM AIR)
16	HUMID STAT	JHONSON CONTROL
		HONEYWELL AUTOMATION
		PENN
17	PRESSURE/ DIFF. PRESSURE GAUGE	GENERAL INSTRUMENT CONSORTIUM
		BELLS CONTROLS LTD
		H. GURU IND
		WAAREE INSTRUMENTS
		H. GURU INST
		Forbes Marshall
		Manometer India
		A. N Instrument
		Gauges Bourdon
		GLUCK INDIA
		WIKA.
		ASHCROFT INDIA PVT LTD.
		BAUMER TECHNOLOGIES INDIA PVT. LTD.
		PRECISION MASS PRODUCTS
		BOSE PANDA INSTRUMENTS PVT.LTD.
18	TEMPERATURE GAUGE	H. GURU IND
		H. GURU INST
		FORBES MARSHALL
		DETRIVE INST & ELECTRONICS
		PYRO ELECTRIC
		TOSHNIWAL
		BROSS
		WAREE INSTRUMENTS
		A. N Instrument
		GOA INSTRUMENTS



VENTILATION SYSTEM

LIST OF MAKES OF SUB-VENDOR ITEMS

		WIKA
		ASHCROFT INDIA PVT LTD.
		H. GURU IND
		BAUMER TECHNOLOGIES INDIA PVT. LTD.
		GOA THERMOSTATIC
		Gauges Bourdon
		BUDENBERG GAUGE
		PRECISION MASS PRODUCTS
19	LEVEL INDICATOR	GENERAL INSTRUMENT CONSORTIUM
		CHEMTROL
		SBEM
		AUTOMAT MUMBAI
		SIGMA
		TOSHNIWAL
		TECHNOMATIC
		TELACO
		LEVCON
		D K INSTRUMENTS
		PUNE TECHTROL
		FLOW STAR
		BLISS ANAND
20	PRESSURE/ DP/ VACUUM/ TEMPERATURE SWITCH	BELLS CONTROLS LTD
		DANFOSS
		DK INSTRUMENTS
		DRESSER
		SOR INC
		VASU
		SWITZER INSTRUMENT LTD.
		INDFOSS
		TRAFAG
		GIC
		ASHCROFT INDIA PVT LTD.
		KASTURBA UDYOG
		BARKSDALE GMBH
		PRECISION MASS PRODUCTS
		MITTAL REFRIGERATION
21	LEVEL SWITCH-FLOAT TYPE	SBEM
		BLISS ANAND
		HI-TECH
		RAMAN INST
		SIGMA
		SOR INC



VENTILATION SYSTEM

LIST OF MAKES OF SUB-VENDOR ITEMS

		WAREE INST
		LEVCON
		DK INSTRUMENTS
		V AUTOMAT
		CHEMTROL
		SIEMENS
		FLOW STAR
		TRAC
		FLOW TECH
		NIVO CONTROLS
		PUNE TECHTROL
		SAPCON INSTRUMENT
		BAUMER TECHNOLOGIES INDIA PVT. LTD.
		GIC
22	LEVEL SWITCH- CAPACITANCE TYPE	SBEM
		BLISS ANAND
		HI-TECH
		RAMAN INST
		SIGMA
		SOR INC
		WAREE INST
		LEVCON
		DK INSTRUMENTS
		V AUTOMAT
		CHEMTROL
		SIEMENS
		FLOW STAR
		TRAC
		FLOW TECH
		NIVO CONTROLS
		PUNE TECHTROL
		SAPCON INSTRUMENT
		BAUMER TECHNOLOGIES INDIA PVT. LTD.
		GIC
23	Y / POT STRAINER	MULTITEX
		GREAVES COTTON
		JAYPEE
		SANT VALVES
		OTOKLIN
		GRAND PRIX
		GUJARAT OTOLIFT
		DS ENGG



VENTILATION SYSTEM

LIST OF MAKES OF SUB-VENDOR ITEMS

24	LOCAL CONTROL PANEL	SAROJINI ENTERPRISE
		BHATIA ENGINEERING
		FILTRATION ENGINEERS INDIA PVT LTD
		SUNGOV ENGINEERING
		INDUSTRIAL CONTROL & APPLIANCE
		PYROTECH ELECTRONICS PVT. LTD.
		POSITRONICS PVT. LTD.
		CONTROL & SWITCHGEAR
		SIEMENS
		L&T
		GE POWER
		RITTAL
		HOFFMAN

NOTES:

1. *Designed by Hyderabad Pollution Control / SK SYSTEM/ ADVANCE VENTILATION / DRAFT AIR/BLUE STAR/ VOLTAS/ STERLING WILSON/ROOTS COOLING SYSTEM/ C DOCTOR/ TAP/ Pack Plast/ Industrial projects and products & fabricated by their approved fabricator.
2. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL. BIDDER TO PROPOSE SUB VENDOR WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED.
3. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER.
4. PLEASE ALSO REFER RESPECTIVE SUB-SECTION C-3, C-4 FOR ELECTRICAL AND C&I RELATED EQUIPMENT LIST OF MAKE.



1X800 TANGEDCO NORTH CHENNAI TPP

SPECIFICATION NO. PE-TS-423-554-A001

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**SECTION-I
SUB SECTION -E**

**ANNEXURE-II
MANDATORY SPARE LIST**



1X800 TANGEDCO NORTH CHENNAI TPP

**VENTILATION SYSTEM
PAINTING & COLOUR SCHEME**

SPECIFICATION No: PE-TS-423-554-A001

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SECTION-I

SUB SECTION E

ANNEXURE-III

PAINTING & COLOUR SCHEME

(AS PER SECTION C2C)



1x800 TANGEDCO NORTH CHENNAI TPP

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**VENTILATION SYSTEM
LIST OF TOOLS & TACKLES**

**SECTION-I
SUB-SECTION-E
ANNEXURE-IV
LIST OF TOOLS & TACKLES**



1x800 TANGEDCO NORTH CHENNAI TPP

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**VENTILATION SYSTEM
LIST OF TOOLS & TACKLES**

SECTION : I

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SL NO	ITEM DESCRIPTION	UNIT	QTY
1	MEASURING TAPE	SET	1
2	TACHOMETER	SET	1
3	DOUBLE ENDED SPANNER	SET	1
4	RING SPANNERS	SET	1
5	GASKET PUNCH	NO.	1
6	CENTER PUNCH	NO.	1
7	HAMMER WITH WOODEN HANDLES	NO.	1
8	SCISSORS FOR SHEET METAL CUTTING	NO.	1
9	TORCH LIGHT (SUITABLE FOR 2 CELL)	NO.	1
10	MULTIMETER	NO.	1
11	ANEMOMETER	NO.	1
12	COMPOUND PRESSURE GAUGE	NO.	1
13	SLIDE WRENCH 8"	NO.	1
14	SLIDE WRENCH 10"	NO.	1
15	SLIDE WRENCH 6"	NO.	1
16	BOX SPANNER SET	NO.	1
17	SCREW DRIVER SET	NO.	1
18	ALIGN KEY SET	NO	1
19	MS TOOL BOX	NO	1



1X800 TANGEDCO NORTH CHENNAI TPP

**VENTILATION SYSTEM
SERVICE WATER ANALYSIS**

SPECIFICATION No: PE-TS-423-554-A001

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SECTION-I

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ANNEXURE-V

SERVICE WATER ANALYSIS

**1 x 800MW NORTH CHENNAI COAL BASED SUPER CRITICAL THERMAL POWER
PROJECT STAGE – III, TAMIL NADU, INDIA**

SERVICE WATER ANALYSIS

Sr. No	Parameter	Unit	SWRO Permeate (After Passivation)
1.	pH at 25 ⁰ C	-	7.5-8.5
2.	TDS	ppm	<600
3.	Calcium	ppm	>50
4.	Magnesium	ppm	3.3
5.	Sodium	ppm	175
6.	Potassium	ppm	5.9
7.	Stronium	ppm	0.03
8.	Ammonia	ppm	0.07
9.	Barium	ppm	0.003
10.	Alkalinity	ppm	>50
11.	Chlorides	ppm	<300
12.	Sulphate	ppm	9.2
13.	Nitrate	ppm	10.4
14.	Fluoride	ppm	0.05
15.	Boron	ppm	0.06
16.	Silica	ppm as SiO ₂	0.001



1x800 TANGEDCO NORTH CHENNAI TPP

**VENTILATION SYSTEM
DRAWINGS / DOCUMENTS SUBMISSION
PROCEDURE**

SPECIFICATION No: PE-TS-423-554-A001

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SECTION-I

SUB-SECTION-E

ANNEXURE-VI

DRAWINGS / DOCUMENTS SUBMISSION PROCEDURE



1x800 TANGEDCO NORTH CHENNAI TPP

**VENTILATION SYSTEM
DRAWINGS / DOCUMENTS SUBMISSION
PROCEDURE**

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ALL DOCUMENTS & DRAWINGS SHALL BE IN ENGLISH AND IN METRIC UNITS

SI		Consultant	TANGEDCO (HQ)	TANGED CO-SITE	BHEL SITE	PMG BHEL	PEM/ UNITS/ PSSR
1	Master list of drawings / document (duly indicating schedule of submission)	Soft copy	Soft copy	Soft copy		Soft copy (S)	Soft copy
2	Drawings / docs for Approval/ Information (First Submission)	Soft copy	Soft copy + 1 print	Soft copy		Soft copy	Soft copy (S)
3	Return with comments/approval	Soft copy	Soft copy (S)	Soft copy		Soft copy	Soft copy
4	Drawings / Documents for approval (second & subsequent submissions till approval)	Soft copy	Soft copy	Soft copy		Soft copy	Soft copy (S)
5	Drawings / documents for distribution (RFC)(Approved in Cat. 1 or Received for Information)	Soft copy + 1 print	Soft copy + 1 prints	Soft copy + 2 prints	Soft copy + ~~3~~ (2) prints	Soft copy	Hard copy (S)
6	Erection Drawings / documents	-	Soft copy + 1 print	Soft copy + 2 prints	Soft copy + 3 prints	Soft copy	Soft copy (S)
7	As built Drawings / documents	Soft copy + 1 print	Soft copy + 1 print	Soft copy + 2 prints	Soft copy + 3 prints	Soft copy	Soft copy (S)
8	Operation & Maintenance Manual	-	Soft copy + 1 print	Soft copy + 2 prints	Soft copy + 3 prints	Soft copy	Soft copy (S)
9	Type Test Certificate	Soft copy	Soft copy + 1 print	Soft copy + 1 prints	Soft copy + 3 print	Soft copy	Soft copy (S)

NOTES:

1. The above schedule of submission does not include Docs/Drgs. of quality assurance/inspection and delivery/dispatches. QAP documents to be submitted as per distribution schedule.
2. Date of uploading drawing/documents in PEDM shall be taken as date of submission.
3. S – Source for generation of document.



1x800 TANGEDCO NORTH CHENNAI TPP

**VENTILATION SYSTEM
MASTER DRAWING LIST WITH SCHEDULE
OF SUBMISSION**

SPECIFICATION No: PE-TS-423-554-A001

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SECTION-I

SUB-SECTION-E

ANNEXURE-VIII

**MASTER DRAWING LIST WITH SCHEDULE OF
SUBMISSION**



1x800 TANGEDCO NORTH CHENNAI TPP

VENTILATION SYSTEM

MASTER DRAWING LIST WITH SCHEDULE

OF SUBMISSION

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S. NO.	DRAWING NO	DRG./ DOC. TITLE	SCH. WEEK (FROM DATE OF LOI)
1	PE-V0-423-554-A001	INSPECTION CATEGORISATION PLAN	4
2	PE-V0-423-554-A002	QUALITY PLAN OF AIR WASHER & UAF	12
3	PE-V0-423-554-A003	QUALITY PLAN OF CENTRIFUGAL PUMPS	12
4	PE-V0-423-554-A004	QUALITY PLAN OF CENTRIFUGAL FANS	13
5	PE-V0-423-554-A005	QUALITY PLAN OF AXIAL FLOW FANS & RE UNITS	14
6	PE-V0-423-554-A006	QUALITY PLAN OF MOTOR	15
7	PE-V0-423-554-A101	VENTILATION FAN SCHEDULE.	22
8	PE-V0-423-554-A201	DATA SHEET & GA FOR AIR WASHER ALONGWITH FAN AND PUMP WITH FOUNDATION DETAILS.	12
9	PE-V0-423-554-A202	DATA SHEET & GA FOR UAF ALONGWITH FAN AND PUMP FOUNDATION DETAILS.	10
10	PE-V0-423-554-A203	DATA SHEET & GA FOR ROOF EXTRACTOR, AXIAL EXHAUST AND SUPPLY AIR FANS WITH FIXING ARRANGEMENT.	12
11	PE-V0-423-554-A204	DATA SHEET & GA FOR VALVES AND STRAINER.	8
12	PE-V0-423-554-A205	DATA SHEET FOR INSULATION.	8
13	PE-V0-423-554-A206	DATA SHEET & GA FIRE DAMPER.	8
14	PE-V0-423-554-A207	DATA SHEET FOR INSTRUMENTS (PRESSURE GAUGE, TEMP GAUGE, LEVEL GAUGE, PRESSURE SWITCH, LEVEL SWITCH).	14
15	PE-V0-423-554-A208	DATA SHEET OF PIPE.	5
16	PE-V0-423-554-A209	DATA SHEET OF GI AND MS SHEET.	5
17	PE-V0-423-554-A210	DATA SHEET & GA FOR PRE AND FINE FILTERS.	8
18	PE-V0-423-554-A211	DATA SHEET FOR MOTORS (A/W Fan, A/W pumps, UAF Fan, UAF Pump, RE units, Supply and Exhaust axial fans)	15
19	PE-V0-423-554-A401	TYPICAL Details DUCT FABRICATION DRAWING / SUPPORT / ERECTION. INSULATION OF DUCTING / PIPING & EQUIPMENTS PIPE ERECTION	7
20	PE-V0-423-554-A402	GA OF PROPELLER FAN.	9
21	PE-V0-423-554-A601	SCHEME FOR AIR DISTRIBUTION IN TG BUILDING AND ESP BUILDING.	5
22	PE-V0-423-554-A602	PID FOR AIRWASHER AND UAF UNIT.	8
23	PE-V0-423-554-A603	AIR WASHER LAYOUT OUTSIDE "A ROW" SIDE ALONGWITH FOUNDATION DETAILS - TG BUILDING	14



1x800 TANGEDCO NORTH CHENNAI TPP

VENTILATION SYSTEM

MASTER DRAWING LIST WITH SCHEDULE

OF SUBMISSION

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S. NO.	DRAWING NO	DRG./ DOC. TITLE	SCH. WEEK (FROM DATE OF LOI)
24	PE-V0-423-554-A604	AIR WASHER LAYOUT FOR "B-C BAY" SIDE ALONGWITH FOUNDATION DETAILS - TG BUILDING	14
25	PE-V0-423-554-A605	UAF LAYOUT ALONGWITH FOUNDATION DETAILS - ESP BUILDING.	11
26	PE-V0-423-554-A606	VENTILATION DUCT LAYOUT FOR TG BUILDING - 'A' ROW SIDE (UNIT I & II).	12
27	PE-V0-423-554-A607	VENTILATION DUCT LAYOUT FOR TG BUILDING - 'BC BAY' SIDE (UNIT I & II).	12
28	PE-V0-423-554-A608	VENTILATION DUCT LAYOUT FOR ESP BUILDINGS.(UNIT I & II).	12
29	PE-V0-423-554-A609	LOCATION OF ROOF EXTRACTOR UNIT IN TG BUILDING ALONGWITH FIXING DETAILS.	12
30	PE-V0-423-554-A610	VENT. ARRANGEMENT FOR BATTERY ROOM.	13
31	PE-V0-423-554-A611	VENT. ARRANGEMENT FOR VARIOUS AUXILIARY BUILDING.	18
32	PE-V0-423-554-A701	ELECTRICAL FEEDER LIST.	18
33	PE-V0-423-554-A702	VENTILATION CABLE SCHEDULE	18
34	PE-V0-423-554-A901	P.G. TEST PROCEDURE.	12
35	PE-V0-423-554-A902	O & M MANUAL.	25

Note:

The above is not the complete list and may change during detail engineering



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**VENTILATION SYSTEM
FORMAT FOR OPERATION AND
MAINTENANCE MANUAL**

SECTION-I

SUB-SECTION-E

ANNEXURE-IX

**FORMAT FOR OPERATION AND MAINTENANCE
MANUAL**



1x800 TANGEDCO NORTH CHENNAI TPP

**VENTILATION SYSTEM
FORMAT FOR OPERATION AND
MAINTENANCE MANUAL**

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Project name :
Project number :
Package Name :
PO reference :
Document number :
Revision number :

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
1.	COVER PAGE				
1.1	Project Name				
1.2	Customer/consultant Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX ,email address , Emergency Contact number				
1.5	Name and sign of prepared by , checked by & approved by				
1.6	Revision history with approval Details				
2.0	INDEX				
2.1	showing the sections & related page nos All the pages should be numbered section wise				
3.0	DESCRIPTION OF PLANT/SYSTEM				
3.1	Description /write up of operating principle of system equipment/ associated sub-systems & accessories/controls system , operating conditions, performance parameters under normal , start up and special cases				
3.2	Equipment list and basic parameter with Tag numbers				
3.3	Data sheets approved by Customer/for information and catalogues provided by original manufacturer				
3.4	Associated other packages and Interface /terminal points				
3.5	P&ID & Process Diagrams				
3.6	GA Layout drawings, As-built drawings , Actual photograph of items/system (Drawings of A2 & bigger sizes are to be attached in the last)				
3.7	Single line/wiring diagrams				
3.8	Control philosophy /control write-ups				



1x800 TANGEDCO NORTH CHENNAI TPP

**VENTILATION SYSTEM
FORMAT FOR OPERATION AND
MAINTENANCE MANUAL**

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Sl.no. & Sections	Description	Tick (✓)if included in Manual			Remarks
		Yes	No	Not Applicable	
4.0	COMMISSIONING ACTIVITIES (IF NOT COVERED IN SEPARATE DOCUMENT I.E. ERECTION MANUAL, COMMISSIONING MANUAL)				
4.1	Pre-Commissioning Checks				
4.2	handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	OPERATION GUIDELINES FOR PLANT PERSONAL/USER/OPERATOR				
5.1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
5.2	Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5.3	Do's & Don't of the equipments.				
5.4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5.5	Parameters to be monitored with normal values and limiting values				
5.6	Trouble shooting with causes and remedial measures				
5.7	Routine operational checks, recommended logs & records				
5.8	Changeover schedule if more than one auxiliary for the same purpose is given				
5.9	Painting requirement and schedule				
5.10	Inspection, repair , Testing and calibration procedures				
6.0	MAINTENANCE GUIDELINES FOR PLANT PERSONAL				



1x800 TANGEDCO NORTH CHENNAI TPP

**VENTILATION SYSTEM
FORMAT FOR OPERATION AND
MAINTENANCE MANUAL**

SPECIFICATION No: PE-TS-423-554-A001

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SUB-SECTION : E

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Sl.no. & Sections	Description	Tick (V)if included in Manual			Remarks
		Yes	No	Not Applicable	
6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				
6.3	Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to be given				
6.4	Long term maintenance schedules especially for structural, foundations etc.				
6.5	Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/handling requirement of consumables/self-life.				
6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest addresses, service centres ,Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts list				
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				
6.10	Guarantee and warranty clauses				
7.0	Statutory and other specific requirements considerations.				
8.0	List of reference documents				
9.0	Binding as per requirement				



1X800 TANGEDCO NORTH CHENNAI TPP

**VENTILATION SYSTEM
SITE STORAGE AND PRESERVATION**

SPECIFICATION No: PE-TS-423-554-A001

SECTION : I

SUB-SECTION : E

REV 01

DATE: NOV 2017

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SECTION-I

SUB-SECTION-E

ANNEXURE-X

SITE STORAGE AND PRESERVATION

SITE STORAGE AND PRESERVATION GUIDELINES

FOR

MECHANICAL BOPs

(Doc No: PE-DC-SSG-A001 REV.00)



PROJECT ENGINEERING MANAGEMENT, POWER SECTOR
BHARAT HEAVY ELECTRICALS LIMITED-NOIDA

CONTENT

- 1 SCOPE OF THE DOCUMENT
- 2 PURPOSE OF STORAGE & PRESERVATION
- 3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION
 - a) GENERAL STORAGE REQUIREMENTS
 - b) GENERAL PRESERVATION REQUIREMENTS
 - c) GENERAL INSPECTION REQUIREMENTS
- 4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT
5. CONCLUSION
6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL

1. SCOPE OF THE DOCUMENT

This guideline is prepared in intent to provide proper site storage and preservation of the Mechanical, Electrical and C & I items / equipment supplied under various bought out packages/items. This storage procedure shall be followed at different power plant sites by concerned agency for storage and preservation from the date of equipment received at site until the same are erected and handed over to the customer.

2. PURPOSE OF STORAGE & PRESERVATION

Many of the items may be required to be kept in stores for long period. It shall therefore be essential that proper methods of storage and preservation be applied so that items do not deteriorate, loose some of their properties and become unusable due to atmospheric conditions and biological elements.

3. MEASURES TO BE TAKEN FOR STORAGE, HANDLING & PRESERVATION

a) GENERAL STORAGE REQUIREMENTS

1. To the extent feasible, materials should be stored near the point of erection. The storage areas should have adequate unloading and handling facilities with adequate passage space for movement of material handling equipment such as cranes, fork lift trucks, etc. The storage of materials shall be properly planned to minimise time loss during retrieval of items required for erection.
2. The outdoor storage areas as well as semi-closed stores shall be provided with adequate drainage facilities to prevent water logging. Adequacy of these facilities shall be checked prior to monsoon.
3. The storage sheds shall be built in conformity with fire safety requirements. The stores shall be provided with adequate lights and fire extinguishers. 'No smoking' signs shall be placed at strategic locations. Safety precautions shall be strictly enforced.
4. Adequate lighting facility shall be provided in storage areas and storage sheds and security personnel positioned to ensure enforcement of security measures to prevent theft and loss of materials.
5. Adequate number of competent stores personnel and security staff shall be deployed to efficiently store and maintain the equipment / material.
7. The equipment shall be stored in an orderly manner, preserving their identification slips, tags and instruction booklets, etc., required during erection. The storage of materials shall be equipment-wise. Loose parts shall be stored in sheds on racks,

preserving the identification marks and tags in good condition. The group codes shall be displayed on the racks

6. At no time shall any materials be stored directly on ground. All materials shall be stored minimum 200 mm above the ground preferably on wooden sleepers

b) GENERAL PRESERVATION REQUIREMENTS

1. All special measures to prevent corrosion shall be taken like keeping material in dry condition, avoiding the equipment coming in contact with corrosive fluid like water, acid etc.
2. Materials which carry protective coating shall not be wrapped in paper, cloth, etc., as these are liable to absorb and retain moisture. The material shall be inspected and in case of signs of wear or damages to protective coating, that portion shall be cleaned with approved solution and coated with an approved protective paint. Complete record of all such observations and protective measures taken shall be maintained.
3. Generally equipment supplied at site are properly greased or rust protective oil is applied on machined/ fabricated components. However periodic inspection shall be carried out to ensure that protection offered is intact.
4. While handling the equipment, no dragging on the ground is permitted. Avoid using wire rope for lifting coated components. Use polyester slings (if possible) otherwise protective material (e.g. clothes, wood block etc.) should be used while handling the components with rope / slings
5. For Equipment supplied with finished paint, touch paint shall be done in case any surface paint gets peeled off during handling. Otherwise such surfaces shall necessarily be wrapped with polythene to avoid any corrosion. Further for equipment wherein finish coat is to be applied at site, site to ensure that equipment is received with primer coat applied.
6. It shall be ensured by periodic inspection that plastic inserts are intact in tapped holes, wherever applicable.
7. Pipes shall be blown with air periodically and it shall be ensured that there is no obstruction.
8. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.
9. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion/jamming due to prolonged storage.

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.
11. Following preservatives/preservation methods can be used depending upon type of equipment
 - a. Rust preventive fluid (RPF)
 - b. Rust protective paints
 - c. Tarpaulin covers, in case of outdoor storage
 - d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –
 - Ingress of moisture and corrosion damages.
 - Damage to protective coating.
 - Open ends in pipes, vessels and equipment -
 - In case any open ends are noticed, same shall be capped.
2. Any damages to equipment / materials.
 - In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
 - Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

The types of storage are broadly classified under the following heads:

i **Closed storage with dry and dust free atmosphere. (C)**

The closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated asbestos sheets / galvanised iron sheets for roofing. Brick walls / asbestos sheets can be used to cover all the sides. The floor of the shed can be finished with plain cement concrete suitably glazed. The shed shall be provided with proper ventilation and illumination.



ii **Semi-closed storage. (S)**

The semi closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated / asbestos sheets for roofing. The floor shall be brick paved. If required a small portion of sides can be covered to protect components from rainwater splashing onto the components.





iii Open storage (O)

The open yard shall be levelled, well consolidated to achieve raised ground with the provision of feeder roads for crane approach along with access roads running all sides. One part of the open yard shall be stone pitched, levelled and consolidated with raised ground suitable for storing / stacking heavier and critical components with due space to handle them by cranes etc . Adequate number of sleepers, concrete block etc. to be provided to make raised platforms to stack critical materials.

A separate yard to be identified as “scrap yard” slightly away from main open yard to store wooden/steel scraps, which are to be disposed off. This is required to avoid mix up with regular components as well as to avoid fire hazard.

Some of the components, which are having both machined & un-machined surfaces and are bulky, shall be stored in open storage area on a raised ground and suitably covered with water proof / fire retardant tarpaulin.



The equipment listed below shall be stored and inspected as per requirement mentioned in the table below.

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
Raw material /mechanical items like pipes, plates, structure sections etc.)				
1.	Steel pipes (lined/unlined)	S	Damage , paint, corrosion, rubber lining peeling	Provide end cap
2.	MS Plates	S	Damage, paint, corrosion	
3.	SS Plates	S	Damage	
4.	Non-metallic pipes	S	Damage, cracks	Provide end cap
5.	Stainless steel pipes	S	Damage ,	Provide end cap
6.	MS sections, beams	S	Damage, paint, corrosion	
7.	Cable trays	S	Damage, condition of preservations	
8.	Insulation sheets	S	Damage	
9.	Insulation	C	Damage, packing	
10.	Hangers Rods	S	Damage, paint, packing	
11.	Tubes	S	Damage, paint , packing	Provide end cap
12.	Hume pipes	O	Damage	
13.	Castings	O	Damage, paint, corrosion	
Fabricated mechanical items (pressure vessels, tanks etc.)				
14.	Pressure vessels (unlined)	O	Damage, paint, corrosion,	Covered nozzles
15.	Atmospheric storage tanks (unlined)	O	Damage, paint, corrosion	Covered nozzles

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
16.	Pressure vessels (lined)	S	Damage, paint, corrosion, rubber lining	
17.	Atmospheric storage tanks(lined)	S	Damage, paint, corrosion, rubber lining	
18.	Support structures	O	Damage , paint, corrosion	
19.	Flanges	C	Damage , paint, corrosion	
20.	Fabricated pipes	S	Damage , paint, corrosion	Provide end cap
21.	Vessels internals	C	Damage , paint, corrosion ,packing	
22.	Grills	S	Damage , paint, corrosion	
23.	Angles	S	Damage , paint, corrosion	
24.	Bridge mechanism/clarifier mechanism	O	Damage , paint, corrosion	
25.	Cranes, rails	S	Damage , paint, corrosion	
26.	Stair cases	O	Damage , paint, corrosion	
27.	Ladders/handrails	O	Damage , paint, corrosion	
28.	Fabricated ducts	S	Damage , paint, corrosion	
29.	Isolation Gates	O	Damage , paint, corrosion	
30.	Fabricated boxes/panels	S	Damage , paint, corrosion	
Mechanical components like valves, fittings, cables glands, spares etc.)				
31.	Valves	S	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
32.	Fittings	S	Damage , packing	Provide end cap
33.	Cable glands	C	Damage , packing	
34.	Tools & tackles	C	Damage , packing	
35.	Nut , bolts, washers,	C	Damage , packing	
36.	Gasket & Packings	C	Damage , packing	
37.	Copper tubes	C	Damage , packing, corrosion	Provide end cap
38.	SS tubing	C	Damage , packing	Provide end cap
Rotating assemblies (pumps, blowers, stirrers, fans, compressors etc.)				
39.	Pumps	S	Damage , packing, corrosion	Shaft rotation
40.	Blowers/Compressors	S	Damage , packing, corrosion	Shaft rotation
41.	Agitators/stirrers/radial launders	C	Damage , packing, corrosion	Shaft rotation
42.	Rollers for chlorine tonner mounting	C	Damage , packing, corrosion	
43.	Centrifuge	S	Damage , packing,	
44.	Gear box	C	Damage , packing, corrosion	
45.	Bearings	C	Damage , packing, corrosion	
46.	Fans	S	Damage , packing, corrosion	
47.	Dosing skids	S	Damage , packing, corrosion	
48.	Pump assemblies	S	Damage , packing, corrosion	
49.	Air washers(INTERNALS)	S	Damage , packing	
50.	Air conditioners (split)	C	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H ₂ SO ₄)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
68.	Sodium hydroxide (NaOH)	Store in canes/ storage tank in dyke area	Date of production/ leakage/ fumes/ breather	hazardous chemical ,breather to be checked for air ingress
69.	Sodium hypo chlorite	To be stored under shed	Date of production/ leakage/ fumes	hazardous chemical ,self-life normally 15-30 days after which strength of chemical decays
70.	Ammonia	S	Date of production/ leakage/ fumes	Store in closed storage tanks, hazardous chemical
71.	CW treatment chemicals	S	Date of production , Self-life	Store in closed canes
72.	RO/UF cleaning chemicals	S	Date of production , Self-life	Store in closed canes
73.	Lime	C	Damage to packing , seepage	Prevent moisture, rain
74.	Alum bricks	C	Damage to packing	Prevent moisture, rain
75.	Poly electrolyte	S		Store in closed storage tanks
76.	Laboratory chemicals(powder)	C	Damage, Packing self-life	
77.	Laboratory chemicals(liquid)	C	Damage, Packing self-life	
78.	Lubrication oils	C	Leakage	
79.	Paints	S	Leakage ,air tightness	
80.	Sand	O	Damage of packing	No hooks
81.	Salt (NaCl)	C	Damage of packing, water ingress	Prevent moisture, rain
82.	Anthracite	S	Damage of packing	
83.	Activated carbon	S	Damage of packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
84.	Thermal insulation	S	Damage of packing	
85.	Cement	C	Damage of packing	Prevent moisture, rain
86.	Gravels	O	Damage of packing	
87.	ION exchange resins	C	Damage , packing	Refer manufacturer guidelines
88.	RO membranes	C	Damage , packing	Refer manufacturer guidelines
89.	UF membranes	C	Damage , packing	Refer manufacturer guidelines
90.	Cleaning chemicals	C	Damage , packing	Refer manufacturer guidelines
91.	Chemicals for analysers/calibration	C	Damage , packing	Refer manufacturer guidelines
Electrical and C & I items (motors, cables etc.)				
92.	Motors	C	Damage , packing	
93.	Cable drums	O	Damage	
94.	Control Panel /control desk, UPS ,JB	S	Damage, Packing	
95.	Instruments(gauges/analysers)	C	Damage	
Special items		As per Manufacturer's item, like Hydrogen cylinders, Ozonator, Analyser, Chlorine dioxide generators etc.		

5. CONCLUSION

Concerned storage agency at site should make sure that loss in equipment performance and wear & tear are minimised through proper storage and preservation. The above are broad guidelines and cover major equipment / materials. However specific storage practices shall be followed as per manufacturer recommendation. All the necessary measures even in addition to the ones mentioned above, if found necessary, should be taken to achieve the objective.

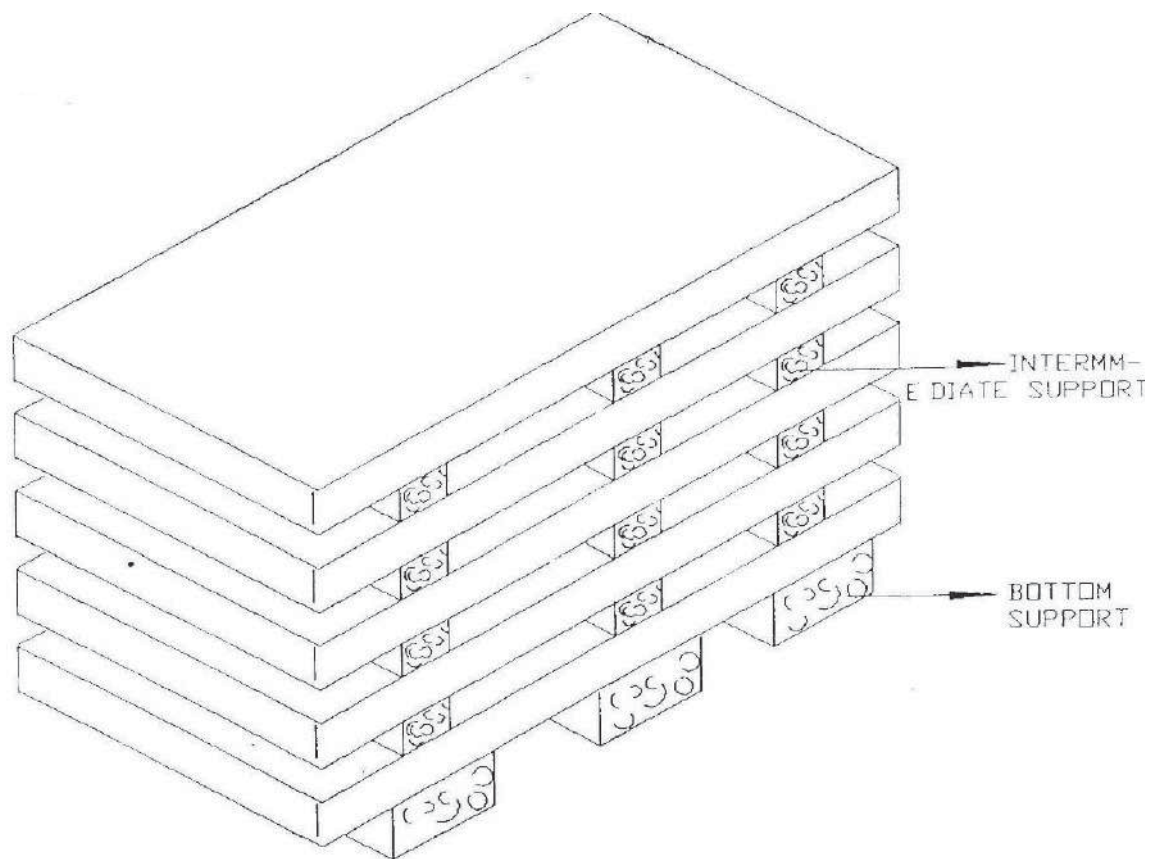


Figure – 1 – PLATE STACKING ARRANGEMENT

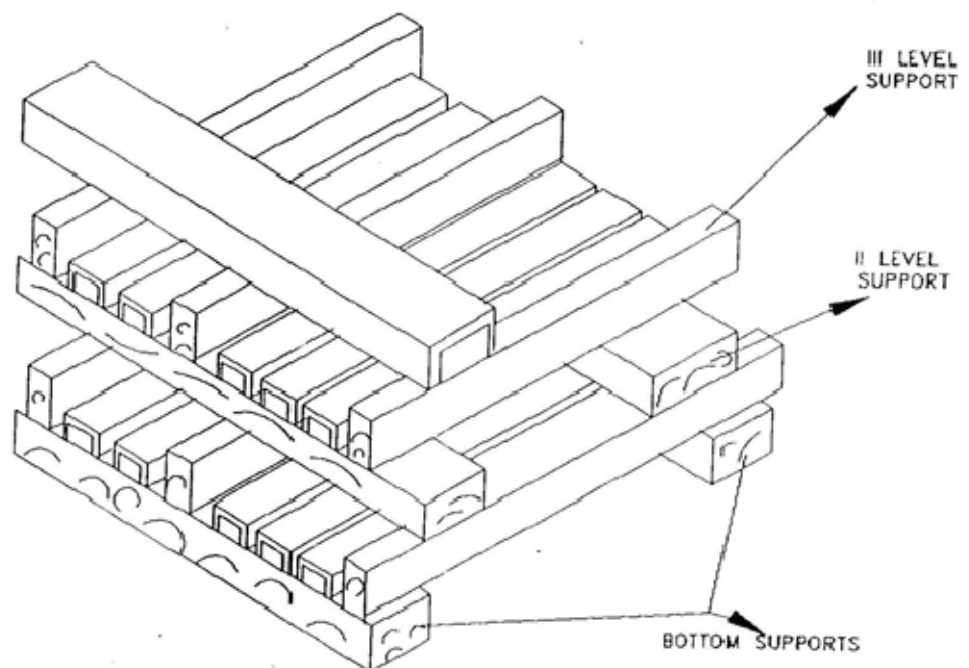


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT



1x800 TANGEDCO NORTH CHENNAI TPP

VENTILATION SYSTEM

SPECIFICATION No: PE-TS-423-554-A001

SECTION: II

REV. 01 **DATE: NOV 2017**

SECTION II



1X800 TANGEDCO NORTH CHENNAI TPP

**VENTILATION SYSTEM
INSPECTION AND TESTING**

SPECIFICATION No: PE-TS-423-554-A001

SECTION : II

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SECTION-II

SUB-SECTION-1

INSPECTION AND TESTING

	1X800 TANGEDCO NORTH CHENNAI TPP VENTILATION SYSTEM INSPECTION AND TESTING	SPECIFICATION No: PE-TS-423-554-A001	
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		SUB-SECTION : 1	
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1.01.00	Inspection and Tests during Manufacture.		
1.01.01	The method and techniques to be used by the Bidder for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner.		
1.01.02	The Owner’s general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.		
1.01.03	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.		
1.01.04	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 Bidder may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results. The owner’s representative shall have at all reasonable times access to bidder’s or his sub-vendor’s premises and shall have power to inspect/ examine materials and workmanship or equipment under manufacture. The Bidder shall forthwith forward to the engineer duly certified copies of the Test Certificates in six copies (one to the Purchaser and five to the Consulting Engineer) for approval. Further nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere. For electrical equipment, routine tests as per relevant IS spec are to be carried out on all equipment. Type tests are also to be carried out on selected equipment as detailed in the specs of concerned electrical equipment.		
1.01.05	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.		
1.01.06	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 Bidder shall allow for trial assembly prior to despatch from place of manufacture.		
1.01.07	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. Equipment or parts coming under any statutory		

	1X800 TANGEDCO NORTH CHENNAI TPP VENTILATION SYSTEM INSPECTION AND TESTING	SPECIFICATION No: PE-TS-423-554-A001	
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Regulations shall be certified by a Competent Authority under the regulations in the specified format.			
1.01.08	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.		
1.01.09	All necessary non-destructive examinations shall be performed to meet the applicable code requirements.		
1.01.10	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 but welding joints shall be radiographed unless otherwise stipulated.		
	Statutory payments in respect of IBR approvals including inspection shall be made by the bidder. Bidder's scope shall include to preparation of all necessary documents, co-ordination and follow-up for above approval. Owner shall only forward assistance/endorsement of documents /design /drawings /reports/records to be submitted for approval as stipulated/ required by Statutory Authorities till registration of the unit and clearance for commercial operation.		
1.02.00	Performance Tests at Site		
1.02.01	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 Bidder on site under normal operating conditions. The 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.		
1.02.02	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.		
1.02.03	The 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.		
1.03.00	For details of specific tests required on individual equipment refer to respective section of this specification.		
	All Statutory testing / clearance is in Bidder's scope including payment of all fees, etc. as required		

**1X800 TANGEDCO NORTH CHENNAI TPP**

SPECIFICATION No: PE-TS-423-554-A001

VENTILATION SYSTEM INSPECTION AND TESTING

SECTION : II

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QAP FORMAT

BHARAT HEAVY ELECTRICALS LIMITED

CORPORATE QUALITY ASSURANCE

PROJECT:

SYSTEM :

VENDOR :

ITEM :

[illegible]

Legend:

1. BHEL

2. Vendor

3. Sub-Vendor

QP No

CQS/SQP/31

Signature

Date

Rev

Name _____

Page No

1 of 1

Party

Customer/Consultant

Bhel

Vendor



1x800 TANGEDCO NORTH CHENNAI TPP

**VENTILATION SYSTEM
LIST OF DOCUMENTS TO BE SUBMITTED WITH
BID**

SPECIFICATION No: PE-TS-423-554-A001

SECTION : II

SUB-SECTION : 2

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**BIDDER SHOULD SUBMIT THE SIGNED AND STAMPED COPY OF THE
FOLLOWING DOCUMENTS:**

1. Compliance cum confirmation certificate
2. Guaranteed power consumption (In the format attached in the spec mentioning KW rating).
3. Un priced format for main package (mentioning quoted against each item)
4. Un priced format for mandatory spare (mentioning quoted against each item)
5. Un priced format for Tools and Tackles (mentioning quoted against each item)
6. Un priced format for Commissioning spare (mentioning quoted against each item)
7. Complete set of technical specification
8. No deviation certificate

	1x800 TANGEDCO NORTH CHENNAI TPP VENTILATION SYSTEM COMPLIANCE CUM CONFIRMATION CERTIFICATE	SPECIFICATION No: PE-TS-423-554-A001	
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COMPLIANCE CUM CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing / stamping this compliance certificate (every sheet) and furnish same with the offer.

- a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions, other than those mentioned under "exclusion and those resolved as per 'Schedule of Deviations', with regard to same.
- b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'
- c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL / CUSTOMER approval & customer hold points for inspection / testing shall be marked in the QP at the contract stage. Inspection / testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This is within the contracted price without any extra implications to BHEL after award of the contract.
- d) All drawings/ data-sheets / calculations etc. submitted along with the offer shall not be taken cognizance off.
- e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified / intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre-bid discussions, otherwise BHEL / Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.

- f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.
- g) All sub vendors shall be subject to BHEL / CUSTOMER approval in the event of order.
- h) Guarantee for plant/equipment shall be as per relevant clause of GCC / SCC / Other Commercial Terms & Conditions
- i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities within the scope of work as tender specification. This clause will apply in case during site commissioning, additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account

	1x800 TANGEDCO NORTH CHENNAI TPP VENTILATION SYSTEM COMPLIANCE CUM CONFIRMATION CERTIFICATE	SPECIFICATION No: PE-TS-423-554-A001	
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		REV. NO. 01	DATE: NOV 2017
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j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's / Customer's / Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time. k) As built drawings shall be submitted as and when required during the project execution. l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder. m) Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier. n) Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement. o) In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.			



1x800 TANGEDCO NORTH CHENNAI TPP

VENTILATION SYSTEM
PRE-BID CLARIFICATION SCHEDULE

SPECIFICATION No: PE-TS-423-554-A001

SECTION : II

SUB-SECTION : 4

REV. NO. 01

DATE: NOV 2017

SHEET: 1 OF 1

PRE-BID CLARIFICATION SCHEDULE

S. NO.	SECTION/CLAUSE/PAGE NO.	STATEMENT OF THE REFERRED CLAUSE	CLARIFICATION REQUIRED

The bidder hereby clarifies that above mentioned are the only clarifications required on the technical specification for the subject package.

Signature: _____

Name: _____

Designation: _____

Company: _____

Date: _____

Company Seal



1X800 TANGEDCO NORTH CHENNAI TPP

NO DEVIATION CERTIFICATE

SPECIFICATION No: PE-TS-423-554-A001

SECTION : II

SUB-SECTION : 5

REV: 01

DATE: NOV 2017

SHEET 1 OF 1

NO DEVIATION CERTIFICATE

Refer GCC-6, Annexure-II Deviation sheet (Cost of withdraw)



1X800 TANGEDCO NORTH CHENNAI TPP

VENTILATION SYSTEM
GAURANTEE POWE CONSUMPTION

SPECIFICATION No: PE-TS-423-554-A001

SECTION : II

SUB-SECTION : 6

REV. NO. 01

DATE: NOV 2017

SHEET: 1 OF 1

REFER ANNEXURE-III



1X800 TANGEDCO NORTH CHENNAI TPP

**VENTILATION SYSTEM
SUGGESTIVE PRICE FORMAT**

SPECIFICATION No: PE-TS-423-554-A001

SECTION : II

SUB-SECTION : 7

REV 01

DATE: NOV 2017

**SECTION-II
SUB-SECTION-7
SUGGESTIVE PRICE FORMAT**

SUGGESTED PRICE FORMAT		Doc No:	PE-PF-423-554-A001			
		Rev No:	1			
		Date of issue	Nov-17			
NAME OF PROJECT:		1X800 TANGEDCO NORTH CHENNAI TPP				
NAME OF PACKAGE:		VENTILATION SYSTEM				
TECHNICAL SPECIFICATION No:		PE-TS-423-554-A001				
S. No.	DESCRIPTION	UNIT	QTY	AMOUNT (Ex-Works)		
1	Total lump sum firm price inclusive of all prevailing taxes, duties and other levies for Supply part, Services part and Mandatory spares comprising of design (i.e.preparation and submission of drawing /documents including “As Built” drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor’s & sub-vendor’s works, painting, maintenance tools & tackles fill of lubricants & consumables, mandatory spares alongwith spares for erection, startup and commissioning as required, forwarding, proper packing, shipment and delivery at site, unloading, handling, transportation & storage at site, in-site transportation, assembly, erection & commissioning, final painting at site, minor civil work, trial run at site, preperation of layout drawings 3D (as applicable) 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.	Lot	1			
2	MAJOR BREAK-UP OF PRICES GIVEN IN 1.0 ABOVE.					
2.1	Total lump sum firm price inclusive of all prevailing taxes, duties and other levies for Supply part comprising of design (i.e.preparation and submission of drawing /documents including “As Built” drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor’s & sub-vendor’s works, painting, maintenance tools & tackles, fill of lubricants & consumables alongwith spares for erection as required, startup and commissioning spares as required, forwarding, proper packing, shipment and delivery at site, preperation of layout drawings 3D (as applicable) for the total scope defined as per BHEL NIT & tender technical specification as specified above, amendment & agreements till placement of order. (Break-up as per Annexure-I)	Lot	1			
2.2	Total lumpsum firm prices inclusive of all prevailing taxes, duties and other levies for Services part comprising of service part for unloading, handling, transportation & storage at site, in-site transportation, assembly, erection & commissioning, final painting at site, minor civil work, 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. (Break-up as per Annexure-I)	Lot	1			
2.3	Total lumpsum firm price inclusive of all prevailing taxes, duties and other levies for Mandatory spares comprising of manufacture, fabrication, assembly, inspection / testing (as applicable) at vendor’s & sub-vendor’s works, painting, forwarding, proper packing, shipment, delivery at site & guarantee as per tender technical specification above, amendment & agreements till placement of order. (Price break up of mandatory spares is to be furnished as per Annexure- II)	Lot	1			

Note:

1.) Bidder to quote **Guaranteed Power Consumption for Ventillation System as per Annexure-III.**

2.) PG to consider and suitably incorporate taxes, duties and other commercial aspects.

Particulars of bidder / authorised representative					
	Name	Designation	Signature	Date	Company Seal

SUGGESTED PRICE FORMAT ANNEXURE - I PRICE BREAKUP (FOR MAIN PLANT, ESP AND OTHER AUX BUILDINGS)						Doc No:	PE-PF-423-554-A001
						Rev No:	1
						Date of issue	Nov-17
NAME OF PROJECT:				1X800 TANGEDCO NORTH CHENNAI TPP			
NAME OF PACKAGE:				VENTILATION SYSTEM			
TECHNICAL SPECIFICATION No:				PE-TS-423-554-A001			
SL NO	DESCRIPTION OF EQUIPMENT/ ITEM	Qty	UNIT	AMO UNT	AMOUNT (Ex-Works)		
1	Sheet metal type air washer unit with centrifugal fan (DIDW) with motor, pumps with motors, filters, air washer internals, inlet air louvers, piping as per IS:1239, Part-I (heavy class galvanised), valves, nozzles, back wash arrangement, galvanised drain piping, etc as per specification of capacity 250000 CMH. Each air washer has 2 no centrifugal fan (2 x 50% duty) of capacity 1,25,000 CMH at min. 95 mm SP. Each centrifugal fan shall be provided with VFD driven motor alongwith VFD and other accessories as required for VFD shall also be included in the price.	4	NO				
2	Unitary air filtration unit with centrifugal fan with motor, pumps with motors, filters, UAF internals, inlet air louvers, piping as per IS: 1239 pt I (heavy class galvanised), valves, nozzles, back wash arrangement, galvanised drain piping etc. as per specification of capacity 110,000 CMH. Each UAF has 1 no centrifugal fan (1 x 100% duty) of capacity 110,000 CMH at min. 80 mmWC SP. Each centrifugal fan shall be provided with VFD driven motor alongwith VFD and other accessories as required for VFD shall also be included in the price.	1	NO				
3*	Supply air ducting (finished) for above area complete with dampers, grills (with VCD & without VCD), supports (painted) and all accessories as specified.						
3.1*	Finished GSS (zinc coating 275 gms/sq.m) Ducting with support structure etc.						
a)*	18 G	2500	SQM*				
b)*	20 G	2700	SQM*				
c)*	22 G	2700	SQM*				
d)*	24 G	3500	SQM*				
3.2*	MS Duct With Epoxy paint for battery room.	200	SQM*				
3.3*	Extruded Aluminium Grilles with VCD	100	SQM*				
3.4*	Extruded Aluminium Grilles without VCD	8	SQM*				
3.5*	Thermal insulation alongwith finish as per specification for supply air duct	1000	SQM*				
3.6*	Wall mounted dampers (gravity operated) for different areas.	30	SQM*				
3.7*	Inlet Louvres	50	SQM*				
3.8*	VOLUME CONTROL DAMPERS in GI construction as per specifications	20	SQM*				
4*	FIRE DAMPER						
a)*	Fire damper	20	SQM*				
b)*	Motorized Actuator with single phase power supply for the above Fire damper with auto resetting, limit switches, indication lamps etc	25	NO*				
c)*	Fusible Link type Fire Damper	5	SQM*				

SUGGESTED PRICE FORMAT ANNEXURE - I PRICE BREAKUP (FOR MAIN PLANT, ESP AND OTHER AUX BUILDINGS)						Doc No:	PE-PF-423-554-A001
						Rev No:	1
						Date of issue	Nov-17
NAME OF PROJECT:			1X800 TANGEDCO NORTH CHENNAI TPP				
NAME OF PACKAGE:			VENTILATION SYSTEM				
TECHNICAL SPECIFICATION No:			PE-TS-423-554-A001				
SL NO	DESCRIPTION OF EQUIPMENT/ ITEM	Qty	UNIT	AMO UNT	AMOUNT (Ex-Works)		
5*	Roof extractor units (axial flow type) with hood, disconnect switch and all accessories as specified. Following fan shall have 15 mmwc static pressure.						
a)*	Capacity 50,000 CMH with Motor rating 5.5 KW	24	Nos.*				
b)*	Capacity 40,000 CMH with Motor rating 5.5 KW	5	Nos.*				
c)*	Capacity 20,000 CMH with Motor rating 2.2 KW	2	Nos.*				
6*	Axial flow supply fans with pre and fine filter (wall mounted) complete with casing, TEFC sq cage induction motors & mounting frame, MS rain protection cowl, bird screen and all other accessories (suitable for 415V/3-phase supply). Following fan shall have 32 mmwc static pressure.						
a)*	Capacity 10,000 CMH with Motor rating 2.2 KW	4	Nos.*				
b)*	Capacity 7,500 CMH with Motor rating 1.5 KW	4	Nos.*				
c)*	Capacity 6,000 CMH with Motor rating 1.1 KW	10	Nos.*				
d)*	Capacity 4,000 CMH with Motor rating 0.75 KW	6	Nos.*				
7*	Axial flow supply fans with pre filter (wall mounted) complete with casing, TEFC sq cage induction motors & mounting frame, MS rain protection cowl, bird screen and all other accessories (suitable for 415V/3-phase supply) as specified. Following fan shall have 20 mmwc static pressure.						
a)*	Capacity 10,000 CMH with Motor rating 1.5 KW	8	Nos.*				
b)*	Capacity 7,500 CMH with Motor rating 1.1 KW	8	Nos.*				
c)*	Capacity 6,000 CMH with Motor rating 1.1 KW	4	Nos.*				
d)*	Capacity 4,000 CMH with Motor rating 0.75 KW	4	Nos.*				
8*	Axial flow exhaust fans (Bifurcated type, spark proof construction, wall mounted) complete with casing, flame proof motor & mounting frame, MS rain protection cowl, bird screen and all other accessories epoxy painted (suitable for 415V/3-phase supply) as specified. Following fan shall have 15 mmwc static pressure.						
a)*	Capacity 15,000 CMH with Motor rating 2.2 KW	6	Nos.*				
b)*	Capacity 10,000 CMH with Motor rating 1.5 KW	5	Nos.*				
c)*	Capacity 7,500 CMH with Motor rating 1.1 KW	12	Nos.*				
d)*	Capacity 4,000 CMH with Motor rating 0.75 KW	2	Nos.*				
e)*	Capacity 2,000 CMH with Motor rating 0.55 KW	6	Nos.*				

SUGGESTED PRICE FORMAT ANNEXURE - I PRICE BREAKUP (FOR MAIN PLANT, ESP AND OTHER AUX BUILDINGS)						Doc No:	PE-PF-423-554-A001
						Rev No:	1
						Date of issue	Nov-17
NAME OF PROJECT:			1X800 TANGEDCO NORTH CHENNAI TPP				
NAME OF PACKAGE:			VENTILATION SYSTEM				
TECHNICAL SPECIFICATION No:			PE-TS-423-554-A001				
SL NO	DESCRIPTION OF EQUIPMENT/ ITEM	Qty	UNIT	AMO UNT	AMOUNT (Ex-Works)		
9*	Axial flow exhaust fans (Wall mounted) complete with casing, TEFC sq cage induction motor & mounting frame, MS rain protection cowl, bird screen and all other accessories epoxy painted (suitable for 415V/3-phase supply) as specified. Following fan shall have 10 mmwc static pressure.						
a)*	Capacity 15,000 CMH with Motor rating 1.1 KW	6	Nos.*				
b)*	Capacity 10,000 CMH with Motor rating 0.75 KW	6	Nos.*				
c)*	Capacity 7,500 CMH with Motor rating 0.55 KW	20	Nos.*				
d)*	Capacity 6,000 CMH with Motor rating 0.55 KW	6	Nos.*				
e)*	Capacity 4,000 CMH with Motor rating 0.55 KW	2	Nos.*				
f)*	Capacity 2,000 CMH with Motor rating 0.37 KW	5	Nos.*				
10*	Exhaust fan (propeller type) completes with induction motor & mounting frame MS rain protection cowl, bird screen and all other accessories as specified (suitable for 240V/ 1 phase). Following fan shall have 5 mmwc static pressure.						
a)*	Capacity 1200 CMH with Motor rating 100 watts	60	Nos.*				
11*	Handling arrangement for ventilation equipments						
(a)*	Manually operated, platform trolley of 1 Ton capacity with base area 2m x 1.5m	2	NO*				
(b)*	1T Chain pulley block	2	NO*				
(c)*	1T Chain pulley block with travelling trolley	2	NO*				
12*	Online Non chemical scale preventer, with all accessories for as required to meet system requirements						
a*	For a combination of two Air washer placed at A row and BC bay	2	NO*				
b*	For a combination of two UAF	1	NO*				
13	Total lumpsum price for special tools & tackles for maintenance inclusive of packing forwarding, transportation up to site, etc. (Bidder shall submit item-wise price break-up).	1	LOT				
14	Total lumpsum price for commissioning spares inclusive of packing forwarding, transportation up to site, etc. (Bidder shall submit item-wise price break-up).	1	LOT				
15	Cable tray, conduits, junction box, Local control panel and Field instruments like pressure gauge, temperature gauge, temperature and pressure transmitters, DP transmitters, flow transmitters, flow indicator, etc. as required for the complete system	1	LOT				
16	Total lumpsum price for Mandatory Spare inclusive of packing forwarding, transportation up to site, etc. (Bidder to submit item-wise price break-up separately).	1	LOT				
17	Any other item not indicated above, but required to make the system complete in all respects.	1	LOT				

SUGGESTED PRICE FORMAT ANNEXURE - I PRICE BREAKUP (FOR MAIN PLANT, ESP AND OTHER AUX BUILDINGS)						Doc No:	PE-PF-423-554-A001
						Rev No:	1
						Date of issue	Nov-17
NAME OF PROJECT:				1X800 TANGEDCO NORTH CHENNAI TPP			
NAME OF PACKAGE:				VENTILATION SYSTEM			
TECHNICAL SPECIFICATION No:				PE-TS-423-554-A001			
SL NO	DESCRIPTION OF EQUIPMENT/ ITEM	Qty	UNIT	AMO UNT	AMOUNT (Ex-Works)		
NOTE							
1	The bidder shall furnish unit rates for variable item (marked *) for necessary adjustment (plus or minus) variation during detailed engg. stage. The unit rates quoted above shall be considered and no separate unit rates shall be quoted. Unit rates shall be valid throughout the contract.						
Particulars of bidder / authorised representative							
Name		Designation	Signature	Date	Company Seal		

SUGGESTED PRICE FORMAT APPENDIX-A Special tools & tackles for maintenance				Doc No: PE-PF-423-554-A001	
				Rev No: 1	
				Date of issue Nov-17	
NAME OF PROJECT:			1X800 TANGEDCO NORTH CHENNAI TPP		
NAME OF PACKAGE:			VENTILATION SYSTEM		
TECHNICAL SPECIFICATION No:			PE-TS-423-554-A001		
SL NO	DESCRIPTION	UNIT	Qty	AMOUNT (Ex-Works)	
1	Measuring tape	NO	1		
2	Tachometer	NO	1		
3	Double ended spanner	SET	1		
4	Ring spanners	SET	1		
5	Gasket punch	NO.	1		
6	Center punch	NO.	1		
7	Hammer with wooden handles	NO.	1		
8	Scissors for sheet metal cutting	NO.	1		
9	Torch light (suitable for 2 cells)	NO.	1		
10	Multimeter	NO.	1		
11	Anemometer	NO.	1		
12	Compound pressure gauge	NO.	1		
13	Slide wrench 8"	NO.	1		
14	Slide wrench 10"	NO.	1		
15	Slide wrench 6"	NO.	1		
16	Box spanner set	SET	1		
17	Screw driver set	SET	1		
18	Align key set	SET	1		
19	MS tool box	NO	1		
NOTES					
1	ABOVE IS THE MINIMUM LIST. ANY OTHER TOOL / TACKEL REQUIRED FOR THE SYSTEM SHALL ALSO BE PROVIDED BY THE VENDOR WITHOUT ANY COST IMPLICATION.				
Particulars of bidder / authorised representative					
	Name	Designation	Signature	Date	Company Seal

SUGGESTED PRICE FORMAT APPENDIX-B Commissioning spares				Doc No:		PE-PF-423-554-A001
				Rev No:		1
				Date of issue		Nov-17
NAME OF PROJECT:				1X800 TANGEDCO NORTH CHENNAI TPP		
NAME OF PACKAGE:				VENTILATION SYSTEM		
TECHNICAL SPECIFICATION No:				PE-TS-423-554-A001		
SL NO	DESCRIPTION	UNIT	Qty	AMOUNT (Ex-Works)		
1	FAN BELTS	SET	1			
2	PRESSURE GAUGE	NO	1			
3	TEMPERATURE GAUGE	NO	1			
4	FILTER	SET	1			
NOTES						
1	ABOVE IS THE MINIMUM LIST. ANY OTHER COMMISSIONING SPARE REQUIRED FOR THE SYSTEM SHALL ALSO BE PROVIDED BY THE VENDOR WITHOUT ANY COST IMPLICATION.					
Particulars of bidder / authorised representative						
	Name	Designation	Signature	Date	Company Seal	

SUGGESTED PRICE FORMAT ANNEXURE - II LIST OF MANDATORY SPARES		Doc No:	PE-PF-423-554-A001			
		Rev No:	1			
		Date of issue	Nov-17			
		NAME OF PROJECT:			1X800 TANGEDCO NORTH CHENNAI TPP	
NAME OF PACKAGE:		VENTILATION SYSTEM				
TECHNICAL SPECIFICATION No:		PE-TS-423-554-A001				
S. No.	Description	UNIT	Qty	AMOUNT (Ex-Works)		
A	C&I portion					
	The quantity of following spares includes a minimum of 20 % spares for replacement of each type of lamps, PBs, ILPBs, fuse, MCB, MCCB used in the equipment/system offered by him even if this is not detailed below.					
i)	Measuring Instruments - Indicators, Recorders, Electrical Metering and Skid Mounted Instruments	Lot	1			
1	10% of the number of indicators, recorders and meters offered from each model for the project or a minimum of one number per model, whichever is more. These instruments shall be supplied with three sets of blank scales.					
2	For skid mounted instruments (if any) - 10% of total number of instruments for each model and type for the project or a minimum of one number for each model and type, whichever is more.					
ii)	Temperature Elements and Thermowells	Lot	1			
1	10% spare thermocouple/RTD elements, suitable for replacement for each type and length of element furnished with thermocouple/RTD assemblies, or a minimum of one number of each type & length, whichever is more.	%	10%			
2	10% thermo wells for each type of temperature sensors or a minimum of one for each type, whichever is more	%	10%			
3	Temperature Transmitters and Electronic Transmitters (For Pressure, DP, Temp, Flow, Level), Temperature, Pressure, Flow & Level Switch, safety switches, Gauges, meters, Transducer or any other instrument etc.					
	10% of total number of instruments/transducers offered for each model and type for the project or a minimum of one number, whichever is more.	Lot	1			
iii)	Relay Based Control Panels	Set	1			
1	10% LEDs for indicating lights shall be furnished.					
2	Three times, the one hundred percent (300% of installed) spare replacement control circuit fuses/MCB/MCCB of each current rating required shall be furnished.					
3	20% spare replacement relays modules & contactors of each type.					
iv)	Alarm Annunciation System	Set	1			
1	20% spares of each type installed shall be provided for logic modules, group card modules, power supply modules, Hooters and any other electronic module.					
2	5% spares of each size shall be provided for un-engraved window boxes complete with LED etc.					
3	20% of installed LEDs for annunciation facia windows and LEDs box assemblies offered for the project shall be provided as mandatory spares.					
4	One (1) spare annunciator hooter of each type.					
v)	Erection hardware	Set	1			
1	Ten (10) percent of each type & Size installed instrument valve, manifold for each type, rating, model number and size of devices supplied for the project.					

SUGGESTED PRICE FORMAT ANNEXURE - II LIST OF MANDATORY SPARES		Doc No:	PE-PF-423-554-A001		
		Rev No:	1		
		Date of issue	Nov-17		
2	Ten (10) percent of total number of condensate pots or four numbers whichever is higher of each type & Size installed.				
3	Ten (10) percent of each type & Size installed Fittings				
vi)	Bidder to supply 10% or 1 no. (whichever is more) of each type of sensor/instrument, analyzers /special instruments/Electronic card, instrumentation/mechanical fittings etc. for any other electronic system, feeder control cabinets, hydra step (EWLI), Vibration Monitoring System, CCTV, C&I Lab Instruments, On line Carbon in Ash analyzer system, On line Coal mass flow/speed measurement system, On line secondary air flow measurement system Mass Flow meter, Solid flow meter, 3 D Acoustic type level transmitters, Nucleonic & non nucleonic density transmitter etc.				
B	Electrical portion				
1	415V Motors				
1.1	Terminal plates	Nos.	10 Nos. each for small motors upto 30 KW & 4 Nos. each for more than 30 KW		
1.2	Heaters	Set	2 sets		
1.3	Greasing arrangements	Set	4 sets each type of motor		
1.4	Motor of each type and rating	Nos.	10% of the installed quantity or minimum 1 number whichever more		
1.5	Bearings (DE and NDE) for each type and rating of motor	Set	4 set		
NOTE					
1	Mandatory spares listed above is bare minimum requirement. In case any additional mandatory spares requirement is covered elsewhere in the tender specification apart from specified above, same shall be deemed to have been covered in bidders scope of supply.				
Particulars of bidder / authorised representative					
	Name	Designation	Signature	Date	Company Seal

SUGGESTED PRICE FORMAT ANNEXURE - III Guaranteed Power Consumption For Ventilation System					Doc No:		PE-PF-423-554-A001
					Rev No:		1
					Date of issue		Nov-17
NAME OF PROJECT:		1X800 TANGEDCO NORTH CHENNAI TPP					
NAME OF PACKAGE:		VENTILATION SYSTEM					
TECHNICAL SPECIFICATION No:		PE-TS-423-554-A001					
S.NO.	DESCRIPTION OF EQUIPMENT	NO OF EQUIPMENT		TOTAL GUARANTEED POWER CONSUMPTION FOR EACH EQUIPMENT AT MOTOR INPUT TERMINAL AND CONTROL PANEL (IN KW)	DUTY FACTOR		TOTAL KW
		WORKING	STANDBY				
		3A	3B	4	5		6=3Ax4x5
1	VENTILATION SYSTEM FOR TG						
1.1	Centrifugal Fan of air washers.	8	0		1		
1.2	Pumps for circulation of water in spray chamber of above air washer	4	4		1		
1.3	RE Units 50,000 CMH	16	0		1		
1.4	Centrifugal Fan of UAF for ESP bld.	1	0		1		
1.5	Pump for above UAF.	1	1		1		
				TOTAL (KW)			
Note:	Estimated power consumption (EPC) figure for the system (for working drives only) has been considered as 691 KW. So long bidder's quoted guaranteed power consumption (GPC) above remains within this EPC, there will be no technical loading of bid on power consumption for evaluation. However, if bidder's quoted GPC exceeds EPC, there shall be technical loading of bid for evaluation @ Rs 588401/- per KW of additional power over EPC. Bidder's guaranteed power consumption at motor input terminals (not shaft power) as furnished in relevant schedule shall be demonstrated by the successful bidder during performance testing at works/ site. In case power consumption is noted higher than EPC / bidder's quoted GPC whichever is higher, during inspection/ PG test, penalty @ Rs 588401/- per KW shall be levied on vendor.						
Particulars of bidder / authorised representative							
	Name	Designation	Signature	DATE	Company Seal		

