

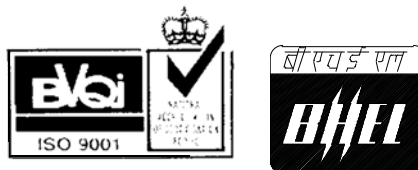
TECHNICAL SPECIFICATION

CONDENSER ON LOAD TUBE CLEANING SYSTEM
(COLTCS)

WBPDCL

1X660 MW SAGARDIGHI TPP, PHASE-III (UNIT-5)

Specification No.: PE-TS- 445-165-N002 (REV. 00)



BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
PPEI BLDG., SEC-16A, PLOT NO. 25
NOIDA – 201301 (UP)

523866/2021/PS-PEM-MSE

	TITLE: TECHNICAL SPECIFICATION COLTCS 1X660 MW SAGARDIGHI, PHASE-III (UNIT-5) SPECIFIC TECHNICAL REQUIREMENTS	SPEC. NO.: PE-TS-445-165-N002
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SECTION - I

SPECIFIC TECHNICAL REQUIREMENTS

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SUB-SECTION – IA

SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)

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1.0 GENERAL

1.1 This enquiry covers the design, manufacture, assembly, inspection and testing at manufacturer's and / or his sub-contractors works, proper packing for delivery, installation checks, commissioning and PG test for Condenser On-line Tube Cleaning System (COLTCS) with mandatory spares complete with all accessories as per the requirements specified in this specification.

The Condenser On Load Tube Cleaning Systems (COLTCS) complete with all accessories shall conform to the standard technical specifications (Section-II) and Data Sheet-A enclosed herewith. In addition, the requirements of this Section-I including customer specification attached (as applicable) shall also be complied with. However, wherever the details given in Section-II and Data Sheet-A are different, the requirements of Data Sheet-A shall prevail. Similarly, in the event of contradictions between Section-I/ customer specification (as applicable) / Section-II/ Data Sheet-A, the same shall prevail in the order as: customer specification (as applicable), Section-I, Datasheet-A, Section-II. The decision of BHEL shall be final in case of any discrepancy.

Section I consists of 4 Sub-Sections Viz. Sub-Sec. IA, IB and IC for Mechanical, Electrical and C&I respectively and Sub-Sec. ID for Datasheet-A, the requirements of all 4 sub-sections shall be complied with.

1.2 The omission/ addition of specific reference to any component / accessory necessary for the proper performance of the equipment shall not relieve the supplier of the responsibility of providing such facilities to complete the supply within the quoted prices.

1.3 The bids for the project shall be evaluated as per NIT.

1.4 Bidder to quote for items as per price schedule attached in NIT.

2.0 DESCRIPTION OF EQUIPMENTS:

3.0 CONDENSER ON LOAD TUBE CLEANING SYSTEMS (COLTCS):

The condenser on load tube cleaning system (COLTCS) is intended to prevent formation of various forms of fouling and scaling in the condenser tubes. The cooling water system is of closed circuit type with cooling towers or open circuit type as specified. The water analysis is indicated with Datasheet-A.

4.0 SCOPE OF SUPPLY UNDER THE SPECIFICATION IN THE BIDDER'S SCOPE FOR COLTCS.

4.1 The details of COLTCS with quantities, design parameters, size and MOC's as per Data Sheet-A.

4.2 SCOPE OF SUPPLY IN THE BIDDER'S SCOPE FOR COLTCS:

4.2.1 Each set of COLTCS shall comprise following:

- a) One No. Ball Separator at Condenser CW outlet pipe.
- b) One No. Ball recirculation pump with drive motor.
- c) One No. Ball collector.
- d) One No. Manual ball sorter (Bucket type sorter with sieves to manually sort out the undersized balls by shaking the sieved bucket manually) for each set of COLTCS.
- e) Differential pressure measuring system for ball separator.

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DP measuring system shall comprise of 2 nos. DPT and 1 no. DPG for each COLTCS.

Instrument shall be with Remote seal arrangement. Stubs for DPT and DPG shall be independent.

- f) Ball monitoring system comprising an independent balls recirculation monitor and an independent balls oversize monitor. If bidder is not manufacturing Ball over size monitor, then they can offer other alternatives like automatic ball sorter etc.
- g) Length of Ball separator, Scope of Counter Flange, Nuts, bolts and gaskets shall be as per Datasheet-A. Thickness of body flange and counter flange shall be as per Drg no PE-DG-999-141-MO17 enclosed at enclosures at Annexure-4 of Datasheet-A.
- h) For Clarified water: - Pipe work (excluding interconnection piping), flanges/counter flanges for valves & pipes, bends, fittings, distributors, nozzles and support installation materials shall be in Bidder's scope. Bidder shall finalize the pipework to suit the layout at contract stage in such a way that no site welding is required for his pipework otherwise the same shall be carried out by bidder at site.
- i) Additional manhole for access to BFV for its inspection shall be provided in case of BFV mounted on Ball Separator body.
- j) The Electrical and C&I item / accessory as specified in succeeding clause/ respective sections herein.
- k) Power and Control cables between starter Panel (Switch Gear) and various drives in bidder's scope of supply.
- l) Starter Panel (Switch Gear Panel) shall be as follows:

2 Sets of COLTCS shall have one Common Starter Panel (Switch Gear Panel) for DCS based control system.

Switch Gear Panel should have suitable arrangement like Bus Coupler for providing redundancy to incoming supply feeder (1Working + 1 Standby feeder).
- m) Control cables between field instruments and Switch gear panel.
- n) All the field instruments stipulated in this specification shall be in Bidder's scope.
- o) Commissioning balls and other commissioning spares on "As required basis" and to be supplied at the time of commissioning of COLTCS system.
- p) Balls required for Performance Guarantee test on "As required basis" and to be carried at the time of PG test of COLTCS system.
- q) Set of mandatory spares as indicated in Data Sheet A. Spare balls (if applicable) to be supplied at the time of commissioning of COLTCS system.
- r) Supporting arrangement complete with saddle support, foundation plates, anchor bolts, nuts, sleeves, inserts, all installation materials, fixing bolts, clamps and other accessories etc. for complete equipment supplied under this package.
- s) Finish paints for touch up painting of equipment after erection at site, in sealed containers.



TITLE:

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- t) Set of special tools and tackles if required for maintenance and erection of the equipment supplied.
- u) Various drawings, data test reports/ certificates instruction manuals for erection operation and maintenance etc. as specified in Data Sheet-C. and cables schedule indicating BOQ for power & control cables.
- v) Panels & Instruments: Scope and Type as specified in C&I section wherever required.

Any item not specified but required to make COLTCS a complete package shall also be in bidder's scope.

5.0 SCOPE OF SERVICES INCLUDED IN THE BIDDER'S SCOPE:

The bidder's scope also includes following services at site, for scope under this specification for COLTCS:

- a) Installation checks (Erection in BHEL's scope).
- b) Commissioning of equipment.
- c) Performance Testing.

The commissioning of equipment shall be generally conducted immediately after erection while PG testing shall be conducted at a later date. These activities for different units shall be timed separately.

- **For drawings/documents approval**

In the event of order all drawings / documents in soft as well as hard copy shall be submitted as per cl. 10.0 (b) below.

Further on receipt of Customer comments, if required bidder's engineer shall visit BHEL/ Customer along with soft copy to resolve all issues and incorporate comments in the soft copy for across the table finalization and Category-I approval.

- **Site Visits for Installation Check, Commissioning and PG Testing:**

Bidder to consider adequate number of site visits to complete the activity of installation check, commissioning and PG testing. Overall responsibility for successful completion of these activities lies with bidder.

6.0 EXCLUSIONS:

The following are excluded from the bidder's scope.

- 6.1 Civil foundation works required for installation
- 6.2 Erection of Equipment at site.

7.0 DESIGN CONSTRUCTION:

In addition to the requirements of Section-IIA the following shall also be complied.

- 7.1 Layout Piping Arrangement Drg. is enclosed in the specifications at Annexure-5 of Datasheet-A.

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- 7.2 Thickness of body flange and counter flange of COLTCS shall be as per Drg no PE-DG-999-141-MO17 enclosed at enclosures at Annexure-4 of Datasheet-A.
- 7.3 The materials of construction specified in Data Sheet-A are minimum requirements and materials of construction for other components not specified shall be similarly selected by the bidder for the intended duty which shall be subject to purchaser's approval during detailed engineering in the event of order.
- 7.4 Housing/ body of COLTCS shall be designed and manufactured as per the applicable codes for pressure vessels and to take care of force and moments as enclosed in the specification. However, in no case thickness of housing/ body shall be less than connecting pipe thickness as specified in Data Sheet-A of COLTCS.
- 7.5 Adequate provision for future installation of Cathodic Protection for COLTCS (Sacrificial type) shall be kept by the bidder in the equipment.
- 7.6 Flow straightener for streamlining the CW flow in balls collecting strainer if required shall be supplied by the bidder along with mounting arrangement and the fixing details.
- 7.7 Velocity in the pipe work shall be less than 1.5 m/ sec for pump suction and less than 2.5 m/ sec. in other pipe work. All valves upto 150 NB shall be ball valves. For higher sizes, gate/ globe/ B.F. valves shall be provided. All instrument valves shall be needle valves.

8.0 Performance Guarantee and Bid Evaluation criteria for Condenser on Load Tube Cleaning System.

Performance Parameters to be guaranteed by bidders under demonstration category under compulsory corrections shall be as under:

- i) Percentage recovery of balls (min. 95% recovery for 1000 hrs of normal plant operation with 8 hrs Operation of COLTCS per day).
- ii) Life of Sponge Rubber Ball (Min. 3 weeks with 8 hrs operation of COLTCS per day).
- iii) Max. Pressure drop in ball separator in clean condition (Test to be conducted along with commissioning) – not exceeding 0.2 MWC. The Bids shall be technically rejected for pressure drop quoted higher than 0.2 MWC.

Any deviation to above balls life, percentage recovery and pressure drop will not be accepted.

In case the successful bidder fails to demonstrate any of these parameters he shall carry out modifications at his own cost, to purchaser's approval.

In case bidder fails to demonstrate above parameters to purchaser's satisfaction even after modification carried by him at site, the purchaser has the right to reject the equipment out rightly.

9.0 SPARES:

9.1 Mandatory Spares

Mandatory Spares shall be as per Data Sheet-A or annexure enclosed with data sheet A.

10.0 Quality Plan

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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 and 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. Charges for 3rd party inspection (TUV/ equivalent) for imported components wherever required shall be included by bidder in the base price itself. If BHEL or BHEL customer decides to witness the tests along with third party, the cost of travel of BHEL or BHEL customer shall be borne by BHEL or BHEL customer themselves.

11.0 DELIVERY & DRAWINGS/ DOCUMENTS DISTRIBUTION SCHEDULE:

- Delivery of Equipment shall be as per NIT.
- The drawings to be submitted by bidder in event of award of contract.

PACKAGE	BHEL DRG NO	DRG TITLE
COLTCS	Primary Documents -	
	PE-V2-445-165-N001	P&ID OF COLTCS SYSTEM
	PE-V2-445-165-N002	TECHNICAL DATA SHEET-COLTCS
	PE-V2-445-165-N003	INSTALLATION PLAN- COLTCS
	PE-V2-445-165-N004	GENERAL ARRANGEMENT OF BALL SEPERATOR
	PE-V2-445-165-N005	DETAILS OF BR SKID,BALL INJECTION PIPE & FIXING DETAILS
	PE-V2-445-165-N006	C&I Part-I,PANEL-TDS, I/O LIST, CABLE SCH AND CONTROL PHILOSPHY FOR COLTCS
	PE-V2-445-165-N008	QP-COLTCS
	PE-V2- 445 -165-N007	C&I Part-II, GA & WIRING DIAGRAM OF PANEL-COLTCS
	Secondary Documents -	
	PE-V2- 445 -165-N009	O& M MANUAL –COLTCS
	PE-V2-445-165-N010	PG Test procedure of COLTCS

Note: Drawing submission schedule shall be as per NIT

12.0 The Make of various bought out items shall be subjected to approval of Customer/ BHEL in the event of order.

13.0 It is mandatory for the bidders to submit along with the bid the deviations if any whether major or minor in the schedule of deviations only. ***In the absence of deviations listed in the schedule of deviations the offer shall be deemed to be in full conformity with the specification "non-withstanding" anything else stated elsewhere in bidder's offer, data sheets etc. The implied/ indirect deviations in data sheets etc. Shall not be binding on the purchaser.***

14.0 The following documents shall be furnished by the bidder with his offer:

- Compliance certificate duly signed and stamped (Enclosed at section-III).

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- Guarantee schedule duly signed and stamped (Enclosed at section-III).
- GA drawings of following with empty/ filled-ups.
 - Balls Collecting Strainers (as applicable).
 - Balls recirculating Skids.
 - Other equipments considered necessary for Layout/ Civil.
- Electrical Load Data (Enclosed at section-IIB of Specification)
- Schedule of Deviation (As per NIT format)

The bidder to note that load requirement furnished and finalized during tender stage shall only be provided by BHEL and any changes or additional requirement of Electrical load by bidder during contract stage shall be provided by BHEL with cost repercussions to the bidder.

NOTE: Apart from above, no other drawing/ document/ data sheet etc. shall be submitted along with the offer. If any drawing/ document etc. is submitted with the offer, same shall be considered as for 'Reference' purpose only and shall not be reviewed/ commented upon and any deviation, exclusion to scope, etc. taken in documents but not highlighted in the deviation schedule shall not be taken cognizance of.

15.0 COLTCS packing procedure before dispatch

The purpose of this procedure is to outline the requirements and procedures for protecting the equipment's during shipment and preserving during the storage.

15.1 Preparation for Packing:

- After hydro testing, operation, all fluids e.g. water etc., shall be completely drained from all COLTCS's parts, and the equipment blown dry.
- All material shall be cleaned internally and externally to remove, scale, rust fillings and any other foreign material.
- The COLTCS shall be placed on a strong wooden base & bolted to the wooden base using the foundation holes for further transportation up to site.

15.2 Protection of parts:

- BALL SEPARATOR) shall be packed in properly in high grad bubble plastic wrap for transportation, and long storage at site.
- Actuators shall be packed in separate wooden box of proper sizes.
- COLTCS items (EXCEPT BALL SEPARATOR) shall be packed in proper sizes of wooden cases. High grade woods like Rubber woods, jungle wood, hard wood, mango wood, pine wood, etc. is used for packing.
- Loose material, & Electrical & Electronics items shall be packed in corrugated box and plastic bags with proper tagging and marking of handle with care in proper sizes of wooden cases
- All finished (or) machined (External C.S. Surfaces shall be protected against corrosion with corrosion resisting coating, which is easily removable (Compound shall be such that it will remain on the surface at temperature normally encountered during shipping & storage).
- All machined surfaces shall be protected from mechanical damage. All external unfinished carbon steel surfaces shall be sand blasted & shall be coated with rust



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preventive primer.

- Flanged opening if any shall be covered with blank flanges sealed with blank gasket of natural rubber or equivalent. Butt welded opening shall be closed with temporary closing covers. Internal threads shall be protected with metal plug sealed with Teflon tape (if applicable). External thread shall be protected with PVC sleeve.
- Wooden cases shall be covered with HDPE cloth from inside wooden box and the top. All the opening in COLTCS shall be closed properly by suitably covering to prevent foreign material entering in COLTCS.
- All fabricated wooden cases & crates conform to the requirement as per table given below:

Gross Weight [Kgs.]	Board Thickness	Batton / Rafter Thickness
2000 to 9000	Min. 30 mm	Min. 35 mm
9000 to 18000	Min. 50 mm	Min. 35 mm

- All the equipment shall be protected for entire period of dispatch, storage and erection against corrosion, incidental damage due to vermin, sunlight, rain, high temperature, humid atmosphere, rough handling in transit and storage. All MS parts which are not painted shall be provided with coating of grease.
- Clay Desiccant or such other moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.

15.3 **Preservation**

The equipment's shall be stored under closed/open space in packed condition until installation. The packages containing loose items are to be protected from extreme climatic conditions.

15.4 **Photographs**

Bidder to take photographs of all parts like Ball separators, screen, pumps, piping, valves, instruments, actuators, panel (inside & outside) and sent to engineering deptt along with all inspection reports before final dispatch.



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SECTION-VII

CONDENSER ON LINE TUBE CLEANING SYSTEM





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SECTION-VII

CONDENSER ON LINE TUBE CLEANING SYSTEM

1.00.00 GENERAL INFORMATION

For maintenance of degree of cleanliness of the condenser tubes, the on load ball re-circulation type tube cleaning system and debris filters at CW inlet line to condenser will be employed. The on line condenser tube cleaning system shall maintain a circulation of resilient balls in a closed loop through the condenser tubes. Thus, while passing through the tubes, the balls get deformed thereby cleaning the inner surface of the tubes. The balls will be injected at the C.W. inlet pipe by ball recirculation pumps, which subsequently will be distributed evenly throughout the cross-section of the condenser tube sheet to effect uniform cleaning of tubes. The balls after passing through the tubes will be taken out of the C.W. outlet pipes. The balls are then led to the C.W. inlet pipe once again for recirculation.

Technical requirements of the condenser On Line Tube Cleaning System have been indicated in the "Data Specification Sheet" in Annexure-I of this section.

2.00.00 SCOPE OF WORK

The scope of supply under Condenser On Line Tube Cleaning System (COLTCS) shall be as below. Items not mentioned but deemed necessary by the Bidder for making the system completely reliable and efficient shall also be included. No of COLTCS shall be decided by the bidder based on the design of condensing equipment.

- a) Each Condenser On Line Tube Cleaning Systems (COLTCS) comprising of -
 - i) Ball separator or Ball Collecting Strainer on the C.W. outlet pipes. Each ball separator shall consist of Carbon Steel flanged shell, ball separator screens, ball extraction arrangement, drive units for actuation of screens, differential pressure measuring system etc.
 - ii) Ball re-circulation units complete with non clog type ball recirculation pumps, drive motors, ball collectors, etc.
 - iii) Ball Recirculation Monitors and ball injection arrangement on the C.W. inlet pipes.
- b) Debris filters in each C.W inlet lines, if recommended by the bidder based on the quality of condenser circulating water. Each Debris Filter shall consist of Carbon Steel flanged shell, filter screen, debris flushing and extraction assembly, drive units for operation of debris flushing assembly, differential pressure measuring system etc.





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- c) One (1) set of debris flushing and discharge system for each condenser complete with flushing pumps, drive motors, debris discharge butterfly valves with electric actuators, etc.
- d) All interconnecting pipes with necessary valves, fittings, pipe supports etc. for connecting ball separator section to ball re-circulating skid, re-circulating skid to injection point, Debris Filter to debris discharge point on the C.W. outlet pipes at down stream of ball separator, all integral piping for debris flushing system and ball re-circulating skid, drain line, vent line, drain collectors (floor level), sample points with suitable valves etc.
- e) All supporting steel structures for the equipment, piping and instrument for the skid.
- f) All foundation bolts and embedded inserts required for anchorage of machines, equipments, structures, and cable trays.
- g) Required number of cleaning balls (normal sponge balls as well as abrasive balls) for commissioning of the system.
- h) The scope of Instrumentation & Control shall include but not be limited to the following :
 - i) Required number of local control panel for tube cleaning systems (two condensers) with installed local instrumentation, controls, alarms, completely wired. The control panel shall be provided with segregated power compartment. This local control panel shall be supplied with anti vibrations supports.
 - ii) Required number of local control panels for debris filtration units (two condensers) with installed local instrumentation, controls, and alarms, completely wired. The control panel shall be provided with segregated power compartment. This local control panel shall be supplied with anti vibrations supports.
 - iii) All field and local control board mounted instruments along with accessories; their supports and all logic necessary to satisfy the requirements described in this specification.
 - iv) All necessary Pressure Gauges, Differential Pressure Gauges, D.P. Transmitters, Ball Monitoring Units required for the functional completeness of the above systems/equipments.
 - v) Instrumentation and control cables along with accessories as necessary.
- i) Cable trays, conduits, their supports and all mounting materials within the skid.





3.00.00

CODES AND STANDARDS

The design, material, construction, manufacture, inspection, testing and performance of Condenser on-line tube cleaning system and debris filters for Auxiliary system and associated equipment shall comply with the latest edition of all currently applicable standards, statutory regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall be construed to relieve the Bidder of his responsibility. In case of conflict between the standards, stringent specifications out of these standards shall govern, whereas in case of conflict between the standards and this specification, requirements of this specification shall govern. Other National standards are acceptable if they are established to be equal to or superior to the listed standards. In all such cases, however, copies of English translation of such National standards shall be attached to the tender. The tenders not complying with this requirement are liable for rejection.

The design, materials requirement, manufacture, testing and performance requirements of the condenser On Line Tube Cleaning System shall conform to the latest edition of the following codes, standards, specification and regulation:

- a) Standards of the Hydraulic Institute of USA.
- b) PTC 8.2 : Power Test Codes - Centrifugal pumps.
- c) ASME Section VIII: Pressure Vessel Code, 2001.
- c) ASTM - American Society for Testing & Materials.
- d) American National Standards (ANSI) on -
 - i) Steel Pipe Flanges and Flanged Fittings (B 16.5).
 - ii) Steel Fittings S.W. and Threaded (B 16.11).
 - iii) Butt welding ends-Pipe, valves, & fittings (B16.25).
 - iv) Valves – Flanged, Threaded and Welding End (B 16.34).
- e) American Society for Non destructive Testing (SNT-TC-1A).
- f) NEMA : National Electrical Manufacturer's Association.
- g) OSHA : Occupational Safety and Health Act.
- h) IEEE : Institute of Electronics and Electrical Engineers.
- i) ISA : Instrument Society of America





Other standards such as IEC, VDI, DIN, BS, IS etc. shall also be accepted subject to the owner's approval for which the Bidder shall furnish along with the bid adequate information to justify that these standards are equivalent or superior to the standards mentioned above. For such alternate standards, which are not normally published in English, bidder shall also furnish a complete translation for them.

In case of any contradiction between the above standards and data sheets, the stipulations in the data sheet shall prevail and shall be binding on the Contractor.

4.00.00 **DESIGN AND MANUFACTURING / CONSTRUCTION REQUIREMENT**

4.01.00 **Design Considerations**

Equipment/works offered shall be designed for high availability, high reliability, low maintenance and ease of operation & maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability, availability, operability and ease of maintenance. He shall also furnish details of availability records in plants stated in his experience list.

All similar parts of the equipment shall be made to gauge and shall be interchangeable with and shall be made of same material and workmanship as the corresponding parts of the equipment. Where feasible common components shall be employed in different pieces of equipment in order to optimize the spares inventory and utilization.

Provision of manual and automatic back wash arrangement shall be made with automatic collection of balls prior to back washing.

Provision of ball monitoring system, which should at least consist of separate ball recirculation monitor and ball oversize monitor.

Provision shall be made to prevent loss of balls under normal and abnormal operation including tripping of CW pumps.

The no. of balls in circulation shall be at least 10% of no. of condenser tubes. Bidder shall indicate no. of ball losses in 1000 hours of normal operation.

Provision shall be made to avoid any dead zone inside water box. There shall not be crowding of balls at the inlet of ball collecting strainer at discharge pipe.

Enough provision for homogeneous ball injection and even distribution of balls throughout the condenser.

4.02.00 **General Performance Requirement**

4.02.01 Performance requirements of the tube cleaning system and debris filter covered by this specification are as follows:





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- i) The cleanliness of the condenser tubes utilising continuous operation of the system such that the contribution of the tube waterside fouling to the variation of the condenser vacuum from its design value is negligible.
- ii) The pressure drop across the ball separator screens and debris filter screens during normal cleaning operation shall be minimum (it should not be more than 30 millibar).
- iii) In the automatic system, sequential operations of various equipment in tube cleaning system must be performed in such a manner that there is absolutely no loss of balls during any cleaning or washing mode of operation of the system..
- iv) The online condenser tube cleaning system shall perform satisfactorily under the specified flow indicated in the technical specification (in the condenser) and shall be capable of removing the various forms of fouling and scaling from condenser tubes. The condenser back pressure / overall heat transfer co-efficient shall be guaranteed to the close limits as specified as long as the tube cleaning system is in operation.
- v) The quantity of cleaning balls worn out and/or lost shall be as minimum as possible. The quantity of cleaning balls required for an operating period of one year shall be guaranteed.
- vi) The Owner will do the mechanical and chemical cleaning of the condenser of each unit when on line condenser tube cleaning system is to be commissioned and put into service for the first time. At this stage, the cleanliness of the condenser tube shall be assumed as 100%. This will ensure that condenser tubes are in clean condition when on line condenser tube cleaning system is commissioned.

4.03.00 Constructional Features

General

Unless inconsistent with this specification, the supplier's standard or usual construction is desired.

The equipment shall be capable of safe, reliable and continuous operation at all conditions of circulating water flow through the condenser tubes maintaining the design cleanliness factor of the tubes.

Ball Separator

The design of the ball separator section shall aim at the maximum rigidity of the screens by adequate stiffening bars.





The construction of the ball extraction area shall ensure smooth and reliable removal of the balls out of the separator section.

The separator shall have flanged ends and flange drilling shall conform to AWWA C207 standard.

Ball Collector

The size of the ball collector shall be determined by the number of condenser tubes coming per path, the relevant ball circulation frequency and the cleaning ball diameter.

The integral non-return flap shall ensure no reverse flow in case of ball recirculation pump-motor failure thereby avoiding any loss of balls.

Ball Injection System

The design of the injection system shall be such that it performs an even distribution of requisite cleaning balls at the C.W. inlet pipe so that each condenser tube receives a cleaning ball regularly at fairly short intervals.

Cleaning Balls

Resilient balls of proper hardness and correct size shall be selected based on factors like tube material, nature of fouling expected, tube internal diameter and desired service life of the balls.

Only a single type of ball to cater for the entire range of tube fouling may not adequate.

The supplier shall furnish different types of balls as required in sufficient quantities to take care of all possibilities like (a) normal maintenance of tube cleanliness when function of the ball is more of that of polishing than removing of scales (b) removal of comparatively hard scale formed due to non-availability of the tube cleaning system for reasons like failure of the system, long shutdown of the generation unit, etc.

Schedule of Materials

Materials of construction of components of various equipment covered by this specification shall not be inferior to those specified in data specification sheet, Annexure-I of this section.

In selecting materials of construction of equipment, the Contractor shall pay particular attention to the atmospheric conditions existing at the Site and the nature of material/fluid handled. Carbon steel parts exposed to circulating water shall be epoxy coated. Wherever deviations are taken in respect of materials specified, the reasons shall be spelt out clearly in the proposal.



All materials shall be new, and shall be of the quality most suited to the proposed application.

In as far as is possible, materials shall be in accordance with national or international standard specifications and shall be used in accordance with national or international codes of practice. Where such standards or codes of practice are not available sufficient information shall be provided to allow the owner to assess the suitability of the material for the particular application.

All materials used shall have demonstrated lengthy satisfactory service in similar or more arduous conditions to those proposed by the Contractor.

Drive Motor

Drive motor and actuators for valves and screen shall be as per Specifications for Electrical Equipment & Accessories, Volume-II-F of this specification.

4.04.00 Instrumentation and Control

Operation of the condenser on line tube cleaning system and debris filters with necessary audio / visual alarm / indications will be initiated locally by the Proprietary Local Control Panel. The system shall be controlled from the local control panel, either in 'Auto' or 'Manual mode, by means of a selector switch. Following are the major control logics to be provided for operation of the automatic tube cleaning system. However, the bidder shall offer additional control features also, if necessary, for smooth and trouble-free operation of the system.

- a) Start-up of the cleaning system after manually feeding the requisite number of balls into the collector:

The above operation & control will be achieved through steps like setting the selector switch on local control panel to "Auto" mode and pressing the push button to "system ON". Other steps will follow sequentially viz. tilting of the screens in the strainer section to "ball circulating position", starting of recirculation pump, turning the ball catching flap in the collector to "ball circulation" position, etc. In case of manual mode, all steps will be achieved manually by operating the corresponding push buttons.

- b) Automatic shut-down of the cleaning system either periodically or as per operator's requirement by pressing the push button from the local control panel.

Under "Auto" mode, pushing of "System OFF" push button shall initiate the above operation, through steps like turning the ball catching flap in the collector to "ball catching" position, stopping the recirculation pump after a set period.



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- c) Monitoring of strainer section screen fouling by differential pressure measuring system.
- d) Indicators & Alarms

The following indications as a minimum shall be provided :

- i) Tube cleaning system ON-OFF.
- ii) Pump ON-OFF.
- iii) "Screen Operation".
- iv) DP High-Normal.
- v) DP indication.
- vi) MOV "Open"-"Close".
- vii) Various failure positions.

The following alarms as a minimum shall be provided :

- i) Pump tripped.
- ii) DP - high and very high.
- iii) M.O.V failure to open or close.
- iv) Screen Actuator failure.

There shall also be provision for remote control & monitoring facilities from Unit DCS. Suitable interfaces shall be provided between local control panels and DCS.

The above list of logics is not exhaustive and the supplier shall provide all other control logics required for the safe and trouble-free operation of the system. Necessary interlocks, (e.g. recirculation pump will not run if the strainer section is in 'screen wash' position) for proper operation of the system shall also be provided. The supplier shall furnish the write-up and logic diagrams for interlock and protection.

5.00.00 OPERATING CONDITIONS / REQUIREMENTS

5.01.00 Operational Features.

The tube cleaning system shall be semi automatic and shall be operated from local control panels, with display of selected parameters and alarms in DDCMIS.





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5.02.00 **Ball Separator Strainer Section and Differential Pressure Measuring System.**

During the normal cleaning mode the screens shall allow the circulating water leaving the condenser to pass through with very little pressure drop across the screens. However, the cleaning balls coming out of the condenser tubes will be prevented from escaping. These balls will get collected over the separator screens and are extracted from the strainer section and pumped back to the system for re-cycling.

Whenever the pressure drop across the strainer, as sensed by the differential pressure measuring system, exceeds a pre-set limit, there will be annunciation in the local panel.

5.03.00 **Recirculation Pump and Injection Nozzles**

The recirculation pump will extract the balls from the ball separator strainer section and push them through the ball collector to the ball injection nozzles. The ball injection nozzles shall point against the direction of the C.W. flow for better ball distribution.

6.00.00 **INSPECTION AND TESTING**

The manufacturer shall conduct all tests and inspections (including stage inspections, as necessary) required to ensure that the equipment offered by him conforms to the requirement of this specification. The particulars of the proposed tests and the procedures for the tests shall be submitted to the Purchaser for approval before conducting tests.

Test certificates for all tests shall be submitted to the Owner for approval.

6.01.00 **Material Test**

All materials used for the manufacture of the equipment covered under this specification will be of tested quality. Physical and chemical tests on materials shall be done to ensure the quality of the material offered. Test procedures and sampling shall be guided by the applicable test Codes and Standards. Components for which material test has been done and approved shall be stamped for identification.

Components viz. ball separators, debris filters, ball vessels, and ball recirculation pumps, debris flushing pumps, fabricated main flanges and counter flanges shall be subjected to Non-Destructive Testing as per following requirement and the acceptable limits shall be guided by relevant standard(s):

Visual Tests

All the parts/components shall be visually inspected in full (100%) for configuration, size, surface finish etc with approved drawings and documents.





Liquid Penetrant and Ultrasonic Tests

- i) All weldments, pressure containing parts of pumps (casing and shaft), screen shaft, fabricated main flanges and counter flanges shall be surface inspected inside and outside by means of magnetic particle or liquid penetrant test to ensure freedom from cracks and other defects. Test procedure shall be in accordance with Owner approved procedure.
- ii) Ball separator/debris filter shell nozzles and flanges (>40 mm thk plate), screen shaft and pressure containing parts of pumps made from forging shall be 100% ultrasonic tested in accordance with the relevant ASTM Standards.

Radiography Test

All weldments of fabricated main flanges, counter flanges and screen assembly shall be 100% radiographed and butt welding joints of pipe work will be at least 10% radiographed in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code and shall comply with the Standards of Section VIII of the ASME Boiler and Pressure Vessel Code.

6.02.00 Hydrostatic Testing

Pump casing, ball separator shell, debris filter shell and the interconnecting piping shall be hydrostatically tested at one and one-half times the design pressure.

6.03.00 Performance Testing

Each pump in the tube cleaning system and debris flushing system shall be tested to determine pump performance. Prior to performance tests, the Contractor shall furnish the procedures and methods of testing to the Owner for approval.

7.00.00 DRAWINGS, DATA AND MANUALS

7.01.00 To be submitted with the bid:

The Bidder shall submit the following along with his formal proposal besides the different information required as indicated elsewhere in this specification.

- i) Piping and Instrumentation Diagram
- ii) Equipment GA, Layout, interlock, Instrument List, Instrument Data Sheet Alarm List, Local Control Panel GA and Layout, Technical literature, Operational write up with logic diagram.

7.02.00 Drawing/Document to Be Submitted After Award

Final version of all drawings/documents listed in 7.01.00 above.





ANNEXURE-I

DATA SPECIFICATION SHEET
CONDENSER ON LINE
TUBE CLEANING SYSTEM AND DEBRIS FILTERS

1. Condenser Data

No. of condensers for generating unit : 2 nos. series condenser

2. Material of Construction

a) Ball Separator Section

- i) Separator shell flanges : Carbon Steel.
- ii) Separator shell : Carbon Steel.
- iii) Internals : SS 316
- iv) Bolts & nuts in contact with circulating water : SS 316

b) Ball Recirculation pumps & debris flushing pumps

- i) Casing/ impeller : SA 351 CF8M
- ii) Shaft : SS 316

c) Ball Collector

- i) Housing : Stainless Steel.
- ii) Internals : SS-317L

d) Debris Filter

- i) Debris Filter shell : Carbon Steel.
- ii) Debris Filter shell flanges : Carbon Steel.
- iii) Screen basket : SS316
- iv) Bolts & nuts in contact with circulating water : SS 316

e) Ball Valves

- i) Body : SA 351 CF8M





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- ii) Ball : SA 351 CF8M
- iii) Stem : SS 316

f) **Interconnecting piping**

- i) Interconnecting piping & fittings between Debris Filter to debris discharge point on the C.W. outlet pipes : Carbon Steel.
- ii) Interconnecting piping and fittings between ball separator section to ball re-circulating skid and re-circulating skid to injection point : SS 316
- g) Details of cleaning balls for commissioning of the system.

Normal sponge balls & abrasive balls

- i) Type : Spherical.
- ii) Number of balls per charge per system : Bidder to decide.
- iii) No. of charges per system : To suit the system.
- iv) Size : To suit the system.





SECTION-XI

PROTECTIVE COATING AND PAINTING

1.00.00 INTENT OF SPECIFICATION

1.01.00 This specification addresses the requirements of all labour, material, and appliances necessary with reference to preparations for lining / painting, application as well as finishing of all lining / painting for all mechanical and electrical equipment, piping and valves, structures etc. included under the scope of this Package.

1.02.00 The Bidder shall furnish and apply all lining, primers including wash primers if required, under-coats, finish coats and colour bands as described hereinafter or necessary to complete the work in all respects.

2.00.00 CODES & STANDARDS

2.01.00 The Bidder shall follow relevant Indian and International Standards wherever applicable in cleaning of surface, selection of lining material / paints and their application. The entire work shall conform to the following standards / specifications (latest revision or as specified).

a)	SSPC SP 10 / NACE 2 / Sa2½	:	Near White Blast Cleaning
b)	SSPC PA 2	:	Measurement of dry film coating thickness with magnetic gauges.
c)	ASTM D 45	:	Method for pull off strength using portable Adhesion Tester.
d)	NACE RP 0274 – 2004	:	High-Voltage Electrical Inspection of Pipeline Coatings.
e)	NACE SP 0188 – 2006	:	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
f)	NACE RP 0169 – 2002	:	Control of External Corrosion of Underground or Submerged Metallic Piping Systems.
g)	AWWA C 210 – 2007	:	Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
h)	IS 3589:2001 Annexure-B	:	Steel Pipes for Water and Sewage Specification.
i)	AWWA C222-2000	:	Polyurethane Coating for the Interior and Exterior of Steel Water Pipe and Fittings.



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- j) IS 13213 : 2000 : Polyurethane Full Gloss Enamel (Two pack)
- k) ISC HD 20 (11902) : Polyurethane coating for Interior and Exterior of steel pipe and fittings.
- l) ISC HD 20 (11055) : Solvent less Liquid epoxy system by application of Interior and Exterior surface of steel pipeline.

3.00.00 GENERAL REQUIREMENTS

- 3.01.00 The steel surface preparation prior to actual commencement of coating shall conform to SSPC SP 10 / NACE 2 / Sa2½ (near white metal) with sand blasting.
- 3.02.00 The contractor shall submit a detailed written description in the form of a manual covering coating equipment, procedures, materials inspection test, and repair etc. to Owner/Consultant for approval.
- 3.03.00 The contractor shall also provide copies of test reports from NABL approved laboratory (like National Test House, Kolkata) in support of the paint/primer materials to be used shall conform to the specification requirement.
- 3.04.00 The contractor shall also provide certificates from paint/primer manufacturer mentioning the batch numbers, date of manufacture and shelf life etc. of the materials to be used. In addition to that Manufacturing Quality Plan (MQP) and Field Quality Plan (FQP) shall also be submitted prior to commencement of supply of material and field application.
- 3.05.00 Paint/coating application work at site shall be done either by paint manufacturer or by their authorized applicator. The authorized applicator shall have proper training & certification from manufacturer. Applicator shall possess all the necessary specialized equipment and manpower experienced in similar job.
- 3.06.00 Applied coating shall be tested for dry film thickness, holiday (electrical inspection for continuity) and adhesion as per relevant standard such as SSPC PA 2, NACE RP 0274 and ASTM D 4541.
- 3.07.00 If necessary, the material may be heated and applied by airless spray / plural component spray system.
- 3.08.00 Manufacturer's specific recommendation, if any, shall be followed during application of lining / paints.
- 3.09.00 In areas where there is danger of spotting automobiles or other finally finished equipment or building by wind borne particles from paint spraying, a Purchaser approved method shall be adopted.





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- 3.10.00 The colour scheme of the entire Plant, covered under this specification shall be approved by the Purchaser in advance before application.
- 3.11.00 All indoor and outdoor piping, insulated as well as uninsulated will have approved colour bands painted on the pipes at conspicuous places throughout the system, as approved by Purchaser.
- 3.12.00 Inside surfaces of vessels / tanks shall be protected by anticorrosive paints or rubber lining as required / specified elsewhere in the specification. External surfaces of all vessels / tanks shall be protected by anti-corrosive painting.
- 3.13.00 For vessels / tanks requiring lining and epoxy painting all inside surface shall be blast cleaned using non-siliceous abrasive after usual wire brushing.
- 3.14.00 Natural rubber lining shall be provided on the inside of vessels / tanks as required / specified elsewhere in the specification, in three layers resulting in a total thickness not less than 4.5 mm.
- 3.15.00 Surface hardness of rubber lining shall be 65 +/- 5 deg. A (shore).
- 3.16.00 After the lining is completed, the vessels / tanks shall not be subjected to any prolonged exposure to direct sunlight in course of its transportation, erection etc. They shall not be stored in direct sunlight. No further lining or burning shall be carried out on the vessel, after application of the lining.
- 3.17.00 All lining projecting outside of the vessel shall be protected adequately from mechanical damages during shipment, handling storage etc.
- 3.18.00 Suitable warnings, indicating the special care that must be taken with respect to these lined vessels shall be stenciled on their outside surface with the letters at least 12 mm high.
- 3.19.00 All insulated piping shall have aluminium sheet jacketing.
- 4.00.00 **EQUIPMENT, MATERIAL AND SERVICES TO BE FURNISHED BY THE BIDDER**
- 4.01.00 After erection at site, the outside surfaces of all equipment having a shop coat shall be given further priming coat and finished coats of paint as detailed in following clauses. However, if the painting system is such that the shop coat and primer coat to be applied at site are not compatible, then shop coat has to be removed from the surface of equipment before application of primer coat with prior blasting.

All factory finished paints shall be touched up at site as required.

All uninsulated piping shall be finished with final paintings after use of proper wash primer and primer. Aluminium sheet jacketed piping need not be painted. Colour bands of Purchaser's approved shade shall however be





applied on jacketed piping near walls or partitions, at all junctions, near valves and all other places as instructed by the Purchaser. All structures shall be painted with approved paint.

4.02.00 **Surface Preparation**

4.02.01 Unless mentioned otherwise, all rust and mill scale shall be removed by blasting up to SSPC SP10/NACE2/Sa2½ level to get “near white metal” surface before applying the primer.

4.02.02 Special care shall be taken to remove grease and oil by means of suitable solvents like Trichloroethylene or Carbon Tetrachloride.

4.03.00 **Painting**

4.03.01 Specification for application of paints for external surfaces protection of vessels / tanks / equipment / piping / fittings / valves shall be as follows :

- a) Surface preparation shall be done by means of sand blasting, which shall conform to SSPC SP10/NACE 2/Sa2½ Standard.
- b) Primer Coat shall consist of one coat (minimum DFT of 100 microns) of epoxy resin based zinc phosphate primer.
- c) Intermediate Coat (or Under Coat) shall consist of one coat (minimum DFT of 100 microns) epoxy resin based paint pigmented with Titanium Dioxide.
- d) Top Coat shall consist of one coat (minimum DFT of 75 microns) of epoxy paint of approved shade and colour with glossy finish. Additional one coat (minimum DFT of 25 microns) of Finish Coat of polyurethane shall be provided.
- e) Total DFT of paint system shall not be less than 300 microns.

4.03.02 Specification for application of paints for external surfaces protection of steel pipes and fittings which are buried underground / laid inside a Hume Pipe & or submerged Under Water and laid under Pipe Trenches (in road/rail/pipe or trench crossings) shall be as follows :

- a) Surface preparation by means of sand blasting and shall conforms to SSPC SP10/NACE2/ Sa2½.
- b) External surface of the pipe, fittings, specialties etc. handling raw water/ clarified water/filter water shall be painted with one coat of two part chemically cured polyurethane primer of min 50 micron dry film thickness followed by three or maximum four coats of two part solvent less polyurethane to build up coating of dry film thickness of 1500 micron including primer coat.



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4.03.03 Specification for application of paints for internal surface protection of large diameter pipes, if any, shall be as follows :

- a) Surface preparation by means of sand blasting which shall conforms to SSPC SP10/NACE2/Sa2½ standard.
- b) All Internal surfaces of steel pipes, fittings, specialties etc. buried underground or located within pipe trenches shall be given epoxy coating to protect them from (except for drinking water service, where the compatible painting shall be so selected to meet relevant quality standards) corrosion.
- c) Internal surface of the pipe should be coated with one coat of two part epoxy primer with not less than 50 micron DFT (dry film thickness) followed by two part polyamide cured solvent less epoxy.
- d) The minimum dry film thickness (DFT) of internal lining shall be 500 micron.

4.03.04 Specification for application of paints for protection of internal surfaces of DM Water Storage Tank(s) shall be as follows :

- a) Primer - One coat of epoxy primer containing high level of Zinc Phosphate anticorrosive pigment. Total Dry Film Thickness (DFT) of primer shall not be less than 125 microns.
- b) Finish Paint - Three (3) coats Polyamine HB Epoxy Paint. Total Dry Film Thickness (DFT) of finish paint shall not be less than 125 microns per coat.
- c) Total thickness of primer and paint should not be less than 500 microns.

4.03.05 All motors, local push button stations, cable racks, structures used for supports etc. are to be painted with acid proof paint.

4.03.06 The following surfaces shall not be painted - stainless steel, galvanized steel, aluminum, copper, brass, bronze and other nonferrous materials.

4.03.07 No painting or filler shall be applied until all repairs, hydrostatic tests and final shop inspection are completed.

4.03.08 All machined surfaces shall have two (2) coats of water repellant grease after thorough cleaning.

5.00.00 COATING PROCEDURE AND APPLICATION

5.01.00 Surface preparation :

Pipe shall be blast cleaned by sand. The cleanliness achieved prior to application shall be in accordance with the requirement of SSPC SP 10 /





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NACE 2 / Sa2½ of ISO 8501 (near white metal)

- a) The blast pattern or profile depth shall be 40 to 100 micron and shall be measured by dial micrometer.
- b) Before sand blasting is started or during blasting or coating, temperature of the pipe surface should be more than 3°C above dew point temperature. Blast cleaned surface should be primed within 4 hours and shall be protected from rainfall or surface moisture and shall not be allowed to flash rust. If the rust occurs, the surface again to be prepared by sand blasting or wire brushing.

5.02.00 Application of Epoxy Coating

- a) Coating shall be applied when
 - i) When the pipe surface temperature shall be at least 3°C above dew point temperature.
 - ii) The temperature of mixed coating material and the pipe at the time of application shall not be lower than 10°C or greater than 50°C.

- b) Material preparation shall be in accordance with manufacturer's recommendations.

- c) Application of epoxy coating system :

The epoxy coating system shall be applied as per recommendation of the manufacturer and shall be applied by airless spray / plural component spray machine. For more than one coat, the second shall be applied with the time limits as recommended by the manufacturer.

5.03.00 Application of PU Coating

- a) PU coating shall be applied when the pipe surface temperature at least 3°C above dew point temperature (when R.H is more than 85%).
- b) Material preparation and application shall be done as per manufacturer recommendation.

6.00.00 TEST REQUIREMENTS

6.01.00 Measurement of dry film thickness

Measurement of dry film thickness of coating: Coating thickness shall be in the range of ±20% and as per SSPC PA 2.





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6.01.01 Apparatus / Instrument

The instrument used for dry film thickness may be Type 1 pull of gauges or Type 2 electronic gauges.

6.01.02 Procedures

a) Number of measurements

For 100 square feet (9.29 square meters), five (5) spots per test area (each spot is 3.8 cm) in diameter. Three gauge readings per spot (average becomes the spot measurement).

b) If the structure is less than 300 square feet, each 100 square feet should be measured.

c) If the structure is between 300 and 1000 sq ft, select 3 random 100 square feet test areas and measure.

d) For structure exceeding 1000 square feet, select 3 random 100 square feet testing areas for the first 1000 sq ft and select 1 random 100 square feet testing area for each additional 1000 square feet

e) Coating thickness Tolerance: Individual reading taken to get a representative measurement for the spot are unrestricted (usually low or high readings are discarded). Spot measurements (the average of 3 gauge readings) must be within 80% of the minimum thickness and 120% of the maximum thickness.

Area measurement must be within specified range.

6.02.00 Electrical Inspection (Holiday) Test

6.02.01 All the coated / lined pipes shall be tested with an approved high voltage holiday detector preferably equipped with an audio visual signaling device to indicate any faults, holes, breaks or conductive particles in the protective coating.

6.02.02 The applied output voltage of holiday detector shall have a spark discharge of thickness equal to at least twice the thickness of the coating to assure adequate inspection voltage and compensate for any variation in coating thickness. The electrode shall be passed over the coated surface at approximately half the spark discharge distance from the coated surface only one time at the rate of approximately 10 to 20m/min. The edge effect shall be ignored. Excessive voltage shall be avoided as it tends to induce holiday in the coated surface thereby giving erroneous readings.

6.02.03 While selecting test voltages, consideration should be given to the tolerance on coating thickness and voltage should be selected on the basis of maximum coating thickness likely to be encountered during testing of a particular pipe.





The testing voltage shall be calculated by using following formula. (as per NACE 0274 : 2004)

Testing Voltage $V = 7900 \sqrt{T} \pm 10$ percent where T is the average coating thickness in mm.

6.02.04 Any audio visual sound or spark leads to indicate pinhole, break or conductive particle.

6.03.00 **Adhesion Pull off Test**

After holiday the coated surface is subjected to adhesion pull off test as per ASTM D 4541.

6.03.01 Apparatus / Instrument: Adhesion tester consists of three basic components:

A hand wheel, a black column containing a dragging indicator pin and scale in the middle and a base containing three legs and a pulling “Jaw” at the bottom and also dollies.

6.03.02 **Prepare the test surface**

Once test area is selected, test area shall be free of grease, oil, dirt, water. The area should be flat surfaces and large enough to accommodate the specified number of replicate test.

6.03.03 **Prepare Dolly (Test Pull Stub)**

The dolly is a round, two sided aluminium fixture. Both sides of the dolly looks same, however, one side sloped on top surface while flat on bottom surface. As the surface of the dolly is polished aluminium, roughen the same using a coarse sand paper.

6.03.04 **Select an adhesive**

Use araldite, a 100% solid epoxy adhesive. This adhesive requires at least 24 hours at room temperature to cure.

6.03.05 **Attach the dolly to the surface**

- a) Using a wooden stick, apply an even layer of adhesive to the entire contact surface area of the dolly.
- b) Carefully remove the excessive adhesive by using a cotton swab. Allow the adhesive to fully cure before performing the adhesion test.
- c) Attach the dolly to the coated surface and gently push downward to displace any excessive adhesive.
- d) Push the dolly inward against the surface, then apply tape across the head of the dolly.

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6.03.06 **Adhesion Test Procedure**

- a) Attach the adhesion tester to the dolly by rotating the hand wheel counter clockwise to lower the jaw of the device.
- b) Slide the jaw completely under the head of the dolly. Position the three legs of the instruments so that they are sitting flat on the coated surface.
- c) Slide the dragging indicator pin on the black column to zero by pushing it downward.
- d) Firmly hold the base of the instrument in one hand and rotate the hand wheel clockwise to raise the jaw of the device that is attached to the head of the dolly. The dragging indicator pin will move upward on the black column as the force is increased and will hold the reading. Apply the tension using a moderate speed. Continue to increase the tension on the head of the dolly until (a) the minimum PSI/MPa/Kg/cm² required by project specification is exceeded and the test is discontinued, (b) the maximum PSI/MPa/Kg/cm² of adhesion tester has been achieved and dolly is still attached, (c) The force applied by the adhesion tester causes the dolly to dislodge.
- e) Read the scale and record the adhesion value.

6.04.00 **Coating Repair**

Defective Coating shall be repaired in accordance with the following subsections.

6.04.01 **Surface Preparation**

Accessible areas of pipe requiring coating repairs shall be cleaned to remove debris and damaged coating using surface grinders or other means. The adjacent coating shall be feathered by sanding, grinding or other method. Accumulated debris shall be removed by blowing with contaminant free air or wiping with clean rags.

6.04.02 Areas not accessible for coating repair such as interior surfaces of small diameter pipe shall be reprocessed and recoated.

6.04.03 **Coating Application**

The coating system shall be applied to the prepared areas in accordance with procedure.

6.04.04 **Repair Inspection:**

Repaired portion shall be electrically inspected using a holiday detector.



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6.05.00 **Welded Field Joints**

6.05.01 **Preparation**

The weld joints shall be cleaned so as to be free from mud, oil, grease, welding flux, weld spatter and other foreign contaminants. The cleaned metal surfaces of the weld joint shall then be blasted or abraded using rotary abrading pads. The adjacent liquid Epoxy / PU coating shall be feathered by abrading the coating surface for a distance of 25 mm.

6.05.02 **Electrical Inspection**

After curing the coating system applied to the welding joints shall be holiday tested. Any holidays indicated by the detector shall be marked with chalk to identify the area of repair.

7.00.00 **INFORMATION/DATA REQUIRED**

The Bidder shall submit complete list of paints and primers proposed, giving detail information, such as, chemical composition, drying time etc. and also unit rates for application of each type of paint along with supply shall be furnished.

523866/2021/PS-PEM-MSE

	TITLE: TECHNICAL SPECIFICATION COLTCS 1X660 MW SAGARDIGHI, PHASE-III (UNIT-5) SPECIFIC TECHNICAL REQUIREMENTS	SPEC. NO.: PE-TS-445-165-N002
		SECTION: I
		SUB-SECTION: IB
		REV. NO. 00 DATE 23.09.2021
		SHEET 1 OF 1

SUB-SECTION – IB

SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)

523866/2021/PS-PEM-MSE:



**TECHNICAL SPECIFICATION
FOR
COLTCS**

**SAGARDIGHI THERMAL POWER PROJECT
1 x 660 MW UNIT NO. 5, PHASE – III**

SPECIFICATION NO.

VOLUME NO. : **II-B**SECTION: **C**REV NO. : **00** DATE: 09.07.21

SHEET: 1 OF 1

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The requirements mentioned in Section-I shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the descriptive portion in Section-II.



**TECHNICAL SPECIFICATION
FOR
COLTCS
(ELECTRICAL PORTION)**

**SAGARDIGHI THERMAL POWER PROJECT
1 x 660 MW UNIT NO. 5, PHASE – III**

SPECIFICATION NO.

VOLUME NO. : **II-B**

SECTION : **C**

REV NO. : **01** DATE : 09/07/21

SHEET : **1** OF **1**

SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER/ PURCHASER:

- 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 equipments.
- d) Electrical load requirement for Coltcs.
- 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 compliance certificate/No deviation certificate.
- 3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

4.0 LIST OF ENCLOSURES

- a) Electrical scope between BHEL & vendor (Annexure –I)
- b) Electrical Load data format (Annexure –I)
- c) Cable schedule(Annexure –I)
- d) BHEL cable listing format (Annexure –I)
- e) Technical specification for motors(Annexure –II)
- f) Datasheets & quality plan for motors. (Annexure –II)
- g) Technical specification for cabling, grounding and lightning protection(Annexure –II)

REV-0, DATE: 02.12.2020

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)**PACKAGES: COLTCS****SCOPE OF VENDOR: SUPPLY****PROJECT: 1X660 MW SAGARDIGHI**

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC Starter cum control panel (if applicable)	BHEL Vendor	BHEL BHEL	240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	BHEL Vendor BHEL	BHEL BHEL 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. Cabling/ termination by BHEL.
4	Junction box for control & instrumentation cable	Vendor	BHEL	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, fibre optical etc.	Vendor	BHEL	Refer scope/ C&I portion of specification for scope of fibre Optical cables if used between PLC/ micro processor & DCS.
6	Cable trays, accessories & cable trays supporting system	BHEL	BHEL	
7	Cable glands and lugs for equipment supplied by Vendor	Vendor	BHEL	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty copper lugs for power & control cables.
8	Conduit and conduit accessories for cabling between equipment supplied by vendor	Vendor	BHEL	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537.
9	Lighting	BHEL	BHEL	
10	Equipment grounding & lightning protection	BHEL	BHEL	

REV-0, DATE: 02.12.2020

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)**PACKAGES: COLTCS****SCOPE OF VENDOR: SUPPLY****PROJECT: 1X660 MW SAGARDIGHI**

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
11	Below grade grounding	BHEL	BHEL	
12	LT Motors with base plate and foundation hardware	Vendor	BHEL	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	BHEL	
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 in enclosed excel format shall be submitted by vendor during detailed engineering stage.
17	Equipment layout drawings	Vendor	-	For preparation of cabling layout drawings by BHEL, vendor shall furnish Electrical equipment 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,
18	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

1. Make of all electrical equipment/ items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
3. In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.



SECTION - II

SECTION-I

A.C. & D.C. MOTORS

1.00.00 SCOPE

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

2.00.00 STANDARDS

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

3.00.00 SERVICE CONDITIONS

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

4.00.00 TYPE AND RATING

4.01.00 A.C. Motors

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





SECTION-I

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



SECTION-I

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

4.03.00 **D. C. Motors**

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

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

5.00.00 **PERFORMANCE**

5.01.00 **Running Requirements**

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

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

5.02.00 **Starting Requirements**

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

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

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

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

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

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

5.03.00 **Stress During Bus Transfer**

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

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





SECTION-I

5.04.00 Locked Rotor Withstand Time

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

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

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

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

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

5.05.00 Torque Requirements

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

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

6.00.00 SPECIFIC REQUIREMENTS

6.01.00 Enclosure

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

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

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

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

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





SECTION-I

6.02.00 Cooling

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

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

6.03.00 Winding and Insulation

6.03.01 All insulated winding shall be of copper.

6.03.02 HT motors shall have Class F insulation with winding temperature limited to 120°C. Windings shall be impregnated to make them non-hygroscopic and oil resistant. The lightning impulse and coil inter-turn insulation surge withstand level shall be as per IEC-60034 – Part 15.

6.03.03 LT motors shall have Class F or higher insulation with temperature limited to 120°C.

6.04.00 Tropical Protection

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

6.04.02 All fittings and hardware shall be corrosion resistant.

6.05.00 Bearings

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

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

6.06.00 Noise & Vibration

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

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

6.07.00 Motor Terminal Box

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

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

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





SECTION-I

- 6.07.04 The terminal box shall have sufficient space inside for termination /connection of suitable sized HT cables. Where the specified main cable size demands, adopter/extension box of suitable size shall be provided as a part integral to the motor, for easy termination of the cable.
- 6.07.05 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.
- 6.07.06 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.
- 6.07.07 The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.
- 6.07.08 For HT motor, the terminal box shall be phase segregated type. The neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type) with shorting links for star connection.
- 6.07.09 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match Owner's cable. All threads shall be ISO metric thread only.
- 6.07.10 The gland plate for single core cable shall be non-magnetic type.
- 6.08.00 **Grounding**
- 6.08.01 The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.
- 6.08.02 The grounding connection shall be suitable for accommodation of ground conductors as follows:
- | | |
|------------------------------|-------------------|
| Motor above 90 kW | 50 x 6 mm GI Flat |
| Motor above 30 kW upto 90 kW | 35 x 6 mm GI Flat |
| Motor above 5 kW upto 30 kW | 25 x 3 mm GI Flat |
| Motor upto 5 kW | 8 SWG GI Wire |
- The above sizes shall be superseded by different sizes if so indicated in the relevant clause of the General Electrical Specification.
- 6.08.03 The cable terminal box shall have a separate grounding pad.
- 6.09.00 **Rating Plate**
- In addition to the minimum information required by IS, the following information shall be shown on motor rating plate :
- Temperature rise in °C under rated condition and method of measurement.
 - Degree of protection.
 - Bearing identification no. and recommended lubricant.
 - Location of insulated bearings.



SECTION-I

7.00.00 ACCESSORIES**7.01.00 General**

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

7.02.00 Space Heater

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

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

7.03.00 Temperature Detectors

7.03.01 All HT motors shall be provided with minimum four (4) numbers simplex or two (2) numbers duplex platinum resistance type winding temperature detectors per phase.

7.03.02 Each bearing of HT shall be provided with minimum one (1) duplex or two (2) simplex type temperature detectors.

7.03.03 The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0°C.

7.04.00 Indicator/Switch

7.04.01 Dial type local indicator with alarm contacts shall be provided for the following: -

- a) HT motor bearing temperature.
- b) Hot and cold air temperature of the closed air circuit for CACA and CACW motor.

7.04.02 Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used.

7.04.03 Alarm switch contact rating shall be minimum 0.5 A at 220V D.C. and 5A at 240V A.C.

7.05.00 Current Transformer for Differential Protection

7.05.01 Motor above 1000 kW shall be provided with three differential current transformers (PS class) mounted over the neutral leads within the enclosure. Matching three (3) numbers PS class CTs shall be mounted on the switchgear end.

7.05.02 The arrangement shall be such as to permit easy access for C.T. testing and replacement. Current transformer characteristics shall match Owner's requirements to be intimated later.



SECTION-I

7.06.00 Accessory Terminal Box

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

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

7.07.00 Drain Plug

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

7.08.00 Lifting Provisions

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

7.09.00 Dowel Pins

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

7.10.00 Painting

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

8.00.00 TESTS

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

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

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

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

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





SECTION-I

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

9.00.00 SPARE

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

10.00.00 DRAWINGS, DATA & MANUALS

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

10.01.00 Along with the bid

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

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

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





ANNEXURE-A

SECTION-I

DESIGN DATA

1.0 AUXILIARY POWER SUPPLY

Supply	Description	Consumer
H.T. Supply	11 kV, 3 Ø/, 3W, 50 Hz Non-effectively earthed Fault level 40 KA symm. for 3 second.	Motors above 1500 kW
H.T. Supply	3.3 kV, 3 Ø/, 3W, 50 Hz Non-effectively earthed Fault level 40 KA symm. for 3 second.	Motors above 160kW upto 1500 kW.
L.T. Supply	415V, 3 Ø/, 3W, 50 Hz Effectively earthed Fault level 50 KA symm. for 1 seconds.	Motors above 200W upto 160 kW
	240V, 1 Ø/, 2W, 50 Hz Effectively earthed	Motors below 200W Lighting, space heating, A.C. control protective devices
D.C. Supply	220V, 2W, unearthed Fault level 25* KA for 1 second (Min.)	D.C. alarm, control protective devices

* However actual value shall be substantiated by the bidder through calculation.

2.0 RANGE OF VARIATION

A.C. Supply

Voltage	:	±10%
Frequency	:	±5%
Combined Volt & frequency	:	10% (absolute sum)

D.C. Supply

Voltage	:	190 to 240 Volt

3.0 Paint Shade	:	RAL 7032



523866/2021/PS-PEM-MSE



LV MOTORS DATA SHEET-A

**SAGARDIGHI THERMAL POWER PROJECT
1 x 660 MW UNIT NO. 5, PHASE – III**

SPECIFICATION NO.

SECTION-I

VOLUME II B

SECTION D

REV NO. 00 DATE 09.07.21

SHEET 1 OF 1

1.0	Design ambient temperature	:	50 °C
2.0	Maximum acceptable kW rating of LV motor	:	Upto & Including 160KW
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Details of supply system		
a)	Rated voltage (with variation)	:	415V $\pm$ 10%
b)	Rated frequency (with variation)	:	50 Hz (Variation: +5% TO –5%)
c)	Combined voltage & freq. variation	:	10% (sum of absolute values)
d)	System fault level at rated voltage	:	50 kA for 1 sec
e)	Short time rating for terminal boxes		
	*Above 90 kW upto & including 160kW(Breaker Controlled)	:	50 KA for 0.25 sec.
	* Rated upto & including 90 kW (Contactor Controlled)	:	50 KA protected by MCCB
f)	LV System grounding	:	Solidly
5.0	Class of insulation	:	Class 'F', with temp rise limited to class B.
6.0	Minimum voltage for starting	:	80% of rated voltage
7.0	Power cables data	:	Shall be given during Detailed engg.
8.0	Earth Conductor Size & Material	:	Shall be given during Detailed engg.
9.0	Space heater supply (30KW & ABOVE)	:	240 V, 1 Φ , 50 Hz
10.0	Rating up to which Single phase motor	:	Acceptable below 0.20 Kw
11.0	Locked rotor current		
a)	Limit as percentage of FLC	:	As per IS 12615
12.0	Makes	:	BHEL/ Customer approval (Package owner to take care)
13.0	Paint shade	:	RAL 7032
15.0	Additional tests	:	As per QP
14.0	Degree Of protection for motor/ terminal box	:	IP 55

* LT motors of continuous duty shall be energy efficient IE3 class conforming to IS-12615

15.0 TESTING REQUIREMENTS: IN LINE WITH SPECIFICATION

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

SECTION-I**ANNEXURE-I****SUB-VENDOR LIST**

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

S.No.	LIST OF LT MOTORS
1.	BHARAT BIJLEE LTD.
2.	CROMPTON GREAVES
3.	ASEA BROWN BOVERI
4.	KIRLOSKAR ELECTRIC CO LTD.
5.	NGEF
6.	SIEMENS
7.	MARATHON
8.	GE-POWER
9.	RAJINDRA ELECT INDUSTRIES
10.	LAXMI HYDRAULICS PVT. LTD

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

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	TITLE: TECHNICAL SPECIFICATION COLTCS 1X660 MW SAGARDIGHI, PHASE-III (UNIT-5) SPECIFIC TECHNICAL REQUIREMENTS	SPEC. NO.: PE-TS-445-165-N002	
		SECTION: I	
		SUB-SECTION: IC	
		REV. NO. 00	DATE 23.09.2021
		SHEET 1	OF 1

SUB-SECTION – IC

SPECIFIC TECHNICAL REQUIREMENTS (C &I)


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

 SECTION: C
 SUB SECTION : C&I

**C&I SPECIFICATION FOR
COLTCS, SCS & DF**

INDEX

S. No.	DESCRIPTION
1	TITLE SHEET
2	INDEX SHEET
3	C&I SPECIFIC TECHNICAL REQUIREMENTS
4	LIST OF DOCUMENTS/DELIVERABLES
5	MOTORISED VALVE ACTUATORS
6	SPECIFICATION FOR FIELD INSTRUMENTS & CONTROL PANEL
7	SIGNAL EXCHANGE BETWEEN DRIVES & DCS
8	INSTRUMENT CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY
9	ERECTION HARDWARE
10	QUALITY ASSURANCE
11	TYPE TEST REQUIREMENT
12	APPLICABLE CODES AND STANDARDS
13	INSTRUMENT INSTALLATION DRAWING
14	MANDATORY SPARE LIST
15	SUB VENDOR LIST

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	1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	SECTION: C SUB SECTION : C&I
	C&I SPECIFICATION FOR COLTCS, SCS & DF	
C&I SPECIFIC TECHNICAL REQUIREMENT		

523866/2021/PS-PEM-MSE 1x660 MWSagardighi Thermal Power Extn. Project (JOB NO. 445)
COLTCS

1.00	SYSTEM	COLTCS
2.00	COMMON / PER UNIT	ONE UNIT
3.00	CONTROL SYSTEM	DCS (STN C&I)
3.10	PROCESSOR CONFIGURATION FOR PLC SYSTEM	NA
4.00	LOCATION OF CONTROL SYSTEM	CCR
4.10	CONTROL SYSTEM SCOPE (BIDDER/ BHEL/ CUSTOMER)	BHEL
5.00	HARDWIRED INTERFACE WITH DCS (Y/N)	NA
6.00	SOFTLINK TO DCS (Y/N)	NA
7.00	PROTECTION CLASS FOR PLC / RIO PANEL	NA
8.00	CONTROL FROM PB's ON LCP/OWS ON LCP	CONTROL FROM PB's ON LCP
9.00	ANNUNCIATION ON LCP (Y/N) -- IF Y, MIN NO. OF HARDWIRED ALARMS / INDICATIONS	Y, REFER NOTE 6
9.10	MIMIC ON LCP (Y/N)	NA
10.00	CONTROL FROM DCS IN CCR (Y/N)	Y
11.00	TYPE OF SOFTLINK (TP/OFC)	NA
12.00	RIO / RPU (Y/N)	NA
13.00	## NO. OF OWS / LAPTOP	NA
14.00	NO. OF PRINTER	NA
15.00	\$\$ POWER SUPPLY AVAILABLE FOR BALL MONITOR (24V DC / 110 V AC UPS / 230 V AC UPS)	240 V AC UPS
15.10	&& POWER SUPPLY AVAILABLE FOR PLC PANEL (3PHASE, 415 V AC/ 1PHASE, 110 V UPS/ 1PHASE, 230 V UPS)	NA
15.20	REDUNDANT FEEDERS (R) / NON-REDUNDANT (NR) FEEDERS FOR POWER SUPPLY	R
15.30	UPS BATTERY CONFIGURATION (1X100% / 2X100%)	NA
15.40	BATTERY TYPE (LEAD ACID/ Ni-Cd)	NA
15.50	BATTERY BACK-UP TIME (in minutes)	NA
16.00	ACTUATOR WITH INTEGRAL STARTER (Y/N)	Y
17.00	PG/ DPG/ PS/ DPS/ PT/ DPT per Balls Collecting Strainer	DPT=2 no. DPG = 1 no (ACROSS EACH BALL SEPARATOR)
18.00	REMARKS	
19.00	PROJECT SPECIFIC INFO	

NOTES:

- 1.00 OPERATION THROUGH HARDWIRED PUSH BUTTON MOUNTED ON LOCAL CONTROL PANEL SHALL BE PROVIDED.
- 2.00 BIDDER TO TERMINATE ALL INSTRUMENTATION AND CONTROL ELEMENTS IN JUNCTION BOXES FOR FURTHER CABLING TO DCS BY BHEL/CUSTOMER. BIDDER TO PROVIDE INPUT/OUTPUT LIST, DRIVES LIST, JUNCTION BOX SCHEDULE AND TERMINATION DETAILS, RECOMMENDED CONTROL LOGICS / WRITE-UP ETC. DURING DETAILED ENGINEERING
- 3.00 ALL THE INSTRUMENTS ALONG WITH NECESSARY FITTINGS, ACCESSORIES AND VALVE MANIFOLD ETC., INSTRUMENT RACK & JUNCTION BOXES, ERECTION HARDWARE SHALL BE IN BIDDER SCOPE OF SUPPLY.
- 4.00 INSTRUMENT RACK AND JUNCTION BOXES SHALL BE IN BIDDER'S SCOPE OF SUPPLY.
- 5.00 BIDDER TO FURNISH ELECTRICAL LOAD DATA DURING DETAILED ENGINEERING.
- 6.00 ALARM FACIA SHALL BE UNDER BIDDER'S SCOPE. NO. OF FACIA SHALL BE DECIDED DURING DETAILED ENGINEERING.
- 7.00 THE SCOPE OF CABLE SHALL BE REFERRED IN ELECTRICAL SCOPE SPLIT SHEET IN ELECTRICAL PORTION OF THE SPECIFICATION.
- 8.00 THE NUMBER OF INSTRUMENTS SHALL BE AS PER TENDER/ APPROVED PIDS. HOWEVER BIDDER TO PROVIDE ANY OTHER INSTRUMENT FOR COMPLETENESS OF THE SYSTEM.

	1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	SECTION: C SUB SECTION : C&I
	C&I SPECIFICATION FOR COLTCS, SCS & DF	
Specific Technical Requirements (C&I): - COLTCS, SCS and Debris Filter shall be controlled from DCS through operator work stations located in central control room (in BHEL Scope). The operation and control philosophy of COLTCS, SCS and DF shall be as per design memorandum given elsewhere in the specification. Bidder to provide Local Control cum starter Panel for COLTCS, SCS and DF. - Push buttons and indication lamps for Open/Close and Start/Stop of drives/equipment's shall be provided on the starter panel. Remote and local indication, indicating lamps / LED cluster for instruments/drives/equipment's status and critical alarms shall be provided on the starter panel. Nos. shall be decided during detailed engineering. - The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial and delivery implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements (to be decided by BHEL) among them are to be complied with. - These requirements are to be read in conjunction with detailed Technical specification enclosed in the specification. In case of any conflict and repetition of clauses in the specification, the more stringent requirement as per interpretation of Customer shall prevail without any commercial implication. No deviations shall be acceptable. - All local gauges as well as transmitters and sensors for parameters like pressure, temperature, 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, instrument racks and all the other accessories required for mounting / erection of these local instruments, transmitters and sensors shall be supplied by bidder even if not specifically asked for. Also the proposal shall include the necessary cables, flexible conduits, instrument racks, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg / Cm². The contacts of equipment mounted instruments; sensors, switches etc. for external connection including spare contacts shall be wired out to suitably located junction boxes. - Electrical Actuators with integral starter shall be provided for all on/off and inching type valves along with necessary interface units for linking to corresponding Control System as applicable, typical Hook-up diagram of drives is included for reference. Non-contact type electronic 2-wire position transmitters shall be provided for all inching type motorised valves. The detailed specification is attached elsewhere in the specification. - The solenoid valves shall have limit switches for open/close feedback. - Interface of MCC, HT SWGR, Actuators, solenoid drives, control valves etc. with DCS based control system shall be as per Drive Control Philosophy attached in the specification.		

	1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	SECTION: C SUB SECTION : C&I
	C&I SPECIFICATION FOR COLTCS, SCS & DF	
9) All the instruments/drives shall be terminated on JB's/Panels in field. JB's/Panels shall be in Bidder's scope. Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 12-15 mtrs) and trunk cable. 10) All local gauges, transmitters and switches shall be mounted on suitable enclosures, racks subject to owner's approval. All transmitters shall be HART compatible. 11) Bidder to terminate all instrumentation and control elements in junction boxes. Bidder to provide input/output list, drives list, junction box schedule and termination details, recommended control logics / write-up etc. the list of documents to be submitted after award of contract is to be referred by bidder. 12) All field instruments enclosure shall be IP65. Local panel/cabinet enclosure shall be IP 55, unless otherwise specified. Electronics located outside control room shall be tropicalized and enclosed in dust & weatherproof cabinets (IP-65/67) suitable for the environment. 13) Components of instruments, control devices, accessories, piping etc. which contact steam, condensate or boiler feed water shall be manufactured from copper-free materials. 14) 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. 15) Double root valve shall be provided for all pressure tapings where the line pressure is 40kg/cm² and above. Single root valve for below 40Kg /sq. cm. 16) Bidder to comply with codes and standards as mentioned in the specification. 17) Instrument installation shall be as per the attached "Standard Hook-up diagram of instrument." However, any instrument/ analyser installation not covered in the same shall be subject to Customer and BHEL approval during detailed engineering. 18) Bidder shall provide erection hardware as per installation drawings. 19) Bidder to provide mandatory spares as per mandatory spares list attached elsewhere in the specification. 20) Bidder to perform tests of C&I items/instruments/systems as per Quality plans/type test attached in the specification. However, if any test not specified in the quality plan but specified in specification Tests for I&C equipment included elsewhere in specification will have to perform by Bidder without any cost implication. The make/model of various instruments/items/systems shall be as per Customer/BHEL approved vendor list. No commercial and delivery implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.		

	1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	SECTION: C SUB SECTION : C&I
	C&I SPECIFICATION FOR COLTCS, SCS & DF	
21) Bidder must offer general tools and tackles and special calibration instruments required during start-up, trial run, operation and maintenance of the system. 22) Power Supply Requirement: 415 V, 3 phase AC power supply shall be provided by Customer for the local control panel. Further any electrical distribution shall be in bidder's scope. Any other voltage requirement to be arranged/derived by bidder by providing suitable control transformer. 23) Bidder to furnish electrical load/UPS load data during detailed engineering. 24) Scope of Instrumentation cables (Screened Control Cables), Fibre Optic cable & Control cables shall be as per Electrical Cable scope matrix in Electrical portion of specification. Any cable in Bidder's scope shall be as per specification. 25) Number of pairs to be selected for Screen /Control cable (Size : 0.5 mm²) a) F-Type: 2P/4P/8P/12P b) G-Type: 2P/4P/8P/12P 26) Number of cores to be selected for Control cable (Size: 2.5 mm²): a) 3 Core b) 5 Core c) 12 Core 27) Any part/module of the C&I system which are not listed under recommended spares shall be deemed as having life expectancy not less than the expected life of the plant i.e. 30 years. 28) Instrument ranges shall be selected to have the normal reading, preferably between 50% and 70% of full scale for linear parameters and 70% to 80% for flow measurements. Deviation indicators shall have the null position at mid-scale. The normal operating parameter shall be identified with a clear green mark. 29) The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by bidder without any technical, commercial and delivery implication to BHEL. 30) The bidders shall specifically mention any deviation they would like to take on the C&I specification. In absence of only deviation, a No deviation certificate is to be furnished. 31) In addition to requirements specified here, all C&I systems/ sub-systems/ equipment/ devices shall also meet other requirements stipulated under other Sub-sections/ parts/ sections of specification. 32) In case of any conflict and repetition of clauses in the specification, BHEL discretion will prevail. 33) All the outdoor field instruments such as analysers/transmitters/meters etc. shall be provided with suitable Free standing cabinet(s)/panel/rack so that the equipments are protected against rain/ sunlight etc. Site fabricated racks are not accepted 34) Control & Instrumentation equipment shall be guaranteed against manufacturing defect for at least two (2) years from the date of handing over to Owner.		



- h) The scope of Instrumentation & Control shall include but not be limited to the following :
- i) Required number of local control panel for tube cleaning systems (two condensers) with installed local instrumentation, controls, alarms, completely wired. The control panel shall be provided with segregated power compartment. This local control panel shall be supplied with anti vibrations supports.
 - ii) Required number of local control panels for debris filtration units (two condensers) with installed local instrumentation, controls, and alarms, completely wired. The control panel shall be provided with segregated power compartment. This local control panel shall be supplied with anti vibrations supports.
 - iii) All field and local control board mounted instruments along with accessories; their supports and all logic necessary to satisfy the requirements described in this specification.
 - iv) All necessary Pressure Gauges, Differential Pressure Gauges, D.P. Transmitters, Ball Monitoring Units required for the functional completeness of the above systems/equipments.
 - v) Instrumentation and control cables along with accessories as necessary.



4.04.00

Instrumentation and Control

Operation of the condenser on line tube cleaning system and debris filters with necessary audio / visual alarm / indications will be initiated locally by the Proprietary Local Control Panel. The system shall be controlled from the local control panel, either in 'Auto' or 'Manual mode, by means of a selector switch. Following are the major control logics to be provided for operation of the automatic tube cleaning system. However, the bidder shall offer additional control features also, if necessary, for smooth and trouble-free operation of the system.

- a) Start-up of the cleaning system after manually feeding the requisite number of balls into the collector:

The above operation & control will be achieved through steps like setting the selector switch on local control panel to "Auto" mode and pressing the push button to "system ON". Other steps will follow sequentially viz. tilting of the screens in the strainer section to "ball circulating position", starting of recirculation pump, turning the ball catching flap in the collector to "ball circulation" position, etc. In case of manual mode, all steps will be achieved manually by operating the corresponding push buttons.

- b) Automatic shut-down of the cleaning system either periodically or as per operator's requirement by pressing the push button from the local control panel.

Under "Auto" mode, pushing of "System OFF" push button shall initiate the above operation, through steps like turning the ball catching flap in the collector to "ball catching" position, stopping the recirculation pump after a set period.





- c) Monitoring of strainer section screen fouling by differential pressure measuring system.
- d) Indicators & Alarms

The following indications as a minimum shall be provided :

- i) Tube cleaning system ON-OFF.
- ii) Pump ON-OFF.
- iii) "Screen Operation".
- iv) DP High-Normal.
- v) DP indication.
- vi) MOV "Open"-"Close".
- vii) Various failure positions.

The following alarms as a minimum shall be provided :

- i) Pump tripped.
- ii) DP - high and very high.
- iii) M.O.V failure to open or close.
- iv) Screen Actuator failure.

There shall also be provision for remote control & monitoring facilities from Unit DCS. Suitable interfaces shall be provided between local control panels and DCS.

The above list of logics is not exhaustive and the supplier shall provide all other control logics required for the safe and trouble-free operation of the system. Necessary interlocks, (e.g. recirculation pump will not run if the strainer section is in 'screen wash' position) for proper operation of the system shall also be provided. The supplier shall furnish the write-up and logic diagrams for interlock and protection.

5.00.00 OPERATING CONDITIONS / REQUIREMENTS

5.01.00 Operational Features.

The tube cleaning system shall be semi automatic and shall be operated from local control panels, with display of selected parameters and alarms in DDCMIS.





WBPDCCL

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

5.02.00 **Ball Separator Strainer Section and Differential Pressure Measuring System.**

During the normal cleaning mode the screens shall allow the circulating water leaving the condenser to pass through with very little pressure drop across the screens. However, the cleaning balls coming out of the condenser tubes will be prevented from escaping. These balls will get collected over the separator screens and are extracted from the strainer section and pumped back to the system for re-cycling.

Whenever the pressure drop across the strainer, as sensed by the differential pressure measuring system, exceeds a pre-set limit, there will be annunciation in the local panel.

5.03.00 **Recirculation Pump and Injection Nozzles**

The recirculation pump will extract the balls from the ball separator strainer section and push them through the ball collector to the ball injection nozzles. The ball injection nozzles shall point against the direction of the C.W. flow for better ball distribution.



	1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	SECTION: C SUB SECTION : C&I
	C&I SPECIFICATION FOR COLTCS, SCS & DF	
C&I DELIVERABLES LIST		


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

 SECTION: C
 SUB SECTION : C&I

**C&I SPECIFICATION FOR
COLTCS, SCS & DF**
C&I DELIVERABLES LIST

<u>C&I DELIVERABLES LIST FOR COLTCS</u>		
SI.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE
INSTRUMENTATION		
1	PE-V9-423-165-I901A	INSTRUMENT DATA SHEETS
2	PE-V9-423-165-I902A	BOQ
3	PE-V9-423-165-I903A	INSTRUMENT QP / CHECK LIST
RELAY BASED LCP		
1	PE-V9-423-165-I950A	LOCAL CONTROL PANEL DATA SHEET
2	PE-V9-423-165-I951A	WIRING DIAGRAM
3	PE-V9-423-165-I952A	PANEL EXTERNAL GA DRAWING (INCLUDING FOUNDATION DETAILS & FLOOR CUT-OUT)
4	PE-V9-423-165-I953A	PANEL INTERNAL GA DRAWING
5	PE-V9-423-165-I954A	PANEL FRONT VIEW DRAWING
7	PE-V9-423-165-I956A	BILL OF MATERIAL
8	PE-V9-423-165-I957A	LOCAL CONTROL PANEL QUALITY PLAN
9	PE-V9-423-165-I958A	RELAY BASED PANEL O & M MANUAL

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	1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	SECTION: C SUB SECTION : C&I
	C&I SPECIFICATION FOR COLTCS, SCS & DF	
SPECIFICATION FOR MOTORISED VALVE ACTUATOR		

523866/2021/PS-PFM-MSE

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		DOCUMENT NO.: PE-ID-445-145-I902		
			VOLUME	II B	
			SECTION	D	
			REV. NO.	01	DATE:27/03/2020
			SHEET	1	OF 5
Data Sheet A & B					
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)		
GENERAL *	* PROJECT	1 X 660 MW SAGARDIGHI STPP			
	OFFER REFERENCE				
	* TAG NO. SERVICE				
	* DUTY	☐ ON / OFF ☐ INCHING			
	* LINE SIZE (inlet/outlet): MATERIAL				
	* VALVE TYPE	☐ GLOBE ☐ GATE ☐ REG. GLOBE ☐ BUTTERFLY			
	* OPENING / CLOSING TIME				
	* WORKING PRESSURE				
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF -20 to 70 DEG C AND RELATIVE HUMIDITY OF 0-95% IN HOT HUMID AND TROPICAL ATMOSPHERE AND HIGHLY POLLUTED AT PLACES OF COAL DUST AND FLY DUST			
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY			
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY			
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY			
	CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF, DUST TIGHT SUITABLE FOR OUTDOOR USE WITHOUT CANOPY, NEMA6/IP:68		
MECHANICAL POSITION INDICATOR		TO BE PROVIDED FOR 0-100% TRAVEL			
BEARINGS		DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.			
GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION		METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.			
SIZING		OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. FOR INCHING SERVICE - 150 STARTS/HR MINIMUM & FOR REGULATING SERVICE - 600 STARTS/HR MINIMUM as per IEC60034-1			
HANDWHEEL as per standard EN 12570:2000	* REQUIRED	☒ YES ☐ NO			
	* ORIENTATION	☐ TOP MOUNTED ☐ SIDE MOUNTED			
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.				
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY			
	MOTOR MAKE / MODEL / TYPE / RATING (KW) (REFER NOTE NO. 6 & 7)	BIDDER TO SPECIFY			
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT-INCLUSIVE OF I.S. TOLERANCE			
	ACTUATOR APPLICABLE WIRING DIAGRAM	☒ ENCLOSED (BIDDER TO CONFIRM) A: ☒ DRG. NO. 3-V-MISC-24227 R00 B: ☐ DRG. NO. 3-V-MISC-24550 R00 C: ☐ DRG. NO. 3-V-MISC-24283 R00 D: ☐ DRG. NO. 4-V-MISC-90271 R11 E: ☐ For Thyristor based Integral starter, Bidder/Vendor to furnish wiring diagram			
	COLOUR SHADE	☐ BLUE (RAL 5012) ☐ ☒ TO BE DECIDED DURING DETAILED ENGINEERING			
	PAINT TYPE	☐ ENAMEL ☒ EPOXY CONFIRMING TO CORROSION CATEGORY C5-I			
	SHAFT RPM	BIDDER TO SPECIFY			
	OLR SET VALUE	BIDDER TO SPECIFY			

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		DOCUMENT NO.: PE-ID-445-145-I902		
			VOLUME	II B	
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			REV. NO.	01	DATE:27/03/2020
			SHEET	2	OF 5
Data Sheet A & B					
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)		
INTEGRAL STARTER	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY			
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY			
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC			
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ☐ 230 V ☐ 110 V			
	@ ENCLOSURE CLASS OF MOTOR	☐ IP 67 ☒ IP 68 ☐ FLAME PROOF			
	@MOTOR BEARING WITH 2 EARTH TERMINALS	DOUBLE SHIELDED; GREASE LUBRICATED ANTI FRICTION			
	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B			
	@ WINDING TEMP PROTECTION	☒ THERMOSTAT (3 Nos., 1 IN EACH PHASE)			
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED (THERMISTOR PTC)			
	INTEGRAL STARTER	☒ REQUIRED ☐ NOT REQUIRED			
	TYPE OF SWITCHING DEVICE	☒ CONTACTORS ☐ THYRISTORS			
	TYPE	☒ CONVENTIONAL ☐ SMART (NON-INTRUSIVE)			
	IF SMART (REFER BELOW POINT a – h)				
	a) SERIAL LINK INTERFACE	☐ INTEGRAL ☐ FIELD MOUNTED			
	b) SERIAL LINK PROTOCOL	☐ FOUNDATION FIELD-BUS ☐ PROFI-BUS ☐ DEVICE NET ☐			
	c) SERIAL LINK MEDIA	☐ TWISTED PAIR Cu-CBL ☐ CO-AXIAL Cu-CBL ☐ OFC			
	d) HAND HELD PROGRAMMER	☐ REQUIRED ☐ NOT REQUIRED			
	e) TYPE OF HAND HELD PROGRAMMER	☐ BLUETOOTH ☐ INFRARED ☐			
	f) MASTER STATION	☐ REQUIRED ☐ NOT REQUIRED			
	g) MASTER STN INTRFACE WITH DCS	☐ MODBUS ☐ TCP/IP			
h) DETAILS OF SPECIAL CABLE	☐ ENCLOSED ☐ NOT REQUIRED				
STEP DOWN CONT. TRANSFORMER	☒ REQUIRED				
OPEN / CLOSE PB	☒ REQUIRED ☐ NOT REQUIRED				
STOP PB	☒ REQUIRED ☐ NOT REQUIRED				
INDICATING LAMPS	☒ REQUIRED ☐ NOT REQUIRED				
LOCAL REMOTE S/S	☒ REQUIRED ☐ NOT REQUIRED				
STATUS CONTACTS FOR MONITORING	☒ REQUIRED ☐ NOT REQUIRED				
INTEGRAL STARTER DISTURBED SIGNAL(Refer Note 14)	REQUIRED MOTOR THERMOSTTTRIP O/L RELAY OPTD, CONT./POWER SUPPLY FAILED, S/S IN LOCAL/REMOTE/OFF MODE, TORQUE SWITCH OPEN/CLOSE CUT OFF/STOP PB OPTD, VALVE JAMMED ETC)				
ACTION ON LOSS OF EXTERNAL ELECTRIC POWER	☒ STAYPUT ☒ FAIL SAFE TO BE DECIDED DURING DETAILED ENGINEERING				
INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter) DATASHEET & WIRING DIAGRAM OF ISOLATION DEVICE TO BE PROVIDED	TYPE OF ISOLATING DEVICE	☒ INTERPOSING RELAY ☐ OPTO COUPLER TO BE DECIDED DURING DETAILED ENGINEERING			
	QUANTITY	☐ 2 NOs. ☒ 3 NOs.			
	DRIVING VOLTAGE	☒ 20.5 – 24V DC ☐ _____ V DC			
	DRIVING CURRENT	☒ 125mA MAX ☐ _____ mA MAX			
	LOAD RESISTANCE	☒ > 192 ohms - <25 k ohms ☐ > _____ ohms - < _____ ohms			

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	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		DOCUMENT NO.: PE-ID-445-145-I902	
			VOLUME II B	
			SECTION D	
			REV. NO. 01	DATE:27/03/2020
			SHEET 3	OF 5
Data Sheet A & B				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
TORQUE SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY		
	OPEN / CLOSE	☐ 1 No. ☐ 2Nos. / ☐ 1 No. ☐ 2Nos		
	CONTACT TYPE	2 NO + 2 NC		
	RATING	5A 240V AC AND 0.5A 220V DC		
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE		
	ACCURACY	+3% OF SET VALUE		
LIMIT SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY		
	OPEN : INT : CLOSE	☐ 1 No. ☐ 2 Nos.	2 Nos. (ADJ.)	☐ 1 No. ☐ 2Nos.
	CONTACT TYPE	2 NO + 2 NC		
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC		
	ACCURACY	2% OF SET VALUE		
POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty & other specific applications**)	☐ REQUIRED ☐ NOT REQUIRED		
	MFR & MODEL NO.	BIDDER TO SPECIFY		
	TYPE	☐ ELECTRONIC (2 WIRE) R/I CONVERTER ☐ ELECTRONIC (2 WIRE) CONTACTLESS		
	SUPPLY	☐ 24V DC ☐		
	OUTPUT	☐ 4-20mA		
	ACCURACY	$\pm 1\%$ FS		
SPACE HEATER	@SPACE HEATER	REQUIRED		
	@ POWER SUPPLY (NON INTEGRAL)	230V AC,1 PH.,50 Hz		
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY		
	@ RATING			
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED		
	ENCL CLASS ACTUATOR/MOTOR T.B.	@ ☐ IP 68 @ ☐		
	@ EARTHING TERMINAL	REQUIRED		
	PLUG & SOCKET	☐ REQUIRED ☐ NOT REQUIRED		
	NO. OF PINS REQUIRED(TO BE CHECKED AS PER SIGNALS IN DRIVE CONTROL PHILOSOPHY)			
	NOS. OF PLUG & SOCKET	☐ 1 Nos. for ON/OFF ☐ 2 NOS. (for inching duty) ☐ OTHER (TO BE SPECIFIED INLINE WITH DRIVE CONTROL PHILOSOPHY)		
CABLE GLANDS	@ POWER CABLE GLAND	SIZE:-----		
	@ SPACE HEATER CABLE GLAND	SIZE:-----		
	CONTROL CABLE GLANDS-1	CABLE GLAND SUITABLE FOR INSTRUMENTATION CABLE SIZE OF 4P X 1.5 SQMM		
	CONTROL CABLE GLANDS-2	CABLE GLAND SUITABLE FOR INSTRUMENTATION CABLE SIZE OF 8P X 0.5 SQMM		
	CONTROL CABLE GLANDS-3 (Additional for inching duty)	CABLE GLAND SUITABLE FOR INSTRUMENTATION CABLE SIZE OF 2P X 0.5 SQMM		
WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY _____ Kg.		

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Data Sheet A & B				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	

NOTES:

- SCOPE:** DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.
- CODES & STANDARDS:** DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATIONAL STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH: IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691, IS-4722, IEC 60947-5-1 AND EN 15714-3 .2010 OR LATEST VERSION.
- TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
- CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED.
- THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION.THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE.
- THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.
- THE MOTOR SHALL BE CAPABLE OF STARTING AT 85 PERCENT OF RATED VOLTAGE RUNNING AT 80 PERCENT OF RATED VOLTAGE AT RATED TORQUE AND 85 PERCENT RATED VOLTAGE AT 33 PERCENT EXCESS RATED TORQUE FOR A PERIOD OF 5 MINUTES EACH.
- IN ADDITION TO ABOVE REQUIREMENTS FOR LIMIT/TORQUE SWITCH, **MECHANICAL END STOP** WITH ACCURACY OF 2% SHALL BE SUPPLIED.
- IT SHOULD BE POSSIBLE TO OPERATE THE ACTUATOR LOCALLY. LOCKABLE LOCAL/REMOTE SELECTION SHALL BE PROVIDED ON THE ACTUATOR.
- LOCAL POSITION INDICATOR SHALL BE PROVIDED FOR 0 TO 100 % TRAVEL.
- CONTROL WIRING SHALL BE SUITABLE VOLTAGE GRADE COPPER WIRE 1.5 SQ. MM.
- ENDURANCE: RATED TORQUE RANGE SHOULD BE BASED ON ISO 5211, ISO5210.
- TAG PLATE SHALL BE CONFIRMING TO STANDARD BS-15714.
- THE ACTUATORS SHALL BE DESIGNED TO BE SELF-LOCKING UPON LOSS OF POWER. MOTOR SHALL BE DESIGNED TO CLOSE IN 30 SECS. FROM FULL OPEN POSITION AND SHALL HAVE ADEQUATE CAPACITY TO OPEN AND CLOSE UNDER FULL UNBALANCED DESIGN PRESSURE.
- AUTOMATIC PHASE CORRECTION FACILITY AND POTENTIAL FREE CONTACT FOR ANNUNCIATION OF POWER FAILURE SHALL BE PROVIDED.
- LIMIT SWITCHES SHALL BE SILVER PLATED WITH HIGH CONDUCTIVITY AND NON-CORROSIVE TYPE. CONTACT RATING SHALL BE SUFFICIENT TO MEET THE REQUIREMENT OF CONTROL SYSTEM SUBJECT TO A MINIMUM OF 60 V, 6 VA RATING. PROTECTION CLASS SHALL BE IP67.
- THE TERMINAL BOX SHALL BE WEATHER PROOF WITH REMOVABLE FRONT COVER & CABLE GLANDS FOR CABLE CONNECTION.IT SHALL BE SUITABLE FOR 2.5 SQ MM COPPER CONDUCTOR.
- ACTUATOR SHALL ATTAIN FULL SPEED OPERATIONS BEFORE VALVE LOAD IS ENCOUNTERED AND IMPART AN UNSEATING BLOW TO START THE VALVE IN MOTION (HAMMER BLOW EFFECT).
- ** VALVES WITH 10 DEGREE/20DEGREE FEEDBACK REQUIREMENT FOR APPLICATIONS SUCH AS CW/ACW/PLANT WATER SYSTEM SHALL BE CONSIDERED AS INCHING DUTY VALVES. ACCORDINGLY, POSITION FEED BACK TRANSMITTER, PLUG & SOCKET REQUIREMENT SHALL BE CONSIDERED.**

\$\$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE.

	PREPARED BY	CHECKED BY	APPROVED BY	VENDOR COMPANY SEAL
NAME	ANJALI RAMAN	VIPUL KUMAR VERMA	SURESH CHAND SHARMA	NAME
SIGNATURE				SIGNATURE
DATE	27.03.2020	27.03.2020	27.03.2020	DATE

NOTES* = TO BE FILLED BY MPL (LEAD AGENCY), @ BE FILLED BY ES

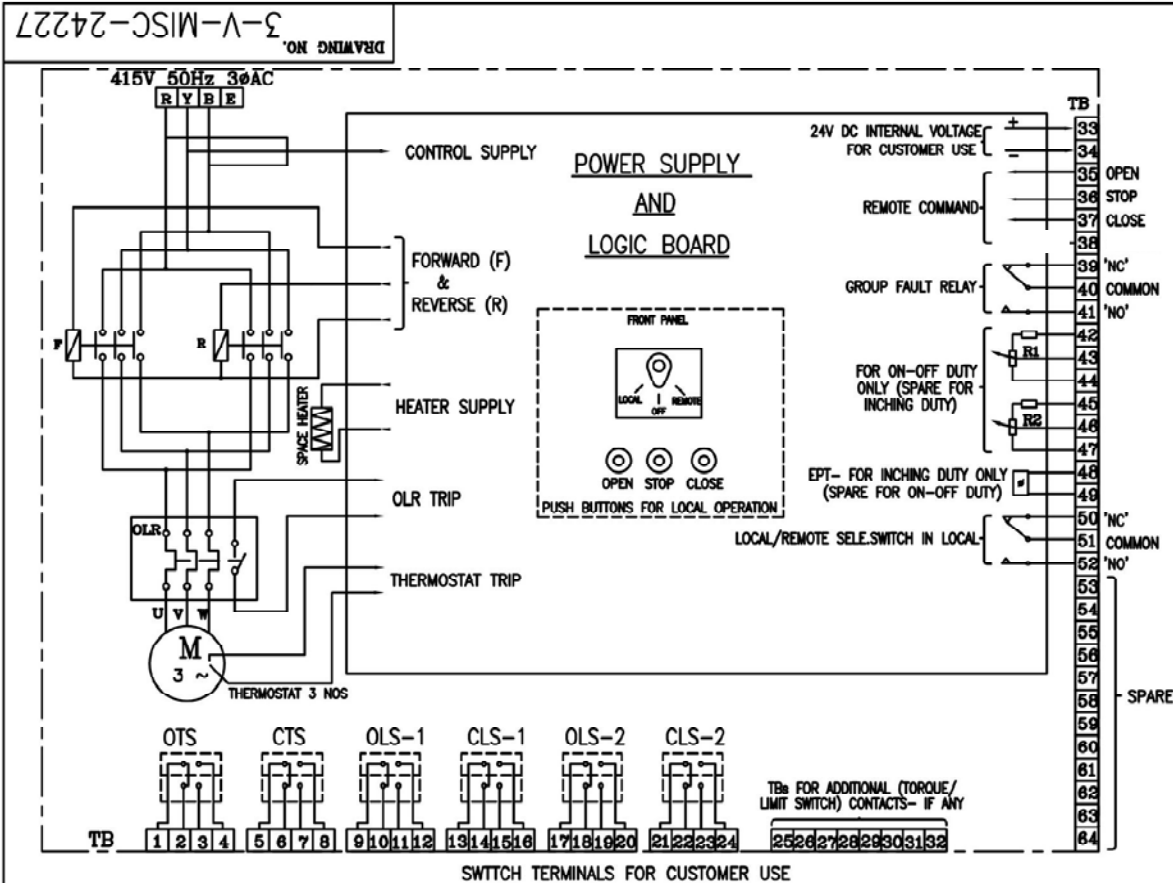
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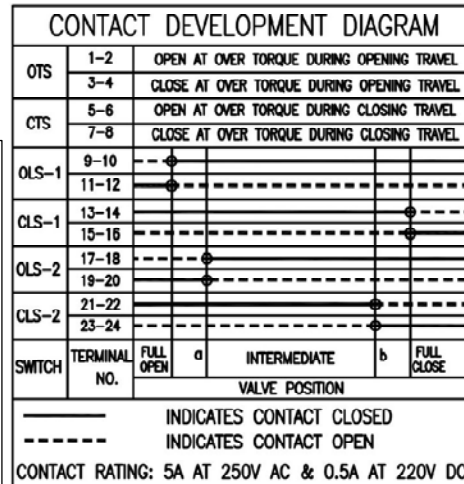
ADDITIONAL NOTES FOR SAGARDIGHI PROJECT:

- TEST WITNESS: TESTS SHALL BE PERFORMED IN THE PRESENCE OF OWNER/PURCHASER'S REPRESENTATIVE SO DESIRED BY THE OWNER/ PURCHASER. THE CONTRACTOR SHALL GIVE AT LEAST FIFTEEN (15) DAYS ADVANCE NOTICE OF THE DATE WHEN THE TESTS ARE TO BE CARRIED OUT.
- ADVANCE NOTICE SHALL BE GIVEN TO THE OWNER AS AGREED IN THE CONTRACT, PRIOR TO THE STAGE OF MANUFACTURE BEING REACHED, AND THE PIECE OF PLANT MUST BE HELD AT THIS STAGE UNTIL THE OWNER HAS INSPECTED THE PIECE, OR HAS ADVISED IN WRITING THAT INSPECTION IS WAIVED, IF HAVING CONSULTED THE OWNER AND GIVEN REASONABLE NOTICE IN WRITING OF THE DATE ON WHICH THE PIECE OF PLANT WILL BE AVAILABLE FOR INSPECTION, THE OWNER DOES NOT ATTEND, THE SUCCESSFUL BIDDER MAY PROCEED WITH MANUFACTURE HAVING FORWARDED TO THE OWNER DULY CERTIFIED COPIES OF HIS OWN INSPECTION AND TEST RESULTS.
- ACTUATOR SHALL ATTAIN FULL SPEED OPERATIONS BEFORE VALVE LOAD IS ENCOUNTERED AND IMPART AN UNSEATING BLOW TO START THE VALVE IN MOTION (HAMMER BLOW EFFECT).
- A SPACE HEATER SHALL BE INCLUDED IN THE LIMIT SWITCH COMPARTMENT SUITABLE FOR 240V, 1 PHASE, 50 HZ SUPPLY.

ALL DIMENSIONS ARE IN MILLIMETRES. FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER RELEVANT QCP / QP.



Separate wire (no common wire) to be used for signal exchange between DCS and actuator. Additionally, separate TBs are to be used at actuator end. Please refer attached dwg 12A05-DWG-I0021 for the same.



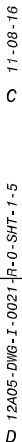
NOTE:-

- ALL TORQUE AND LIMIT SWITCHES (OTS, CTS, OLS1&2, CLS1&2) ARE WITH 2NO+2NC CONTACTS '1NO+1NC' IS TERMINATED IN TBS 1-24, REMAINING CONTACTS ARE FOR INTERNAL USE.
- ANY SPARE CONTACTS WHICH ARE NOT USED INTERNALLY ARE TO BE TERMINATED IN TBS 25-32
- CTS - TORQUE SWITCHES FOR CW ROTATION (CLOSE)
- OTS - TORQUE SWITCHES FOR CCW ROTATION (OPEN)
- OLS-1, OLS-2 - LIMITSWITCHES FOR POSITION OPEN
- CLS-1, CLS-2 - LIMITSWITCHES FOR POSITION CLOSE
- EPT - ELECTRONIC POSITION TRANSMITTER (POTENTIOMETRIC TYPE, FOR INCHING DUTY)
- R1-R2-POTENTIOMETER 2 x 100 OHMS (FOR ON-OFF DUTY)
- FOR COMMANDS & EPT EITHER INTERNALLY GENERATED 24 VDC OR EXTERNAL SUPPLY OF 24VDC CAN BE USED
- M - MOTOR 3 ϕ 415V 50 Hz AC SUPPLY

REV	DATE	ALTERED
		CHD & APPD

CAUTION: The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD. It must not be used directly or indirectly in any way detrimental to the interest of the company.

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT		ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS (DRAWN FOR INTERMEDIATE POSITION OF VALVES)			
DEPT	VL	DRN	NAME	SIGN	DATE
CODE		CHD	N.P.ESWAR	N.P	07.10.04
TITLE		APPD	D.DINAKARAN	D.D	07.10.04
WIRING DIAGRAM (TERMINAL PLAN) FOR ACTUATOR WITH INTEGRAL STARTER		U 01	KARUNACHALAM	K.A	07.10.04
REFERENCE INFORMATION		DRAWING NO. 3-V-MISC-24227			
NO. OF TUBES		REV 0			





SECTION – III

ELECTRIC MOTOR ACTUATORS

1.00.00 SCOPE

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

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

2.00.00 CODES & STANDARDS

2.01.00 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian standards (IS), IEC, ANSI & NEMA. Standards except when otherwise stated herein or in the driven equipment specification.

2.02.00 Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted. In such case the seller shall provide details of how his standards comply with the Buyer's requirement and duly certified copies of the English version of the standard adopted shall be submitted.

3.00.00 SERVICE CONDITIONS

3.01.00 The actuator shall be suitable for operation in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash.

3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.

4.00.00 RATING

4.01.00 For isolating service, the actuator shall be rated for three successive open-close operation of the valve/damper or minimum S2-15 minutes as per IEC-60034-1, whichever is longer.

4.02.00 For regulating service, the actuator shall be suitably time rated for the duty cycle involved with necessary number of starts per hour, but in no case less than 150 starts per hour.

5.00.00 PERFORMANCE

The actuator shall meet the following performance requirements:

5.01.00 Open and close the valve completely and make leak-tight valve closure without jamming.

5.02.00 Attain full speed operations before valve load is encountered and impart an unseating blow to start the valve in motion (hammer blow effect).



5.03.00 Operate the valve stem at standard stem speed and shall function against design differential pressure across the valve seat.

5.04.00 The motor reduction gearing shall be sufficient to lock the shaft when the motor is de-energised and prevent drift from torque switch spring pressure.

5.05.00 The entire mechanism shall withstand shock resulting from closing with improper setting of limit switches or from lodging of foreign matter under the valve seat.

6.00.00 **SPECIFIC REQUIREMENT**

6.01.00 **Construction**

6.01.01 The actuator shall essentially comprise the drive motor, torque & limit switches, gear train, self locking features, clutch, hand wheel, position indicator & transmitter, in-built thermostat for over load protection, space heater and internal wiring.

6.01.02 The actuator enclosure shall be totally enclosed, dust tight, weather-proof suitable for outdoor use without necessity of any canopy.

6.01.03 All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.

6.01.04 The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.

6.01.05 All motorized actuators shall be Smart Type and shall be furnished with Integral Starter mounted on the actuator and compatible with DCS/PLC. The Integral Starter shall be complete with:

1. One (1) triple pole breaker
2. One (1) no. reversing starter with mechanically interlocked contactors, 3 thermal overload relays, 2 NO + 2 NC aux. contacts for each contactor.
3. One (1) no. Remote- Local selector switch
4. CLOSE-STOP-OPEN oil tight push buttons with indication lights. STOP push button shall be latchable type.
5. 415 / 240 V control transformer with primary and secondary fuses.

These actuators shall have diagnostic feature with valve checking facility from remote.

6.02.00 **Motor**

6.02.01 The drive motor shall be three phase, squirrel cage, induction machine with minimum class F insulation and weatherproof IPW-55 enclosure, designed for high torque and reversing service.



6.02.02 The motor shall be designed for full voltage direct on-line start, with starting current limited to 6 times full-load current.

6.02.03 The motor shall be capable of starting at 85 percent of rated voltage and running at 80 percent of rated voltage at rated torque and 85 percent rated voltage at 33 percent excess rated torque for a period of 5 minutes each.

6.02.04 Earthing terminals shall be provided on either side of the motor.

6.03.00 **Limit Switches**

Each actuator shall be provided with following limit switches: -

6.03.01 2 torque limit switches, one for each direction of travel, self-locking, adjustable torque type.

6.03.02 4 end-of-travel limit switches, two for each direction of travel.

6.03.03 Open / Close command termination logic with position and torque limit switch positioner circuitry shall be suitably built in a PCB inside the actuator.

a) For binary drive, open/close/stop command and status thereof and disturbance monitoring signal (common contact for overload, thermostat, control supply failure, L/R selector switch at local, other protections operated) shall be provided.

Interface with the control system shall be through hardwired signal only. Interposing relays provided (with coil burden 2.5 VA) in the actuator shall be energized to initiate opening and closing, by 24V DC signal from the external control system.

b) For modulating drive, the command to actuator shall be in form of 4-20mA signal. The necessary positioning circuit and motor protection shall be provided

c) Open/close command termination logic shall be suitably built inside actuator.

6.03.04 2 position limit switches, one for each direction of travel, each adjustable at any position from fully open to fully closed positions of the valve/damper.

6.03.05 Each limit switch shall have 2 NO + 2 NC potential free contacts. Contact rating shall be 5A at 240V A.C. or 0.5A at 220V D.C.

6.04.00 **Hand Wheel**

Each actuator shall be provided with a hand wheel for emergency manual operation. The hand wheel shall declutch automatically when the motor is energized.

6.05.00 **Position Indicator/Transmitter (applicable for inching services only)**

The actuator shall have:

6.05.01 One (1) built-in local position indicator for 0-100% travel.



6.05.02 One (1) no. transducer (4-20 ma) for remote position indicator for 0-100 % travel

6.06.00 **Space Heater**

A space heater shall be included in the limit switch compartment suitable for 240V, 1 phase, 50 Hz supply.

6.07.00 **Wiring**

All electrical devices shall be wired up to and terminated in a terminal box. The internal wiring shall be of sufficient size for the power rating involved but in no case less than 1.5 Sq.mm copper. All wiring shall be identified at both ends with ferrules.

6.08.00 **Terminal Box**

The terminal box shall be weather proof, with removable front cover and cable glands for cable connection. The terminal shall be suitable for connection of 2X2.5 Sq.mm copper conductors.

7.00.00 **TEST**

The actuator and all components thereof shall be subject to tests as per relevant Standards. In addition, if any special test is called for in equipment specification, the same shall be performed.

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	1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	SECTION: C SUB SECTION : C&I
	C&I SPECIFICATION FOR COLTCS, SCS & DF	
SPECIFICATION FOR FIELD INSTRUMENTS & CONTROL PANEL		



SECTION-VI

TECHNICAL SPECIFICATION

CONTROL AND INSTRUMENTATION SYSTEMS

1.00.00 FIELD INSTRUMENTS

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

- i) HART management system shall be integral feature of the DDCMIS and shall be provided for centralised configuration, maintenance, diagnostics & record-keeping for all electronic transmitters.
- ii) Bidder shall provide following facilities as a minimum through software:
 - a) Constant scanning to monitor faults of changes to instrument configuration.
 - b) Owner-defined and standard calibration and configuration procedures for all transmitters.
 - c) Constant signal data collection facilities to maintain continuously updated records.
 - d) Automatic tracking of configuration changes made in the field, such as may be introduced by hand-held communicator. All configuration function associated with hand-held communicators shall be available in the system.
 - e) Event and log reports on screen as well as on printer.
 - f) Any addition/deletion of transmitter will be reported on printer and logged in hard disk.



1.02.00 Differential Pressure Transmitter

01. Type : Microprocessor based Smart, HART protocol compatible
02. Transmission : 2-Wire
03. Output signal : Simultaneous transmission of digital and 4-20 mA DC signal.
04. Signal Processing Unit : Silicon solid-state electronic circuitry
05. Sensor type : Capsule/Diaphragm
06. Element material : AISI-316 (Stainless Steel) or better
07. Static Pressure/





Overload Pressure	:	Maximum line (or static) pressure on either side without permanent deformation or loss of accuracy
08. Turn-down ratio	:	10 : 1 for vacuum/very low pressure application; 30 : 1 minimum for other applications.
09. Span and Zero	:	Locally adjustable, non-interacting
10. Enclosure class	:	Weather proof as per IP-65 with durable corrosion resistant epoxy coating (Explosion proof for NEC Class-1, Division 1 area wherever required))
11. Zero suppression / elevation	:	At least 100% of Span
12. Output Indicator	:	Backlit LCD type
13. Nameplate	:	Tag number and Service engraved in stainless steel tag plate
14. Body	:	Forged Carbon Steel (SS for DM Water)
15. Ambient temperature	:	0 - 50° C
16. Power supply	:	16 - 48 Volts DC
17. Load	:	500 Ohms (min.) at 24 Volts DC
18. Performance :-		
i) Accuracy	:	±0.2 % of span or better
ii) Repeatability	:	± 0.05 % of span or better
iii) Response time	:	100 msec or better
iv) Stability	:	± 0.1% of Calibrated Span for 6 months up to 70 Kg/cm ²
v) Zero and span drift	:	± 0.015% per deg. C at max span and 0.11% per deg. C at min span
19. Sealing/Isolation	:	Extended diaphragm with 5 meters. SS armored capillary for corrosive, viscous and dirty fluid applications. Material for separator diaphragm, depending on application.
20. Diagnostics	:	Self indicating feature
21. Accessories	:	a) Universal mounting bracket suitable for 2" pipe mounting.



- b) High tensile carbon steel U-bolts.
- c) Installation accessories as per relevant installation drawing.
- d) Syphons for steam and hot water services.
- e) ½" NPT 5-valve stainless steel manifold, constructed from SS316 bar stock.
- f) Companion flange with nuts, bolts and gaskets.
- g) Hand held configurator kit for calibration of Smart Transmitter.



1.07.00 Pressure Gauge and Differential Pressure Gauge

01.	Type	:	Bourdon/Bellows/Diaphragm
02.	MOC Sensing & Socket	:	AISI-316 SS
03.	Movement Material	:	AISI-304 SS
04.	Case Material	:	Stainless steel..
05.	Bezel Material	:	SS 304.
06.	Socket Material	:	SS 316
07.	Enclosure	:	IP-65.
08.	Dial Size	:	150 mm





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



- d) 5-valve SS316 manifold constructed from barstock for differential pressure gauge. Process connection ½" NPT.
- e) Union, nut & tail piece and other Installation accessories as required.
- f) Syphons for steam and hot water services.

20. Applicable standard : IS-3624 / 1996 , EN-837-1

21. Nameplate : Tag number, service engraved in stainless steel tag plate

1.08.00 Temperature Gauge

- 01. Type : Inert gas filled remote mounting system.
- 02. Sensing Element Material : Bourdon - AISI-316 SS
- 03. Capillary Armoring : Stainless steel flexible
- 04. Movement Material : AISI 304 SS
- 05. Bulb / Stem Diameter : 12 mm
- 06. Bulb / Stem Material : AISI 316
- 07. Capillary : Stainless Steel
- 08. Thermometer connection to well : ½" NPT
- 09. Case Material : Stainless steel
- 10. Dial Size : 150 mm in general (100 mm for SWAS gauges)
- 11. Scale : Black lettering on white background in 270 Deg. arc.
- 12. Mounting : Surface/Panel
- 13. Over range Protection : 125 % of range or more
- 14. Instrument connection : Bottom connection for local mounting and back connection for panel mounting.





15.	Range	:	Normal temperature – 50 ~ 70% of range approximately.
16.	Zero adjuster	:	Micrometer screw adjustable from front.
17.	Window	:	Shatterproof glass.
18.	Accuracy	:	$\pm 1\%$ or better
19.	Enclosure Class	:	IP-65
20.	Capillary	:	5 meters (local)/15.0 meters (local panel) - armoured stainless steel
21.	Compensation	:	Capillary and Case Compensation
22.	Accessories	:	a) Forged/barstock SS316 thermowell screwed as per ASME PTC code. Process connection M 33X2 (M). Material of construction of thermowell: 1) SS 316: in general 2) Inconel: For flue gas application 3) Tungsten carbide: For coal mill application b) Installation accessories as required.
23.	Nameplate	:	Tag number, service engraved in stainless steel tag plate



1.11.00 Resistance Temperature Detector

01. Type : Platinum (Duplex), Ungrounded
02. Resistance : 100 ohm at 0°C
03. Base : Wound on ceramic (anti-inductive)
04. Wiring : 3 /4 Wire





05. Protecting Tube :-
- i) O.D. : 8 mm
 - ii) Material : SS-316, Seamless
 - iii) Filling : Magnesium oxide (Purity above 99.4%).
06. Response time : a) < 20 seconds for measurement.
b) < 10 seconds for control.
07. Calibration : DIN 43760
08. Accuracy : $\pm 0.5\%$ of range
09. Head :
- i) Type : IP-65 universal screwed type. (Explosion proof for NEC Class-1, Division 1 area)
 - ii) Material : Die cast aluminum or better
 - iii) Terminal blocks : Nickel plated Brass-screw type / silver plated
 - iv) Cable connection : $\frac{1}{2}$ " NPT gland and grommet.
 - v) Others : Terminal head cover with SS chain and suitable gasket. All thermowells in the high velocity steam service shall be checked for Strouhal's frequency limit to arrive at a safe size and design of thermowells"
10. Accessories :
- a) Adjustable nipple-union-nipple [$\frac{1}{2}$ " Sch 80 X $\frac{1}{2}$ " NPT (M)] with thermowell connection
 - b) Compression fittings/unions
 - c) Flanges etc. (for flanged connections only)
 - d) Barstock thermowell of stepless tapered design as per ASME PTC19.3 code.
- Process connection M33x2 (M) in general or $1\frac{1}{2}$ " flanged for flue gas/Furnace/air etc. application.
- Material of construction of thermowell:
- 1) SS 316: in general
 - 2) Inconel: For flue gas application



- 3) Tungsten carbide: For coal mill application.

11. Nameplate : Tag number, service engraved in stainless steel tag plate



2.00.00 NOT USED

3.00.00 **CONTROL PANEL/DESK MOUNTED INSTRUMENTS AND ELECTRICAL SYSTEM ACCESSORIES.**

(For electrical System's Meter and for synchronisation, bidder shall refer to Electrical volume of specification)

3.01.00 Digital Indicator (If required)

01. Type : Five and half digit LED seven-segment display with sign.
02. Display Character : 13.8 mm, RED (LED)
03. Accuracy : 0.1% of reading, ± 2 digit



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- 04. Input : 4-20mA DC/1-5 V DC/ pulse (as applicable)
- 05. Mounting : Flush Panel
- 06. Power Supply : 240V $\pm$ 10%, 50 $\pm$ 2.5 Hz

3.02.00 PUSH BUTTON

- 01. Type : Shrouded square format
- 02. Face Dimension : 32 x 32 mm (maximum)
- 03. Contact Configuration : 2 NO + 2 NC
- 04. Contact Addition : Add-on block up to 4 each with 2 pairs of contacts
- 05. Contact Material : Hard Silver Alloy
- 06. Contact Rating : 500V / 10 A
- 07. Utilization Category : AC11 / DC11
- 08. Insulation Voltage : 2 KV for 1 minute between terminals and earth
- 09. Mechanical Life : 1 million operation
- 10. Construction : Aluminum shrouding with plastic lens
- 11. Colors : Red, Green, Yellow, Black, etc.
- 12. Connection : Screw terminals
- 13. Enclosure Class : IP-52
- 14. Legend : Engraving

3.03.00 ILLUMINATED PUSH BUTTON

- 01. Type : Square format
- 02. Face Dimension : 32 x 32 mm (maximum)
- 03. Contact Configuration : 2 NO + 2 NC (minimum)
- 04. Contact Addition : Add-on-Block up to 4 each with 2 pairs of contacts
- 05. Contact Material : Hard Silver Alloy
- 06. Contact Rating : 500 V/ 10A





07. Utilization Category : A C11 / DC11
08. Insulation Voltage : 2 KV for 1 minute between terminals and earth
09. Mechanical Life : 1 Million Operation
10. Lamp : LED with built-in resistors as required
11. Lamp Rating :-
 - a) Voltage : 240 V AC
 - b) Watt : 2 Watt (approx.)
12. Lamp and Lens Replacement : From front
13. Construction : Transparent Plastic Lens
14. Color : Red, Green, Amber, Yellow etc.
15. Connection : Screw terminals
16. Enclosure Class : IP-52
17. Legend : Engraving

3.04.00

SELECTOR SWITCH

01. Type : 2/3/4 position stay put type with rotary lever actuator.
02. Face Dimension : 32 x 32 mm (maximum)
03. Contact Configuration : 4 pair of contacts
04. Contact Addition : Add-on-Block up to 4 each with 2 pairs of contact
05. Contact Material : Hard silver Alloy
06. Contact Rating : 500 V/10 A
07. Utilization Category : AC11 / DC11
08. Insulation Voltage : 2 KV for 1 minute between terminals and earth
09. Mechanical Life : 1 million operation
10. Construction : Aluminum shrouding
11. Connection : Screw terminals





	12.	Enclosure Class	:	IP-52
3.05.00	INDICATING LAMP			
	01.	Type	:	LED with built-in resistor
	02.	Face Dimension	:	32 x 32 mm (maximum)
	03.	Voltage	:	240 V AC
	04.	Watt	:	2.5 Watt (approximate)
	05.	Lamp and Lens Replacement	:	From front
	06.	Construction	:	Transparent Plastic lens
	07.	Color	:	Red, Green, Amber, Yellow etc.
	08.	Connection	:	Screw terminals
	09.	Legend	:	Engraving
3.06.00	INDICATING METERS (A.C)			
	01.	Type	:	Rectifier type taut band
	02.	Face Dimension	:	96 x 96 mm
	03.	Scale	:	Radial arc of 240 Deg.
	04.	Accuracy	:	1.5% of full scale. ±0.5 Hz for frequency meter
	05.	Input	:	0-1/0-5A for current measurement, 0-240V for voltage measurement, 50 ± 2.5 Hz for Frequency measurement
	06.	Zero Adjustment	:	Screw on meter face
	07.	Enclosure	:	Shielded Case IP-52
	08.	Mounting	:	Flush Panel
	09.	End Scale	:	
		Suppression	:	6 times the measuring range only for motor ammeters
3.06.01	INDICATING METERS (D.C)			
	01.	Type	:	Taut band moving coil
	02.	Face Dimension	:	96 x 96 mm

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03.	Scale	:	Radial arc of 240 Deg.
04.	Accuracy	:	1.5% of full scale
05.	Input	:	0-75 mA for current measurement. Direct reading for voltage measurement.
06.	Zero Adjustment	:	Screw on meter face
07.	Enclosure	:	Shielded case IP-52
08.	Mounting	:	Flush Panel
09.	End Scale	:	
	Suppression	:	2 times the measuring range only for motor ammeters.

3.07.00 AUXILIARY RELAY

01.	Type	:	Plug-in type with base/DIN rail Mounted
02.	Coil voltage	:	240 V AC/24V DC / 220V DC
03.	Contact Configuration	:	2 NO & 2 NC (Minimum), additional contacts as per requirement
04.	Contact rating	:	250V/5A (A.C/D.C.)
05.	Operating range	:	80 to 110% of rated voltage
06.	Insulation	:	2 KV for 1 minute between terminals & earth.
07.	Mechanical life	:	20 million operations
08.	Enclosure	:	Transparent cover
09.	Connection	:	Screw terminals.
10.	Mounting	:	Projection mounting inside panel /DIN rail Mounting

Note : Coil protection: diode/surge suppressor shall be provided

3.08.00 COUPLING RELAY

01.	Type	:	Miniature plug-in type/ DIN rail Mounting
02.	Coil voltage	:	24 V D.C. / 48 V DC or others as required.
03.	Contact	:	2 NO & 2 NC (Minimum)-Additional contact as per requirement





04.	Contact rating	:	250 V/10A (A.C)/220V/2A (D.C)
05.	Operating range	:	70 to 110% of rated voltage.
06.	Insulation	:	2 KV for 1 minutes between terminal & earth.
07.	Mechanical life	:	20 million operations
08.	Coil protection	:	Diode
09.	Indication	:	Coil on LED
10.	Enclosure	:	Transparent cover
11.	Connection	:	Screw terminals.
12.	Mounting	:	Projection mounting inside panel / DIN rail mounting

3.11.00 Push Button Station (Emergency Stop)

01.	Function	:	Hardware communication between P/B Station & DCS
02.	Type	:	Mechanical keys Shrouded
03.	Size	:	48 mm
04.	Mounting	:	On Auxiliary Console
05.	Signal Level	:	24V DC Binary
06.	Ambient temperature	:	0-50 ° C
07.	Ambient Humidity	:	0-95% RH (max.)



5.00.00 CONTROL DESK / PANEL / RACK

5.00.01 Convenient and logical approach to operational interfaces shall be considered to enhance aesthetics in the overall view of the control room..



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- 5.00.02 For items susceptible to vibration, suitable rubber gaskets or padding shall be provided to prevent damage or malfunction.
- 5.00.03 All items like MCB, Terminals, instruments, lamps etc. inside the panels/cabinets shall be neatly arranged with easy access/ maintenance approach to avoid undue disturbing the wiring.
- 5.00.04 Incoming power supply feeders shall be Redundant UPS Power supply feeders, so that a single failure shall not affect the operation of the unit. Required isolation & protection through MCB shall be provided in all cases. Alarm shall be provided against failure of a single power supply. Duplication/looping of Power supply feeders at the Panel terminal is not acceptable. Redundant UPS power supply feeders shall form Primary & Secondary power supply Bus and further power distribution shall be from these busbars.
- 5.00.05 Desk / panel shall be provided with interior illumination lamp with door switch, space heater with thermostat and 5A, 3 Pin receptacle with plug. Exhaust/cooling fans with fan failure alarm shall be provided.
- 5.00.06 Lamp, heater, exhaust fan and receptacle circuits shall be suitable for available AC supply and furnished with individual ON-OFF switch. The ON-OFF switch of the 3 pin receptacle circuit shall be Illuminating type.
- 5.00.07 Panel / Desk shall have gland plate at cable entry to panel. Thickness of gland plate shall not be less than 3 mm.
- 5.00.08 Panels / enclosure shall be provided with 20% spare terminals. In addition, the spare hot on rail mounted input output channels /modules shall be in fully wired & terminated condition for system cabinets.
- 5.00.09 Wire shall be routed/laid in the covered PVC cable trough/tray.
- 5.00.10 Nameplate
- a) Nameplate shall be furnished for each instrument or device mounted on the panel/desk.
 - b) The material shall be laminated phenolic, 3 mm thick with white letters on black background.
 - c) The nameplates for panels / consoles shall be provided both on the front and the rear.
 - d) Nameplates for all devices shall be located adjacent to the respective devices.





5.02.00 BACK UP PANEL / ELECTRICAL PANEL

5.02.01 Back Up Panel shall be of free standing type vertical panel with doors at the back. Construction shall be made from sheet steel of thickness not less than 3mm with mosaic grid structure of approximate size 24 X 48 on the front surface. Grid shall be heat resistant, flame retardant, self extinguishing, shrinkage free, non reflecting type. Finish shall be mat type without flaring. Indicators /ammeters, conductivity type EWLI for separator, electromatic safety valve controls etc. shall be mounted on the panel..

5.02.02 Electrical Panel construction & design shall be similar to back up panel. Required control switches, meters, indicators, synchronizer, excitation control switch, annunciation window etc. alongwith associated mimic diagram shall be provided for manual synchronization of generator.

5.02.03 Crating of the panels shall protect against shock, vibration, inappropriate handling and inclement weather conditions during transportation and warehousing. Mounted equipment shall have protection against damage during handling, transit and storage. Suitable desiccant shall be used inside the packing case.

5.03.00 CABINETS / ENCLOSURE / PANELS

01.	Material of construction	:	Cold rolled steel sheet
02.	Thickness of Sheet	:	a) 3.0 mm for faces supporting instruments / terminals. Mounting plate shall also be 3.0 mm. b) 2.0 mm for other sides inclusive of top.
03.	Construction	:	Welded throughout as per (metallic parts) approved National Standards.
04.	Panel height	:	2300 mm maximum
05.	i) Corners	:	7 mm inner radius
	ii) Dimensional Tolerances	:	a) In height & length - 3 mm b) In height between adjacent sections - 2 mm. c) Total for a group - 6 mm
06.	Doors	:	Double, recessed, turned back edges. Doors shall have 4 point IP Lock
	i) Thickness of Sheet	:	2 mm





- ii) Hinges : Stainless steel
- iii) Door latches : Three point type
- iv) Door gaskets : Neoprene rubber on fixed frame to result dust proof/weatherproof enclosure.
- v) Opening of the doors : Outward. Door swing shall be Min. 110-120 Degree
- vi) Louvers : With removable wire mesh to ensure dust and vermin proof.
- 07. Color of interior : Brilliant white (Approval shall be accorded by owner during detail engineering)
- 08. Colour external : RAL 7032
(Approval shall be accorded by Owner during engineering)
- 09. Painting : Epoxy powder coated or better. Minimum Paint thickness shall be 80-100 microns
- 10. Gland plates : Removable 4 mm thick (bottom)
- 11. Cable entry : Bottom
- 12. Hardware :
 - a) Anti vibration pad- 15 mm
 - b) Predrilled base channel ISMC - 100 or equivalent for all sides.
 - c) Lifting hook / Eye bolt
 - d) Drawing pocket
 - e) Door switch, lamps, thermostat, heaters and fans
- 13. Enclosure Protection : As per environment condition of the area of installation. Refer to Section-I of Vol-II E clause 6.16.00.

5.04.00 LOCAL INSTRUMENT RACKS & ENCLOSURE (EXCEPT OFFSITE/BOP AREAS)

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, isolation valves, integral junction box with outside access door, illumination etc. Racks used for furnace, flue gas and air application shall be provided with intermittent & continuous air purging. Following requirements for LIE/LIR shall be met:

- 1) Not more than Six (6) Instruments shall be grouped in a single Rack/enclosure".
- 2) Racks shall be installed above the tapping points for air, flue gas and coal air mixture application where as for applications such as for water and steam, racks to be installed below the source point.
- 3) Service air connection shall be provided for continuous and intermittent purging of impulse pipe in dusty medium. Continuous purging shall be adopted for differential and gauge Pressure measurements such as flue gas, furnace and coal air mixture applications. Intermittent purging shall be adopted for Pressure measurements in air application or wherever required.



5.04.02 Open Type Transmitter Racks

- a) Open type transmitter racks may be provided for mounting transmitters, switches, gauges, converters and other accessories in rooms, buildings and closed areas like the power house building.
- b) The open type racks shall be shop fabricated. Transmitters, switches, converters and transducers of enclosure class IP-65 or better can be directly mounted on open racks. However, enclosures not conforming to the above protection standard shall have to be housed in enclosures conforming to IP-65 class prior to mounting them on open structures.
- c) The following shall be provided for open type transmitter racks:
 1. Rack shall be constructed from 6mm thick steel channel frame.
 2. Canopy shall be of 3mm thick CRCA steel.
 3. 2"NB Galvanised pipes shall be laid horizontally and supported at two end channels to mount transmitters/switches at accessible height.
 4. Adequate support for Manifold, impulse pipe and cable tray to be provided and the same shall be adjustable.
 5. Individual Instrument blowdown line shall be connected to the common blowdown drain header through regulating globe type blowdown valves. The common blowdown drain header shall be 2" NB ASTM A106, Sch-80 Gr. C installed at a slope of 1:25
- d) For operational convenience, the open type racks shall be used for mounting pressure and temperature gauges and switches and the local operating stations for electrical drives in the vicinity. Gauges mounted in racks shall be bottom connected and secured by double lock nuts. All gauges shall be located within 1500 mm from the floor for easy readability.
- e) The structural design shall be such that no item shall interfere with maintenance and removal of instrument, equipment and their accessories.
- f) Service Power and Lighting
 - i) Each rack shall be provided with one receptacle, one light fixture with wire guard and one lighting switch. Outlet box, switch box and device covers shall be galvanized stamped steel. Light fixtures shall be installed on the canopy of the rack.
 - ii) Power supply for receptacles and lighting shall be arranged. Power supplies for miscellaneous devices shall be provided with MCB located within the rack JB. MCBs shall be mounted in blocks. MCB ratings will be given on electrical schematic diagrams. Nameplates



shall be furnished above the MCB blocks, identifying the devices being served.

g) Control Air

Same as for closed type transmitter rack. Refer 5.01.01 (j) above

h) Service Air

Same as for closed type transmitter rack. Refer 5.01.01 (k) above

i) Power Supplies

Same as for closed type transmitter rack. Refer 5.01.01(l) above

j) Equipment Installation

Contractor shall prepare rack fabrication and piping drawings indicating the layout of each instrument. The drawings shall clearly indicate Contractor's piping arrangement for the sharing of process connections between two or more instruments. Special attention shall be given in the piping layout to avoid air traps in liquid filled piping or water pockets in piping intended to be dry.

k) Impulse Piping / Tubing

Same as for closed type transmitter rack. Refer 5.01.01 (n) above

l) Instrument Tubing

Same as for closed type transmitter rack. Refer 5.01.01 (o) above

5.04.03 Wiring of the Racks

- a) A fully enclosed IP 65 type junction box shall be provided in each rack for housing the terminal blocks connectors, power supply fuses and other electrical accessories, as required.
- b) Junction boxes for modular enclosures shall be fabricated externally on one end of each enclosure assembly to accept field wiring/cabling through the top or bottom of the junction box. A hinged door shall give access to the interior of the junction box.
- c) All electrical connections between instruments and the junction box terminal blocks shall be made. In addition all utility wiring for lighting and service power shall be installed.
- d) All wiring used within the enclosures shall conform to NEC /IEC standards. All wiring shall run through flexible or rigid conduits and shall be terminated at suitable terminal blocks. Sufficient clearance shall be provided for all control and instrument leads and all incoming



and outgoing leads shall be connected to terminal blocks suitably located for connecting external circuits.

- e) High impedance circuits shall be connected using shielded or coaxial wire suitable for the service.
- f) Conduits shall be supported properly at regular intervals with suitable conduit clamps.
- g) Wire shall be neatly arranged and routed/laid in PVC trough/tray.

5.04.04 Junction Box

Junction boxes shall be of metallic construction.

- a) Junction box shall be provided with front opening type cover. Junction box shall be of sheet steel construction with thickness not less than 2 mm. Junction box shall be complete with DIN rail mounted terminals, MCB, receptacles and earth bar. Earth bar shall be made of tinned copper of 25 X 6 MM size. Earth stud shall be furnished for safety grounding.
- b) Terminals shall be screwless cage-clamp type and 20% spare terminals shall be furnished. Power terminals shall be screw type.



6.00.00 DESIGN CRITERIA

This section lays down the general design criteria to be adapted in designing the Control & Instrumentation system of the plant.

6.01.00 General Requirements

Instrumentation, control and automation devices and accessories shall be designed with the following considerations:

- a) Stable in spite of temperature fluctuations.
- b) Able to withstand high humidity.
- c) Weather proof.
- d) Dust proof.
- e) Corrosion resistant.
- f) Erosion resistant.
- g) Able to withstand high vibration.
- h) Easily accessible for operation & maintenance.

6.03.00 Parts subject to high pressure, temperature or other severe duty shall be of materials and construction suitable for the service conditions and long operating life.

6.04.00 Components of instruments, control devices, accessories, piping etc. which contact steam, condensate or boiler feed water shall be manufactured from copper-free materials.

6.05.00 Instrument Accuracy, Standard Scales and Ranges

6.05.01 Instrument Accuracy

Instruments shall meet the following general requirements.

- a) Pressure measurement shall be linear with respect to the measured pressure.
- b) Flow meter shall meet the specified accuracy criteria when operating between 25 and 100 % of full-scale flow. The accuracy shall include the effect of errors in the differential head measuring device, square root converter and signal generator.
- c) Level measurement shall be linear with respect to the measured level based on a water specific gravity of 1.00.
- d) Wherever the measured parameter is influenced by process pressure & temperature, required compressibility correction shall be introduced.





6.05.02 Instrument Scale Displays

- a) All displays shall be in engineering units. Instrument scales displayed on screen will have graduations with scale divisions based on multiples of 10. The smallest division shall preferably be a whole number approximately 1% of the scale range if not otherwise impracticable.
- b) Pressure instrument shall have the unit suffixed with 'a' or 'g' to indicate absolute or gauge pressure, respectively.
- c) Scales and charts of all instruments shall have linear graduations

6.05.03 Instrument Ranges

Instrument range shall be selected to have the normal reading, preferably between 50% and 70% of full scale for linear parameters and 70% to 80% for flow measurements. Deviation indicators shall have the null position at mid scale. The normal operating parameter shall be identified with a clear green mark.



6.08.02 Measurement & Channel Redundancy

To meet the failure and self checking criteria for the control system, measurement redundancy shall be provided for all the critical parameters. Throughout the control system, the security and validity of signals are to be ensured based on the following design principles.

- a) Where a plant measurement is to be duplicated or triplicated such signals shall be separately fed to the different input modules.
- b) Signals, after due security and validity checking by means of voting, averaging, median, difference monitoring or similar technique shall be used for control functions.
- c) Where duplex measurements are used, provision shall be there for selecting any one as the duty signal. Continuous monitoring of Deviation between the signals shall be made in the system.
- d) For binary and analog inputs required for protection of SG , TG and major auxiliaries whose non availability may result in loss of generation triple sensing devices shall be provided . Binary and analog inputs , which are required for protection of more than one equipment as well as protection signals for important auxiliaries and HT drives etc. triple sensing devices shall be provided .Also other binary and analog inputs required for CLCS dual sensing devices shall be provided . However,for those binary and analog inputs which are also required for protection in addition to CLCS, triple sensing devices shall be provided.
- e) Measurement system, CLCS and OLCS shall all be configured with redundancy at processor modules,communication modules, data bus and power supply modules.Triple redundancy shall be followed as described elsewhere in the specification. All servers shall be dual redundant.
- f) Both CLCS & OLCS shall be configured with Redundant I/O channels for each sensor/signals. Where redundant sensors are provided redundant I/O channels shall be provided for each sensors/signals.
- g) Redundant sensors shall be provided for all control applications. For all major closed loop controls (CLCS) triple redundant sensors shall be provided. For other CLCS loops dual redundant sensors shall be provided.
- h) Similarly for critical protection logic requirements triple redundant sensors for 2 out of 3 logic shall also be provided to avoid spurious tripping. For all other control application dual redundant sensors shall be provided. Dual and Triple redundant sensors shall also be provided as described elsewhere in the specification.
- i) Signals shall be verified against cable failure / non coincidence monitoring for critical trip signals.





6.14.00 Panels, Cubicles and Enclosures

6.14.01 General

- a) All panels, cubicles and enclosures shall be furnished complete with integral piping, internal wiring, convenience outlets, internal lighting, grounding, ventilation, space heating, vibration isolating pads and other accessories.
- b) Unless otherwise specified cable entry for panels / desks / cabinets shall be through bottom via glanding plate. Fireproof seal shall be used to seal the bottom to prevent entry of dust.
- c) Panels and cabinets shall be constructed from steel sheet reinforced as required to provide true surface and adequate support for devices mounted thereon. Thickness of the CRCA steel for UCP / backup panel and other panels/cabinets shall be as described in Section VII of this volume of the specification. Panels and cabinets shall be of adequate strength to support mounted components during shipment





and to support a concentrated load of 100 Kilograms on their top after erection.

- d) Panel /cabinet shall have eyebolt on top for lifting.
- e) Mounting , wiring , powering of all items to be mounted / installed on desks irrespective of the source of procurement shall fall in the scope of erection of Bidder ,this shall include freeissue items furnished by Owner.

6.14.02 Surface Preparation and Painting

Sheet metal exterior steel surfaces shall be sand blasted, ground smooth and painted as specified below:

- a) Suitable filler shall be applied to all pits, blemishes and voids in the surface. The filler shall be sanded so that surfaces are level and flat; corners are smooth and even. Exposed raw metal edges shall be ground burr-free. The entire surface shall be blast clean to remove rust and scale. Oil, grease and salts etc. shall be removed from by one or more solvent cleaning methods prior to blasting.
- b) Two spray coats of 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 color (Catalyzed epoxy or polyurethane) shall be applied to all surface of dry film thickness 2.0 Mil. The Min. Paint shade thickness at exterior & Interior shall be 80 to 100 Microns. The finish colors for exterior and interior surfaces shall conform to the following shades:
 - i) Exterior : RAL 7032
 - ii) Interior – Brilliant White (Preferred) / RAL 7032.
- c) Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections shall not be acceptable.

6.14.03 Wiring

Wiring within the panels shall conform to NEC standards and shall be factory installed and tested at the works. All interior wiring shall be installed neatly. Features shall not be limited to the following :

- a) All spare contacts of relays, switches and push buttons shall be wired up to the terminal blocks.
- b) Each wire shall be identified at both ends with wire designation as per approved wiring diagram. Heat shrinkable type ferrules with indelible computerized print shall be used with cross- identification.
- c) Wire termination shall be made with insulated sleeve and crimping type lugs. All external connections shall be made with one wire per terminal. Wire shall not be spliced or tapped between terminals. Open-ended terminal lugs shall not be used.





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- d) Internal wiring shall be terminated uniformly on one side of the terminal block leaving the other side available for termination of outgoing cables.
- e) Thermocouple lead wires, analyzer measuring lead wires, or any other lead wires carrying measuring signal of the order of low milli volt or micro volt shall be electrically and physically isolated from other AC and DC wiring.
- f) All low-level signal cables shall be separately bundled from control cable.
- g) Wires shall be dressed and run in troughs with clamp-on type covers. Wirings shall be neatly bunched in groups by non-metallic cleats or bands. Each group shall be adequately supported along its run to prevent sagging or strain on termination.
- h) Shield wires shall be terminated on separately.
- i) Common connections shall be limited to two wires per terminal. Looping of wires for power distribution in the panel to be avoided. Busbars to be provided for Power distribution".
- j) Wiring to door mounted devices shall be provided with multi-strand wires of (49 strands minimum) adequate loop lengths of hinge-wire so that multiple door openings will not cause fatigue to the conductor.
- k) Wiring shall be arranged to enable instruments or devices to be removed and/or serviced without disturbing the wiring. No wire shall be routed across 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.
- l) Panel internal wiring shall follow distinct color-coding to segregate different voltage levels viz. 24V DC, 48V, 110V AC, 240V AC, 220V DC etc.
- m) Panels /cabinets /desks shall be provided with removable gasketed cable gland plates and cable glands. Split type grommets shall be used for prefab cables.
- n) Wire shall be multistranded annealed flexible high purity copper conductor with heat resistant FRLS PVC insulation and shall pass vertical flame test per IPCEAS-1981.
- o) Wire sizes used for internal wiring shall not be lower than the followings :

Control wiring (switches, : 1.5 Sq.mm
pushbuttons etc.)

Power supply /receptacle : 2.5 sq. mm or higher as per
illumination wiring load





4-20mA DC current and low : 0.5 Sq. mm
voltage signal upto 48V DC

- p) Identification of conductors shall be done by insulation color-coding identified on drawings or by printed wiring lists.

6.14.04 Grounding

- a) System cabinet AC and DC ground shall be electrically isolated from each other and also electrically isolated from the Instrumentation signal ground. All the above ground shall be individually connected to the single point on the ground pit. Dedicated redundant earth pit shall be provided which shall be away from the HV equipment. This earth pit shall not be shared with other electrical equipment ground and shall also be insulated from other electrical system ground to ensure single point grounding of the system. Grounding resistance shall be better than 1.0 ohm. IEEE guideline shall be followed while designing the grounding system.
- b) Panels and cabinets shall be provided with a continuous tinned copper ground bus bar of minimum 25 mm x 6 mm cross section, extending along the entire length of the panel / desk / cabinet assembly. The ground bus shall be bolted to the panel structure and effectively ground the entire structure.
- c) The panel /desk /enclosure /JB ground shall have two (2) bolt drilling with GI bolts and nuts at each end to connect to GI/ copper flat ground riser by means of insulated copper ground cable of required cross section with lug.
- d) Circuits requiring grounding shall be individually and directly connected to the panel ground bus.
- e) For electronic system cabinets, the electronic system ground bus shall be similar but insulated from the cabinet and shall be separately connected to the system ground. Signal cable shields shall be grounded at the panel end only and shall not be left open. The ground in between panels of a shipping section shall be firmly looped.
- f) Electrical meters, relays, transmitters and switching devices, operating at a voltage less than 50V may be grounded through the steel structure.

6.15.00 Panel / Cabinet/ Desk/ Enclosures / junction boxes & instruments Environmental Protections

- a) Panels, cabinets, desks, distribution boxes, racks ,junction boxes, terminal boxes , instruments and all other field mounted equipment / enclosures shall suit the environmental condition of the area and shall not be inferior than the requirement indicated in the following table.



SL. NO.	LOCATION	ENCLOSURE TYPE
1.	Indoor type non- ventilated enclosure in non-hazardous area	IP-54
2.	Indoor type ventilated enclosure in non-hazardous area	IP -42
3.	Enclosure in Air conditioned area	IP-32 with suitable canopy at top to prevent ingress of dripping water.
4.	Outdoor type in non-hazardous areas	IP-65 with anticorrosion coating.
5.	Outdoor in hazardous areas	As per requirements of the NEC Code for the location

- b) The construction of electrical enclosures located in areas subject to conditions classified in the National Electrical Code (NEC) as hazardous shall be of a type designated suitable for the environment in which they are located.

6.16.00

Terminal Blocks

- a) Terminals shall be chromated galvanized DIN rail mounted screwless cage clamp type or maxi termi type. Terminals shall have screwed connection for conductor cross-section above 2.5 mm². Terminal blocks shall conform to IEC 947-7-1.
- b) The characteristics of the terminal blocks shall be as follows.
- High contact force, independent of conductor cross-section and large contact surface area.
 - Integrated self-loosening protection to avoid shifting of contact surface that may allow contamination of connection point.
 - Inspection and maintenance free (resistant to thermal aging and vibration)
 - Low and constant voltage drop
- c) Material of the clamping yoke of screwed terminals shall be electroplated, chromated, case hardened steel with high strength clamping screw. For screwless terminals, the tension spring shall be made of high quality, non-rusting, acid-resistant steel. The current bar shall be of tin-lead plated copper or brass.
- d) Terminals shall be of non flammable suitable thermoplastic material such as polyamide.

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1x660 MW Unit No. 5, Phase - III

- e) Terminal blocks shall be mounted vertically in panels and cubicles with clearance for at least 100 mm between two sets and between wall and terminal block.
- f) Terminal blocks shall be provided with white marking strips / self-adhesive marker cards. Power terminals shall have protection covers.
- g) At least 20 percent spare unwired terminals shall be provided for all panels /cabinets /desks /junction box etc... This shall be in addition to 20% spare wired terminals of spare IO channels.
- h) Bottom of the terminal block shall be at least 200 mm above the cable gland plate for bottom entry type panels.
- i) For extending 24 V DC supply to panels, the size of the terminals shall be decided based on voltage drop and not based on current.
- j) Other requirements of the terminal blocks are as follows:
 - i) The last terminal in a rail-mounted assembly shall be closed with an end plate and end bracket.
 - ii) For visual and electrical separation of terminal groups, partition plates shall be provided, which can be push fitted after forming an assembly.
 - iii) Design shall permit testing of incoming and outgoing signals by using suitable test plug and socket without disconnecting the cable connections.
 - iv) It shall be possible to use jumper plugs through the above test plug socket to connect adjacent terminals. Adequate number of short circuit jumper plugs shall be provided for the purpose.
 - v) Where more than one connection to a terminal block is required, two tier terminals shall be used.
 - vi) The terminal blocks for Power, control and signal cable terminal block shall be separate with separate colour coding for ease in recognition..

7.00.00 METERING BASES AND CHART UNITS

The following system of units shall be followed for various displays and scales unless otherwise mentioned:

- i) Pressure : Kg/cm²
 Differential Pressure : mm of H₂O column / Kg/cm²
- ii) Draught : mm of H₂O column
- iii) Vacuum : Kg/cm² (abs)/mm of Hg column





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iv)	Temperature	: Degree Celsius ($^{\circ}$ C)
v)	Flow (Steam, Water)	: Tonnes / hr, M ³ /Hr
vi)	Flow (Oil)	: M ³ / Hr, Liter/Hr
vii)	Flow Air	: Tonnes / hr / M ³ / Hr.
viii)	Density	: gms / c.c.
ix)	Level	: mm /%
x)	Conductivity	: Micro Siemens / cm
xi)	Gas Analyzer	: Percentage by weight or as specified in respective case.
xii)	Dissolved Oxygen / Silica / Sodium	: ppm /ppb

8.00.00 PROCESS CONNECTION & INSTRUMENT HOOK UP

- 8.01.00 Instrument connection to the process system (piping, vessel etc.) shall be according to the process & piping specification upto and including the root valves. Root valves shall be installed as close as possible to the piping or vessel.
- 8.02.00 Each instrument shall have its own independent connection to the process except for instruments located on standpipe. Each instrument shall be connected independently to the standpipe through isolation valve.
- 8.03.00 Process connection for instruments lines and vessels shall be in accordance to standards such as ASME or other recognized international standards.





10.00.00 ENVIRONMENTAL CONSIDERATIONS

C&I components shall operate properly with no degradation in expected lifetime or in operation parameter in the normal power plant environment. C&I system shall be designed considering all the operating conditions which may be encountered during installation and operation.

10.01.00 Temperature

10.01.01 Where the environmental extreme exceeds the capabilities of the selected system, Bidder shall take appropriate steps to control the environment.

10.02.00 Humidity

10.02.01 C&I system shall be designed to withstand the humidity limits specified for the project. Condensation shall not be allowed to form in the cabinets nor shall water be allowed to be admitted through conduit entering the cabinets from top or sides.

10.03.00 Atmospheric Contamination

10.03.01 Particulate contamination from fly ash and coal dust and gaseous contaminants such as SO₂ and other flue gas constituents in the coal fired plant are foreseen. This hazard shall be taken into design considerations.

10.04.00 Vibration

10.04.01 Design of the systems shall include features such as locking devices, anti vibration pads etc, to withstand vibration. In general, C&I equipment shall be installed away from the vibration zone.

10.05.00 Lightning

10.05.01 Protection against lightning shall be considered by providing proper grounding, metal oxide varistors, spark gap lightning arrestor, optical isolator and isolation transformer.

11.00.00 SECURITY

11.01.00 IP Door lock shall be provided in all Panels, Cabinets and Enclosures.

11.02.00 System mode key switch or password to prevent tampering of system program.





- 11.03.00 Redundant elements of the system shall not be exposed to the common hazards. For example routing of the redundant network cable through separate cable raceway, using separate cabinet / separate rack for redundant controller and redundant IO modules.

	DATA SHEET FOR LOCAL PANELS		SPECIFICATION NO.: PES-145-054A	
			VOLUME	
			SECTION	
			REV. NO. 01	DATE: 24.01.2019
			SHEET 1	OF 2
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	☒ 3.0 mm (FOR FACES SUPPORTING INSTRUMENTS/TERMINALS)	
		OTHER	☒ 2.0 mm (FOR OTHER SIDES AND TOP)	
		DOOR	☒ 2.0 mm	
		HEIGHT	☐ 2365 mm for stand alone panels. (THIS SHALL BE DECIDED BY BHEL DURING DETAILED ENGG.)	
	OTHER	☐		
TECHNICAL	INPUT POWER SUPPLY *		☐ 240V 50 Hz AC ☐ 220V DC ☐ 415V 3 PHASE 3W ☐ 415V 3 PHASE 4W	
	NO. OF FEEDERS		☐ ONE ☒ TWO	
	CONTROL SUPPLY		☐ 110V AC ☐ 220V AC ☐ 220V DC ☐ Other. (As per requirement)	
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)		_____ NOS. (AS REQUIRED)	
	PAINT TYPE		☐ EPOXY ENAMEL ☒ EPOXY POWDER COATED OR BETTER (THIS SHALL BE DECIDED BY BHEL DURING DETAILED ENGG.)	
	PANEL COLOUR (EXTERNAL)		☐ LIGHT GREY (Shade 631 IS-5) ☐ OPALINE GREEN (Shade 275) . ☒ RAL 7032 (THIS SHALL BE DECIDED BY BHEL DURING DETAILED ENGG.)	
	FINISH (EXTERNAL)		☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY	
	PANEL COLOUR (INTERNAL)		☐ WHITE ☐ CREAM ☐ OFF WHITE ☒ BRILLIANT 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	
	FOUNDATION ARRANGEMENT		☐ FOUNDATION BOLTS ☐ ANCHOR FASTENERS	
	WEIGHT OF PANEL (Kg.)			
	PANEL TYPE		☐ PRESSURISED ☐ UNPRESSURISED As per Requirement	
	CABLE GLAND		☐ DOUBLE COMPRESSION	
AMMETER (TYPE OF INPUT) *		☐ 1 Amp CT ☐ 4-20 mA		

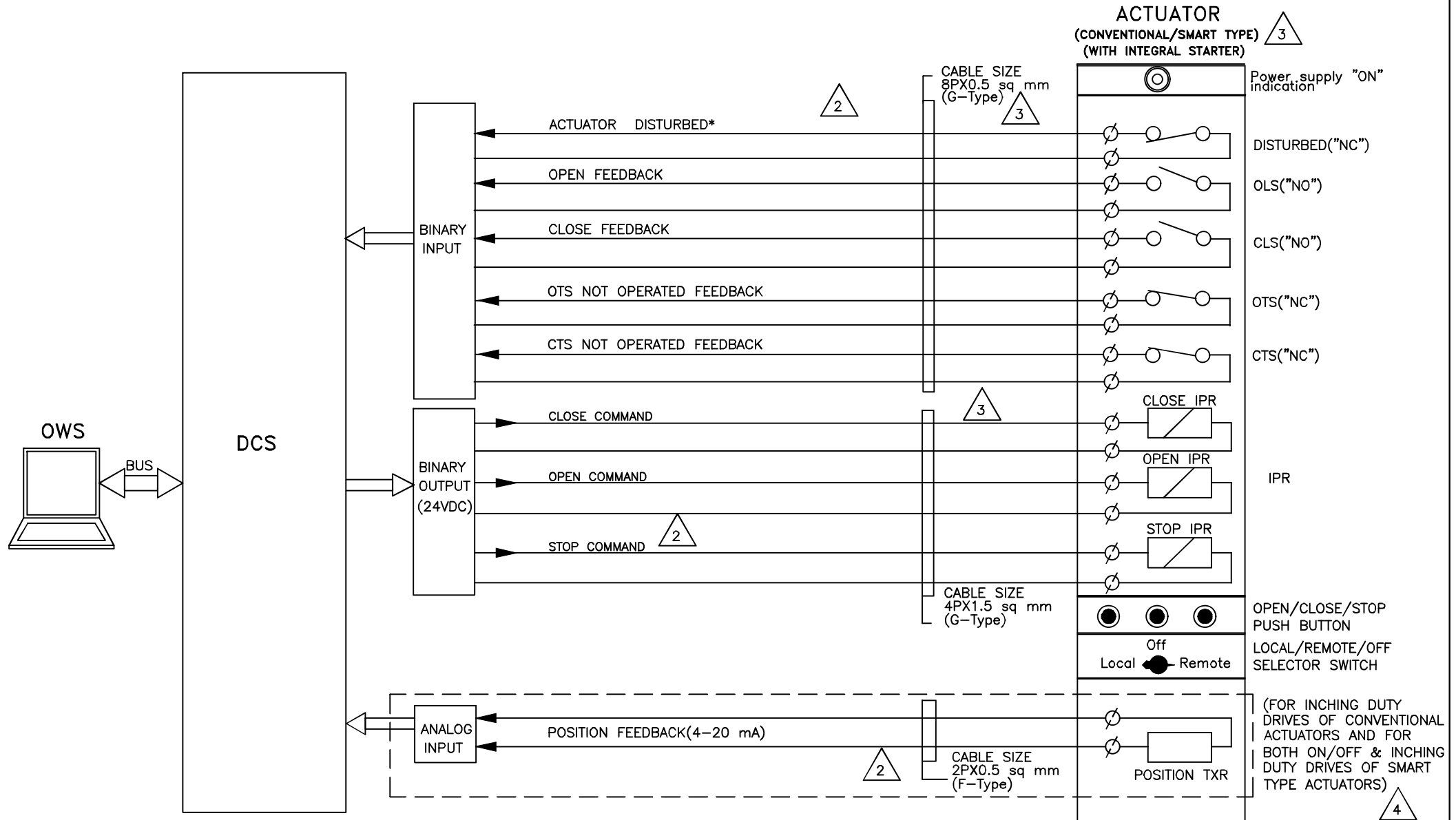
523866/2021/PS-PEM-MSE

FORM NO. PEM-6666-0

	DATA SHEET FOR LOCAL PANELS			SPECIFICATION NO.: PES-145-054A		
				VOLUME		
				SECTION		
				REV. NO.	01	DATE: 24.01.2019
				SHEET	2	OF 2
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)		
* TO BE CO-ORDINATED WITH PEM ELECTRICAL						
NAME SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY			
			COMPANY SEAL			
			NAME:			
			SIGNATURE:			
			DATE:			

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	1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	SECTION: C SUB SECTION : C&I
	C&I SPECIFICATION FOR COLTCS, SCS & DF	
SIGNL EXCHANGE BETWEEN DRIVES & DCS		



NOTE:

* DISTURBED=

Loss of Power supply (1 Phase/3 Phase)/
 Loss of control supply/ Motor thermostat trip/
 Thermal over load/ Local/Off/Remote Sel.
 switch in local or off mode/ Stop PB optd/
 Torque open/close cutoff/ Valve jammed



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

TITLE DDCMIS INTERFACE FOR
 BIDIRECTIONAL DRIVE

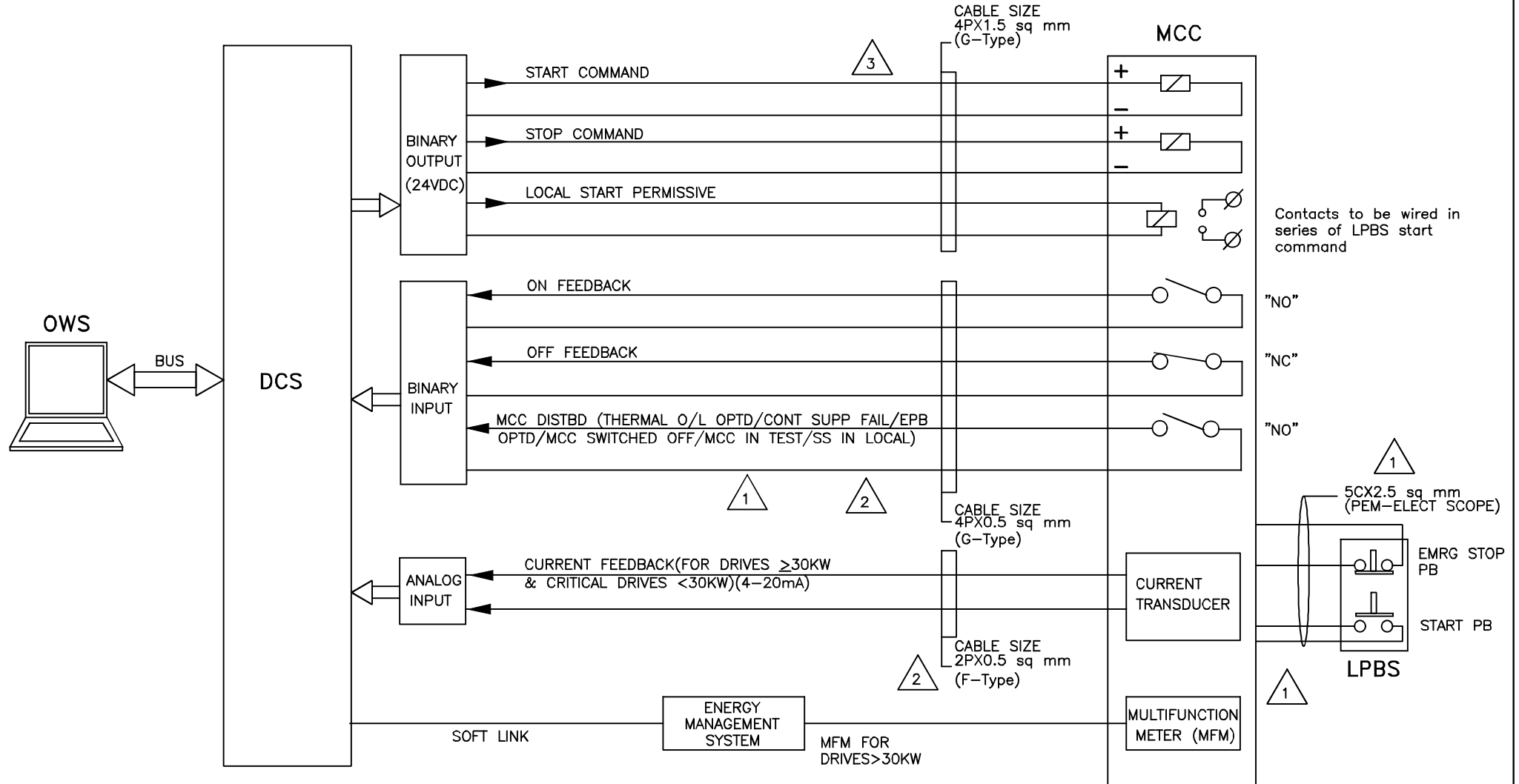
DRG.NO. PE-DM-445-145-I002

DATE 15.03.2021

REV.NO. 04

SHT 7 **OF** 11

523866/2021/PS-PEM-MSE

DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE (CONTACTOR OPERATED) 1

NOTES:

REDUNDANCY IN OUTPUT SHALL BE PROVIDED FOR ALL CRITICAL LT DRIVES 2PROJECT: 1X660MW SAGARDIGHI THERMAL POWER
EXTENSION PROJECT (UNIT #5)TITLE DDCMIS INTERFACE FOR
UNIDIRECTIONAL LT DRIVE (CONTACTOR OPERATED)

DRG.NO. PE-DM-445-145-I002

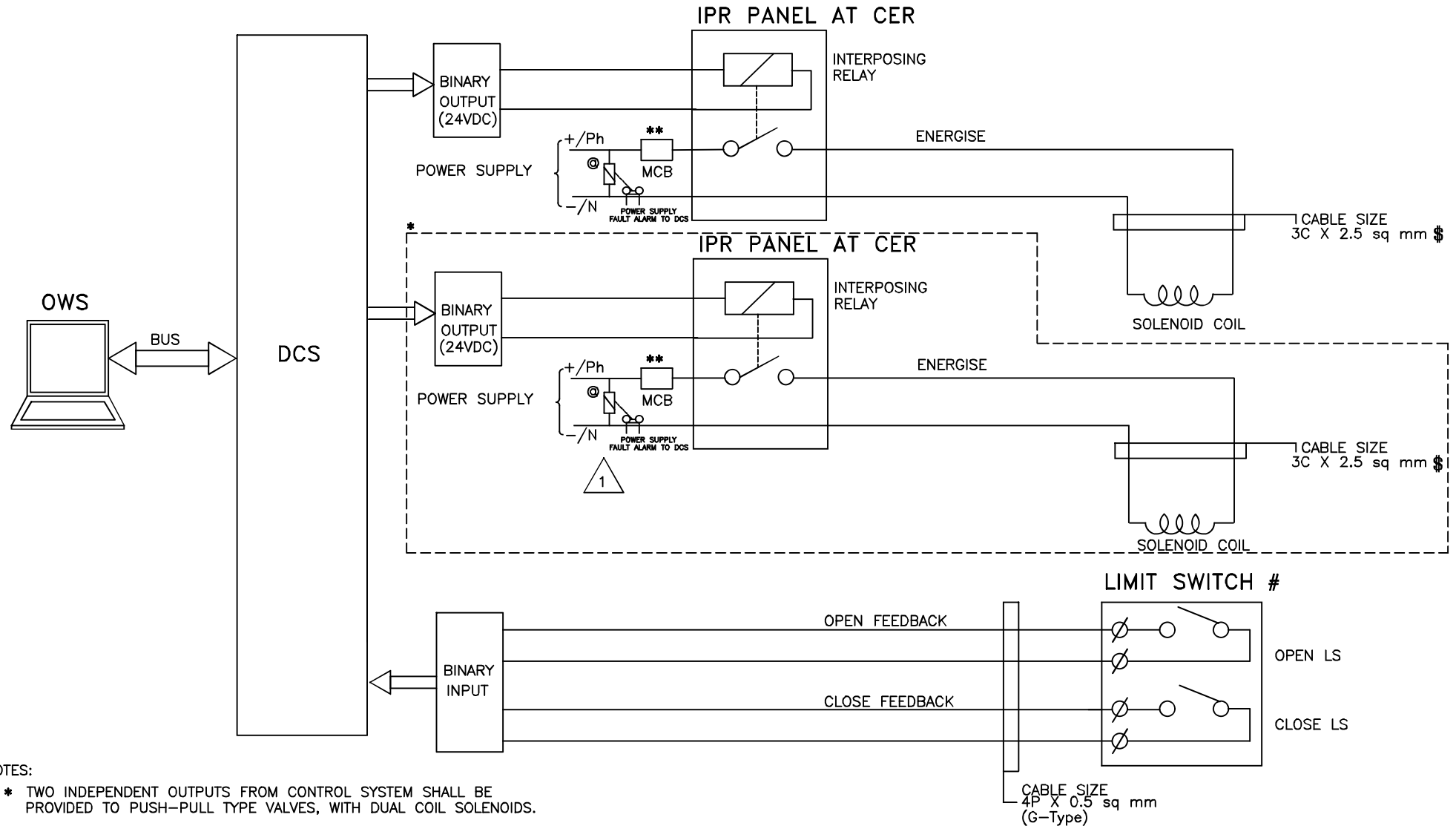
DATE 15.03.2021

REV.NO. 04

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523866/2021/PS-PEM-MSE

DCS INTERFACE FOR SOLENOID DRIVE (24V DC / 240V AC UPS)



NOTES:

* TWO INDEPENDENT OUTPUTS FROM CONTROL SYSTEM SHALL BE PROVIDED TO PUSH-PULL TYPE VALVES, WITH DUAL COIL SOLENOIDS.

** MCB SHALL BE PROVIDED FOR EACH SOLENOID

FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL/ PNEUMATIC VALVE.

@ COMMON FOR ALL SOLENOID VALVES SIMILAR COIL VOLTAGE RATING PER PANEL.

\$ POWER CABLE CROSS SECTION SHALL BE AS PER CABLE SIZING CALCULATION.



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

TITLE DDCMIS INTERFACE FOR
SOLENOID DRIVE

DRG.NO. PE-DM-445-145-I002

DATE 15.03.2021

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	1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	SECTION: C SUB SECTION : C&I
	C&I SPECIFICATION FOR COLTCS, SCS & DF	
INSTRUMENT CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY		



11.03.00 Instrumentation Cable Interconnection and Termination Philosophy

The cable interconnection philosophy to be adopted shall be such that extensive grouping of signals by large scale use of field mounted Group JB's at strategic locations (where large concentration of signals are available, e.g. switchgear) is done and consequently cable with higher number of pairs are extensively used. JB's to be furnished under this specification shall be of 6/12/24/36/48 way. The material dimension and interior / exterior colour of JB's shall be subject to Owner's approval. The details of termination to be followed is mentioned in TABLE – 3 :



TABLE- 3
CABLE TERMINATION TO BE FOLLOWED

SL. No	APPLICATION		TYPE OF TERMINATION		TYPE OF CABLE
	FROM (A)	To (B)	END (A)	END (B)	
01.	Valves / Dampers Drive (Integral Junction Box)	Marshalling Cubicle / Local Group JB / Termination Control Cabinets / System Cabinets	Plug-in Connector	Post mounted Maxitermi / Cage Clamp type	G
02.	Transmitters, Process actuated switches to be mounted in LIE / LIR	Integral Junction Box of LIE / LIR	Plug-in Connector	Maxitermi / Cage Clamp (Rail mounted) type.	F, G
03.	RTD Heads	Local Junction Box	Plug-in Connector	Maxitermi / Cage Clamp (Rail mounted) type.	H
04.	Thermocouples	CJC Box	Manufacturer's standard	Screwed / Cage Clamp Type	A,B,C*
05.	Local Junction Box, CJC Box, Int. Junction Box of LIE / LIR / Group JB / MCC / Switchgear	Marshalling Cubicle / Local Group JB / Termination / Control Cabinets / System Cabinets	Maxitermi / Cage Clamp (Rail mounted) type.	Post mounted Maxitermi / Cage Clamp type	F, G
06.	Local Junction Box, MCC / Switchgear	Group JB	Maxitermi / Cage Clamp (Rail mounted) type.	Maxitermi / Cage Clamp (Rail mounted) type.	F, G
07.	Field mounted Instrument	Group JB	Maxitermi / Cage Clamp (Rail mounted) type.	Maxitermi / Cage Clamp (Rail mounted) type.	F, G
08.	Marshalling Cubicle /	Electronic System	Post mounted Maxitermi /	Post mounted Maxitermi /	F, G



SL. No	APPLICATION		TYPE OF TERMINATION		TYPE OF CABLE
	FROM (A)	To (B)	END (A)	END (B)	
	Termination Cabinet	Cabinet	Cage Clamp type.	Cage Clamp type.	
09.	UCP mounted equipments	Post mounted Maxitermi / Cage Clamp type	Post mounted Maxitermi / Cage Clamp type.	Plug in Connector / Cage Clamp type (rail mounted)	F, G (with connector at one end)
10.	DCS/ PLC Cabinets	PC, Printers etc.	Plug in connector	Plug in connector	Manufacturer Standard

NOTES :

01. For Sl. No. 05, 06, 07 & 08, normally 10% spare core shall be provided.
02. For analog signals individual pair shielding & overall shielding & for Binary signals only overall shielding of instrumentation cables shall be provided.
- 03 *For high temperature application only.

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	1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	SECTION: C SUB SECTION : C&I
	C&I SPECIFICATION FOR COLTCS, SCS & DF	
ERECTION HARDWARE		



12.00.00 ERECTION HARDWARE

This section provides the general technical guidelines for the erection materials for instruments. All erection materials shall be of good quality and conform to the operating environment of the corresponding instrument.

12.01.00 ELECTRICAL ACCESSORIES

Electrical conduit and associated materials shall conform to the requirements of the articles which follow :

a) Rigid Steel Conduit

- i) Conduits up to and including 25 mm shall be of 16 SWG and conduits above 25 mm shall be of 14 SWG. Minimum size of conduits shall be 19 mm.
- ii) Each piece of conduit shall be straight, free from blister and other defects and covered with capped bushing at both ends.
- iii) All rigid conduit couplings and elbows shall be hot dip galvanized rigid mild steel in accordance with ANSI C 80.1 and UL6. The conduit interior and exterior surfaces shall have a continuous zinc coating with an over coat of transparent enamel or zinc chromate. Conduits shall be furnished in standard length of 3 meters, threaded at both ends.
- iv) All conduit fittings shall conform to the requirements of ANSI C 80.4 and UL-514 where these standards apply.

b) Flexible Conduit

- i) Flexible conduit shall be of three layer construction of very high quality of lead coated steel. Outside and inside layer shall be reinforced with heat resistant material.
- ii) Lead coating outside and inside of the conduit steel surface shall provide a non-corrosive characteristic particularly in acidic atmosphere. Besides flexibility, this shall be strong enough to stay at the desired profile without support and shall be durable and strong so as to offer sufficient mechanical protection. It shall also be fully liquid dust and air tight and shall withstand a continuous hydraulic pressure up to 2 Kg/Sq. cm and temperature up to 200 °C.

c) Special Fittings





- i) Conduit sealing and fittings shall be provided as required and shall be consistent with the area and equipment with which they are installed.
- ii) Double locknuts shall be provided on all conduit terminations not provided with threaded lugs and couplings. Locknuts shall be designed to securely bond the conduit to the enclosure when tightened. Locknuts shall not loosen due to vibration.

12.01.01 Junction Box

01. Type of Enclosure : Dust tight & weatherproof conforming to IP 65
02. Material : 2 mm sheet steel
03. Type of Cover : Solid Hinged Door with steel handle and IP lock
04. Paint : 631 IS 5 Epoxy Powder Coated
05. Mounting : Surface
06. Cable Entry : 3 mm (min) Gland plate
07. Gasket : Neoprene
08. Grounding : Brass earth lug with green screw head
External-2 nos , Internal-1no.M6.
09. Number of Drain Holes : Two at bottom capped.
10. Identification : Label for JB and Tags for cable
11. Accessories : a) Rail mounted cage clamp type screwless terminals with markers
b) Cable gland
c) Ferrules
d) Canopy at top

12.01.02 Cable Gland

01. Type : Double compression
02. Entry Thread : NPT
03. Material : Brass
04. Finish : Cadmium Plated.
05. Protection : IP 65 or better





06. Accessories : Neoprene gasket, locknuts, reducers etc.

12.01.03 Cable Tray

01. Material : Mild steel
02. Thickness : not less than 2.0 mm
03. Finish : Hot dip galvanized
04. Perforation : As per MFR standard.
05. Cover : Suitable for tray
06. Height of the cable tray : 100 mm for 450mm and above width.
(width cannot be less than 100 mm)

12.02.00 PROCESS HOOK UP ACCESSORIES & SPECIFICATION

Material and rating of the hook up items shall suit the piping and fluid condition. ~~Hook up materials shall be IBR certified for applicable cases.~~
 Bidder shall furnish hook up drawings and the drawings for open racks & closed racks for Owner's approval.

12.02.01 Specification for Process Hook Up Materials

PROCESS CONNECTION PIPING

SL. NO.	SYSTEM / LINE DESCRIPTION	PIPING CLASS	IMPULSE PIPING MATERIAL	SCHEDULE (SIZE)	MATERIALS FOR FITTING / VALVE BODY	VALVE STEM MATERIAL	RATING OF PIPING / FITTINGS	PRESS. CLASS OF VALVE
01.	MAIN STEAM / UPSTREAM OF HP BYPASS AND AUXILIARY STEAM PRESSURE REDUCING VALVE	A	ASTM-A335 GR. P-91/22 (NOTE-2)	XXS (1/2 INCH)	ASTM-A182 Gr. F-22	ASTM-A182 Gr. F-6a	9000 LB	3000 SPL
02.	BFP DISCHARGE / SUPERHEATER ATTEMPERATOR / SPRAY TO PRDS	B	ASTM-A106 GR. C	160 (1/2 INCH)	ASTM-A105	ASTM-A-182 GR. F6A	6000 LB	2500
03.	REHEATER ATTEMPERATOR	C	ASTM-A106 GR. C	160 (1/2 INCH)	ASTM-A105	ASTM-A-182 GR. F6A	6000 LB	1500





04.	HOT REHEAT / DOWN STREAM OF AUX. STEAM PRESSURE REDUCING VALVE UPTO DESUPER- HEATER / FLASH TANK DRAIN MANIFOLD	D	ASTM- A335 GR. P-91/22 (NOTE-2)	160 (1/2 INCH)	ASTM- A182 GR.F-22	ASTM- A182 Gr.F-6a	3000 LB	900
05.	COLD REHEAT UPTO TEE-OFF FOR HP BYPASS / EXTRACTION STEAM NO. 5 TO HPH	E	ASTM- A335 GR. P-22	80 (1/2 INCH)	ASTM- A182 GR.F-22	ASTM-A- 182 GR. F6A	3000 LB	800
06.	COLD REHEAT DOWN-STEAM OF TEE-OFF (HP BYPASS)	F	ASTM- A106 GR. C	80 (1/2 INCH)	ASTM- A105	ASTM-A- 182 GR. F6A	3000 LB	800
07.	BFP SUCTION / CONDENSATE SYSTEM / EXTRACTION TO LPH / EXTRACTION-4 TO BFP-T, DEAERATOR / AUXILIARY STEAM	G	ASTM- A106 GR. B	80 (1/2 INCH)	ASTM- A105	ASTM-A- 182 GR. F6A	3000 LB	800
08.	AIR / FLUE GAS OUTSIDE FURNACE	M	ASTM- A106 GR. B/C	80 (3/4 INCH)	ASTM- A105	ASTM-A- 182 GR. F6A	3000 LB	800
09.	AIR / FLUE GAS INSIDE FURNACE	N	ASTM- A335 GR. P-22	80 (3/4 INCH)	ASTM- A182 GR. F-22	ASTM-A- 182 GR. F6A	3000 LB	800
10.	Purge Air	—	ASTM- A106 Gr. C	80 (3/4 inch)	ASTM- A 105 Gr. F-22	SS or better	3000 lb	800
11.	DM Cooling Water	—	ASTM A312 TP 316	40 (1/2 inch)	ASTM A182 F316	SS or better	3000 lb	800
12.	CW & ACW	—	ASTM- A106 Gr. C	80 (1/2 inch)	ASTM- A 105	SS or better	3000 lb	800

NOTE :

- (1) RATING OF PIPING / FITTINGS / VALVES ETC. IS SUBJECTED TO THE DESIGN PRESSURE & TEMPERATURE DURING THE DETAILED ENGINEERING.
- (2) IN CASE TEMPERATURE IS MORE THAN 540 DEG. C, THE MATERIAL SHALL BE P-91 ONLY.





12.02.02 Seamless Stainless Steel Pipe

01. Reference : ASTM A-312 TP 316
02. Material Grade : TP 316
03. Type : Seamless /Plain end
04. Size : ½" NB
05. Schedule : 40
06. Standard Length : 5 meter

12.02.03 Stainless Steel Pipe Fittings

01. Reference : ASTM A-182 F 316 / ANSI B16.11
02. Type : Forged
03. Rating : 3000 lbs / 6000 lbs / 9000 lbs
04. Size : ½" NB
05. End connection : Generally socket weld
06. Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

12.02.04 Seamless Stainless Steel Tube

01. Reference : ASTM A-213 TP 316
02. Material Grade : TP 316
03. Size : ½" OD X 2.1 MM Thick
04. Type : Cold drawn annealed, pickled, passivated, de-scaled, hydraulically cleaned seamless tube.
05. Properties : The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80.
06. Test Pressure : 400 Kg/Sq. cm (minimum)
07. Tolerance : ± 0.13 mm for outside diameter
± 15 % for wall thickness





08. Standard Length : 5 meter
09. Test : Flare, Hardness, Ball and Bubble Test

12.02.05 Stainless Steel Tube Fittings

01. Reference : ASTM-A-182
02. Type : Double ferrule double compression
03. Material : 316 Stainless steel forged
04. Ferrule : 316 Stainless Steel
05. Type of Fittings : Male / female connector, elbow, cross /equal tee, straight connector, bulkhead union, ferrule etc. as required to suit installation.
06. Size : To suit SS tubing and NPT end connection

12.02.06 C.S. Pipe

01. Reference : ASTM-A 106 Gr. C
02. Material : Cold drawn seamless black C.S.
03. Type : Seamless / Plain ends
04. Size : ½" NB
05. Schedule : 80, 160, XXS as required
06. Standard Length : 5 meter

12.02.07 C.S. Pipe Fittings

01. Reference : ASTM-A 105 / ANSI B16.11
02. Type : Forged
03. Rating : 3000 lbs / 6000 lbs / 9000 lbs
04. Size : ½" NB
05. End connection : Generally socket weld
06. Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.





- 12.02.08 A.S. Pipe
01. Reference : ASTM-A 335 P22 AS PER ANSI B 36.10
 02. Material : Cold drawn seamless A.S.
 03. Type : Seamless / Plain ends
 04. Size : ½" NB
 05. Schedule : XXS
 06. Standard Length : 5 meter
- 12.02.09 A.S. Pipe Fittings
01. Reference : ASTM-A 182 F22 AS PER ANSI B 16.11
 02. Type : Forged
 03. Rating : 9000 lbs
 04. Size : ½" NB
 05. End connection : Generally socket weld
 06. Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.
- 12.02.10 Carbon Steel Globe Valve
01. Reference : ASTM A-105
 02. Type : Globe
 03. Construction : Forged Body Cadmium Plated
 04. End Connection : ½" Socket Weld
 05. Rating : Cl. 800 / CL. 2500
 06. Material : Body - Carbon steel
Stem - Hardened Steel
Plug - AISI 316 SS
Seat- Stainless steel stellited
 07. Packing : Teflon / Grafoil as required



- 08. Yoke : ASTM A105
- 09. Handwheel : Carbon steel
- 10. Design standard : As per ANSI B 16.34

12.02.11 Stainless Steel Globe Valve

- 01. Reference : ASTM A-182 F316
- 02. Type : Globe
- 03. Construction : Forged Body
- 04. End Connection : Socket Weld
- 05. Proof Pressure : 400 Kg/Cm2
- 06. Material : Body - Stainless steel
Stem - Hardened Steel
Plug - AISI 316 SS
Seat- Stainless steel stellited
- 07. Packing : Teflon as required
- 08. Yoke : ASTM A182 F316
- 09. Handwheel : Carbon steel
- 10. Design standard : As per ANSI B 16.34

12.02.12 Alloy Steel Globe Valve

- 01. Reference : ASTM A-182 F22
- 02. Type : Globe
- 03. Construction : Forged Body
- 04. End Connection : ½" Socket Weld
- 05. Rating : CL. 2500
- 06. Material : Body - Alloy steel
Stem - Hardened Steel
Plug - AISI 316 SS
Seat- Stainless steel stellited





- 07. Packing : Grafoil as required
- 08. Yoke : ASTM A182 F22
- 09. Handwheel : Carbon steel
- 10. Design standard : As per ANSI B 16.34

12.02.13 Condensate Pot

- 01. Reference : ASTM A182 F22 /ASTM A105
- 02. Material : Alloy steel / carbon steel as per application
- 03. Construction : Drilled from barstock
- 04. End connection : 3 nos. ½" socket weld end
- 05. Accessories : Vent valves

12.02.14 Instrument Valve Manifold

- 01. Type : a) Two valve manifold
b) Five valve manifold
- 02. Mounting : Remote 2" Pipe Mounting
- 03. Construction : Single block (bar stock)
- 04. Material : Forged body and bonnet AISI 316 stainless steel
- 05. Ports : 1/2 " NPT (F)
- 06. Rating : 420 Kg/Sq. cm at ambient
- 07. Operating Temperature : (-) 30 to (+) 170 Deg C
- 08. Packing : PTFE Wafer
- 09. Seat & Stem : AISI 316 SS
- 10. Plug : AISI 316 SS free to turn on stem / 17-4 PH
- 11. Handle Bar : AISI 316 SS
- 12. Connection : Straight
- 13. Accessories : i) Plugs for all ports





ii) Mounting Bracket , bolts , nuts

12.03.00 PNEUMATIC HOOK UP ACCESSORIES

12.03.01 Air Header

Technical Particulars :

		For Panel	For Field
01.	Material of Construction :	Stainless steel	Stainless steel
02.	Inlet Connection :	2" NPT (M)	1" NPT (M)
03.	Header Take-off :	Stainless steel	Stainless steel
04.	Take off connection :	1 / 2" NPT (M)	1/ 2" NPT (M)
05.	Take-off Valves :	stainless steel	stainless steel
06.	Tube Take-off :	Tube adapter on valve	Tube adapter on valve
07.	Drain :	SS drain valve at lowest point	SS drain valves at lowest point

12.03.02 Seamless Stainless Steel Tube

01.	Reference :	ASTM A-269 TP 31605
02.	Material Grade :	TP 316
03.	Size :	¼" OD X 0.049" wall thickness
04.	Type :	Cold drawn annealed, pickled, passivated, de-scaled, ,hydraulically cleaned seamless tube.
05.	Properties :	The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80.
06.	Test Pressure :	400 Kg/Sq. cm
07.	Tolerance :	± 0.13 mm for outside diameter ± 15 % for wall thickness
08.	Standard Length :	5 meter
09.	Test :	Flare, Hardness, Ball and Bubble Test



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	1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	SECTION: C SUB SECTION : C&I
	C&I SPECIFICATION FOR COLTCS, SCS & DF	
QUALITY ASSURANCE PLAN/CHECK LIST		



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2.00.00 GENERAL REQUIREMENTS - QUALITY ASSURANCE

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





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

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

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

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

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

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

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

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

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

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

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

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





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

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

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

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

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

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

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

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

3.00.00 **QUALITY ASSURANCE DOCUMENTS**

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

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





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

4.00.00 INSPECTION, TESTING AND INSPECTION CERTIFICATES

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

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



**WBPDC**

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

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	1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	SECTION: C SUB SECTION : C&I
	C&I SPECIFICATION FOR COLTCS, SCS & DF	
APPLICABLE CODES AND STANDARDS		



13.00.00 TYPE TEST REQUIREMENTS

13.01.00 General Requirements

- 13.01.01 Contractor shall furnish the type test reports of all type tests as per relevant standards and codes as well as other specific tests indicated in this specification. A list of such tests are given for various equipment in table titled 'Type Test Requirement for C&I Systems' at the end of this sub-section. For the balance equipment instrument, type tests may be conducted as per manufacturers standard or if required by relevant standard.
- 13.01.02 Out of the tests listed, Bidder/ sub-vendor/ manufacturer is required to conduct certain type tests specifically for this contract (and witnessed by Owner or his authorized representative) even if the same had been conducted earlier, as clearly indicated subsequently against such tests.
- 13.01.03 For the rest, submission of type test results and certificate shall be acceptable provided:
- a) The same has been carried out by Bidder/ sub-vendor on exactly the same model / rating of equipment.
 - b) There has been no change in the components from the offered equipment & tested equipment.
 - c) The test has been carried out as per the latest standards along with amendments as on the date of bid opening.
- 13.01.04 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 Bidder within the quoted price and no extra cost will be payable by Owner on this account
- 13.01.05 As mentioned against certain items, the test certificates for some of the items shall be reviewed and approved by Bidder or his authorized representative and the balance have to be approved by Owner.
- 13.01.06 The schedule of conduction of type tests/ submission of reports shall be submitted and finalized during pre-award discussion.
- 13.01.07 For the type tests to be conducted, Contractor shall submit detailed test procedure for approval by Owner. This shall clearly specify test setup, instruments to be used, procedure, acceptance norms (wherever applicable), recording of different parameters, interval of recording precautions to be taken etc. for the tests to be carried out.
- 13.01.08 Bidder shall indicate in his bid, the cost of the type test for each items only for which type tests are to be conducted specifically for this project.



13.02.00 Special Requirement for Solid State Equipments/ Systems

The minimum type tests reports, over and above the requirements of above clause which are to be submitted for each of the major C&I systems like SG-C&I system, TG- C&I system, Station - C&I system, Flame monitoring system, Coal feeders control and instrumentation system, Boiler flame analysis system, Turbine supervisory system, BFP Turbine supervisory instruments, Analyzer instruments, Vibration monitoring systems, etc. shall be as indicated below:

13.02.01 Surge Protections for Solid State Equipments/ Systems

All solid state systems/ equipments shall be able to withstand the electrical noise and surges as encountered in actual service conditions and inherent in a power plant. All the solid state systems/ equipments shall be provided with all required protections that needs the surge withstand capability as defined in ANSI 37.90a/ IEEE-472. Hence, all front end cards which receive external signals like analog input & output modules, binary input & output modules etc. including power supply, data highway, data links shall be provided with protections that meets the surge withstand capability as defined in ANSI 37.90a/ IEEE-472. Complete details of the features incorporated in electronics systems to meet this requirement, the relevant tests carried out, the test certificates etc. shall be submitted along with the proposal. As an alternative to above, suitable class of IEC-255-4 which is equivalent to ANSI 37.90a/ IEEE-472 may also be adopted for SWC test.

13.02.02 Dry heat test as per IEC-68-2-2.

13.02.03 Damp heat test as per IEC-68-3.

13.02.04 Vibration test as per IEC-68-2-6.

13.02.05 Electrostatic discharge tests as per IEC 801-2 or equivalent.

13.02.06 Radio frequency immunity test as per IEC 801-6 or equivalent.

13.02.07 Electromagnetic immunity as per IEC 801-3 or equivalent.

Test listed at clause no. 13.02.05, 13.02.06 & 13.02.07 above are applicable for front end cards only as defined under clause no. 13.02.01 above.

14.00.00 SPECIAL TOOLS & TACKLE AND TEST EQUIPMENT FOR DCS AND OTHER SYSTEMS

14.00.01 Bidder shall supply a complete set of new, unused and reliable type of special tools and tackle and test equipment which are necessary or convenient for erection, commissioning, maintenance and overhaul of the plant and equipment provided under this specification.

14.00.02 The tools & tackle and Test Equipment shall be shipped in separate container, clearly marked with names of the equipment for which they are intended.





- 14.00.03 Bidder shall furnish list of tools & tackle and test equipment proposed to be supplied along with the bid, if applicable. Minimum two (2) nos antistatic wrist band in each control panels are mandatory and shall be included in the bid.

13.03.00 Type Test Requirement for C&I Systems

SL. No.	ITEM	TEST REQUIREMENT	STANDARD	TEST TO BE SPECIFICALLY CONDUCTED	APPROVAL REQUIRED ON TEST CERTIFICATE	REMARKS
01.	THERMOCOUPLES	DEGREE OF PROTECTION TEST	IS-2147	NO	NO	
02.	RTD	AS PER STANDARD	IEC-751	NO	NO	
03.	C.J.C. Box	DEGREE OF PROTECTION TEST AMBIENT TEMP. EFFECT	IS-2147	NO	YES	
			APPROVED PROCEDURE	NO	YES	
04.	ELECTRONIC TRANSMITTER	AS PER STANDARD	BS-6447 / IEC-770	NO	YES	
05.	E/P CONVERTER	AS PER STANDARD	MFR. STANDARD	NO	YES	
06.	DUST EMISSION MONITOR	DEGREE OF PROTECTION TEST	IS-2147	NO	YES	
07.	INSTRUMENTATION CABLES TWISTED & SHIELDED			YES	YES	
	A) CONDUCTOR	• RESISTANCE TEST	VDE-0815			
		• DIAMETER TEST	IS-10810			
		• TIN COATING TEST (DRAIN WIRE)				
	B) INSULATION	• LOSS OF MASS	VDE-0472			
		• AGING IN AIR OVENS	VDE 0472 **			** AS PER VDE 0207 FOR TEFLON INSULATED CABLES
		• TENSILE STRENGTH AND ELONGATION	VDE 0472 **			
		• HEAT SHOCK	VDE 0472 **			
		• HOT DEFORMATION	VDE 0472			
		• SHRINKAGE	VDE 0472			
		• BLEEDING & BLOOMING	IS-5831			
	C) INNER SHEATH	• LOSS OF MASS	VDE-0472			
		• HEAT SHOCK	VDE 0472 **			
		• COLD BEND / COLD IMPACT TEST	IS-5831			
		• HOT DEFORMATION	VDE 0472			

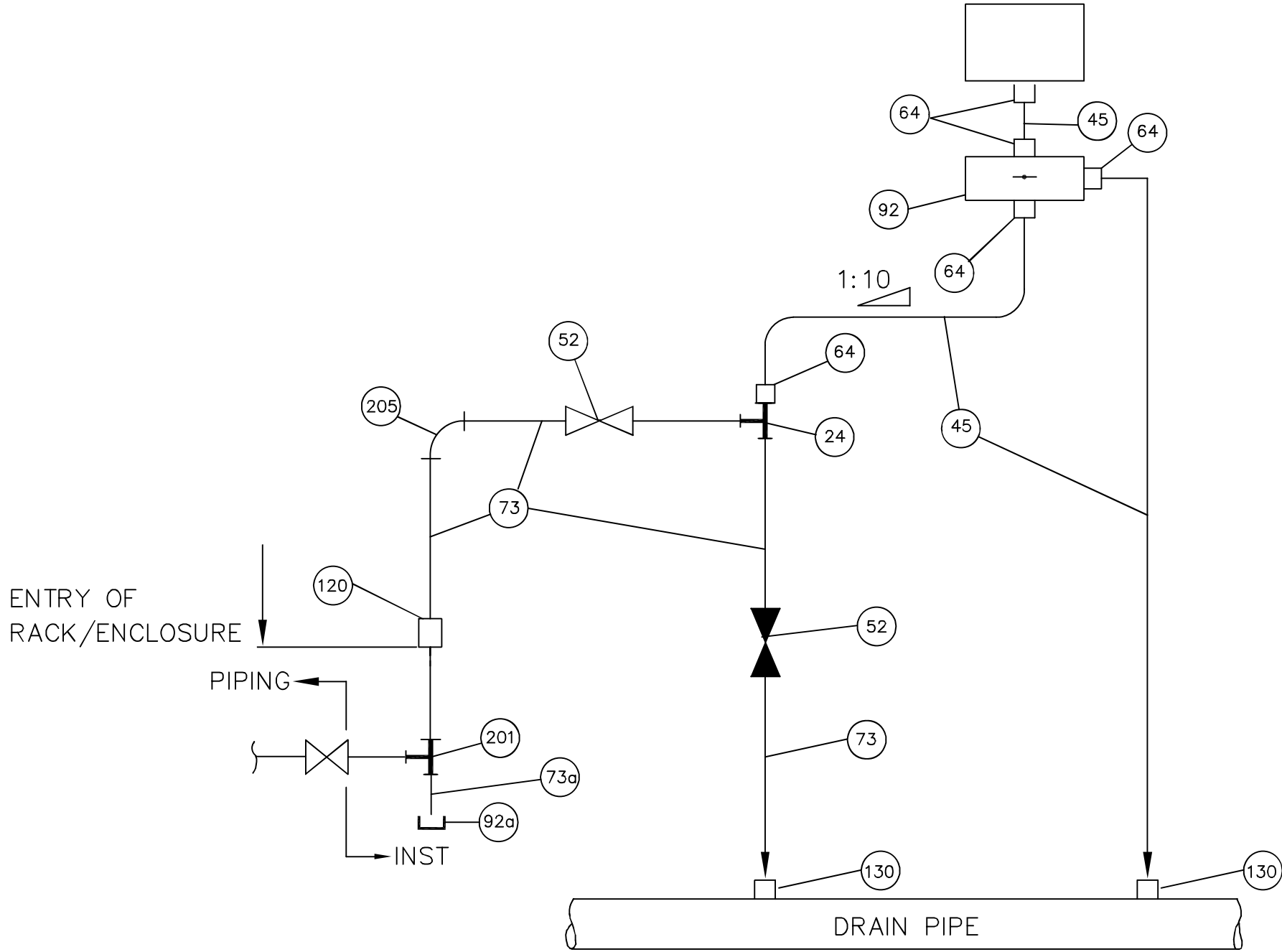
SL. No.	ITEM	TEST REQUIREMENT	STANDARD	TEST TO BE SPECIFICALLY CONDUCTED	APPROVAL REQUIRED ON TEST CERTIFICATE	REMARKS
		• DIMENSIONAL CHECKS	IS 10810			
		• CROSS TALK				
		• MUTUAL CAPACITANCE	VDE 0472			
		• HV TEST	VDE 0472			
		• DRAIN WIRE CONTINUITY				
08.	PRESSURE GAUGE	• DEGREE OF PROTECTION TEST	IS-2147	NO	NO	
		• TEMPERATURE INTERFERENCE TEST	IS-3624	NO	NO	
09.	TEMPERATURE GAUGE	DEGREE OF PROTECTION TEST	IS-2147	NO	NO	
10.	PRESSURE & DIFFERENTIAL PRESSURE SWITCH	• DEGREE OF PROTECTION TEST	IS-2147	NO	NO	
		• AS PER STANDARD	BS 6134	NO	NO	
11.	LEVEL SWITCH	DEGREE OF PROTECTION TEST	IS-2147	NO	NO	
12.	CONDUCTIVITY LEVEL SWITCH	DEGREE OF PROTECTION TEST	IS-2147	NO	YES	
13.	CONTROL VALVES	CV TEST	ISA 75.02	YES	NO	
14.	FLOW NOZZLES & ORIFICE PLATE	CALIBRATION	ASME PTC, BS-1042	YES	NO	
15.	PLCs	ALL TESTS AS PER IEC-1131	IEC-1131			
16.	DCS					
	a) I/O MODULES	CMRR & NMRR VERIFICATION	Mfr. standard	NO	YES	
	b) OTHER MODULES	CMRR & NMRR VERIFICATION	Mfr. standard	NO	YES	
	c) CLCS SYSTEMS	MODEL TEST	Approved Procedure	YES	YES	
17.	LIE / LIR / JUNCTION BOX	DEGREE OF PROTECTION TEST	IS-2147	YES	YES	
18.	FLUE GAS O ₂ ANALYZER	DEGREE OF PROTECTION TEST	IS-2147	NO	YES	
19.	FLUE GAS CO ₂ ANALYZER	DEGREE OF PROTECTION TEST	IS-2147	NO	YES	

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	1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	SECTION: C SUB SECTION : C&I
	C&I SPECIFICATION FOR COLTCS, SCS & DF	
INSTRUMENT INSTALLATION & HOOKUP DIAGRAM		

PRESSURE TRANSMITTER/PRESSURE SWITCH
MOUNTED ABOVE SOURCE POINT

PRESSURE TRANSMITTER/
SWITCH



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
24	1	UNEQUAL TEE, 1/2" SW X 1/2" NPT (F)
45	3 M	TUBE, 1/2" OD
52	2	GLOBE VALVE, 1/2" SW
64	5	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD
73	15	IMPULSE PIPE, 15 NB
73a	1	NIPPLE, 1/2" SW X 1/2" NPT (F), 150 MM
92	1	2- VALVE MANIFOLD, 1/2" NPT (F)
92a	1	DRAIN PLUG, 1/2" NPT (M)
120	1	BULK HEAD UNION/COUPLING, 1/2" SW
130	2	HALF COUPLING, 1/2" SW
201	1	EQUAL TEE, 1/2" SW
205	2	90° ELBOW, 1/2" SW

SERVICE : CONDENSER PRESSURE ETC.

FOR TENDER PURPOSE ONLY

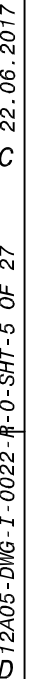
REVIEWED											
				A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	—	0	22.06.2017
				APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM		
THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.		
KOLKATA, INDIA		
SAGARDIGHI THERMAL POWER STATION		
1 x 660 MW, PHASE-III		
EXTN. UNITS # 5		



DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

JOB NO.	DCL- 12A05	SCALE : NIL
DWG. NO.	12A05-DWG-I-0022	REV. 0

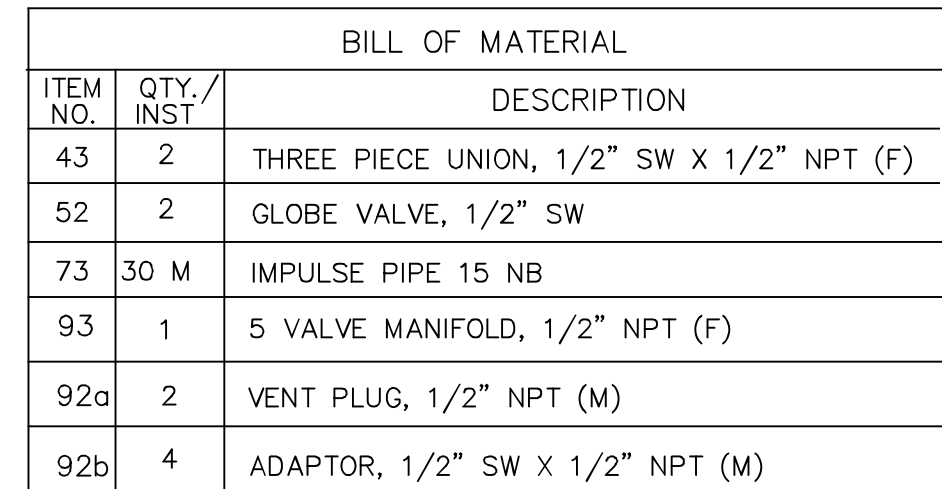


BILL OF MATERIAL		
ITEM NO.	QTY./INST	DESCRIPTION
24	1	UNEQUAL TEE, 1/2" SW X 1/2" NPT (F)
45	3 M	TUBE, 1/2" OD
52	2	GLOBE VALVES, 1/2" SW
64	8	MALE CONNECTOR, 1/2" NPT (M) X 1/2" OD
73	15 M	IMPULSE PIPE, 15 NB
92	1	2 VALVE MANIFOLD, 1/2" NPT (F)
120	1	BULK-HEAD UNION, 1/2" SW
130	2	HALF COUPLING, 1/2" SW
205	1	90° ELBOW, 1/2" SW

SERVICE : CONDENSATE, FEED WATER ETC.

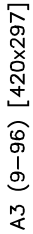
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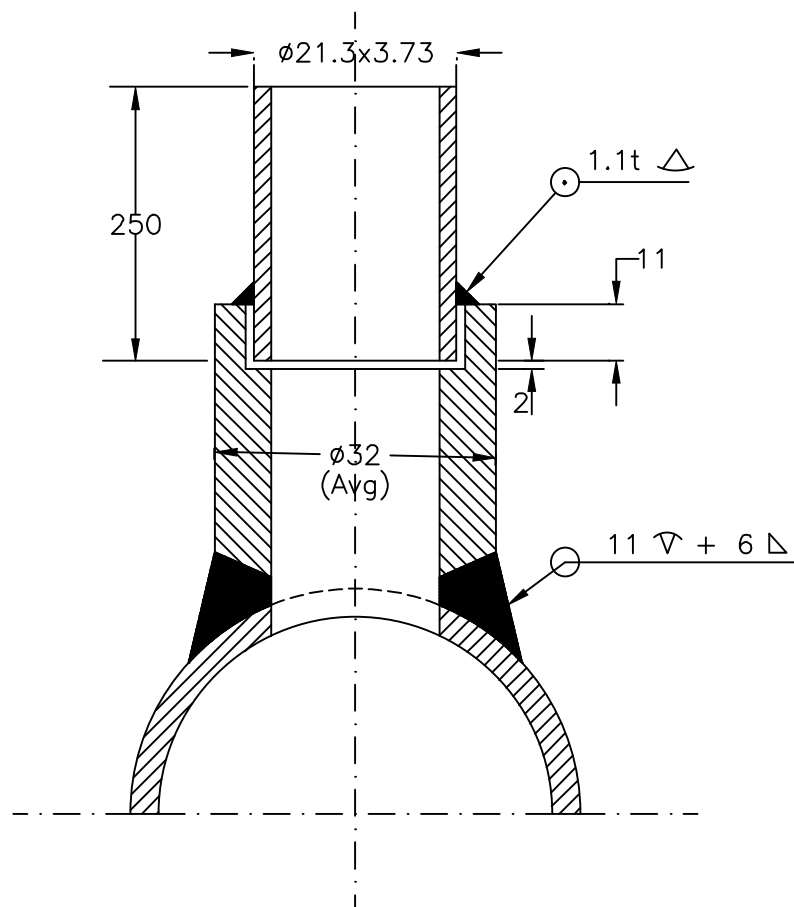
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FOR TENDER PURPOSE ONLY

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NOTE :

1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B16.11.
2. THE LENGTH OF NIPPLE SHALL BE 250 MM.
3. STUB LENGTH SHALL BE 64mm UPTO 200Nb PIPE, 45mm ABOVE 200Nb PIPE SIZE.
4. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED
5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY (1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES
6. STUB & NIPPLE SHALL HAVE IBR CERTIFICATION AS APPLICABLE, ACCORDING TO 



TITLE :
INSTRUMENT STUB DETAILS
FOR PRESSURE MEASUREMENT

(PRESS < 60Kg/Cm², TEMP < 425DegC & Nb15, CLASS 3000#)

DRG. NO.
PE-DG-445-145-I101
REV. 01
SH. 4 OF 8 SHS.

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	1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	SECTION: C SUB SECTION : C&I
	C&I SPECIFICATION FOR COLTCS, SCS & DF	
VENDOR LIST		



WBPDC

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

Annexure-I

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





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

Annexure-I

Sl. No.	Item Description	Vendor Name	
		3	IEC
76	MOOSE CONDUCTOR	1	HINDUSTAN VIDYUT PRODUCTS LTD., HARYANA
		2	GUPTA POWER INFRASTRUCTURE LTD., BHUBANESWAR
		3	HIREN ALUMINIUM Ltd., SILVASSA DADRA & NAGAR HAVELI
77	ALUMINIUM TUBE	1	HINDALCO INDUSTRIES LIMITED
		2	JINDAL ALUMINIUM LIMITED
		3	BALCO
78	STRUCTURE HARDWARE	1	DEEPAK FASTNERS LTD
		2	NAVEEN METAL INDUSTRIES, KOLKATA
		3	NEW INDIA ENGINEERING CORPORATION
79	LUGS	1	UNIVERSAL MACHINES
		2	COMET
		3	MAHAVEER ENGINEERING
		4	DOWELLS
		5	SUNIL & CO. PVT. LTD.
80	FAST BUST TRANSFER	1	AARTECH SOLONICS LTD, MP
		2	ABB
81	RAIL POLE	1	SAIL
		2	RINL
		3	TATA
82	FRP JUNCTION BOXES/ JUNCTION BOXES (POWER/CONTROL), LIGHTING JB	1	SCHNEIDER
		2	CONTROL DEVICE
		3	SWITCHING CIRCUIT
		4	JASPER ENGINEERS
		5	BAJAJ ELECTRICALS
		6	AJMERA
		7	S B EIEC. EENGINEERING CORP. Ltd
		8	PYROTECH
		9	ENGG. CONSTRUCTION CORP.
		10	L&T
83	LOCAL STARTER PANEL, LOCAL CONTROL PANEL, LIGHTING PANEL, ACELP, DCELP	1	PYROTECH
		2	L&T
		3	CONTROL DEVICE
		4	SCHNEIDER
84	LIGHTING WIRE	1	ISI MARK





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

Annexure-I

Sl. No.	Item Description	Vendor Name	
85	ACTUATOR	1	AUMA
		2	LIMITORQUE
86	CABLE for ROLLED -E-CHAIN	1	IGUS
87	CABLE GLAND	1	SUNIL & COMPANY
		2	ARUP ENGG. & FOUNDRY WORKS
		3	COMMET BRASS PRODUCTS
		4	ELECTROMAC INDUSTRIES
		5	BALIGA LIGHTING EQPT.
88	BAY CONTROL UNIT	1	ALSTOM
		2	SIEMENS
		3	ABB
89	TRANSFORMER BUSHING	1	ABB
		2	AREVA
		3	ALSTOM
		4	BHEL
90	EARTH LEAKAGE CB	1	SCHNEIDER
		2	L&T
		3	SIEMENS
		4	ABB
91	EARTH LEAKAGE RELAY [ELR] ALONG WITH CBCT	1	AREVA
		2	PRO'KDEVICES
92	PUSH BUTTON	1	BCH
		2	L&T
		3	SCHNEIDER
		4	SIEMENS
		5	TECKNIC CONTROL
		6	GE – POWER
		7	ABB
93	RELAYS (OTHER THAN INTERPOSING & NUMERICAL RELAYS)	1	ABB
		2	AREVA
		3	SIEMENS
		4	GE – POWER
		5	ALSTOM
94	ENERGY MANAGEMENT SYSTEM	1	SCHNEIDER
		2	SECURE





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

Annexure-I

Sl. No.	Item Description	Vendor Name	
		6	PYROTECH
12	CONTROL PANEL/RACK	1	PYROTECH
		2	RITTAL
13	PRESSURE GAUGES	1	A. N. INSTRUMENTS PVT. LTD.
		2	ASHCROFT INDIA
		3	GENERAL INSTRUMENTS CONSORTIUM
		4	MANOMETER (INDIA) PVT.LTD
		5	WIKA
		6	FORBES MARSHALL LTD.
		7	GLUCK (INDIA) MFG.CO.
		8	WAAREE INDUSTRIES
		9	BUDENBERG GAUGE CO. LTD.
14	PRESSURE SWITCHES	1	ASHCROFT INDIA
		2	INDFOS INDUSTRIES LTD.
		3	SOR INC.
		4	SWITZER INSTRUMENT CO.
		5	TRAFAG-INDIA
		6	DELTA CONTROLS LTD.
15	ELECTRONIC TRANSMITTER	1	EMERSON PROCESS
		2	HONEYWELL
		3	YOKOGAWA
		4	FUJI
16	TEMPERATURE GAUGE	1	A. N INSTRUMENTS PVT. LTD.
		2	ASHCROFT INDIA
		3	GENERAL INSTRUMENTS CONSORTIUM
		4	GOA THERMOSTATIC INSTUMENTS
		5	WIKA
		6	FORBES MARSHALL
		7	WAREE
17	TEMPERATURE SWITCH	1	GENERAL INSTRUMENTS CONSORTIUM
		2	INDFOS INDUSTRIES LTD.
		3	SWITZER INSTRUMENT CO.
		4	AN INSTRUMENTS
18	TEMPERATURE ELEMENT	1	DETRIVE
		2	GENERAL INSTRUMENS CONSORTIUM





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

Annexure-I

Sl. No.	Item Description	Vendor Name	
		3	INDUSTRIAL INSTRUMENTS
		4	PYRO ELEC INSTRUMENTS GOA P. LTD.
		5	TEMPSENS INSTRUMENTS (I) PVT. LTD.
19	ROTA METER	1	EUREKA
		2	FLUIDYNE INSTREMENTS
		3	IEPL
		4	PLACKA INSTRUMENTS INDIA PVT. LTD.
		5	TRAC
20	SIGHT FLOW INDICATOR	1	CHEMTROLS SAMIL
		2	LEVCON INSTRUMENTS PVT. LTD.
		3	V.AUTOMAT & INSTRUMENTS PVT LTD.
		4	FORBES MARSHALL LTD.
21	FLOW SWITCH	1	GENERAL INSTRUMENTS CONSORTIUM
		2	KROHNE MARSHALL
		3	SWITZER INSTRUMENT CO.
22	IMPACT HEAD TYPE ELEMENT	1	DETREICH / EMERSON PROCESS
		2	MIDWEST
		3	STARMECH
		4	SWITZER INSTRUMENT CO.
		5	VERIS INC.
23	LEVEL GAUGE	1	CHEMTROLS ENGG. (P) LTD.
		2	LEVCON INSTRUMENTS (P) LTD.
		3	S. B. ELECTRO-MECHANICALS PVT. LTD.
		4	V. AUTOMAT & INSTRUMENTS PVT. LTD.
		5	DK INSTRUMENTS
		6	SIGMA INSTRUMENTS COMPANY
24	LEVEL SWITCH (FLOAT TYPE)	1	CHEMTROLS
		2	MAGNETROL INTERNATIONAL NV
		3	DK INSTRUMENTS
		4	LEVCON INSTRUMENTS P LTD.
25	LEVEL SWITCH (CONDUCTIVITY TYPE)	1	LEVEL STATE, UK
		2	SOLARTON/MOBREY, UK
		3	YARWAY
26	LEVEL SWITCH	1	ENDRESS + HAUSER





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Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase – III

Annexure-I

Sl. No.	Item Description	Vendor Name	
53	PUBLIC ADDRESSING SYSTEM (ANALOG SYSTEM)	1	BOSCH SECURITY SYSTEMS
		2	STENTOFONE (from ZENITAL GROUP)
		3	INDUSTRONIC
		4	COMMEND
54	EPABX	1	ABB INDIA PVT. LTD.
		2	BPL TELECOM PVT. LTD.
		3	CROMPTON GREAVES LTD.
		4	HCL INFINET LTD.
		5	SIEMENS LTD.
		6	ABC INDIA PVT LTD
55	CCTV System	1	BOSCH
		2	HONEYWELL
		3	PELCO
56	LIE/LIR	1	CHEMIN CONTROLS
		2	ELECTRONICS CORP. OF INDIA LTD.
		3	PYROTECH
		4	FORBES MARSHAL
		5	INSTRUMENTATION LIMITED
		6	PRAMMEN INDUSTRIES
57	CONDENSATE POTS	1	FLOWTECH
		2	INSTRUMENTATION LIMITED
		3	PRECISION ENGG INDUSTRIES
		4	BALDOTA VALVE AND FITTING CO. PVT LTD.
		5	METPRESS ENGINEERING WORKS
		6	MICROPRECISION
58	IMPULSE PIPES	1	BHARAT HEAVY ELECTRICALS LTD.
		2	INDIA SEAMLESS METAL TUBES LTD. (only for CS Pipes)
		3	JINDAL SAW PIPES LTD.
		4	MAHARASHTRA SEAMLESS (only for CS Pipes)
		5	MANNESMANN AG
		6	SUMITOMO CORPORATION
		7	TPS TECHNITUBE ROHREN WERKE GMBH
		8	TROUVAY CAUVIN GULF E.C. DUBAI
		9	BALDOTA VALVE AND FITTING CO. PVT. LTD.





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Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase – III

Annexure-I

Sl. No.	Item Description	Vendor Name	
		10	BHARAT HEAVY ELECTRICALS LTD.
		11	EXCEL HYDRO – PNEUMATICS PVT. LTD.
		12	INSTRUMENTATION LTD.
		13	METPRESS ENGINEERING WORKS
		14	MAHALAKSHMI SEAMLESS
		15	RATNAMANI METALS & TUBES LTD.
59	INSTRUMENT VALVES / MANIFOLDS	1	BHARAT HEAVY ELECTRICALS LTD.
		2	BALDOTA VALVE AND FITTING CO PVT LTD.
		3	INSTRUMENTATION LIMITED
		4	METPRESS ENGINEERING WORKS
		5	EXCEL HYDRO-PNEUMATICS PVT. LTD.
		6	METPRESS ENGINEERING WORKS
		7	FLOWTECH
60	COMPRESSION FITTINGS	1	PARKER HANNIFIN
		2	PRECISION ENGG INDUSTRIES
		3	TROUVAY & CAUVIN
		4	HOKE (TECHNICAL PARTS CO. MUMBAI)
		5	SWAGELOCK
		6	METPRESS ENGINEERING WORKS
61	SOCKET WELD FITTINGS	1	EXCEL HYDRO-PNEUMATICS PVT. LTD.
		2	METPRESS ENGINEERING WORKS
		3	V.K. INDUSTRIES
		4	VIKAS INDUSTRIAL PRODUCTS
		5	BALDOTA VALVE AND FITTING CO PVT LTD.
		6	FLOWTECH

523866/2021/PS-REM-MSE-PLIERS LIST (PERMANENT CATEGORY) AS ON 8/25/2021 12:39:43 PM

SI No	Package Code	Package Name	Supplier Name	Supplier Communication Address	Supplier Works Address
207	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Kaustubha Udyog,	S.No. 36/1/1, Sinhgad Road, Vadgaon Khurd, Near Lokmat Press, Pune, Phone- 020-24393577, Pincode : Email : pressure@vsnl.com,	
208	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 Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com	Works-1->Mr. Hitesh Parmar/Mr. Hitesh Parmar Plot No.2306, Phase II, GIDC Chhatral, -Kalol-GUJARAT INDIA Phone- 9327359227 FAX : 02764-233440 Pincode : 382729 Email : hitesh.parmar@ashcroftindia.com
209	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SWITZER PROCESS INSTRUMENTS PVT. LTD.	Mr. V S Jayaprakash, 128, SIDCO North Phase, Ambattur Estates CHENNAI Phone- 044-26252017/2018 Pincode : 600050 Email : sales@switzerprocess.co.in	Works-1->C S Shankar 127, Sidco North Phase, Ambattur Estates, -CHENNAI-TAMIL NADU INDIA Phone- 8754491904 FAX : 044-26248849 Pincode : 600050 Email : cservice@switzerinstrument.com
210	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 Phone- 02764-233682 Pincode : 382729 Email : Nishit.patel@ashcroftindia.com	
211	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,	Works-1->LARRY DEGARMO/ ROY STUMBOUGH 14685 W. 105TH STREET, LENEXA -KANSAS- USA Phone- 913-888-0767 FAX : 913-888-0767 Pincode : 66215 Email : rstumbough@sorinc.com
212	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 Phone- 9323195251 Pincode : 400016 Email : amarendra@general-gauges.com	
213	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Barksdale GmbH, Germany	Michael Weileder Dorn Assenheimer, Strasse 27 Reichelsheim Phone- +91-9999107840 Pincode : D-61203 Email : msingh@barksdale.de	
214	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS INDUSTRIES LIMITED	B-20-21, INDUSTRIAL AREA, MEERUT ROAD, GHAZIABAD Phone- 0120-2712016 Pincode : Email : mktg@indfos.com	
215	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS (INDIA) LIMITED	MR.L.C.VENKATRANGAN/MR.B.KANNAN New No.17, II Floor, Adwawe Towers, Dr.Sevalia Shivaji Salai, T.Nagar Chennai Phone- +91 44 24353407 Pincode : 600017 Email : delhi@indfos.com	
216	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 Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com	Works-1->MR G.SRINIVASAN/MR ANUJ MALPANI PLOT NO:A-19/2 & T-4/2,I.DA. NACHARAM, -HYDERABAD-TELANGANA INDIA Phone- 09866550762 FAX : 040 27152193 Pincode : 560076 Email :
217	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 Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com	Works-1->Mr. Hitesh Parmar/Mr. Hitesh Parmar Plot No.2306, Phase II, GIDC Chhatral, -Kalol-GUJARAT INDIA Phone- 9327359227 FAX : 02764-233440 Pincode : 382729 Email : hitesh.parmar@ashcroftindia.com
218	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 Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com	Works-1->Mr. Shyam Warilani/Mr. V Suresh Babu Plot No 34 A GIDC A Phase 1, -VAPI-GUJARAT INDIA Phone- +91 11 4161 7111 FAX : 022 2687 3613 Pincode : 396 195 Email : pbajaj@baumer.com
219	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com	Works-1->Shikha Hazra/ Shyamal Hazra 32, Industrial Suburb,Yeshwanthpur -BANGALORE-KARNATAKA INDIA Phone- 080-23370300 FAX : 080-23379890 Pincode : 560022 Email :
220	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 Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net	Works-1->NA NA -- Phone- FAX : Pincode : Email :
221	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,	Works-1->Gauge Bourdon India Pvt. Ltd., Plot No-4, 5, 6,Jawahar Co-operative Industrial Estate, -Kalamboli Taluka Panvel-MAHARASHTRA INDIA Phone- 022-27421095, FAX : 022-27421901, Pincode : 410209, Email :
222	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in	Works-1->Mr. Gautam Mukherjee Kusumba, Sonarpur Station Road,P.O. -Narendrapur, -Kolkata-WEST BENGAL INDIA Phone- 9836878855 FAX : 033-24342748 Pincode : 700103 Email : gkm_an@hotmail.com
223	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	BOSE PANDA INSTRUMENTS PVT.LTD.	Mr. Partha Bose 44, Saheed Hemanta Kumar Bose, Sarani, Kolkata Phone- +91 33 2548 7220 Pincode : 700074 Email : parthabosebpi@gmail.com; bousepanda@vsnl.net	Works-1->Mr. Partha Bose 44, Saheed Hemanta Kumar Bose,Sarani, -Kolkata-WEST BENGAL INDIA Phone- +91 33 2548 7220 FAX : +91 33 2548 0429, Pincode : 700074 Email : parthabosebpi@gmail.com
224	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com	Works-1->Scientific Center, Others By-Pass Junction,Near Kalsekar College kausa, mumbrai, Thane -Mumbai-MAHARASHTRA INDIA Phone- 022-25491409,9892230623 FAX : Pincode : 400612 Email : sdbpl@vsnl.com
225	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Nesstech Instruments Private Limited	26/2, G Type, Global Industrial Park Near Nahuli Railway Crossing, Valvada Vapi Phone- 9920576002 Pincode : 396105 Email : sales@nesstech.co.in	Works-1-> Others 26/2, G Type, Global Ind. Park Near Nahuli Railway Crossing, -Vapi-GUJARAT INDIA Phone- 9920576002 FAX : Pincode : 396105 Email : sales@nesstech.co.in, bkpadia@nesstech.co.in
226	145-10000-A	TEMPERATURE 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 Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com	Works-1->Mr. Shyam Warilani/Mr. V Suresh Babu Plot No 34 A GIDC A Phase 1, -VAPI-GUJARAT INDIA Phone- +91 11 4161 7111 FAX : 022 2687 3613 Pincode : 396 195 Email : pbajaj@baumer.com
227	145-10000-A	TEMPERATURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com	Works-1->Mr. Hitesh Parmar/Mr. Hitesh Parmar Plot No.2306, Phase II, GIDC Chhatral, -Kalol-GUJARAT INDIA Phone- 9327359227 FAX : 02764-233440 Pincode : 382729 Email : hitesh.parmar@ashcroftindia.com
228	145-10000-A	TEMPERATURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,	Works-1->Gauge Bourdon India Pvt. Ltd., Plot No-4, 5, 6,Jawahar Co-operative Industrial Estate, -Kalamboli Taluka Panvel-MAHARASHTRA INDIA Phone- 022-27421095, FAX : 022-27421901, Pincode : 410209, Email :
229	145-10000-A	TEMPERATURE GAUGE	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net	Works-1->NA NA -- Phone- FAX : Pincode : Email :
230	145-10000-A	TEMPERATURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com	Works-1->Shikha Hazra/ Shyamal Hazra 32, Industrial Suburb,Yeshwanthpur -BANGALORE-KARNATAKA INDIA Phone- 080-23370300 FAX : 080-23379890 Pincode : 560022 Email :
231	145-10000-A	TEMPERATURE GAUGE	GOA THERMOSTATIC INSTRUMENTS PVT.LTD.	FLAT -B, GF, HILL CROWN APTS., COLLEGE ROAD, MAPUSA Phone- Pincode : 403525 Email : gtiworks@pyro-electric.in	Works-1->Mrs Saanvi Naik BICHOLIM, -BICHOLIM-GOA INDIA Phone- 9595855152 FAX : Pincode : 403 529 Email : saanvi.naik@thermostatic.in
232	145-10000-A	TEMPERATURE GAUGE	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	D2/5, Mapusa Industrial Estate, Mapusa, Goa, Phone- 09326054551, Pincode : 403507, Email : sumukh@goainstruments.com,	Works-1->Mr. S.G. Dixit D2/5, Mapusa Industrial Estate, -Mapusa-GOA INDIA Phone- 09326054551 FAX : 0832-226231 Pincode : 403 507 Email : sumukh@goainstruments.com
233	145-10000-A	TEMPERATURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in	Works-1->Mr. Gautam Mukherjee Kusumba, Sonarpur Station Road,P.O. -Narendrapur, -Kolkata-WEST BENGAL INDIA Phone- 9836878855 FAX : 033-24342748 Pincode : 700103 Email : gkm_an@hotmail.com
234	145-10000-A	TEMPERATURE GAUGE	FORBES MARSHALL (HYD) LTD.	MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com	Works-1->MR G.SRINIVASAN/MR ANUJ MALPANI PLOT NO:A-19/2 & T-4/2,I.DA. NACHARAM, -HYDERABAD-TELANGANA INDIA Phone- 09866550762 FAX : 040 27152193 Pincode : 560076 Email :
242	145-13000-A	TEMP. ELEMENT	Nesstech Instruments Private Limited	26/2, G Type, Global Industrial Park Near Nahuli Railway Crossing, Valvada Vapi Phone- 9920576002 Pincode : 396105 Email : sales@nesstech.co.in	Works-1-> Others 26/2, G Type, Global Ind. Park Near Nahuli Railway Crossing, -Vapi-GUJARAT INDIA Phone- 9920576002 FAX : Pincode : 396105 Email : sales@nesstech.co.in, bkpadia@nesstech.co.in
243	145-13000-A	TEMP. ELEMENT	DETRIVE INSTRUMENTATION & ELECTRONICS LTD.	320, TV INDUSTRIAL ESTATE, OFF.DRA.BESANT ROAD, BEHIND GLAXO, WORLI, MUMBAI Phone- 24934125,24938403 Pincode : 400025 Email : trivtech@vsnl.com	Works-1->Mr. A.D.Solomon J-14, MIDC, TARAPORE, BOISER STN., -THANE-MAHARASHTRA INDIA Phone- FAX : Pincode : Email : trivtech@vsnl.com
244	145-13000-A	TEMP. ELEMENT	Thermal Instrument India Pvt. Ltd.	Mr. Raghavendra M. Kulkarni 194/195, Gopi Tank Road Behind Citylight Cinema,Mahim Mumbai Phone- 09322664709 Pincode : 400016 Email : ramk@giconindia.com	Works-1->Mr. Raghavendra M. Kulkarni Survey No. 250A/B, Post- Mangaon,Tal. Kudal, Dist.- Sindhudurg, -MAHARASHTRA INDIA Phone- 09322664709 FAX : 022-24455026 Pincode : 416519 Email :
245	145-13000-A	TEMP. ELEMENT	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com	Works-1->Mr. Shyam Warilani/Mr. V Suresh Babu Plot No 34 A GIDC A Phase 1, -VAPI-GUJARAT INDIA Phone- +91 11 4161 7111 FAX : 022 2687 3613 Pincode : 396 195 Email : pbajaj@baumer.com
246	145-13000-A	TEMP. ELEMENT	PYRO ELECTRIC INSTRUMENTS GOA PVT.LTD.	M. D. BICHUR/ M. BICHU G.B, HILL CROWN APARTMENTS, COLLEGE ROAD, MAPUSA Phone- 9326114601 Pincode : 403507 Email : priyanka.marketing@pyro-electric.in	Works-1->A A KULKARNI/ VINOD C G PLOT NO. 71,BICHOLIM INDUSTRIAL ESTATE -BICHOLIM-GOA INDIA Phone- 9326114409 FAX : 91 832 2363381 Pincode : 403529 Email : pyroworks@pyro-electric.in
247	145-13000-A	TEMP. ELEMENT	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,	Works-1->Gauge Bourdon India Pvt. Ltd., Plot No-4, 5, 6,Jawahar Co-operative Industrial Estate, -Kalamboli Taluka Panvel-MAHARASHTRA INDIA Phone- 022-27421095, FAX : 022-27421901, Pincode : 410209, Email :
248	145-13000-A	TEMP. ELEMENT	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	D2/5, Mapusa Industrial Estate, Mapusa, Goa, Phone- 09326054551, Pincode : 403507, Email : sumukh@goainstruments.com,	Works-1->Mr. S.G. Dixit D2/5, Mapusa Industrial Estate, -Mapusa-GOA INDIA Phone- 09326054551 FAX : 0832-2262331 Pincode : 403 507 Email : sumukh@goainstruments.com
249	145-13000-A	TEMP. ELEMENT	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhpura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,	Works-1-> Khasra No.: 218-230& 235, Industrial Estate,Makhpura, -Ajmer-RAJASTHAN INDIA Phone- 9887865856, FAX : 0145-2695174, Pincode : 305002, Email : rajeev.gupta@tipl.com
250	145-13000-A	TEMP. ELEMENT	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com	Works-1->Scientific Center, Others By-Pass Junction,Near Kalsekar College kausa, mumbrai, Thane -Mumbai-MAHARASHTRA INDIA Phone- 022-25491409,9892230623 FAX : Pincode : 400612 Email : sdbpl@vsnl.com

523866/2021/PS-REM-MSE-PLIERS LIST (PERMANENT CATEGORY) AS ON 8/25/2021 12:39:43 PM

SI No	Package Code	Package Name	Supplier Name	Supplier Communication Address	Supplier Works Address
251	145-13000-A	TEMP. ELEMENT	Tempsens Instrument (I) Pvt Ltd	MR. V.P.RATHI/MR. HEMANT RATHI B-188A ROAD NO.5 , M.I.A UDAIPUR Phone- 09352420069 Pincode : 313003 Email : info@tempsens.com	Works-1->Mr. S.D Deval B-188A ROAD NO.5 ,M.I.A -UDAIPUR- RAJASTHAN INDIA Phone- 9352501530 FAX : 0294-3057750 Pincode : 313003 Email : deval@tempsens.com
252	145-14000-A	TRANSMITTERS	ABB INDIA LIMITED	MR. RAJIV GOVIL 14, MATHURA ROAD, FARIDABAD Phone- 09971085678 Pincode : 121003 Email : vipin.swami@in.abb.com	
253	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 Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com	Works-1->Mr. BHAGWAN SINGH/ Mr. NANDAN SINGH F-61, OKHLA INDL AREA, PHASE-I - NEW DELHI-DELHI INDIA Phone- 011-47627200 Extn. 3 FAX : 011- 26819440 Pincode : 110 020 Email :
254	145-14000-A	TRANSMITTERS	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com	
255	145-14000-A	TRANSMITTERS	YOKOGAWA INDIA LIMITED,	PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, BANGALORE, Phone- 080-41586000, Pincode : Email : uday.shankar@in.yokogawa.com,	Works-1-> PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, - BANGALORE-KARNATAKA INDIA Phone- 080-41586000, FAX : 080-28521442, Pincode : Email : uday.shankar@in.yokogawa.com
256	145-14000-A	TRANSMITTERS	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhpura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,	Works-1-> Khasra No : 218-230& 235, Industrial Estate, Makhpura, - Ajmer-RAJASTHAN India Phone- 9887865856, FAX : 0145-2695174, Pincode : 305002, Email : rajeev.gupta@tipl.com
257	145-14000-A	TRANSMITTERS	SBEM PVT. LTD.	MR.N.K. BEDARKAR/MR. VISHWANATH KARANDIK 39, ELECTRONIC CO.OP. ESTATE, PUNE SATARA ROAD PUNE, Phone- 912041030100 Pincode : 411009 Email : newdelhi@sbem.co.in	Works-1->MR. MOHAN PADWAL 691/A/2,BIBWEWADI INDL ESTATE - PUNE-MAHARASHTRA INDIA Phone- 918600042374 FAX : 912024215670 Pincode : 411037 Email : wm@sbem.co.in
258	145-14000-A	TRANSMITTERS	Endress + Hauser (India) Pvt. Ltd.,	Mr. Prakash Vaghela 215-216, DLF Tower 'A', Jasola District Centre, New Delhi, Phone- 9717593001, Pincode : 110025, Email : prakash.vaghela@in.endress.com,	Works-1-> M-171 to 173, MIDC, Waluj, -Aurangabad-MAHARASHTRA India Phone- 9881000474, FAX : 0240-2555179, Pincode : 431136, Email : Narendra.Kulkarni@wetzler.endress.com
259	145-14000-A	TRANSMITTERS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,	Works-1->Mr. Santosh Shukla Others R-628, TTC Industrial Area, MIDC Rabale, -Navi Mumbai-MAHARASHTRA India Phone- 9821350761, FAX : 022-27695559, Pincode : 400701, Email : sales@panamengineers.com
260	145-14000-A	TRANSMITTERS	Moore Industries International Inc.	Leonard.W. Moore/ Matt Moren 16650 Schoenborn St. North Hills Phone- +1 818 830 5548 Pincode : 91343 Email : mmoren@miinet.com	Works-1->Matt Moren/Gina Cruz 16650 Schoenborn St., North Hills - CALIFORNIA- USA Phone- +1 818 894 7111, ext FAX : +1 818 830 5588 Pincode : 91343 Email : gcruz@miinet.com
261	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 Phone- 9619121500 Pincode : 400051 Email : vikramraj.singh@emerson.com	Works-1->Kalpesh Chandan/Hrishikesh Aghor Plot No. A 145/4 TTC IND AREA,MIDC, PAWANE, -NAVI MUMBAI-MAHARASHTRA INDIA Phone- 9619688001 FAX : 022-66736000 Pincode : 400 705 Email :
262	145-14000-A	TRANSMITTERS	NIVO CONTROLS PVT. LTD.	Mr. Praveen Toshniwal 104-115, Electronic Complex, Indore Phone- 0731-4081305 Pincode : 452010 Email : sales@nivocontrols.com	Works-1->Mr. S L Sadani Others 104 - 115,Electronic Complex -Indore- MADHYA PRADESH INDIA Phone- 0731-4081307 FAX : Pincode : 452010 Email : sales@nivocontrols.com;sadanis@nivocontrols.com
263	145-14000-A	TRANSMITTERS	SIEMENS LIMITED	Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai Phone- 0124 383 7377 Pincode : 400018 Email : ankit.varshney@siemens.com	Works-1->Ankit Varshney Kalwa Works, Thane-Belapur Road, Thane, - MUMBAI-MAHARASHTRA INDIA Phone- FAX : Pincode : 400708 Email :
264	145-14000-A	TRANSMITTERS	Honeywell Automation India Limited	Mr. Ritwij Kulkarni 917, INTERNATIONAL TRADE TOWER, NEHRU PLACE, NEW DELHI Phone- 9890200584 Pincode : 110019 Email : rajesh.chaudhary@honeywell.com	Works-1->Mr.Kedar Tillo 53, 54, 56 & 57,Hadapsar Industrial Estate - PUNE-MAHARASHTRA INDIA Phone- 9665034625 FAX : 020 66039905 Pincode : 411013 Email : kedar.tillo@honeywell.com
265	145-14000-A	TRANSMITTERS	SMART INSTRUMENTS LTD, BRAZIL	Agents: Digital Electronic Ltd. 74/11 'C' Cross Road MIDC Andheri (East) MUMBAI Phone- 28208477 Pincode : 400093 Email : corp@delbby.rpgms.ems.vsnl.net.in	
277	145-21000-A	DIFFERENTIAL PRESSURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,	
287	145-25000-A	JUNCTION BOX	K.S.INSTRUMENTS PVT.LTD.	S Raghavan No. 72, 3rd Main, 1st Stage Industrial Suburb, Yeshwanthpur Bangalore Phone- 9880385770 Pincode : 560022 Email : sales1@ksinstruments.net	
288	145-25000-A	JUNCTION BOX	SUCHITRA INDUSTRIES	NO-2,OPP-27 AECS LAYOUT 2ND STG REJAMAHALVILAS EXTN 2ND STG BANGALORE Phone- Pincode : suchitra.industriesblr@gmail.com	Works-1->B. Srinivas Suchitra Industries, Opp No 53, Muneshwara Black Devinagar, Lottagal hai -BANGALORE-KARNATAKA INDIA Phone- 080-23511247 FAX : Pincode : 560094 Email :
289	145-25000-A	JUNCTION BOX	Shrenik & Company,	Mr. Mitesh Shah/Mr. Pulin Shah 39 A/3 ,Panchratna Industrial Estate, Sarkhej- Bavla Road Ahmedabad Phone- 9825024921 Pincode : 382213 Email : sales@pustron.com, pulin@sumip.com	Works-1->Mr.Pulin Shah/ Mr. Kaloesch Parmar 39 A/3 ,Panchratna Industrial Est,Sarkhej-Bavla Road, Changothar -Ahmedabad-GUJARAT INDIA Phone- 98250 80339 1 FAX : 079-26932424 Pincode : 382213 Email : sales@sumip.com
290	145-25000-A	JUNCTION BOX	FLEXPRO ELECTRICALS PVT. LTD.	Mr. Dineshbhai Zaveri C-1/ 27&37, GIDC, Kabilpore, Navsari Phone- 02637-265140,265003 Pincode : 396424 Email : flexpro@flexproltd.com	Works-1->Mr. Dineshbhai Zaveri CEO C-1/ 27&37, GIDC, Kabilpore, - Navsari-GUJARAT INDIA Phone- 02637-265140,265003 FAX : 02637-265308 Pincode : 396424 Email : flexpro@flexproltd.com
291	145-25000-A	JUNCTION BOX	AJMERIA INDUSTRIAL & ENGINEERING WORKS	JIGNESH MAHENDRA AJMERA DENA BANK BLDG.,SHREE NAGESH INDL. ESTATE,STATION ROAD, MUMBAI Phone- 022 67973578 Pincode : 400 088 Email : ajmera@ajmera.net, jmajmera@yahoo.com	Works-1->JIGNESH MAHENDRA AJMERA DENA BANK BLDG., SHREE NAGESHINDL. ESTATE,STATION ROAD, -MUMBAI-MAHARASHTRA INDIA Phone- 022 67973578 FAX : Pincode : 400 088 Email : ajmera@ajmera.net
293	145-32000-A	INSTRUMENTS TUBE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com	Works-1->S.R.SINGH/ NAVEEN SINGH B - 2, SECTOR - 6, -NOIDA-UTTAR PRADESH INDIA Phone- 0120-4352940 FAX : 0120-4352940 Pincode : 201301 Email : naveensingh@vsnl.com
294	145-32000-A	INSTRUMENTS TUBE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com	Works-1->ALEX BAPTIST/ K. SRINIVAS 7. SIDHAPURA INDUSTRIAL ESTATE,SV ROAD, GOREGAON(WEST) -MUMBAI-MAHARASHTRA INDIA Phone- 022-42631700 FAX : 022-40035259 Pincode : 400 062 Email : srinivas@precision-engg.com
295	145-32000-A	INSTRUMENTS TUBE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com	
296	145-32000-A	INSTRUMENTS TUBE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Mochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com	Works-1->Mr. Tansen Choudhari/Mr. Mahesh Darekar Shed No.8, Lonavla Indl.Co-op.Estate Ltd,Nagargao, -Lonavla-MAHARASHTRA INDIA Phone- 9823951347 FAX : (02114) 271132 Pincode : 410 401 Email : factory@hyd-air.com
328	145-38000-A	INSTRUMENTS PIPE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com	
329	145-38000-A	INSTRUMENTS PIPE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com	Works-1->ALEX BAPTIST/ K. SRINIVAS 7. SIDHAPURA INDUSTRIAL ESTATE,SV ROAD, GOREGAON(WEST) -MUMBAI-MAHARASHTRA INDIA Phone- 022-42631700 FAX : 022-40035259 Pincode : 400 062 Email :
330	145-38000-A	INSTRUMENTS PIPE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com	Works-1->S.R.SINGH/ NAVEEN SINGH B - 2, SECTOR - 6, -NOIDA-UTTAR PRADESH INDIA Phone- 0120-4352940 FAX : 0120-4352940 Pincode : 201301 Email : naveensingh@vsnl.com
331	145-38000-A	INSTRUMENTS PIPE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Mochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com	Works-1->Mr. Tansen Choudhari/Mr. Mahesh Darekar Shed No.8, Lonavla Indl.Co-op.Estate Ltd,Nagargao, -Lonavla-MAHARASHTRA INDIA Phone- 9823951347 FAX : (02114) 271132 Pincode : 410 401 Email : factory@hyd-air.com
361	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 Phone- +91-250-2392246 Pincode : 401210 Email : arya@aryaengg.com	
362	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 Phone- 91-9324383121 Pincode : 400008 Email : shahanawaz.khan@perfectinstrumentation.com	Works-1->Shahanawaz Khan Vishwestwar Ind. Premises Co-op Soc. Ltd,F-18/19, Pradhikaran,Bhosadi MIDC -PUNE-MAHARASHTRA INDIA Phone- 020-30694134 FAX : 022-23013010 Pincode : 411026 Email :
363	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 Phone- 9920044113 Pincode : 400008 Email : ab@fluidfitengg.com	Works-1->Mr. Abbas Bhola Unit No. 16, Supreme Industrial Estate,Kaman Bhiwandi Road,Deval, -Vasai East-MAHARASHTRA INDIA Phone- 9920044113 FAX : 07303178243 Pincode : 401208 Email :
364	145-45000-A	INSTRUMENT FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com	Works-1->S.R.SINGH/ NAVEEN SINGH B - 2, SECTOR - 6, -NOIDA-UTTAR PRADESH INDIA Phone- 0120-4352940 FAX : 0120-4352940 Pincode : 201301 Email : naveensingh@vsnl.com
365	145-45000-A	INSTRUMENT FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com	Works-1->ALEX BAPTIST/ K. SRINIVAS 7. SIDHAPURA INDUSTRIAL ESTATE,SV ROAD, GOREGAON(WEST) -MUMBAI-MAHARASHTRA INDIA Phone- 022-42631700 FAX : 022-40035259 Pincode : 400 062 Email : srinivas@precision-engg.com
366	145-45000-A	INSTRUMENT FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com	

523866/2021/PS-REM-MSE SUPPLIER LIST (PERMANENT CATEGORY) AS ON 8/25/2021 12:39:43 PM

SI No	Package Code	Package Name	Supplier Name	Supplier Communication Address	Supplier Works Address
367	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 Phone- 02764-267036/37 Pincode : 382705 Email : marketing@com-fit.com	Works-1->Miss Sonal Pithadia/Miss Pavan Chavda Survey No. 23/1, Part 2, Ahmedabad-Mehsana Highway, Laxmipura -Nandasan-GUJARAT INDIA Phone- 8460848087 FAX : 2764-267036/37 Pincode : 382705 Email : domestic@com-fit.com
368	145-45000-A	INSTRUMENT FITTINGS	HP VALVES & FITTINGS INDIA PVT. LTD.	S. Harichandran/P.S. Pandi B-11, Mugappair Industrial Estate, CHENNAI Phone- 044 26252537 Pincode : 600037 Email : sales@hpvalvesindia.com	Works-1->S. Harichandran/ P.S. Pandi B-11, Mugappair Industrial Estate, - CHENNAI-TAMIL NADU INDIA Phone- 044-26252537 FAX : 044-26252538 Pincode : 600037 Email : sales@hpvalvesindia.com
369	145-45000-A	INSTRUMENT FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Mochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com	Works-1->Mr. Tansen Choudhari/Mr. Mahesh Darekar Shed No.8, Lonavla Indl.Co-op.Estate Ltd,Nagargaon, -Lonavla-MAHARASHTRA INDIA Phone- 9823951347 FAX : (02114) 271132 Pincode : 410 401 Email : factory@bvd-air.com
370	145-45000-A	INSTRUMENT FITTINGS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,	Works-1->Mr. Santosh Shukla Others R-628,TTC Industrial Area, MIDC Rabale, -Navi Mumbai-MAHARASHTRA India Phone- 9821350761, FAX : 022-27695559, Pincode : 400701, Email : sales@panamengineers.com
283	145-24000-A	LOCAL CONTROL PANELS	INDUSTRIAL CONTROLS & APPLIANCES PVT LTD	47, CHAKALA ROAD, ANDHERI(EAST), MUMBAI Phone- 28344494,28221532 Pincode : 400099 Email : indconapp@vsnl.com	
284	145-24000-A	LOCAL CONTROL PANELS	PROCON INSTRUMENTATION PVT. LTD.	1H, SHAKTI TOWERS, 766, ANNA SALAI, CHENNAI Phone- 28266041,2824142 Pincode : 600022 Email : procond1@nda.vsnl.net.in	
285	145-24000-A	LOCAL CONTROL PANELS	C and S ELECTRIC LTD.	222, OKHLA INDUSTRIAL ESTATE, PHASE-II, NEW DELHI Phone- 9871799447 Pincode : 110020 Email : panel.marketing@cselectric.co.in	
286	145-24000-A	LOCAL CONTROL PANELS	PYROTECH ELECTRONICS PVT. LTD	F-16 A, Road No. - 3 M.I.A., Madri UDAPUR Phone- 2492122,31,34 Pincode : 313003 Email : pyrotech@pyrotechindia.com	

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/delivery implication.

523866/2021/PS-PEM-MSE

	TITLE: TECHNICAL SPECIFICATION COLTCS 1X660 MW SAGARDIGHI, PHASE-III (UNIT-5) SPECIFIC TECHNICAL REQUIREMENTS	SPEC. NO.: PE-TS-445-165-N002	
		SECTION: I	
		SUB-SECTION: ID	
		REV. NO. 00	DATE 23.09.2021
		SHEET 1	OF 1

SUB-SECTION – ID

DATASHEET-A



DATA SHEET - A

SPECIFICATION NO.: PE-TS- 445-165-N002

CONDENSER ON LINE TUBE CLEANING SYSTEM (COLTCS)
 (FOR CLARIFIED WATER APPLICATION)

SECTION : I. SUB-SECTION : ID

PROJECT: 1X660 MW SAGARDIGHI TPP, PHASE-III (UNIT-5)

REV. NO.: 00.

DATE : 23.09.2021

SL NO	DESCRIPTION	UNITS	PARAMETERS / DETAILS
1.00	GENERAL		
1.1	Nos. of tube cleaning systems sets required for station	Nos.	Total Two (02) Nos. Viz. One independent set for each half of the condensers placed in series
1.2	Liquid Handled		Clarified water (Refer enclosed water analysis, attached as Annexure-3)
1.3	Size of COLTCS	NB	2200 NB (OD x Thk: 2245 x18)
1.4	Length of Ball Separator	mm	4200 Note: 1. Scope of Ball Separator counter flange is in Purchaser's scope. (Associated Gaskets, nuts and bolts are in Bidder's Scope) 2. Ball Separator shall be mounted directly on the existing Butterfly valve - Refer Annexure-5. 3. Flap of butterfly valve shall be extended to approx 1000 mm inside the Ball separator.
2	DESIGN DATA		
2.1	Operating pressure at Condenser inlet flange	kg/cm ² (g)	Approx 1.5 to 2.8
2.2	Design Pressure for ball separator	kg/cm ² (g)	5.5 kg/cm ² (g)
2.3	Design Mechanical temperature	Deg. C	60
2.4	Condenser Details		
	a) Type of condenser		Single pass
	b) No. of Condenser sections	Nos.	Two (2)
	c) No. of passes per condenser section (viz. condenser half)	Nos.	One (1)
	d) No. of tubes per condenser	Nos.	26400
	• Condensing zone	Nos.	26056
	• Air Cooling zone	Nos.	344

	e) Tube Dia. OD x Thickness		
	• Top two rows	mm x mm	25 x 0.889
	• Remaining	mm x mm	25 x 0.7112
	f) Length of tubes between ends.	mm	13600
	g) Tube material		Welded SS (ASTM A-249, TP-304)
	h) Pressure drop across condenser - At Normal flow (between Inlet and Outlet flanges of condenser)	MWC	2 x 2.6 MWC (viz. 2.6 MWC in each condenser) (However the actual value can vary +/-10% of the design value)
2.5	CW flow rate through each ball separator		
	- Normal	cu.m/hr	36250
	- Maximum	cu.m/hr	43500
2.6	Design differential pressure for ball separator strainer/screen	kg/cm ² (g)	0.2
2.7	Pressure drop across ball separator i.e. between inlet & outlet flanges in clean condition at normal flow.	MWC	0.15
2.8	Pressure drop across ball separator in choked condition when strainer backwashing starts	MWC	Not to exceed 0.30
2.9	No. of balls required for COLTCS per condenser section		Minimum 10% of number of condenser tubes
3	CONNECTING PIPE DETAILS		
3.1	Condenser inlet pipe		
	a) Material		Carbon Steel to IS – 2062 Gr. B rolled & welded conforming to IS:3589
	b) O.D. X Thickness		2245 X 18
3.2	Condenser outlet pipe		
	a) Material		Carbon Steel to IS – 2062 Gr. B rolled & welded conforming to IS:3589
	b) O.D. X Thickness		2245 X 18
3.3	Manhole		Yes, 600 NB size (2 Nos. viz. 1 for BFV side & 1 for screen side)
4	MATERIALS OF CONSTRUCTION		
4.1	BALL SEPARATOR		

	a) Body / housing		Fab. Carbon Steel to IS -2062 Gr.B. with epoxy painted inside (with minimum housing thickness same as connecting pipe thickness)
	b) Screen / Strainer		SS-316
	c) Strainer shaft		SS-316
	e) Internal Hardware in contact with circulating water including nuts, bolts , etc.		SS-316
	f) Site Glass provision		YES
4.2	BALL RECIRCULATING PUMP		Non clog Type
	a) Casing		CF8M
	b) Impeller		CF8M
	c) Shaft		SS-316
4.3	BALL COLLECTOR (BALL VESSEL)		
	a) Body / housing		Stainless steel, SS 304
	b) Screen / Strainer/other internals		SS-317L / Duplex SS
	c) Site Glass Provision		YES
4.4	Differential pressure measuring system		SS-316
4.5	Injection nozzle		SS-316
4.6	Valves		
4.6.1	Check Valves (65 NB & Above)		For sizes 65 NB and above:- Swing check type
	a) Body & Bonnet		SS316, Flanged Ends
	b) Disc for Check Valve		SS316
	c) Stem		ASTM A182 Gr F6a
4.6.2	Check Valves (50 NB & Below)		For size 50 NB and below-Lift check type
	a) Body & Bonnet		SS-316, Socket welded Ends
	b) Disc for Check Valve		SS316
	c) Stem		ASTM A182 Gr F6a
4.6.3	Gate/ Globe Valves 50 Nb & Below		
	Body & Bonnet		SS-316, Socket welded Ends
4.6.4	Gate/Globe Valves (65NB & above)		

	Ø Body & Bonnet		SA 351 CF8M
	Ø Disc		SA 351 CF8M
	Ø Stem		ASTM A182 Gr F6a
	Ø Companion Flange		SS316
4.6.5	BFV Valves (65NB & above)		BFV (400 Nb & above)
	Ø Body & Disc		-
	Ø Sealing, Retaining segment & internals		-
	Ø Bearing		-
	Ø Companion Flange		-
4.6.6	Ball valves		
	i) Body		SA 351 CF8M
	ii) Ball		SA 351 CF8M
	iii) Stem		SS316
4.7	Interconnecting Piping		In Purchaser's scope
	Material		SS-304
5	COUNTER FLANGES FOR BALL SEPARATOR		
5.1	MATERIAL		
	a) Flanges		Carbon Steel to IS 2062 Gr. B or eq for thickness, drilling etc refer Annexure-4 in section 1A (In Bidder's Scope)
	b) Fasteners		A 193 & A 194 (In Bidder's scope).
	c) Gaskets		Min 4 mm thick rubber (In Bidder's scope).
5.2	Drilling Standard		
6	OTHER COUNTER FLANGES		For interconnecting piping, valves, bends, fittings, distributors, nozzles & support installation materials
6.1	MATERIAL		
	a) Flanges		SS316 (In Bidder's scope)
	b) Fasteners		SS316 (In Bidder's scope)
	c) Gaskets		Min 4 mm thick rubber (In Bidder's scope).

7	Material of Other components not specified above		1. All Non-wetted Fastners in Bidder's Scope shall be of SS316 material. 2. Suitable for intended duty and shall be subject to Purchasers approval during detailed engg. In the event of order.
8	PAINING		
8.1	External Surface		
	a) Surface preparation		Surface preparation shall be done by means of sand blasting, which shall conform to SSPC SP10/NACE 2/Sa2½ Standard.
	b) Primer		Primer Coat shall consist of one coat (minimum DFT of 100 microns) of epoxy resin based zinc phosphate primer.
	c) Intermediate		Intermediate Coat (or Under Coat) shall consist of one coat (minimum DFT of 100 microns) epoxy resin based paint pigmented with Titanium Dioxide.
	d) Final paint		Top Coat shall consist of one coat (minimum DFT of 75 microns) of epoxy paint of approved shade and colour with glossy finish. Additional one coat (minimum DFT of 25 microns) of Finish Coat of polyurethane shall be provided.
	e) Total DFT		Total DFT of paint system shall not be less than 300 microns.
8.2	Internal Surface		
	a) Surface preparation		Surface preparation by means of sand blasting which shall conforms to SSPC SP10/NACE2/Sa2½ standard.
	b) Primer		Internal surface of the pipe should be coated with one coat of two part epoxy primer with not less than 50 micron DFT (dry film thickness) followed by two part poly amide cured solvent less epoxy .
	c) Final paint		The minimum dry film thickness (DFT) of internal lining shall be 500 micron.
9	Adequate provision for future installation of cathodic protection		YES (Along with Sacrificial type anodic protection by purchaser)
10	Flow straightener for streamlining the CW flow in ball collecting strainer		If required as per bidder's design – the same to be incorporated by bidder in its constructional feature.
11	The tube cleaning system shall be designed for following operation modes		
	a) Automatic start up initiated by push button		YES

b) Automatic shut down with ball collection effected by : i. Push button ii. Adjustable timer iii. Ball monitoring system		YES
c) Automatic backwashing of ball separator with ball collection effected by : a. Push button b. Adjustable timer c. Diff. Pressure measuring system		YES
d) Automatic emergency backwashing of ball separator effected by diff. Pressure measuring system		YES
e) Automatic ball sorting initiated by push button		YES
f) Provision for manual operation of complete tube cleaning system in case of control system failure		YES
g) Whether the contacts for DPG, DPS and DPT are independent		YES
h) Timer for Backwashing		YES
i) Whether the ball monitoring system is designed to perform the following functions : i. Continuously counting the balls in circulation and giving an alarm calling for investigation of ball losses when the number of balls falls below a set value ii. Continuously measuring the size of the balls in circulation and initiating the shutdown of the tube cleaning system with alarm calling for replacement of balls when the no. of oversized balls falls below a set value		YES
j) Whether the electronic processor of the ball monitoring system is provided with the following : i. Indicators for required basic ball charge ii. Indicators for recirculating ball quantity iii. Indicators for oversized ball quantity iv. Time counters for total cleaning system operating hours v. Time counters for cleaning system operating hours with sufficient no. of oversized balls vi. Recorders for ball consumption		YES
k) Whether provision for self-testing and self-calibration are made		YES

12	MANDATORY SPARES - To be supplied under this specification-		YES
12.1	Complete Set of Pump with Motor	Set	1Set (one set means complete replacement for one pump)
12.2	Valve Complete Assembly	Nos.	10% (Rounded off to the next higher integer) of each type and size of total population or minimum 1(one) No. whichever is higher
12.3	Normal Sponge Rubber Balls	Nos.	32000 Nos.
12.4	Abrasive Balls	Nos.	8000 Nos.
12.5	Electrical Spares as applicable as per the Electrical List		Refer Annexure-1
12.6	C&I Field Instruments & PLC as applicable as per the C&I List		Refer Annexure-2

Notes for Mandatory Spares:

1. In case if such items of spares indicated as "not applicable" by bidder in its offer, are found applicable at a later date during execution of the project, such items of spares are to be supplied within the ordered cost of the mandatory spares.
2. Wherever % is indicated for the mandatory spares, the quantity shall be calculated for % of supply for total quantity for 1 unit of 1 x 660 MW , unless otherwise specified. The quantity to be reckoned for % indicated shall be rounded off to the next higher whole number. For example if the % arrived is 0.2 the quantity to be supplied shall be 1 and if the % arrived is 5.1 the quantity to be supplied shall be 6.
3. In respect of quantity mentioned as 'Set' means the total quantity of all the components/items used in particular equipment unless otherwise specified.

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Mandatory spres list for Electrical items as applicable			Annexure-1
S. No.	Description of item	UOM	Quantity
	415 Volt Motor		
1	Motor of each type and rating (Note : motors covered in mechanical spare items need not to be included here again) 10% of the installed quantity or minimum 1 number whichever be higher	No.	10% of the installed quantity or minimum 1 number whichever be higher
2	End Shield Cover Driving & Non-Driving End	Set	1 set for each type and rating of Motor
3	Heaters	Set	2 sets for each type and rating of motor
4	Bearings (DE and NDE) for each type and rating of motor	Set	2 sets
5	Cooling Fan for all type and rating of LT motors	Set	One (1) set
6	Dust seals and gaskets for each type of motors	Set	1 Set
7	Motor Terminal Block	No.	1 no. for each type and rating of Motor
8	Complete Set of Coupling	Set	1 set for each type and rating

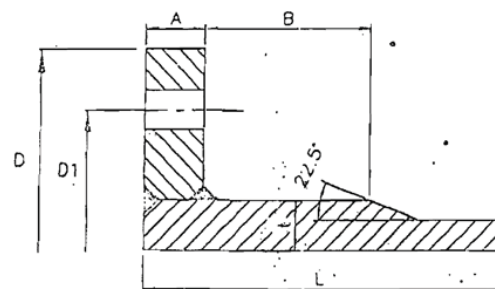
523866/2021/PS-PEM-MSE

Mandatory spres list for C&I items as applicable			Annexure-2
S. No.	Description of item	UOM	Quantity
1	Electronic transmitters		
i	Pressure	Set	1 no. complete set for each type and model/range used in the system
ii	Differential Pressure	Set	1 no. complete set for each type and model/range used in the system
2	Different type of Gauge (Pressure Gauge, Differential Pressure Gauge & Temp. Gauge)	No.	10% of total nos. used in the system or minimum 1 no. Whichever is more for each type and range.
3	Erection hardware		
i	Transmitter's Manifold	No.	10% of total nos. used in the system or minimum 2 nos. Whichever is more for each type and rating/model and size used in the system.
ii	Impluse Line Root/ Source valve	No.	10% of total nos. used in the system or minimum 4 nos. Whichever is more for each type and rating/model and size used in the system.
iii	Impluse Line Isolation valve	No.	10% of total nos. used in the system or minimum 4 nos. Whichever is more for each type and rating/model and size used in the system.
iv	Impluse Line drain valve	No.	10% of total nos. used in the system or minimum 4 nos. Whichever is more for each type and rating/model and size used in the system.
v	Impluse Line fittings	No.	Each type/size 25 nos
vi	Impluse pipe	Mtr	Each type/size 100 Mtrs
vii	Copper/SS tube	Mtr	Each type/size 100 Mtrs
viii	Fittings Copper/SS tube	No.	Each type/size 100 nos
4	Control Panel and Local/remote control desk		
i	Push button station	No.	10% of total quantity used in the system or minimum 2 nos. Whichever is more for each type and model.
ii	Push button station with LED indication	No.	10% of total quantity used in the system or minimum 2 nos. Whichever is more for each type and model.
iii	LED indication station	No.	10% of total quantity used in the system or minimum 2 nos. Whichever is more for each type and model.
iv	Simaphore indicator	No.	2 nos. each type
v	Annunciation system		
a	Each type of PCB	No.	1 no. each
b	Lamp box with facia and lamps (LED type)	No.	10 nos.
c	Hooter	No.	1 no.


Annexure-3
DESIGN CLARIFIED WATER ANALYSIS

CONSTITUENTS	As	CONTENT
Calcium	CaCO ₃	105 ppm
Magnesium	CaCO ₃	52 ppm
Sodium and Potassium	CaCO ₃	138 ppm
Hydrogen (FMA)	CaCO ₃	--
TOTAL CATIONS	CaCO ₃	295 ppm
Bicarbonate	CaCO ₃	196.5 ppm
Carbonate	CaCO ₃	-
Chloride	CaCO ₃	41 ppm
Sulphate	CaCO ₃	57.5 ppm
Nitrate	CaCO ₃	-
TOTAL ANIONS	CaCO ₃	295 ppm
M.O. Alkalinity	CaCO ₃	196.5 ppm
P. Alkalinity	CaCO ₃	
Total Hardness	CaCO ₃	157 ppm
Carbon-di-oxide	CO ₂	3.5
Dissolved Silica	SiO ₂	20 ppm
Total Iron	Fe	1 ppm
pH Value	-	7.9 – 8.0
Turbidity, NTU	-	20
Organic Matter Content in terms of Oxygen in absorbed from (KMnO ₄ (4 Hrs.))		5 ppm

Annexure-4



NOTES:-

Flange thicknesses listed are for
Design pressure = $5 \text{ Kg/cm}^2(\text{g})$ and
Flange dimensions as given in the table.
Final thickness of the flange is to be checked
for actual OD/Bolting PCD/Neck dimensions.

PIPE SIZE	PIPE THK.	FLANGE OD 'D'	Bolt PCD 'D1'	WELD NECK FLANGE				SLIP-ON FLANGE THICKNESS
				FLANGE THK. 'A'	NECK THK. 'L'	NECK Length 'B'	Appx. Total Length 'L'	
1200	10-12	1465	1380	40	24	70	200	90
1400	14	1675	1590	50	24	70	200	100
1600	14	1915	1920	60	32	80	220	110
1800	14-16	2115	2020	70	32	90	250	120
2200	18	2550	2420	80	36	100	300	140
2300	18			90	38	110	325	150
2500	20			90	38	110	325	150
2700	20			90	38	110	325	150

- TENTATIVE

DRAWING FOR BAL. SEPARATOR COUNTER FLANGE

REV.	DATE	ALTU	CHD	APPS	JOB NO.
					999
					STATUS
					DISTRIBUTION

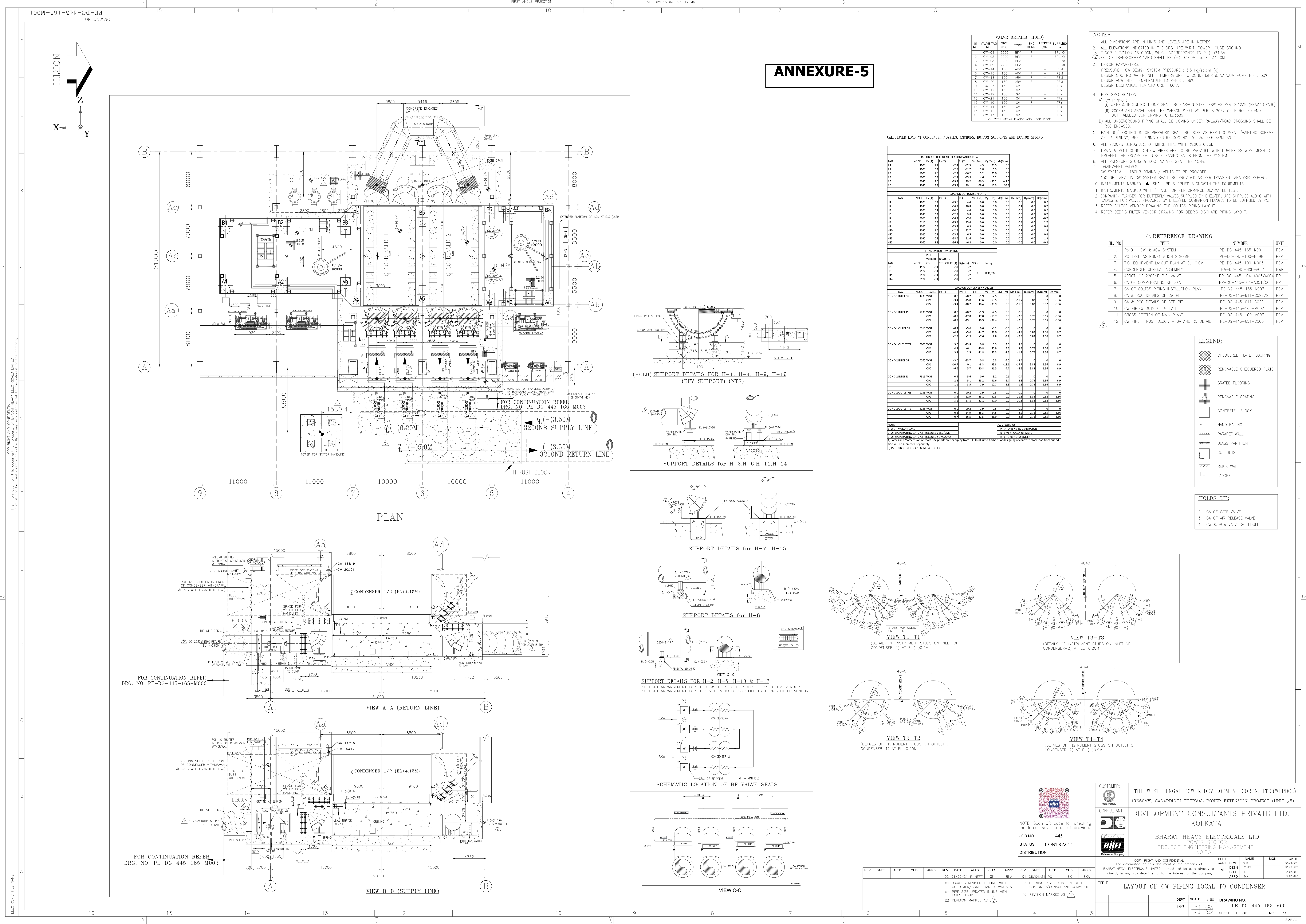


BHARAT HEAVY ELECTRICALS LTD
POWER GROUP
PROJECTS ENGINEERING MANAGEMENT
PPEI, NOIDA

DEPT CODE	JOB SIGN	NAME PR	SIGN	DATE
				23.06.07
				23.06.07
				23.06.07

TITLE
COUNTER FLANGE DETAILS

DRAWING NO.	REV
PE-DG-999-141-M017	00
SHEET 01 OF 01	REV 00



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	TITLE: TECHNICAL SPECIFICATION COLTCS 1X660 MW SAGARDIGHI, PHASE-III (UNIT-5) STANDARD TECHNICAL REQUIREMENTS	SPEC. NO.: PE-TS-445-165-N002		
		SECTION: II		
		SUB-SECTION: IIA		
		REV. NO. 0	DATE	23.09.2021
		SHEET 1	OF 1	

SUB-SECTION - IIA

STANDARD TECHNICAL SPECIFICATION (MECHANICAL)

STANDARD TECHNICAL SPECIFICATION FOR COLTCS

STANDARD QUALITY PLANS

	TITLE : STANDARD TECHNICAL SPECIFICATION CONDENSER ON - LOAD TUBE CLEANING SYSTEM (Sponge Rubber Ball Type)	SPECIFICATION NO. PE-TS-999-165-N002 SECTION : II SUB-SECTION : IIA REV. NO. 01 DATE : 26.05.2016 SHEET 1 OF 11
1.00.00	<u>GENERAL</u> This specification covers the design, performance and operational requirements, configuration and constructional features, manufacture, assembly, inspection and testing at the manufacturer's and/or his sub-contractor's works and painting for delivery of condenser on-load tube cleaning system (sponge rubber balls type) complete with all accessories as specified hereinafter. Each half of the condenser shall be provided with an independent tube cleaning system.	
2.00.00	<u>CODES AND STANDARDS</u>	
2.01.00	The design, materials, manufacture, inspection and testing of the condenser on-load tube cleaning system complete with all accessories, shall comply with the requirements of the latest versions of the following appropriate codes and standards.	
2.01.01	IS/BS/DIN/US Standards regarding pressure vessels, pumps, piping, flanges and others as necessary.	
2.01.02	IS/BS/DIN/ASTM Standards for materials specification and testing procedures.	
2.01.03	IS/BS/DIN/AWWA Standards for valves and the testing.	
2.02.00	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 the matter, the interpretation of the specification by the Engineer shall be final and binding.	
3.00.00	<u>DESIGN AND CONSTRUCTION</u>	
3.01.00	General Requirements	
3.01.01	Unless otherwise necessary, manufacturer's standard and proven models of the tube cleaning system shall be supplied.	
3.01.02	The tube cleaning system shall be capable of safe, continuous and trouble-free operation for removal of fouling and scaling materials from condenser tubes. Vibration, noise, mechanical stresses shall be kept within allowable limits specified by relevant codes/standards. In design, due attention shall be given to ease of maintenance, repair and cleaning.	
3.01.03	Suitable Corrosion allowance shall be provided whenever necessary. Adequate provision for future installation of cathodic protection shall be provided.	
3.01.04	The tube cleaning system shall consist of ball separator at condenser outlet, recirculating pump, ball collector, differential pressure measuring system for ball separator, ball monitoring system, cleaning balls, piping valves, distributors, injection nozzles, instrumentations, control panel, interconnecting cables and others as necessary. The configuration of the tube cleaning system shall be as described in section C and / or as per the scheme enclosed.	

	TITLE : STANDARD TECHNICAL SPECIFICATION CONDENSER ON - LOAD TUBE CLEANING SYSTEM (Sponge Rubber Ball Type)	SPECIFICATION NO. PE-TS-999-165-N002	
		SECTION : II	
		SUB-SECTION : IIA	
		REV. NO. 01	DATE :26.05.2016
SHEET 2 OF 11			

3.02.00

DELETED

3.03.00

Operational Requirements.

The tube cleaning system and other accessories shall be designed for the following operation modes :

3.03.01

Complete automatic start-up of tube cleaning system initiated by pressing the push button (manual command).

3.03.02

Complete automatic shut-down of tube cleaning system with ball collection, effected by the following :

◆ Push button (manual command).

◆ Adjustable timer (after a defined cleaning period).

◆ Ball monitoring system (when the number of oversized balls falls below a set value).

3.03.02

Complete automatic backwashing of ball separator with ball collection, effected by the following :

◆ Differential pressure measuring system at a pre-determined differential across the ball separating strainer/ screen.

◆ Adjustable timer

◆ Push button

3.03.04

Complete automatic emergency backwashing of ball separator with alarm, indication, effected by differential pressure measuring system.

3.03.05

Manual operation for start-up, shut-down with ball collection backwashing of ball separator, flushing of differential pressure measuring system etc., in case of failure of control system.

3..04.00

Ball Separator

3.04.01

Ball separator body shall be of rigid construction and shall be designed and manufactured as per the applicable codes for pressure vessels. It shall house the ball separating screen / strainer and shall have flanged inlet, outlet, ball extraction opening and pressure measuring tappings etc. Body shall be designed and manufactured as per the applicable codes for pressure vessels and to take care of forces and moments as enclosed in the specification. However in no case thickness of housing/body shall be less than the connecting pipe thickness as specified in data sheet A

3.04.02

The ball separator shall be provided with manhole with bolted cover and sight glass to observe its internals.

3.04.03

If specified in Data Sheet -A, ball separator body shall be Epoxy lined.

	TITLE : STANDARD TECHNICAL SPECIFICATION CONDENSER ON - LOAD TUBE CLEANING SYSTEM (Sponge Rubber Ball Type)	SPECIFICATION NO. PE-TS-999-165-N002 SECTION : II SUB-SECTION : IIA REV. NO. 01 DATE : 26.05.2016 SHEET 3 OF 11
3.04.04	The ball separating screen / strainer shall be designed for the maximum differential pressure across the separator and shall be securely mounted in the body. Screen / strainer shaft shall be sized adequately considering the overloading of screens / strainer due to debris accumulation.	
3.04.05	The ball separating strainers / screens shall have electric actuators for swivelling to allow for their backwashing. Also suitable hand wheels shall be provided to enable manual swivelling of strainers / screens.	
3.05.00	<u>Ball Recirculating Pump</u>	
3.05.01	The ball recirculating pump shall be horizontal centrifugal type. The casing shall be designed to withstand 1.5 times the shut-off pressure or twice the operating pressure, whichever is higher.	
3.05.02	The impeller shall be non-clog type and shall be contoured suitably to avoid damage to the cleaning balls. The impeller shall be secured suitably to the shaft and shall be retained against circumferential movement by keys, pins or lock rings. Loctite compound shall be applied after tightening of locknuts to prevent dislocation of impeller.	
3.05.03	Replaceable type wearing ring shall be provided to prevent damage to the casing and impeller.	
3.05.04	Pumps shall be provided with mechanical seals to the extent feasible. If Gland packing is provided it should be of good quality to be provided to prevent leakage of water from pump glands.	
3.05.05	Shaft size selected shall take into Consideration the critical speed which shall be away from the operating speed as recommended in applicable codes / standards. Renewable type fine finished shaft sleeves shall be integral with water thrower plates at the end and the length must extend beyond the outer faces of gland packing so as to distinguish between the leakage between shaft and the shaft sleeve and that past the seals / glands.	
3.05.06	Bearings of adequate design shall be provided for taking the entire pump load arising from all probable conditions of continuous operation through its range of operation. The bearings shall be designed on the basis of 20,000 working hours minimum for the load corresponding to the duty point. Proper lubricating element does not contaminate the liquid being pumped. Bearings shall be easily accessible without disturbing the pump assembly	
3.05.07	Stuffing box of suitable design to permit replacement of packing without removing any part other than the gland shall be provided. The stuffing boxes shall be sealed / cooled by the fluid being pumped.	
3.05.08	Pumps shall be of self-lubricated, self - sealed and self-cooled type. All pipework, fitters etc., for sealing, cooling and lubricating purpose shall be supplied and no external cooling/lubricating/sealing water will be supplied. Pump capacity shall take into account	

	TITLE : STANDARD TECHNICAL SPECIFICATION CONDENSER ON - LOAD TUBE CLEANING SYSTEM (Sponge Rubber Ball Type)	SPECIFICATION NO. PE-TS-999-165-N002	
		SECTION : II	
		SUB-SECTION : IIA	
		REV. NO. 01	DATE :26.05.2016
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the cooling/lubricating/sealing water requirement.

3.05.09 All rotating components shall be statically and dynamically balanced.

3.05.10 The pump shall be designed such that pump impellers and other accessories of the pump, are not damaged due to flow reversal.

3.05.11 The pump shall be capable of developing the required total head at rated capacity for continuous operation. Also the pumps shall be capable of being operated to give satisfactory performance at any point on the head Vs. flow characteristic curve over a range or 40% of rated flow to 120 -130 % of rated flow.

3.05.12 The pump shall preferably be non-overloading type. The total head Vs. capacity curve shall be continuously rising from the maximum flow point towards shut-off without any zone of instability.

3.05.13 The pump shall run smoothly without undue noise and vibration. Peak to peak vibration limits and noise level shall be within the acceptable values of applicable codes/standards.

3.05.14 The pump and motor shafts shall be connected through a pin and rubber bush flexible type of couplings. Suitable coupling guards shall be provided for the couplings.

3.05.15 The pump shall be capable of being started with discharge valve fully opened. Motor rating shall be adequate for this condition. The output KW rating of the pump drive motor shall not be less than the larger of the following :

a) Maximum power input to the pump over the entire range for maximum flow to shut-off condition.

b) 125% of power input to the pump at duty point corresponding to 103% of the rated speed.

3.06.00 **Ball Collector**

3.06.01 The body of the ball collector shall be designed to withstand 2.0 times the operating pressure or 1.5 times the recirculating pump shut-off pressure, whichever is higher. The ball collector shall be designed and manufactured as per the applicable codes for pressure vessels.

3.06.02 Ball collector shall be provided with an inspection window/sight glass for visual inspection of the cleaning balls.

3.06.03 Ball collector shall be provided with suitable ports with covers for ball feeding and removal.

3.06.04 The ball collector shall be provided with vent and drain connections with isolating valves.

3.06.05 Provision shall be made in the ball collector for separating the undersized balls and ball collector shall have a separate chamber for collecting the undersized balls.

	TITLE : STANDARD TECHNICAL SPECIFICATION CONDENSER ON - LOAD TUBE CLEANING SYSTEM (Sponge Rubber Ball Type)	SPECIFICATION NO. PE-TS-999-165-N002 SECTION : II SUB-SECTION : IIA REV. NO. 01 DATE : 26.05.2016 SHEET 5 OF 11
3.06.06	If specified in Data Sheet -A, ball collector body shall be lined with suitable resilient material.	
3.06.07	The differential pressure measuring system shall be provided with D.P. transmitter ,DPS & DPGof remote seal arrangement.	
3.07.00	<u>Differential Pressure Measuring System.</u>	
3.07.01	The ball separator shall be provided with a measuring system for differential pressure across the ball separating strainer/screen, to check debris accumulation and to initiate ball catching and backwashing operations. This shall consist of a differential pressure switch/transmitter for automatic backwashing operation, a differential pressure guage for manual observation with adequate number of tappings with isolating valves.	
3.07.02	The contacts for differential pressure switch/transmitter and for differential pressure guage shall be independent so that in the event of failure of one, the other is available.	
3.07.03	The differential pressure measuring system shall be with remote seal arrangement .	
3.08.00	<u>Ball Monitoring System</u>	
3.08.01	Ball monitoring system shall be provided for continuously monitoring the quantity and size of the cleaning balls in circulation. The monitoring system shall perform the following functions :	
	a) Continuously counting the oversize balls in circulation and giving an alarm calling for investigation of ball losses, when the number of oversize circulating balls falls below a set valve. b) Continuously measuring the size of the balls in circulation and initiating the shut-down of the tube cleaning system with alarm calling-for replacement of balls when the number of oversized balls falls below a set valve. c) Bidder's if not manufacturing ball oversized monitor, can supply automatic ball sorter in lieu of same for automatic sorting of the undersized balls.	
3.08.02	The monitoring system shall be of proven and reliable design and shall be complete with necessary transducers, amplifiers, transmission lines, power cables and electronic processor etc.	
3.08.03	The electronic processor of the ball monitoring system shall be housed in the control panel and shall consist the following : - a) Indicators for ◆ required basic ball charge. ◆ recirculating ball quantity. ◆ oversized ball quantity.	

TS-PEM-MSE बिपिईएम BHEL		TITLE :		SPECIFICATION NO. PE-TS-999-165-N002	
		STANDARD TECHNICAL SPECIFICATION CONDENSER ON - LOAD TUBE CLEANING SYSTEM (Sponge Rubber Ball Type)		SECTION : II	
				SUB-SECTION : IIA	
				REV. NO. 01	DATE :26.05.2016
				SHEET 6	OF 11

b)

Time counters for

- ◆ total cleaning system operating hours.
- ◆ cleaning system operating hours with sufficient number of oversized balls.

c)

Recorder for ball consumption.

3.08.04

The ball monitoring system shall have provisions for self-testing and self-calibration.

3.09.00

Cleaning Balls

3.09.01

The sponge rubber cleaning balls shall be slightly oversized to the internal diameter of condenser tubes and should be able to remove all fouling and scaling deposits in the condenser tubes.

3.09.02

The specific gravity of the cleaning balls shall be such that good distribution of balls across the tube sheet and cleaning of all tubes are ensured.

3.09.03

The composition of the cleaning balls shall be based on natural rubber and shall be suitable for temperature upto 100°C. Hardness of the cleaning balls shall be compatible to tube material and corrosion/fouling behaviour. If cleaning balls consist of abrasive coated balls, the abrasive material shall also be compatible for use with the tube material.

3.09.04

Calculations and basis for selection of cleaning balls circulation quantity, type, size, hardness, cleaning frequency etc., shall be furnished during contract stage.

3.10.00

Piping, Valves, Distributors and Injection Nozzles.

3.10.01

Interconnecting piping, valves, injection nozzles and other fittings shall be designed to withstand 2.0 times the operating pressure or 1.5 times the pump shut-off pressure whichever is higher.

3.10.02

Interconnecting piping shall be sized and routed optimally. Velocity in the pipe work shall be less than 1.5 m/s for pump suction and less than 2.2 m/s in other pipe work.

3.10.03

Necessary isolation valves, vent and drain valves for various equipments shall be provided. Valves shall conform to appropriate standards. Valves provided in ball transport piping shall be ball type. Gland packing of all valve shall be of superior quality to avoid leakage. All valves upto 150 Nb shall be ball valves. For higher sizes , gate / globe /B.F. valves shall be provided. All instrument valves shall be needle valves.

3.10.04

Adequate number of ball injection nozzles shall be provided for proper distribution of cleaning balls in condenser inlet. Ball injection nozzles shall be flanged type and shall have two sets of flanges, one for connecting to ball transport pipe and other for connecting to the stub on condenser inlet pipe for ease of removal during repairs or checking.

3.10.05

Distributors (if applicable) with sight glass shall be provided wherever ball transport

	TITLE : STANDARD TECHNICAL SPECIFICATION CONDENSER ON - LOAD TUBE CLEANING SYSTEM (Sponge Rubber Ball Type)	SPECIFICATION NO. PE-TS-999-165-N002 SECTION : II SUB-SECTION : IIA REV. NO. 01 DATE : 26.05.2016 SHEET 7 OF 11
	piping branching out or joining together for proper guidance of cleaning balls. 3.10.6 Type of valves shall be ball valves, no diaphragm type valve shall be used. 3.11.00 <u>Actuators</u> 3.11.00 Tube cleaning system shall be provided with actuators wherever necessary for various automatic operations. The actuators shall be electric motor operated and shall meet the requirements of the enclosed specification. The actuator shall be provided with auxiliary handwheel for manual operation in the event of control system failure. 3.12.00 <u>Electric Motors</u> The drive motors for recirculating pump and differential pressure measuring system flushing pump shall conform to the requirements of the enclosed specification. 3.13.00 <u>Instrumentation and Control System.</u> 3.13.01 Complete instrumentation and control system for automatic operation of tube cleaning system, protection, interlocking, indication / annunciation of differential pressure and other malfunctions etc., shall be provided. This shall consist of adequate operational hardware, local control panel (As applicable) and interconnecting control and power cabling between the control panel and various equipments in the tube cleaning system. 3.13.02 The control panel shall house all necessary instruments, indicating / annunciation lamps, alarms, differential pressure indicator, timer, function selection switches, ball monitoring system processor, relays, protection and interlocking systems, start / stop push button etc., and shall be complete with internal wiring. The control panel shall meet the requirements of the enclosed specification. 3.13.03 Pressure guages shall be provided at recirculating pump suction and discharge. All instrumentation shall be of reputed make and shall meet the requirements of the enclosed specifications. 3.14.00 <u>Other Accessories.</u> 3.14.01 Counter flanges, complete with gaskets, bolts and nuts etc., shall be supplied for ball separator inlet, outlet connections and all other terminal points Fabrication, dimensions and drilling of the flanges shall conform to the codes/standards specified in Data Sheet-A / Section -C. 3.14.02 Ball recirculating pump, ball collector with interconnecting piping and valves, shall be mounted on a frame. For fixing the frame, necessary foundation plates, bolts, nuts etc. shall be provided. 3.14.03 Suitable lifting arrangement shall be provided for various equipments of the tube cleaning system, for handling during erection and maintenance.	

TS-PEM-002 TS-PEM-002 TITLE : STANDARD TECHNICAL SPECIFICATION CONDENSER ON - LOAD TUBE CLEANING SYSTEM (Sponge Rubber Ball Type)		SPECIFICATION NO. PE-TS-999-165-N002 SECTION : II SUB-SECTION : IIA REV. NO. 01 DATE :26.05.2016 SHEET 8 OF 11	
4.00.00	DELETED		
5.00.00	SHOP INSPECTION AND TESTS		
5.01.01	General		
5.01.01	Manufacturer shall conduct all tests and stage inspections as per the approved quality plan to ensure that the various equipments and other accessories of the tube cleaning system shall conform to the requirements of this specification and of the applicable codes / standards.		
5.01.02	All materials used for manufacture /fabrication of the various equipments of the tube cleaning system shall be of tested quality. Relevant test certificates for chemical analysis, mechanical tests and heat treatment shall be made available before the final shop inspection. In case the relevant test certificates are not available, the manufacturer shall arrange to carry out the necessary tests as per the approved quality plan and applicable codes at his cost for which samples shall be identified by BHEL's representative.		
5.01.03	All shop tests shall be conducted as per approved quality plan and test certificates / reports for the same shall be furnished to BHEL for approval.		
5.01.04	Qualification of welding procedures and welders shall be as per ASME B&PV code, Section - IX / applicable codes.		
5.2.00	Ball Separator		
5.02.01	Chemical analysis, mechanical tests shall be carried out on materials used for body, strainer / screen, strainer / screen shaft and other appurtenances as per the applicable material specification standards.		
5.02.02	All butt welded joints shall be subjected to radiographic/ ultrasonic testing as per applicable codes. However, all welded joints shall be subjected to 100% magnetic particle / penetrant testing to ensure freedom from defects.		
5.02.03	Strainer / screen shaft shall be subjected to ultrasonic test as per ASTM-A388 for subsurface defects with acceptance norms as per ASME B&PV code, Section VIII, Division 1.		
5.03.00	Ball Recirculating Pump		
5.03.01	Chemical analysis, mechanical tests shall be carried out on materials used for casing, impeller, shaft, sleeves, wear rings etc., as per the applicable material specification standards.		
5.03.02	The casting used for pump casing and impeller shall be sound, clean and free from porosity, blow holes, hard spots, cold shuts, distortion and other harmful defects. All accessible surfaces of the impeller shall be subjected to penetrant test as per ASTM-		

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5.03.03	E165 for surface defects with acceptance norms as per ASME B&PV code, Section VIII, Division 1. No welding or repairs shall be carried out without prior permission of BHEL. Pump shaft and sleeves shall be subjected to ultrasonic test as per ASTM - A388 for sub-surface defects and penetrant test after finish machining as per ASTM-E165 for surface defects.	
5.03.04	Wear rings shall be subjected to penetrant test as per ASTM-E165.	
5.03.05	Pump impellers and rotor assembly shall be statically and dynamically balanced as per ISO-1940	
5.04.00	<u>Ball Collector</u>	
5.04.01	Chemical analysis, mechanical tests shall be carried out on materials used for body and other appurtenances / accessories as per the applicable material specification standards.	
5.04.02	All but welded joints shall be subjected to radiographic / ultrasonic testing as per applicable codes. However, all welded joints shall be subjected to 100% magnetic particle / penetrant testing to ensure freedom from defects.	
5.05.00	<u>Piping, Valves, Distributors, and Injection Nozzles.</u>	
5.05.01	Chemical analysis, mechanical tests shall be carried out for materials used for piping, fittings, valves, distributors and injection nozzles.	
5.05.02	All welded joints of distributors & injection nozzles shall be subjected to penetrant test as per ASTM-E165 for surface defects with acceptance norms as per ASME B&PV code, Section VIII, Division 1.	
5.05.03	Inspection and testing of valves including leakage test shall be carried out as per the requirements of the applicable standards. Valve stem and ball shall be subjected to penetrant test as per ASTM-E165.	
5.05.04	All materials for various nozzles, stubs, gaskets, nuts, bolts etc. shall be of tested quality and correlating test certificates for chemical and mechanical properties shall be furnished.	
5.06.00	<u>Rubber Lining (as applicable)</u>	
	Rubber lining shall be subjected to surface crack test, 100% spark and hardness tests and shall be checked for layer thickness, defects etc.	
5.07.00	<u>Flanges</u>	
5.07.01	Chemical and mechanical test certificates shall be furnished for flange materials.	
5.07.02	In case of fabricated flanges, all the welds shall be subjected to 100% radiography as	

	TITLE : STANDARD TECHNICAL SPECIFICATION CONDENSER ON - LOAD TUBE CLEANING SYSTEM (Sponge Rubber Ball Type)	SPECIFICATION NO. PE-TS-999-165-N002 SECTION : II SUB-SECTION : IIA REV. NO. 01 DATE : 26.05.2016 SHEET 10 OF 11
	per ASME B&PV code, Section VIII, Division 1. 5.07.03 In case of forged flanges, ultrasonic testing shall be carried out as per ASTM-A 388. 5.07.04 If the thickness of the plate used for flanges is 40mm or more, the same shall be checked ultrasonically as per ASTM-A435 to demonstrate the absence of lamination and lack of fusion etc. 5.07.05 Flanges shall be checked for edge preparation, fit up and satisfactory working with matching parts. 5.08.00 <u>Dimensional Checks.</u> Dimensional checks for various equipments/components of the tube cleaning system shall be carried out as per assembly drawing approved by BHEL. Alignment and fit up of movable parts shall be checked. 5.09.00 <u>Hydrostatic Test</u> Hydrostatic test shall be conducted on various assemblies / equipments / components of the tube cleaning system at a pressure of 1.5 times and design pressure. The duration of the test shall be minimum 30 minutes. 5.10.00 <u>Leakage Test</u> Leakage test shall be conducted at the design pressure on all assemblies of the tube cleaning system to demonstrate that the assemblies are leak tight and no water seepage shall take place at various nozzles and valve connections. 5.11.00 <u>Performance Test on Recirculating Pump</u> Performance test on recirculating pump with drive motor shall be conducted as per BS-599 / ASME PTC 8.0. Performance curves i.e., discharge flow Vs head, discharge flow Vs power consumption and discharge flow Vs efficiency shall be plotted and acceptance norms shall be as per BS-599 / ASME PTC 8.0. Vibration and noise shall be measure and acceptance norms shall be as per Hydraulic Institute (USA) standard. 5.12.00 <u>Functional Tests</u> Various assemblies / equipments / components of the tube cleaning system shall be subjected to functional tests and the following shall be checked. 5.12.01 Smooth and free operation of all movable parts. 5.12.02 Interlock and sequential operation. 5.12.03 Satisfactory operations of ball monitoring system.	

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5.12.04

Satisfactory operations of actuators torque switches, limit switches etc.

6.00.00

TESTING AT SITE

After completion of installation at site, the tube cleaning system will be tested to check that the tube cleaning system performance meets the requirements of this specification. Rectification of all defects shall have to be done by the supplier at no extra cost to the owner / purchaser. However, the owner / purchaser reserves the right to reject the equipments / parts not meeting the requirement if the deficiency still persists.

7.00.00

QUALITY ASSURANCE & QUALITY PLAN

7.01.00The tube cleaning system and other accessories to be supplied, shall have assured quality and workmanship.

7.02.00Typical quality plans are enclosed herewith this specification for bidder's guidance. The bidder shall furnish his own quality plan based on materials, equipments and components of the tube cleaning system being offered.

8.00.00

NAME PLATE AND TAG NUMBERS

8.01.00Ball separator, recirculating pump, ball collector shall be provided with a permanently attached brass or stainless steel plate indicating the following details :-

a)

Design and maximum flow rates.

b)

Design and test pressures.

d)

Design temperature.

e)

Empty and operating weights.

8.02.00Each valve in the tube cleaning system shall be provided with a name plate indicating the following :-

a)

Service.

b)

Design and test pressures.

c)

Maximum flow and flow direction.

d)

Size.

e)

Tag Number.

Tag Numbers will be indicated on the drawings submitted for approval during contractstage.

8.03.00

Each motor shall be provided with a name plate indicating the following details:

a)

Supply conditions.

b)

KW Rating.

c)

Make.

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	TITLE : DATA SHEET - C		SPECIFICATION NO. PE-TS-999-165-N001	
	CONDENSER ON - LOAD TUBE CLEANING SYSTEM (Sponge Rubber Ball Type)		VOLUME : II B	
			SECTION : D	
			REV. NO. 01	DATE :20.06.16
			SHEET 1 OF 2	

1.00.00 **DRAWING, DATA & INFORMATION TO BE SUBMITTED AFTER THE AWARD OF CONTRACT.**

After the award of contract, the following drawings, data and information is to be submitted for review / approval of BHEL.

1.01.00 The drawings to be submitted by bidder in event of award of contract shall be as per cl. 10.0 (b), sub-section-1A.

1.01.01 Data sheet (s) - B.

1.01.02 Final versions of the following drawings to enable BHEL to finalise the layout and to design foundations and structures:-

- a) General arrangement / installation drawings of ball separator, ball recirculating unit, control panel each complete with all accessories, incorporating the principal dimensions and weights of equipment offered, size and location of various nozzle connection, supporting arrangement (wherever applicable) and scope of supply etc.
- b) Foundation arrangement drawings (wherever applicable) showing load data on supports, size and location of anchor bolts etc.
- c) General arrangement drawing indicating the layout of the equipments and interconnecting piping with pipe supports.

1.01.03 Bar chart and inspection schedule.

1.02.00 Within the stipulated time period as per Vendor's drawing /document list, the following shall be submitted.

1.02.01 Cross Sectional/ detailed drawing of ball separator, recirculating pump, ball collector, differential pressure measuring system, ball monitoring system distributors, injection nozzles actuators, motors, control panel etc, indicating bill of quantities and materials of construction.

1.02.02 Final versions of calculations and basis for selection of cleaning balls circulation quantity, type, size, hardness, cleaning frequency etc.

12.2.03 Flow and control logic diagrams for various operations of the tube cleaning system.

1.02.04 Detailed schedule of valves indicating Tag numbers, type, make size, pressure and temperature ratings, materials etc.

1.02.05 Detailed schedule of instruments indicating tag numbers, type, make, materials , of construction, range and accuracy etc.

1.2.6 Detailed schedule of piping and fittings indicating sizes, materials, maximum working pressure and temperatures etc.

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	TITLE : DATA SHEET - C CONDENSER ON - LOAD TUBE CLEANING SYSTEM (Sponge Rubber Ball Type)	SPECIFICATION NO. PE-TS-999-165-N001	
		VOLUME : II B	
		SECTION : D	
		REV. NO. 01	DATE :20.06.16
		SHEET 2 OF 2	

- 1.02.07 Control panel layout and list of instruments provided on control panel.
- 1.02.08 List of annunciations, protections and interlocks provided.
- 1.02.09 Detailed drawings of flanges.
- 1.02.10 Ball recirculating pump performance characteristic curves.
- 1.02.11 Write-up and instruction manuals for erection, operation and maintenance.
- 1.02.12 Storage instructions.
- 1.02.13 Vendor to send 3 sets of final documents (O&M manual, GA drg, P&ID) direct to site under intimation to PEM.

	MANUFACTURER/BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
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		PROJECT:		PO NO.:	DATE:
		ITEM: COLTCS	SYSTEM: CW SYSTEM	SECTION:	SHEET 1 of 17

SL.NO.	COMPONENT & OPERATIONS	CHACTERISTICS	CLASS	TYPE OF CHECK	QYANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*D	**			
					M	C/ N					M	C	N	
INDEX														
			SI No	COMPONENT / ITEM DESCRIPTION			PAGE No.							
			1	BALL SEPARATOR			2-3							
			2	BALL COLLECTOR			4-5							
			3	BALL RECIRCULATING SKID ASSEMBLY			6							
			4	INTERCONNECTING PIPING / BALL DISTRIBUTOR AND INJECTION NOZZLE			6							
			5-11	BOUGHT OUT ITEMS			7-13							
			12	ALL COMPONENTS/EQUIPMENTS			13							
			13	LOCAL CONTROL (SWITCH GEAR) PANEL			14-17							
			14	FINAL INSPECTION OF PACKING			17							

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,

** M: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, C: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, N: CUSTOMER,

P: PERFORM, W: WITNESS, V: VERIFICATION, AS APPROPRIATE, D : DOCUMENT

MA: MAJOR, MI: MINOR, CR: CRITICAL, IR: Inspection Report, MTC: Manufacturer / Mill Test Certificate, CHP : NTPC. SHALL IDENTIFIED IN COLOUM "N" AS "W"

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	 Digitally signed by Nishant Sekhar, DN: cn=Nishant Sekhar, o=BHEL, ou=PS-PSM, email=nishant.sekhar@bhel.co.in	NISHANT SEKHAR	Checked by:	 Digitally signed by Ashish Panigrahi, DN: cn=Ashish Panigrahi, o=BHEL, ou=PS-PSM, email=ashish.panigrahi@bhel.co.in	ASHISH PANIGRAHI
Reviewed by:	 Digitally signed by Vishal Kumar Yadav, DN: cn=Vishal Kumar Yadav, o=BHEL, ou=PS-PSM, email=vishal.yadav@bhel.co.in	VISHAL KUMAR YADAV	Reviewed by:	 Digitally signed by Ritesh Kumar Jaiswal, DN: cn=Ritesh Kumar Jaiswal, o=BHEL, ou=PS-PSM, email=ritesh.jaiswal@bhel.co.in	RITESH KUMAR JAISWAL

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	MANUFACTURER/BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-N009	DATE: 21.09.2021
		PROJECT:		PO NO.:	DATE:
		ITEM: COLTCS	SYSTEM: CW SYSTEM	SECTION:	SHEET 2 of 17

SL.NO.	COMPONENT	CHACTERISTICS	CLASS	TYPE OF CHECK	QYANTUM OF CHECK		REFERENC	ACCEPTANCE	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*D	**			
					M	C/ N					M	C	N	
1.0.0 BALL SEPARATOR														
1.1.0	Raw Material													
1.1.1	CS Plate-Housing shell,	Chemical & Physical Properties	Major	Chemical & Physical Analysis	One sample/ batch /heat	-	Approved GA Drawing	Approved GA Drawing	MTC / Lab test report	√	P	V	V	In the absence of MTC/Testing , Check Testing shall be carried out in NABL Accredited Lab. Testing report shall be reviewed by TPIA/BHEL.
		Surface Defects	Minor	Visual	100%	-	No Defects	No Defects	IR	√	P	V	-	
		Sub Surface Defects	Major	UT	100%	-	ASME Sec V	ASTM SA 578 level-B	MTC / UT Report	√	V	V	V	≥ 12.5 mm thickness
1.1.2	Nozzle Pipes (Carbon Steel)	Chemical & Physical Properties	Major	Chemical & Physical Analysis	One sample/ batch /heat	-	Approved GA Drawing	Approved GA Drawing	MTC / Lab test report	√	P	V	V	In the absence of MTC/Testing , Check Testing shall be carried out in NABL Accredited Lab. Testing report shall be reviewed by TPIA/BHEL.
		Surface Defects	Minor	Visual	100%	-	No Defects	No Defects	IR	√	P	V	-	
1.1.3	Body Flanges & Nozzle Flange (Carbon Steel)	Chemical & Physical Properties	Major	Chemical & Physical Analysis	One sample/ batch /heat	-	Approved GA Drawing	Approved GA Drawing	MTC / Lab test report	√	P	V	V	In the absence of MTC/Testing , Check Testing shall be carried out in NABL Accredited Lab. Testing report shall be reviewed by TPIA/BHEL.
		Sub Surface Defects	Major	UT	100%	-	ASME,Sec- V	ASTM A578 Level B	UT Report	√	P	V	V	≥ 40 mm thickness
		Surface Defects (only for bodyflanges)	Minor	Dye Penetrant test	100%	-	ASME,Sec-V	ASME, Sec.-VIII Div.-1 Appendix-8	DPT Report	√	P	V	-	
1.1.4	Screen Shaft (Stainless steel)	Chemical & Physical Properties	Major	Chemical & Physical Analysis	One sample/ batch /heat	-	Approved GA Drawing	Approved GA Drawing	MTC / Lab test report	√	P	V	V	In the absence of MTC/Testing, Check Testing shall be carried out in NABL Accredited Lab. Testing report shall be reviewed by TPIA/BHEL.
		Corrosion Resistance	Major	IGC		-	ASTM A 262- E	ASTM A 262- E	test report	√	P	V	V	
		surface defect	Major	Dye Penetrant test	100%	-	ASME,Sec-V	ASME, Sec.-VIII Div.-1 Appendix-8	DPT Report	√	P	V	-	
		Sub Surface Defects	Major	UT	100%	-	ASME Sec V	ASTM SA 388	UT Report	√	P	V	-	

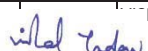
BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	NISHANT SHEKHAR	NISHANT SEKHAR	Checked by:	Ashish Panigrahi	ASHISH PANIGRAHI
Reviewed by:	HAAL KUMAR YADAV	HAAL KUMAR YADAV	Reviewed by:	RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
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	MANUFACTURER/BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN				SPEC. NO :		DATE:	
		CUSTOMER :				QP NO.: PE-QP-999-N009		DATE: 21.09.2021	
		PROJECT:				PO NO.:		DATE:	
		ITEM: COLTCS		SYSTEM: CW SYSTEM		SECTION:		SHEET 3 of 17	

SL.NO.	COMPONENT & OPERATIONS	CHACTERISTICS	CLASS	TYPE OF CHECK	QYANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*D	**			
					M	C/ N					M	C	N	
1.1.5	Screen ribs (Stainless steel)	Chemical & Physical Properties	Major	Chemical & Physical Analysis	One sample/ batch /heat	-	Approved GA Drawing	Approved GA Drawing	MTC / Lab test report	√	P	V	-	In the absence of MTC/Testing , Check Testing shall be carried out in NABL Accrediated Lab. Testing report shall be reviewed by TPIA/BHEL.
		Corrosion Resistance	Major	IGC			ASTM A 262- E	ASTM A 262- E		√	P	V	-	
		surface defect	Minor	Visual	100%	-	No Defects	No Defects	-	-	P	-	-	
1.1.6	Body Fasteners	Chemical & Physical Properties	Major	Chemical & Physical Analysis	one sample / heat	-	Approved GA Drawing	Approved GA Drawing	MTC/Lab Test Report	√	P	V	-	
1.2.0	In process Quality Control													
1.2.1	Welding procedure specification	Correctness	Critical	Scrutiny	100%	-	ASME Sec.IX	QW 482 of ASME Sec.IX	Weld Diagram with applicable WPS,PQR & WPQ	√	P	V	-	Prequalified procedures/ WPQ appd. by reputed TPIA viz. LRA/BVIL/TUV/ DNV/ Velosy are available.
1.2.2	Procedure qualification record	Weld soundness	Critical	Physical test	100%	-	ASME Sec.IX	QW 483 of ASME Sec.IX		√	P	V	-	
1.2.3	Welder performance qualification	Weld soundness	Critical	Radiography	100%	-	ASME Sec.IX	QW 484A of ASME Sec.IX		√	P	V	-	
1.2.4	Fit-up of butt weld	Alignment and dimensions	Major	Visual, Dimensions & Orientation	100%	-	Manufacturing Drawing	ASME Sec VIII Div 1 & MFG drg.	IR	√	P	V	-	
1.2.5	Fit-up of Fillet Weld									√	P	V	-	
1.3.0	Weld quality for Pressure parts													
1.3.1	Root run (Butt weld)	Surface Defects	Major	Dye Penetrant test	100%	-	ASME,Sec-V	ASME, Sec.-VIII Div.-1 Appendix-8	DPT Report	√	P	V	-	
1.3.2	Completed butt welds	a). Surface defects	Major	Dye Penetrant test	100%	-	ASME,Sec-V	ASME, Sec.-VIII Div.-1 Appendix-8	DPT Report	√	P	V	-	
		b). Sub-surface defects of Butt Weld	Critical	Radiography	10% of total weld length & 100% of T joints		ASME Sec. VIII Div.1/ Sec V	ASME Sec. VIII Div.1/ Appendix 4/ UW 52	Radiography Report	√	P	V	V	RT Film to be reviewed
1.3.3	Completed fillet welds	Surface defects	Major	Dye Penetrant test	100%	-	ASME,Sec-V	ASME, Sec.-VIII Div.-1 Appendix-8	DPT report	√	P	V	-	
1.4.0	Fabricated Housing (Prior to sand blasting)	1. Dimensions, Orientation & Workmanship	Major	Measurement	100%	100%	Manufacturing Drawing of Ball Separator	Approved GA Drawing	Dimension report	√	P	W	V	CQIR
		2. Leakage	Critical	Hydro Test	100%	100%	Approved GA Drawing	Approved GA Drawing	Pressure test report	√	P	W	V	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	 NISHANT SHEKHAR	NISHANT SEKHAR	Checked by:	 Ashish Panigrahi	ASHISH PANIGRAHI
Reviewed by:	 RITESH KUMAR JAISWAL	HAL KUMAR YADAV	Reviewed by:	 RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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	MANUFACTURER/BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-N009	DATE: 21.09.2021
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		ITEM: COLTCS	SYSTEM: CW SYSTEM	SECTION:	SHEET 4 of 17

SL.NO.	COMPONENT & OPERATIONS	CHACTERISTICS	CLASS	TYPE OF CHECK	QYANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*D	**			
					M	C/ N					M	C	N	
1.5.0	Pickling & passivation	Protection layer	Major	Visual	100%	-	IS 10117	IS 10117	IR	√	P	V	-	
1.6.0	Final tests of Ball separator Assy.	Dry run function test	Critical	Operational test	100%	100%	Approved Procedure		Dry run test report	√	P	W	V	CQIR
2.0.0	BALL COLLECTOR													
2.1.0	Raw Material													
2.1.1	CS PIPE-Housing Shell	Chemical & Physical Properties	Major	Chemical & Physical Analysis	One sample/ batch /heat	-	Approved GA Drawing	Approved GA Drawing	MTC / Lab test report	√	P	V	V	In the absence of MTC/Testing , Check Testing shall be carried out in NABL Accredited Lab. Testing report shall be reviewed by TPIA/BHEL.
		Surface defects	Minor	Visual	100%	-	No Defects	No Defects	IR	√	P	V	-	
2.1.2	CS Dished End	Chemical & Physical Properties	Major	Chemical & Physical Analysis	One sample/heat/ batch	-	Approved GA Drawing	Approved GA Drawing	MTC / Lab test report	√	P	V	V	In the absence of MTC/Testing , Check Testing shall be carried out in NABL Accredited Lab. Testing report shall be reviewed by TPIA/BHEL.
		Surface defects	Minor	Dye Penetrant test	100%	-	ASME,Sec-V	ASME, Sec.-VIII Div.-1 Appendix-8	DPT report	√	P	V	-	
2.1.3	Nozzle Pipe	Chemical & Physical Properties	Major	Chemical & Physical Analysis	One sample/ batch /heat	-	Approved GA Drawing	Approved GA Drawing	MTC / Lab test report	√	P	V	V	In the absence of MTC/Testing , Check Testing shall be carried out in NABL Accredited Lab. Testing report shall be reviewed by TPIA/BHEL.
		Surface Defect	Minor	Visual	100%	-	No Defects	No Defects	IR	√	P	V	-	
2.1.4	Nozzle Flanges	Chemical & Physical Properties	Major	Chemical & Physical Analysis	One sample/ batch /heat	-	Approved GA Drawing	Approved GA Drawing	MTC / Lab test report	√	P	V	V	In the absence of MTC/Testing , Check Testing shall be carried out in NABL Accredited Lab. Testing report shall be reviewed by TPIA/BHEL.
		Surface Defect	Minor	Dye Penetrant test	100%	-	ASME,Sec-V	ASME, Sec.-VIII Div.-1 Appendix-8	DPT report	√	V	V	-	

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	Sign & Date	Name		Sign & Date	Name
Prepared by:	NISHANT SHEKHAR	NISHANT SEKHAR	Checked by:	Ashish Panigrahi	ASHISH PANIGRAHI
Reviewed by:	VISHAL KUMAR YADAV	VISHAL KUMAR YADAV	Reviewed by:	RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

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Sign & Date	
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		PROJECT:		PO NO.:	DATE:
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SL.NO.	COMPONENT & OPERATIONS	CHACTERISTICS	CLASS	TYPE OF CHECK	QYANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*D	M	C	N	
					M	C/ N								
2.2.0	Inprocess Quality Control													
2.2.1	Welding Procedure Specification	Correctness	Critical	Scrutiny	100%	-	ASME Sec.IX	QW 482 of ASME Sec.IX	Weld Diagram with applicable WPS,PQR & WPQ	√	P	V	V	Prequalified procedures/ WPQ appd. by reputed TPIA viz. LRA/BVIL/TUV/ DNV/ are available.
2.2.2	Procedure qualification record	Weld soundness	Critical	Physical test	100%	-	ASME Sec.IX	QW 483 of ASME Sec.IX		√	P	V	V	
2.2.3	Welder Performance qualification	Weld soundness	Critical	Radiography	100%	-	ASME Sec.IX	QW 484A of ASME Sec.IX		√	P	V	V	
2.2.4	Dished end for ball collector	Dimensions	Major	Template	100%	-	MFG.GAD of Ball Collector	ASME Sec VIII Div.1	IR	√	P	V	-	
2.2.5	Fit up of butt weld	Alignment and dimensions	Major	Measurement	100%	-		Approved Drawing	Fit up report	√	P	V	-	
2.2.6	Fit up of Fillet Weld	Dimensions	Major	Visual & Dimension	100%	-				√	P	V	-	
2.3.0	Weld quality for Pressure parts													
2.3.1	Root run (Butt weld)	Surface Defects	Major	Penetrant test / Visual	100%	-	ASME Sec-V /-	ASME, Sec.-VIII Div.-1 Appendix-8	IR / -	√	P	V	V	
2.3.2	Completed butt weld	Surface defects	Major	Dye Penetrant test	100%	-	ASME,Sec-V	ASME, Sec.-VIII Div.-1 Appendix-8	DPT report	√	P	V	-	
2.3.3		Sub Surface defects	Major	Radiography test	10% of total weld length & 100% of T joints		ASME Sec V	ASME Sec VIII Div.1/ Appendix 4/ UW 52	RT Report	√	P	V	-	RT Film to be reviewed
2.3.4	Completed fillet welds	Surface defects	Major	Penetrant test	100%	-	ASME,Sec-V	ASME, Sec.-VIII Div.-1 Appendix-8	DPT report	√	P	V	-	
2.4.0	Fabricated Housing (Prior to sand blasting)	1. Dimensions, Orientation & Workmanship	Major	Measurement & Visual	100%	100%	Manufacturing Drawing of Ball Collector	Approved drawing	Dimension & Orientation-Inspector report	√	P	W	V	CQIR
		2. Leakage (Ball collector & Piping spools)	Critical	Hydro test	100%	100%	ASME Sec-VIII Div.1	Approved drawing	Pressure Test Report	√	P	W	V	
2.5.0	Pickling & passivation	Protection layer	Major	Visual	100%	-	IS 10117	IS 10117	IR	√	P	V	-	

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Reviewed by:	NISHAL KUMAR YADAV	NISHAL KUMAR YADAV	Reviewed by:	RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

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SL.NO.	COMPONENT & OPERATIONS	CHACTERISTICS	CLASS	TYPE OF CHECK	QYANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*D	**			
					M	C/ N					M	C	N	
3.0.0	BALL RECIRCUALTION SKID ASSEMBLY													
3.0.1	Final Inspection of Recirculating skid assembly	Dimensions	Major	Visual	100%	100%	Manufacturing Ball Recirculation Skid Drawing	Approved Drawing / Manufacturing Ball Recirculation Skid Drawing	IRs	√	P	W	V	CQIR
		Orientation	Major	Visual						√	P	W	V	
		Workmanship	Major	Visual						√	P	W	V	
		Leak Tightness Test	Critical/ Design	Pneumatic test						√	P	W	V	
3.0.2	Final tests of Ball collector assembly	Dry function test	Critical	Operational test			Approved Procedure	Approved Procedure	IR	√	P	W	V	
4.0.0	INTERCONNECTING PIPING / DISTRIBUTOR AND INJECTION NOZZLE													
4.0.1	Raw Material (CS-Pipe, Fittings & Flanges)	Chemical & Physical Properties	Major	Chemical & Physical Analysis	One sample/ batch /heat	-	Approved Installation Plan & Injection Nozzle / Date Sheet		MTC / Lab test report	√	P	V	-	In the absence of MTC/Testing , Check Testing shall be carried out in NABL Accredited Lab. Testing report shall be reviewed by TPIA/BHEL.
		Surface Defects	Major	Visual	100%	-	No Defects	No Defects	IR	√	P	V	-	
4.0.2	Fasteners	Chemical & Physical Properties	Major	Chemical & Physical Analysis	one sample / heat	-	Approved GA Drawing	Approved GA Drawing	MTC / Lab test report	√	P	V	-	
4.0.3	In process Quality Control	Sub Surface defects of weld joint	Critical	Radiography test	10% of total weld length & 100% of T joints		ASME Sec V	ASME Sec VIII Div.1/ Appendix 4/ UW 52	RT Report	√	P	V	-	
4.0.4	Fabricated Piping	Leakage	Major	Hydro test	100%	-	ASME Sec-VIII Div.1	No Leakage	Pressure test report	√	P	V	-	
4.0.5	Injection Nozzle	Chemical & Physical Properties	Major	Chemical & Physical Analysis	One sample/ batch /heat	-	Approved Installation Plan & Injection Nozzle / Date Sheet		MTC / Lab test report	√	P	V	-	In the absence of MTC/Testing , Check Testing shall be carried out in NABL Accredited Lab. Testing report shall be reviewed by TPIA/BHEL.

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SL.NO.	COMPONENT & OPERATIONS	CHACTERISTICS	CLASS	TYPE OF CHECK	QYANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*D	**			
					M	C/ N					M	C	N	
5.0.0	BOUGHTOUT ITEMS													
5.1.0	Ball Recirculation Pump													
5.1.1	Recirculation Pump	Chemical & Physical Properties (Casing, Impeller, Shaft, Wear Plate & SP sleeve)	Major	Chemical & Physical Analysis	sample cast/ heat	-	Approved Technical Data Sheet / Manufacturer QCP /Manufacturer Stan	Approved Technical Data Sheet / Manufacturer QCP	MTC (2.2) /COC	√	P	V	-	
5.1.2		Machined Surface (As applicable)	Major	Dye Penetrant test	100%	-	ASME,Sec-V	ASME, Sec.-VIII Div.-1 Appendix-8	IR /COC	√	P	V	-	
5.1.3		Leakage Test (Casing & Pressure Cover)	Major	Hydro test	100%	-	As per manufacturer std.	As per manufacturer std.	TC (3.1) / COC	√	P	V	-	
5.1.4		Impeller Balancing Test	Major	Impeller Balancing	100%	-	ISO 1940 GR 6.3	ISO 1940 GR 6.3	TC / COC	√	P	V	-	
5.1.5		Vibration and Noise Level	Major	Performance test	100%	-	Appd.Technical Data Sheet / ANSI/ HIS	Approved Technical Data Sheet / ANSI/ HIS	TC / COC	√	P	V	-	
5.1.6		Q Vs Head, Q Vs Pumps efficiency / overall efficiency, Q Vs Power.	Critical	Performance test	1 / Model	-	Approved Technical Data Sheet / Manufacturer QCP /Manufacturer Stan	Approved Technical Data Sheet / Manufacturer QCP	MTC	√	P	V	-	
5.1.7		Complete pump with motor, Coupling and base frame	Major	completeness, cleanliness, Orientation and workmanship	100%	-	Approved GA Drawing of Ball recircualtion skid assy.	Approved GA Drawing of Ball recircualtion skid assy.	COC	√	P	V	-	
5.1.8		Painting	Major	Surface Finish	100%	-	As per manufacturer std.	As per manufacturer std.	MTC / COC	√	P	V	-	

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Reviewed by:	NISHAL KUMAR YADAV	NISHAL KUMAR YADAV	Reviewed by:	RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

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SL.NO.	COMPONENT & OPERATIONS	CHACTERISTICS	CLASS	TYPE OF CHECK	QYANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*D	**			
					M	C/ N					M	C	N	
5.2.0. Ball Recirculation Pump MOTOR														
5.2.1	Assembly	1.Workmanship	Major	Visual	100%	-	MFG. SPEC./ Drawing/ Approved data sheet	MFG. SPEC./ Drawing/ Approved data sheet	Log book		P	-	-	
		2.Dimensions	Major	Visual	100%	-			Log book		P	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/MARK/ COLOUR CODE	Major	Visual	100%	-			Log book		P	-	-	
		4. Overall Dimensions	Major	Measurement & Visual	100%	-			COC	√	P	-	-	
5.2.2	Painting	1.Shade	Major	Visual	SAMPLE	-	MFG. SPEC. / Approved data	MFG. SPEC. / Approved data	Log book /	√	P	V	-	
5.2.3	Tests	1.Routine Test including special test	Major	Visual	100%	-	IS-325 / IS-12615/ Approved data sheet	IS-325 / IS-12615/Approved data sheet	MTC / IR	√	P	V	-	
		2. Degree of Protection	Major	Water & Dust ingress Test	One / Type	-				√	P	V	-	
		3.Name Plate Details	Major	Visual	100%	-			IR	√	P	V	-	
6.0	BALL VALVE													
6.1	MATERIALS													
6.1.1	BODY, END PIECES & BALL,	1. Physical & Chemical Props.	Major	1. Physical & Chemical Testing	One sample / Heat No./Batch No.	-	Appd. Data sheet / REL. STD.	Appd. Data sheet / REL. STD.	MTC / Lab test	√	P	V	-	CORRELATION REQD. FOR BODY & END PIECES W.R.T. HEAT Nos.
6.1.2		2. Surface Defects	Major	Visual	100%	-	MSS-SP-55	Free from defects	-	-	P	-	-	
6.1.3	BODY, END PIECES	3. Surface Defects	CR	Dye Penetrant Test	100%	-	ASME Sec V	ASME, Sec-VIII Div.-1	Test Report	√	P	V	-	APPLICABLE ONLY FOR SS CASTINGS
6.2	IN PROCESS INSPECTION													
6.2.1	MACHINING OF ALL COMPONENTS	1. Dimensions	Major	Measurement	100%	-	Appd. Data sheet / REL. STD.	Appd. Data sheet / REL. STD.	Log book	-	P	-	-	
6.2.2		2. Surface Finish	Major	Visual	100%	-			Log book	-	P	-	-	
6.2.3		3. Hardness (for ball)	Major	Hardness Testing	100%	-			T.C./COC	√	P	V	-	
6.2.4		4. Surface Defects	CR	Penetrant Test	100%	-	ASME Sec V	ASME, Sec-VIII Div.-1 appendix-8	Test Report	√	P	V	-	FOR MACHINED SURFACES.

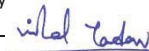
BHEL					
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	Sign & Date	Name		Sign & Date	Name
Prepared by:	 NISHANT SEKHAR	NISHANT SEKHAR	Checked by:	 ASHISH PANIGRAHI	ASHISH PANIGRAHI
Reviewed by:	 VISHAL KUMAR YADAV	VISHAL KUMAR YADAV	Reviewed by:	 RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

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SL.NO.	COMPONENT & OPERATIONS	CHACTERISTICS	CLASS	TYPE OF CHECK	QYANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*D	**			
					M	C/ N					M	C	N	
6.3	ASSEMBLY OF ALL VALVE													
6.3.1	BALL AND SEAT	Mirror Finish (BALL)	CR	BUFFING/ GRINDING / MACHINING	100%	-	The surface shall be smooth and shall have uniform contact with soft seat		Log book	—	P	-	-	
6.4	FINAL TESTING													
6.4.1	ASSEMBLY	1. Dimensions	Major	Measurement	100%	-	Appd. Data sheet / Relevant standard.	Appd. Data sheet / Relevant standard.	IR /COC	√	P	V	-	Face to face
6.4.2		2. Opening/Closing	Major	Operation	100%	-	Smooth Operation of Valve	Smooth Operation of Valve		√	P	V	-	
6.4.3		3. Appearance	Major	Visual	100%	-		Appd. Data sheet / Relevant standard.		√	P	V	-	
6.4.4		4. Workmanship, Marking, Tag no.	Major			-					P			
6.4.5	BODY	1. Leak Tightness	CR	Hydraulic test	100%	-	Appd. Data sheet / Relevant standard.	NO LEAKAGE	MTC /COC	√	P	V	-	
6.4.6	SEAT	1. Leak Tightness	CR	-DO-	100%	-				√	P	V	-	
6.4.7		2. Leak Tightness	CR	Pneumatic test	100%	-				√	P	V	-	
6.5	NON RETURN VALVE													
6.5.1	Body & Disc.	1. Physical & Chemical Props.	Major	1. Physical & Chemical Testing	One sample / Heat No. /Batch No.	-	Appd. Data sheet / Relevant standard.	Appd. Data sheet / Relevant standard.	MTC / Lab test	√	P	V	-	
6.5.2		Leak Test	Major	Hydraulic test	100%	-	Appd. Data sheet / Relevant standard.	Appd. Data sheet / Relevant standard.	MTC / IR	√	P	V	-	

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Prepared by:	 Digitally signed by NISHANT SEKHAR, DN: cn=NISHANT SEKHAR, o=BHEL, email=nishant.sekhar@bhel.co.in, c=IN	NISHANT SEKHAR	Checked by:	 Digitally signed by Ashish Panigrahi, DN: cn=Ashish Panigrahi, o=BHEL, email=ashish.panigrahi@bhel.co.in, c=IN	ASHISH PANIGRAHI
Reviewed by:	 Digitally signed by VISHAL KUMAR YADAV, DN: cn=VISHAL KUMAR YADAV, o=BHEL, email=vishal.yadav@bhel.co.in, c=IN	VISHAL KUMAR YADAV	Reviewed by:	 Digitally signed by RITESH KUMAR JAISWAL, DN: cn=RITESH KUMAR JAISWAL, o=BHEL, email=ritesh.jaiswal@bhel.co.in, c=IN	RITESH KUMAR JAISWAL

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1	2	3	4	5	6		7	8	9	*D	**			
					M	C/ N					M	C	N	
7.0	ELECTRICE ACTUATOR & WARM GEAR BOX													
7.1	Electric Actuator	Make, Model & Functional test	Major	visual	100%	100%	Approved data sheet	Approved data sheet	Manufacturer test certificate / COC	√	P	V	V	
7.2	GEAR, WORM GEAR & SHAFT	1. Physical & Chemical Props.	Major	1. Physical & Chemical Testing	One sample / Heat No./Batch No.	-	Appd. Data sheet / Manufacturer Standrad	Appd. Data sheet / Manufacturer Standrad	MTC / COC	√	P	V	-	
		2. Hardness	Major	MEASUREMENT	100%	-			MTC/ Insp. Test Report	√	P	V	-	
7.3	GEAR BOX ASSEMBLY	1. Appearance	Major	Visual	100%	-	Appd. Data sheet / Manufacturer Standrad	Appd. Data sheet / Manufacturer Standrad	-		P	-	-	
		2. Performance	Major	Operation test	100%	-			MTC/ Insp. Report	√	P	V	V	
		3. Dimensions	Major	Proper fitup with equipment	100%	-			IR / COC	√	P	V	-	
7.4	DESIGN VERIFICATION OF GEAR BOX	Torqure Capaility	Major	Testing (Torque at twice of rated torque of gear box)	One /type/model/ rated/torque		Appd. Data sheet / Relevant standard.	Appd. Data sheet / Relevant standard.	MTC/COC	√	P	V	-	
7.5		Gear Box POD (Life cycle test)	Major	Cycle Testing	One /type/model/ rated/torque				MTC/COC	√	P	V	-	

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Reviewed by:	 VISHAL KUMAR YADAV	VISHAL KUMAR YADAV	Reviewed by:	 RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

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1	2	3	4	5	6		7	8	9	*D	**			
					M	C/ N					M	C	N	
8.0	DIFFERENTIAL PRESSURE GAUGE													
8.1	TEST / CHECKS		QUANTUM OF CHECK		REFERENCE DOCUMENT		ACCEPTANCE NORMS	FORMAT OF RECORDS		M	C	B		
8.1.1	SENSOR TYPE		SEE NOTE-1	APPD. DATA SHEET	APPD. DATA SHEET	MTC/ COC/ Manufacturer catalog.	-	P	V	-	As per approved model and manufacture catalog.			
	DIAL SIZE						-							
	MODEL / TAG NO.						-							
	RANGE / SCALE						-							
	SWITCH CONTACT RATING & NO.						-							
	END CONNECTION						-							
8.1.2	CALIBRATION						-	P	V	-				
	ACCURACY						-							
	REPEATABILITY						-							
	SET POINT ADJUSTMENT						-							
							-							
							-							
8.1.3	OVER PRESSURE & LEAK TEST									-		P	V	-
8.1.4	OPERATION OF PRESSURE RELIEF						ONE FOR LOT					-	P	V
8.1.5	REVIEW OF TC FOR		-	P	V	-								
	MATERIAL OF SENSOR		-											
	MOVEMENT		-											
	PROCESS CONNECTION		-											
	HOUSING		-											
8.1.6	REVIEW OF TC FOR DEGREE OF PRODUCTION		TYPE TEST				-	P	V	-				
8.1.7	Accessories as applicable						-	P	V	-				

LEGENDS: Manufacturer/ Sub- Contractor, C= Contractor/Nominated inspection agency, B= BHEL, P= Perform, W= Witness, V= Verification

Notes: 1) Quantum of checks shall be below: 100%- Manufacturer. 2) Manufacture to carry out ROUTINE TEST on 100%.

3) Manufacturer to maintain calibrated instrument having better accuracy than the item under test.

4) Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same along with test certificate to be verified by BHEL.

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	NISHANT SHEKHAR	NISHANT SEKHAR	Checked by:	Ashish Panigrahi	ASHISH PANIGRAHI
Reviewed by:	VISHAL KUMAR YADAV	VISHAL KUMAR YADAV	Reviewed by:	RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

	MANUFACTURER/BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-N009	DATE: 21.09.2021
		PROJECT:		PO NO.:	DATE:
		ITEM: COLTCS	SYSTEM: CW SYSTEM	SECTION:	SHEET 12 of 17

SL.NO.	COMPONENT	CHACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*D	**			
					M	C/ N					M	C	N	
9.0 DIFFERENTIAL PRESSURE TRANSMITTER														
9.1	TEST / CHECKS	QUANTUM OF CHECK	-	-	-	-	-	-	-	-	M	C	B	-
9.1.1	VISUAL	SEE NOTE-1	-	-	ONE/TYPE	APPD. DATA SHEET	APPD. DATA SHEET	MTC / COC/ MANUFACTURER CATALOG.	-	P	V	-	As per approved model and manufacture catalog.	
9.1.2	MODEL/ TAG NO								-	P	V	-		
9.1.3	PROCESS CONNECTION								-	P	V	-		
9.1.4	ACCURACY								-	P	V	-		
9.1.5	REPEATABILITY								-	P	V	-		
9.1.6	HYSTERESIS								-	P	V	-		
9.1.7	EFFECT OF TEMP VARIATION ON								-	P	V	-		
9.1.8	SPAN/ZERO ADJUSTMENT	-							-	P	V	-		
9.1.9	EFFECT OF SUPPLY VOLTAGE								-	P	V	-		
9.1.10	EFFECT OF LOADING (500								-	P	V	-		
9.1.11	HIGH PRESSURE TEST	SEE NOTE-1							-	P	V	-		
9.1.12	BURN-IN-TEST	ONE/TYPE							-	P	V	-		
9.1.13	DEGREE OF PROTECTION								-	P	V	-		
9.1.14	Accessories as applicable	SEE NOTE-1							-	P	V	-		

LEGENDS:

M= Manufacturer/ Sub-Contractor, C= Contractor/ Nominated inspecion agency, B= BHEL, P= Perform, W= Witness, V= Verifaion

Notes: 1) Quantum of checks shall be below: 100% by Manufacturer.

2) Manufacturer to maintain calibrated instrument having better accuracy than the item under test.

3) Contractor to provide compliance certifiacte for tests/ checks verified by contractor and submit the same along with test cerifiacte to be verified by BHEL.

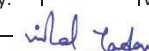
BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	NISHANT SHEKHAR	NISHANT SHEKHAR	Checked by:	Ashish Panigrahi	ASHISH PANIGRAHI
Reviewed by:	NISHAL KUMAR YADAV	NISHAL KUMAR YADAV	Reviewed by:	RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

	MANUFACTURER/BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-N009	DATE: 21.09.2021
		PROJECT:		PO NO.:	DATE:
		ITEM: COLTCS	SYSTEM: CW SYSTEM	SECTION:	SHEET 13 of 17

SL.NO.	COMPONENT	CHACTERISTICS	CLASS	TYPE OF CHECK	QYANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS				
1	2	3	4	5	6		7	8	9	*D	**							
					M	C/ N					M	C	N					
10.0	Pressure Gauge,	1. Make, Range and Model	Critical	Visual	100%	-	Approved Technical Date Sheet	Approved Technical Date Sheet	MTC/ COC	√	V	V						
		2. Degree of Protection	Critical	Water & Dust ingress Tests	100%	-				√	V	V						
		3. Calibration	Critical	Calibration Rreport	100%	-				√	V	V						
11.0	Cleaning Balls	Dimensions	Major	Measurement	Randomly	-	Approved Technical Date Sheet	Approved Technical Date Sheet	IR / COC	√	V	V						
12.0	ALL COMPONENTS / EQUIPMENTS																	
12.1	All Components / Equipments	Painting / Visual	Major	Measurement	Random	-	Painting Schedule	Painting Schedule	IR	√	P / V	V	-					
13.0	SWITCH GEAR PANEL																	
A	RAW MATERIAL																	
13.1	Sheet Steel (CRCA & HR)	1. Chemical Composition	Major	Chemical analysis	Sample	-	IS:1079 / IS:513	IS:1079 / IS:513	MTC/ Lab test report	√	P	V	-					
		2. Bend Test	CR	Mech. test	Sample	-					P	-	-					
		3. Surface finish	Major	Visual	100%	-	Manufacturing Standard	Manufacturing Standard	IR/ COC	√	P	-	-					
		4. Waviness	Major	Visual	100%	-		No Waviness			P	-	-					
		5. Thickness	Major	Measurement	100%	-	Approved Drawing.	Approved Drawing.			P	V	-					
		6. Mill marking	Major	Visual	100%	-	Manufacturing Standard	Manufacturing Standard			P	-	-					
13.2	Flats / Angles / Channels	1. Dimensions	Major	Measurement	Sample	-	IS 2062/ Related Standard	IS 2062/ Related Standard			IR/ COC		P	-	-			
		2. Surface Defects	Major	Visual	100%	-		Manufacturing Standard					P	-	-			
		3. Straightness	Major	Measurement	100%	-	Manufacturing Standard	Manufacturing Standard					P	-	-			
		4. Mill marking	Major	Visual	100%	-							P	-	-			

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	 Digitally signed by NISHANT SEKHAR, DN: cn=NISHANT SEKHAR, o=BHEL, email=nishant.sekhar@bhel.co.in, c=IN	NISHANT SEKHAR	Checked by:	 Digitally signed by Ashish Panigrahi, DN: cn=Ashish Panigrahi, o=BHEL, email=ashish.panigrahi@bhel.co.in, c=IN	ASHISH PANIGRAHI
Reviewed by:	 Digitally signed by VISHAL KUMAR YADAV, DN: cn=VISHAL KUMAR YADAV, o=BHEL, email=vishal.kumar.yadav@bhel.co.in, c=IN	VISHAL KUMAR YADAV	Reviewed by:	 Digitally signed by RITESH KUMAR JAISWAL, DN: cn=RITESH KUMAR JAISWAL, o=BHEL, email=ritesh.kumar.jaiswal@bhel.co.in, c=IN	RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

	MANUFACTURER/BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-N009	DATE: 21.09.2021
		PROJECT:		PO NO.:	DATE:
		ITEM: COLTCS	SYSTEM: CW SYSTEM	SECTION:	SHEET 14 of 17

SL.NO.	COMPONENT & OPERATIONS	CHACTERISTICS	CLASS	TYPE OF CHECK	QYANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*D	**			
					M	C/ N					M	C	N	
13.3	Cables / Wires	1. Visual / Surface defects	Major	Visual	100%	-	IS:1554 or IS:694	IS:1554 or IS:694	IR/ COC		P	-	-	
		2. IR and HV	Major	Electrical	100%	-	IS:1554 or IS:694	IS:1554 or IS:694			P	-	-	
		3. Conductor												
		1) Resistance	Major	Electrical	100%	-	IS:1554 or IS:694	IS:1554 or IS:694	IR /COC		P	-	-	
		2) Size	Major	Measurement	100%	-					P	-	-	
		3) Type / Routine Test Certificates	Major	Verification	100%	-					P	-	-	
13.4	Electrical Components like Annunciator, Transformers, Lamps, Switches, Relays, Timers, Space Heaters, Thermostat, Indicating meters etc.	1. Verification at make and Type	CR	Visual	Sample	-	Approved Drg	Approved Drg	TC/COC		P	-	-	
		2. Verification of Test Certificates	CR	Scrutiny of Type / Routine T.Cs.	100%	-	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	IR /COC		P	-	-	
		3. Operation / Functional check	CR	Electrical	Sample+	-					P	-	-	+ for relay & contactors only
					100%@	-					P	-	-	
13.5	Misc. Components like Gaskets, Terminal Blocks.	1. Verification of Type / Make	Major	Visual	Sample	-	Manufacturing Standard	Manufacturing Standard	Test Certificate /COC		P	-	-	
		2. Surface defects	Major	Visual	Sample	-					P	-	-	
		3. IR / HV on Terminal Blocks	Major	Electrical	Sample	-					P	-	-	
B- IN PROCESS INSPECTION														
13.6	Blanking / Bending / Forming	1. Dimensions	MI	Measurement	100%	-	Approved Drawing.	Approved Drawing.	IR		P	-	-	
		2. Surface defects after bending	Major	Visual	100%	-	Manufacturing Standard	Manufacturing Standard	-		P	-	-	
13.7	Nibbling / Punching	1. Cutout Sizes	MI	Measurement	100%	-	Approved Drawing.	Approved Drawing.	IR		P	-	-	
		2. Deburring	Major	Visual	100%	-			-		P	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	 NISHANT SHEKHAR	NISHANT SEKHAR	Checked by:	 Ashish Panigrahi	ASHISH PANIGRAHI
Reviewed by:	 RISHAL KUMAR YADAV	RISHAL KUMAR YADAV	Reviewed by:	 RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

	MANUFACTURER/BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-N009	DATE: 21.09.2021
		PROJECT:		PO NO.:	DATE:
		ITEM: COLTCS	SYSTEM: CW SYSTEM	SECTION:	SHEET 15 of 17

SL.NO.	COMPONENT & OPERATIONS	CHACTERISTICS	CLASS	TYPE OF CHECK	QYANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*D	**			
					M	C/ N					M	C	N	
C. ASSEMBLY														
13.8	Frame Assembly & Sheet fixing	1. Dimensions	Major	Measurement	100%	-	Approved Drawing.	Approved Drawing.	IR		P	-	-	
		2. Alignment	Major	Measurement	100%	-					P	-	-	
		3. Welding Quality	Major	Visual	100%	-					P	-	-	
		4. Surface defects	Major	Visual	100%	-					P	-	-	
13.9	Pre-treatment and Painting	1. Pretreatment	Major	Visual	100%	-	Manufacturing Standard	Manufacturing Standard	IR		P	-	-	
		2. Process parameters like bath temp. concentration etc.	Major	Measurement	Periodic	-			IR		P	-	-	
		3. Dipping / Removal Time	Major	Measurement	100%	-			IR /COC		P	-	-	
		4. Surface quality after every dip	Major	Visual	100%	-					P	-	-	
13.10	Panel Wiring	1. Wiring Layout	Major	Visual	100%	-	Approved Drawing.	Approved Drawing.	IR /COC		P	-	-	
		2. Wiring Termination (Crimped Lugs)	Major	Visual	100%	-					P	-	-	
		3. Ferrule numbers	Major	Visual	100%	-					P		-	
		4. Colour of wiring	Major	Visual	100%	-					P	V	-	
		5. Size of Conductor	Major	Measurement	100%	-					P	V	-	
13.11	Component Mounting	1. Correct components	Major	Visual	100%	-					P	-	-	
		2. Fixing	Major	Visual	100%	-					P	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	NISHANT SHEKHAR	NISHANT SEKHAR	Checked by:	Ashish Panigrahi	ASHISH PANIGRAHI
Reviewed by:	VISHAL KUMAR YADAV	VISHAL KUMAR YADAV	Reviewed by:	RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

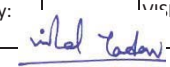
Vishal Yadav

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

	MANUFACTURER/BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-N009	DATE: 21.09.2021
		PROJECT:		PO NO.:	DATE:
		ITEM: COLTCS	SYSTEM: CW SYSTEM	SECTION:	SHEET 16 of 17

SL.NO.	COMPONENT & OPERATIONS	CHACTERISTICS	CLASS	TYPE OF CHECK	QYANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*D	**			
					M	C/ N					M	C	N	
D.- FINAL TESTING														
13.12	Final Inspection	1. Workmanship	Major	Visual	100%	100%	Manufacturing Standard	Manufacturing Standard	IR	√	P	W	-	At Random by BHEL, based on 100 % internal test/ IRs by Mfr.
		2.Component layout (neatness,accessibility & safety) Mounting / Proper fixing of all	Major	Visual	100%	100%	Approved Drawing.	Approved Drawing.	IR	√	P	W	-	
		3. Components identification Marking / Name plates	Major	Visual	100%	100%	Approved Drawing.	Approved Drawing.	MTC / IR	√	P	W	-	
		4. Dimensions (Over all of enclosure)	Major	Measurement	100%	100%				√	P	W	-	At Random by BHEL, based on 100 % internal test/ IRs by Mfr.
		5. Door functioning	Major	Functional	100%	100%				√	P	W	-	
		6. Paint Shade	CR	Visual	100%	100%				√	P	W	-	
		7. Paint Thickness	CR	Measurement	100%	100%				√	P	W	-	
		8. Workmanship of Gaskets	Major	Visual	100%	100%	Manufacturing Standard	Manufacturing Standard	IR	√	P	V	-	
		9. Wiring Layout	Major	Visual	100%	100%	Approved Drg/Datasheet	Approved Drg/Datasheet	IR	√	P	W	-	
		10. Wire Termination	Major	Pulling manually	Sample	Sample	-----	Firm termination		√	P	W	-	
		11. Continuity	Major	Electrical	100%	100%	-----	Continuity OK		√	P	W	-	
13.13	Type Test	Degree of Protection	CR	Mech. Protection	Sample	Sample	ApprovedDrg/ Datasheet/ Relevant IS-13947 Part-1, IS-2148.	Approved Drg/Datasheet/ Relevant IS-13947 Part-1, IS-2148.	Type Test Certificate	√	P	V	-	CQIR of final inspection
13.14	Routine Test	IR before & after HV Test	CR	Electrical	100%	100%	Approved Drawing.	Approved Drawing.	IR	√	P	W	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	 NISHANT SEKHAR	NISHANT SEKHAR	Checked by:	 Ashish Panigrahi	ASHISH PANIGRAHI
Reviewed by:	 RISHAL KUMAR YADAV	RISHAL KUMAR YADAV	Reviewed by:	 RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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	MANUFACTURER/BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-N009	DATE: 21.09.2021
		PROJECT:		PO NO.:	DATE:
		ITEM: COLTCS	SYSTEM: CW SYSTEM	SECTION:	SHEET 17 of 17

SL.NO.	COMPONENT & OPERATIONS	CHACTERISTICS	CLASS	TYPE OF CHECK	QYANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*D	**			
					M	C/ N					M	C	N	
13.15	Functional Test	1. Control Logic Operation	CR	Electrical	100%	100%	Approved Drawing.	Approved Drawing.	IR	√	P	W	-	CQIR of final inspection
		2. Instrument Calibration	CR	Electrical	100%	100%				√	P	W	-	
		3. Temperature	CR	Electrical	100%	100%				√	P	W	-	

NOTES:

1. Copies of all TC's (Test Certificates) for components (as applicable) shall be submitted to BHEL for verification.

14.0	FINAL INSPECTION OF PACKING													
14.1	Final Inspection of packing	1. Ball Separator Assembly	Major	Viusal / Item counting	100%	100%	BHEL Technical Specification	BHEL Technical Specification	IR	√	P	W	-	MDCC
		2. Ball Recirculation skid assembly								√				
		3. Switch Gear Panel								√				
		4. Interconnecting piping & hardware								√				
		5. Loose items (BOIs)								√				

REMARKS

1-	BHEL reserves the right for conducting repeat test, if required and if possible.
2-	After packing and prior to issue of MDCC, Photographs of Complete material (to be dispatched) with witness report of BHEL/ TPIA shall be sent to BHEL-Purchase group for review and cleanrance.
3-	Material shall be packed suitably in order to avoid damage during transit and also during storage at site in tropical climate condition.
4-	All BOIs dcoumemnt shall be provided as per manufacturer std. format of MTC.
5-	The latest revision/ year of issue of all the standards (IS / ASME,etc as applicable) indicated in the QP shall be referred.

LEGENDS: *RECORDS, IDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,

** M: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, C: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, N: CUSTOMER,

P: PERFORM, W: WITNESS, V: VERIFICATION, AS APPROPRIATE, D : DOCUMENT

MA: MAJOR, MI: MINOR, CR: CRITICAL, IR: Inspection Report, MTC: Mill Test Certificate, CHP : NTPC SHALL IDENTIFIED IN COLOUM "N" AS "W"

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	 NISHANT SHEKHAR	NISHANT SEKHAR	Checked by:	 Ashish Panigrahi	ASHISH PANIGRAHI
Reviewed by:	 Vishal Kumar Yadav	VISHAL KUMAR YADAV	Reviewed by:	 RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

523866/2021/PS-PEM-MSE

	TITLE:		SPEC. NO.: PE-TS-445-165-N002		
	TECHNICAL SPECIFICATION		SECTION: II		
	COLTCS		SUB-SECTION: IIB		
	1X660 MW SAGARDIGHI, PHASE-III (UNIT-5)		REV. NO. 0	DATE	23.09.2021
	STANDARD TECHNICAL REQUIREMENTS		SHEET 1	OF 1	

SUB-SECTION - IIB**STANDARD TECHNICAL SPECIFICATION (ELECTRICAL)**

523866/2021/PS-PEM-MSE

	TITLE	LV MOTOR DATA SHEET – C SAGARDIGHI THERMAL POWER PROJECT 1 x 660 MW UNIT NO. 5, PHASE – III	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 $\geq 55KW$)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

523866/2021/PS-PEM-MSE :



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**

523866/2021/PS-PEM-MSE :



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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FOR

LV MOTORS

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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.

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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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- 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.



SECTION - VII

SECTION-II

ERECTION - CABLING, GROUNDING AND LIGHTNING PROTECTION SYSTEM

1.00.00 SCOPE OF WORK

1.01.00 The scope of work covers complete and efficient design, supply, erection, testing and commissioning of cabling, electrical grounding and lightning protection system for the entire plant.

1.01.01 Area-wise, the scope shall broadly cover, but not be limited to :

- A. Main Power House Building
- B. Boiler area, ESP stack
- C. Transformer yard, CHP, AHP, FGD area.
- D. All auxiliary areas/ buildings (including electrical rooms of respective buildings) and structures of balance of plant (BOP) systems as details in the Lead Specification.
- E. Overhead interplant cable trestle and pipe cum cable trestle.

1.01.02 Equipment-wise, the scope of work related to cabling, electrical grounding and lightning protection shall cover all electrical equipment as described in different Sections of the Specification.

1.02.00 Scope of work shall also include all civil and structural works (except cable trenches/tunnels and major equipment foundations) necessary for installation of cabling, electrical grounding and lightning protection system.

2.00.00 SCOPE OF SUPPLY & SERVICES

2.01.00 Scope of Supply

Scope of supply shall include but not be limited to the followings

2.01.01 Transportation to site in properly packed condition of all materials and miscellaneous items required to complete the erection work under this specification.

2.01.02 These materials and miscellaneous items shall include but not be limited to the following:

- a) 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.
- b) Cable trays, Fittings and Accessories
- c) Cable termination and jointing kits as necessary.





SECTION 2

- d) All necessary erection materials, consumables and sundry items including arc welding rods to complete the installation for satisfactory and trouble free operation.
- e) Mild steel rods for main ground mat, grounding electrode, column & structure grounding, risers etc.
Mild steel rod for vertical air terminals,
Materials for electronic grounding,
Galvanized steel flats for horizontal air terminals, for down conductors and for large equipment grounding
Galvanized wire (8 SWG) for small equipment grounding.
- f) Fire-proof cable penetration sealing system,
- g) Fire retardant cable coating system.
- h) Any item of works or erection materials which have not been specifically mentioned but are necessary to complete the work of Cabling, Grounding and Lightning Protection Systems shall be deemed to be included in the scope of this specification and shall be furnished by the Contractor without any extra charge to the Purchaser.

2.02.00 Scope of Services

The scope of Cabling, Grounding and Lightning Protection Systems includes but is not limited to the following:

- 2.02.01 Furnishing of all erection tools and tackles, testing equipment, implements, supplies, hardware and transport for timely and efficient execution of the erection work.
- 2.02.02 Erection work shall be performed with respect to all the equipment/materials mentioned under 'Scope of Supply'.
- 2.02.03 Erection work shall also be performed with respect to the following items:
 - a) Cable trays and accessories
 - a) Power cables
 - b) Cables laid directly buried in ground
 - c) Control, instrument and special cables





3.00.00 GENERAL REQUIREMENTS

3.01.00 Codes and Standards

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

3.02.00 Erection Schedule

3.02.01 The Bidder shall agree to adhere to the Owner's Erection Schedule if such a schedule is attached with the Specification. Alternatively, in case the target completion dates alone are indicated, the Bidder shall furnish detailed erection schedules (starting from zero date) with separate 'S' curves for Cabling, Grounding and Lightning Protection works.

3.02.02 The erection schedule, as approved by the OE shall be strictly followed by the contractor. If the work is held-up for any reason, attributable to him or not, the same shall be brought immediately to the notice of the OE.

4.00.00 DESIGN CRITERIA

4.01.00 Grounding System

4.01.01 Grounding work shall be carried out in compliance to the following standards/codes. All standards, specifications and codes of practice (COP) referred to herein shall be the latest editions including all amendments and revisions as on the date of opening of bid. In case of conflict between the specification and those standards/codes referred to herein, the former shall prevail:

a)	Indian Electricity rules	
b)	National Electrical Code	
c)	Recommended practice for hot-dip galvanizing of iron and steel	IS 2629
d)	Method of testing uniformity of coating on zinc coated articles	IS 2633
e)	COP for earthing	IS 3043
f)	Methods for determination of mass of zinc coating on zinc coated iron and steel articles	IS 6745
g)	IEEE guide for safety in AC substation grounding	IEEE 80
h)	IEEE recommended practice for grounding of industrial and commercial power systems	IEEE 142
i)	IEEE recommended practice for determining the electric power station ground potential rise and induced voltage from a power fault	IEEE 367
j)	IEEE guide for instrumentation and control equipment grounding in generating stations	IEEE 1050





4.01.02 Basic design criteria are delineated below:

- a) The station grounding system shall be an interconnected network of MS conductor and MS ground rods. The system shall (a) provide safety to personnel from contact of dangerous potential caused by ground fault, (b) ensure sufficient grounding current for effective relaying and (c) stabilize circuit potential with respect to ground.
- b) The station grounding system shall be designed in compliance with the IEEE- 80/ IEEE- 665 considering fault current of 50kA for 1 sec. and shall be subject to approval of the Owner.
- c) Actual soil resistivity measurement shall be carried out at proposed site during dry season.
- d) The surface resistivity shall be considered as 3000 Ohm-meter for gravel and 1000 Ohm-meter for concrete.
- e) Major items of equipment, such as generator, switchgear, transformer, motor, relay panels and control panels etc shall have integral ground buses or connection points which shall be connected to the underground grid.
- f) Electronic panels and equipment, where required, shall be grounded utilizing an insulated ground wire connected in accordance with the manufacturer's recommendations. Where practical, electronics ground loops shall be avoided. Where this is not practical, isolation transformers shall be furnished. All indoor and outdoor electrical equipment and associated non-current carrying system, metal works, support structures, buildings columns, fence, neutrals, masts, arrestors, etc shall be connected to the plant ground system.
- g) Instrumentation cable screens shall be single point bonded to the instrument earth network to minimize the effects of electrical interference.
- h) For Signal/case/intrinsically safe signal, grounding of control room instruments, separate earth pit not connected to main ground grid shall be used. Control cabinets shall be connected to this separate earth pit.
- i) A grounding conductor (steel wire armour in case of cables with outer sheath) shall be routed parallel to all power conductors operating above 240 volts.
- j) All ground wires installed in conduits shall be uninsulated.
- k) Embedded grounding grid made of GI flat at basement/grade slab as well as upper floor/suspended slabs shall be provided.





- l) In addition mild steel ground pads at different locations i.e. on wall/floor/ceiling inside the buildings/tunnels/trenches shall be provided. These pads will be in turn connected to below ground level earth mat through galvanized steel flat or riser. Each ground pad shall have provision for connection of at least two GI flats.
- m) Treated earth pit shall be provided for system earthing at locations where generator and transformer neutrals are grounded. Two pits shall be provided for each neutral.
- n) Dedicated treated earth pit shall be provided for lightning protection system.
- o) Clean earthing for instrumentation shall be provided with dedicated earthing system and separate treated earth pits below the main control room, feed water pump house in turbine house etc.
- p) Connection between the equipment earth lead and the grid conductor shall be welded. For rust protection, the welds shall be treated with zinc chromate primer and coated with zinc rich paint.

In order to meet the above design criteria, ground grid mesh will be provided for the main plant complex, viz., switchyard, transformer yard adjacent to power house building, power house building and boiler area up to stack, auxiliary buildings, etc. All electrical equipment, non-current carrying metal parts, structures, building steel, lightning protection system, generator/transformer neutrals will be connected to this station ground grid.

4.01.03 Other major design aspects that are to be considered for grounding system are given below:

1. Ground Grid Conductor

- i) Ground grid conductor of mild steel rod shall be used.
- ii) The minimum conductor section is determined on the basis of ground fault current. This section is then increased by an allowance to account for the soil corrosion loss of 0.3 mm per year over the design life of 30 years. However, the minimum size shall be 1x40 mm dia mild steel conductor.

2. Underground Grid

- i) The ground grid mesh is designed to keep the touch and step voltages within safe limits as per recommendation of IEEE 80 & IEEE665.





- ii) The ground grid conductors will be buried in earth at a minimum depth of 1000 mm. The length of ground conductors below earth will be sufficient to ensure a ground resistance less than 0.5 ohm.
- iii) The ground grid conductor will be so laid as to provide short and direct connection to building steel and major electrical equipment.
- iv) Ground rods shall be provided at the points where system neutrals/lightning protections are connected to the ground grid.
- v) All ground grid conductor connections will be welded type.
- vi) Main Plant ground grid shall be connected with the other auxiliary building /area ground grid at least at two (2) points.
- vii) For test pits, the electrode will be 100 mm dia. Heavy duty C.I. pipe with perforations. Electrodes installed in test pits will have disconnecting facilities

3. Above-ground Connections

- i) Galvanized steel flats shall be used for all connections above earth.
- ii) Inside building, ground conductors will be run for each floor supported on building steel and/or cable trays. These ground conductors in turn will be connected to the station ground grid through riser (at least two) coming up along building columns/cable shafts.
- iii) Two separate and distinct ground connections will be provided for each electrical equipment in compliance with I.E. Rules.
- iv) All connections above ground will be welded type except connection to equipment/structures which shall be bolted type.

4. Equipment Ground Lead

Equipment ground connections will be sized to carry the available ground fault current. Considerations shall also be given to mechanical ruggedness of the connections and to limit the number of sizes.

5. Electronic Equipment Grounding

- i) Internal ground connection of electronic panels shall be insulated from the enclosure, frame, and chassis are to be terminated to an insulated ground bus.
- ii) Insulated ground bus of all electronic panels shall be connected by insulated wire to an insulated common electronic ground bar.





- iii) All connection made above shall be in the form of a radial distribution system without any parallel ground paths.
- iv) Electronic equipment and systems, metal enclosures of all electronic panels shall be connected to a grounding system with which is isolated and separate from the electrical equipment grounding system.

4.01.04 The minimum conductor sizes for connection of various equipment and structures shall be as given in the attached Notes and Details for Grounding & Lightning Protection Systems.

4.01.05 Entire erection of grounding work shall be carried out in such a way as to be capable of withstanding the intended services of carrying full short circuit level currents to ground mat without any damage / deformation.

4.02.00 Lightning Protection System

4.02.01 Lightning protection work shall be carried out in compliance to the following standards/codes. All standards, specifications and codes of practice (COP) referred to herein shall be the latest editions including all amendments and revisions as on the date of opening of bid. In case of conflict between the specification and those standards/codes referred to herein, the former shall prevail:

a)	Indian Electricity rules	
b)	National Electrical Code	
c)	COP for the protection of building and allied structures against lightning	IS 2309
d)	Recommended practice for hot-dip galvanizing of iron and steel	IS 2629
e)	Method of testing uniformity of coating on zinc coated articles	IS 2633
g)	Methods for determination of mass of zinc coating on zinc coated iron and steel articles	IS 6745
k)	IEEE guide for instrumentation and control equipment grounding in generating stations	IEEE 1050

4.02.02 Basic design criteria are delineated below:

- a) The main purposes of the lightning protection system shall be (a) to provide protection to structures from lightning strokes and (b) to provide a low resistance-conducting path to lightning discharge.
- b) Lightning protection shall be provided for Power House building, auxiliary building of CHP, AHP, FGD etc. and other structures.
- c) Lightning protection will also be provided for building/ structures where the overall rise factor exceeds 10^{-6} as per IS: 2309.





- d) For metal structures which are electrically continuous down to the ground level, no lightning protection is required except adequate grounding connections.

4.02.03 Other major design aspects that are to be considered for grounding system are given below:

- a) Air termination network with down conductors and earthing electrodes will be provided on the basis of IS Code of Practice.
- b) Vertical air terminals shall be of 20mm dia galvanized steel rod on the structure/building (except for chimney).
- c) Horizontal air termination of 75x10 mm GS flat conductor on the roof of the installation shall be so laid out that no part of the roof will be more than 9 meters from the nearest conductor.
- d) Shielding angle for one vertical air termination shall be 45 degrees. For more than one rod, shielding angle between the rods shall be taken as 60 Degrees.
- e) Down conductors of 75x10 mm GS Flat for all installations except for conveyor gallery will run along the outer surfaces of the building and shall have a test joint about 1500 mm above ground. It shall be 25x3 mm GS flat for conveyor gallery.
- f) An earth electrode of size 40 mm. diameter 3 metre long MS will be provided at the connection point of the down conductor with the station ground.
- g) All connections will be of welded type.
- h) Risers (for Lightning protection) shall be of 1x40 (minimum) mm dia. MS rod from underground mat to minimum 300 mm above grade level/concrete floor level.
- i) Shielding mast shall be provided at the top of steel columns cap plates of power house building.
- j) All other ancillary items in connection with the work described above shall be furnished to complete the work irrespective of whether such items may have been specifically mentioned or not.

4.02.04 All materials and accessories to be supplied by the Bidder shall be brand new ones of reputed make.

4.02.05 Necessary drawings, data sheets and Technical leaflets for each piece of shop produced/fabricated items.





4.03.00 Cabling System

4.03.01 Cabling work shall be carried out in compliance to the following standards/codes. All standards, specifications and codes of practice (COP) referred to herein shall be the latest editions including all amendments and revisions as on the date of opening of bid. In case of conflict between the specification and those standards/codes referred to herein, the former shall prevail:

a)	Indian Electricity rules	
b)	National Electrical Code	
c)	Steel tubes, tubulars and other steel fittings	IS 1239
d)	COP for installation & maintenance of power cables upto and including 33kV rating	IS 1255
e)	Degree of protection provided by enclosures for low voltage switchgear & control gear	IS 2147
f)	Recommended practice for hot-dip galvanizing of iron and steel	IS 2629
g)	Method of testing uniformity of coating on zinc coated articles	IS 2633
h)	Flexible steel conduits for electrical wiring	IS 3480
i)	Cable Glands	BS 6121 / EN 50262
i)	Methods for determination of mass of zinc coating on zinc coated iron and steel articles	IS 6745
j)	Compression type tubular in-line connectors for aluminium conductors of insulated cables	IS 8309
k)	Conduits for electrical installation	IS 9537
l)	Joints & terminations for polymeric cables for working voltages from 3.3kV upto & including 33kV : performance requirements & type tests	IS 13573
m)	Conduit systems for electrical and communication installation	IS 14930

4.03.02 Erection of cabling work shall be carried out in such a way as to provide a reliable and assured electric power supply system to all station auxiliaries.

4.03.03 Cable routing will be done on unit basis as far as possible.

4.03.04 Cables will generally be laid on cable trays, cable trench, cable rack, overhead supported from building steel/structures or cable bridge/cable trestle. Cables shall be run in concrete trenches in transformer yard and in those electrical rooms at ground level, which are without any spreader room below. However cable trench shall be avoided as far as possible in outdoor areas. Cables shall not be buried directly in ground unless explicitly permitted in some areas.





All cable trestle shall be provided with walkway by the side of cable tray for maintenance. Walkway shall have hand railing with 1200 mm minimum height.

- 4.03.05 Cables will generally be laid on cable trays, cable trench, cable rack, overhead supported from building steel/structures or cable bridge/cable trestle. Cables shall be run in concrete trenches in transformer yard and in those electrical rooms at ground level, which are without any spreader room below.
- 4.03.06 Cable trench shall be avoided in boiler area and in outdoor areas as far as practicable. Cable shall be laid on cable trays along overhead pipe bridges. Where such overhead pipe bridges are not available, overhead pipe trestles are to be erected for taking the cable racks/trays. Cables buried directly in ground are not acceptable.
- 4.03.06 In indoor mechanical equipment areas like pump houses, overhead cable trays shall generally be used.
- 4.03.07 For underground crossing of railways, road, etc. additional protection shall be provided in form of Hume pipe or concrete encased rigid steel conduits (duct bank).
- 4.03.08 A.C. and D.C. circuit will not be run in same cable. Further, separately fused circuit will run in separate cables.
- For Instrumentation cabling system, Bidder shall refer VOL-II-E, Section I of General Technical Requirement Under "C&I Cabling".
- 4.03.09 Cables for redundant equipment system shall be run in separate trays, as far as possible.
- 4.03.11 Erection of cabling work shall be executed keeping in view all necessities and requirements of fire fighting codes for Generating Stations having an adverse industrial environment.
- 4.03.12 Suitable embedded steel inserts shall be provided on wall/floor/ ceiling surfaces for welding of cable tray bracket in order to make the cable tray system withstand, in addition to normal tray cable loadings, horizontal/vertical accelerations due to seismic forces for indoor trays and also wind load for outdoor trays such as on Boiler platforms.
- 4.03.13 Erection work to be carried out under this specification shall conform to the 'Notes and Details for Cabling System' given in Annexure-A and the drawings attached to this specification.





5.00.00 SPECIFIC REQUIREMENTS - SUPPLY

- 5.01.00 Equipment and Material
- 5.01.01 Equipment and material shall comply with description, rating, type and size as detailed in this specification, drawings and annexures.
- 5.01.02 All accessories, fittings, supports, hangers, anchor bolts etc. which form part of the equipment or which are necessary for safe and satisfactory installation and operation of the equipment shall be furnished.
- 5.01.03 All parts shall be made accurately to standard gauges so as to facilitate replacement and repair. All corresponding parts of similar equipment shall be interchangeable.
- 5.02.00 Conduits and Accessories
- 5.02.01 The contractor shall provide and install all conduits, mild steel pipes, flexible conduits, rigid PVC pipes, etc. complete with accessories like tees, bends, adapters, locknuts, pull boxes, conduit plugs, caps, etc as required for the cabling work. Conduits shall be furnished in standard length of 5 metres, threaded at both ends.
- 5.02.02 Conduits diameter upto and including 25mm size shall be of 16 SWG and conduits above 25 mm diameter shall be of 14 SWG. Minimum diameter of conduits shall be 20 mm.
- 5.02.03 Conduits shall be made of hot-dip galvanized steel with an organic corrosion resistant ID coating. In chemical handling areas, battery room, etc., the exterior surface shall be further coated with chromate and polymer for better resistance to corrosion. Conduits, fittings & accessories shall have ISI mark.
- 5.02.04 For sizes above 63 mm, hot dip galvanized - both on inside and outside - steel pipes with necessary fittings & accessories shall be provided and installed by the contractor. The pipes and fittings shall be of heavy duty class with relevant ISI mark.
- 5.02.05 Flexible conduits complying to relevant IS and made with bright, cold-rolled, annealed and electro-galvanized mild steel strips shall be used between embedded conduits/pipes and the motor terminals. It shall also be used between fixed conduit and any equipment with vibration or equipment requiring regular removal.
- 5.02.06 Non-metallic conduits made of HDPE outer jacket with friction-reducing permanent internal lining shall generally be used for control & instrumentation cables in some areas where cable trays do not exist and where the runs are





straight ones Necessary fittings & accessories as may be required for the installation shall also be provided.

5.03.00 Junction Box

5.03.01 Technical requirement for both non-metallic type and galvanized steel Junction Boxes are given below. Unless the choice is specifically mentioned in the General / Lead Electrical Specification or elsewhere in the tender document, galvanized steel Junction Boxes shall be offered.

Non-metallic Junction Boxes:

- a) Material of the Junction Boxes shall be halogen-free and silicon-free, glass fibre-reinforced polycarbonate for outdoor use and/or for cable sizes more than 50 sq.mm. Material shall be ABS/ polycarbonate for indoor use and/or for cable sizes upto 50 sq. mm. Junction boxes for use with fire-survival cables shall be of Duro-plast / powder-coated metal.
- b) Material of all non-metallic junction boxes shall be fire retardant and self-extinguishing in accordance with UL 94 V0. It should be tested at Glow Wire test for 960° C.
- c) Boxes shall be suitable for continuous operation at an ambient temperature range of -10° C to +80° C.
- d) The impact strength of polycarbonate enclosures/boards i.e. the degree of protection against mechanical shock load shall be in accordance with EN 50298-98 for IK 08 (5 Joule).
- e) Degree of protection shall be IP 66 to EN 60529. Junction boxes shall have integrally embedded gaskets made of Polyurethane.
- f) Allowing a minimum of 20% spare terminals after complete termination, the terminal board for control and instrumentation JBs shall have 6 / 12 / 24 / 36 / 48 ways.
- g) Doors shall have stainless steel quick fastening screws.
- h) The boxes shall be complete with all brackets/fasteners as required for installation on walls, columns and structure.

5.03.03 Steel Junction Boxes

- a. Junction boxes with IP 55 (for Indoor) / IP 65 (for Outdoor) degree of protection, shall comprise of a rectangular parallelepiped case hinged door with Handle constructed from cold rolled sheet steel of minimum thickness 2mm. Top of the box shall be arranged to slope towards the rear of the box. Gland plate shall be 3mm thick sheet steel with neoprene/synthetic rubber gaskets. All junction boxes shall be of





adequate strength and rigidity, hot dip galvanized as per relevant IS with epoxy powder coating paint RAL 7032 with min painting thickness 80 micron and suitable for mounting on wall, column, structures etc. The boxes shall be complete with M8 earthing stud and all brackets/fasteners as required for installation.

- b) No. of Ways: 6 / 12 / 24 / 36 / 48 with 20% spare terminals after termination.
- c) All outdoor JB's shall be similar but with a canopy at the top.
- d) Doors shall be hinged and lockable and shall be made of the same material as the case. The doors shall have industrial heavy-duty hinges. The doors shall be easily but firmly lockable with quick release fastener.
- e) The junction boxes shall have the following indelible markings:
 - i) Circuit nos. on top by white-stenciled paint at site.
 - ii) Circuit nos. with ferrules (inside) as per approved drawing.
 - iii) Danger sign in case of 415V circuit.

5.04.00 Terminals

- 5.04.01 Multiway terminal blocks of approved type, complete with screws, nuts; washers and marking strips shall be furnished for connection of incoming/outgoing wires.
- 5.04.02 Each control cable terminal shall be suitable for connection of 2 nos. 2.5 sq.mm. stranded copper conductors without any damage to the conductor or looseness of conductors.
- 5.05.00 Cable Termination & Straight through Joints
- 5.05.01 Bidder shall supply cable termination and jointing kits in requisite quantity for H.T. Power Cables, L.T. Power, Control Cables, Instrumentation Cables, etc. along with all accessories & consumables required for making termination and joints complete. Those shall be of proven design and make which have already been extensively used and type tested.
- 5.05.02 Components shall be pre-moulded type, taped type or heat-shrinkable type. 11kV and 3.3kV grade joints and terminations shall be type tested as per IS: 13573.
- 5.05.03 Kits shall be complete with the aluminium solderless crimping type cable lugs and ferrule as per DIN standard.





5.06.00 Cable Glands

Cable shall be terminated using double compression type cable glands. Cable glands shall conform to BS 6121 or to EN 50262. Ingress Protection rating for cable glands with seal, when offered conforming to EN 50262, shall be minimum IP 66 in line with BS. Cable glands shall be made of tinned brass gland, double compression type complete with necessary armour clamp and tapered washer, etc. Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall match with the sizes of different cables supplied/erected.

5.07.00 Cable Lugs

Cable lugs shall be suitable for termination of different cross-sections of H.T./L.T./Control/Instrumentation cables and shall be of following types:

- i) Aluminium tubular terminal end for solderless crimping to aluminium conductors.
- ii) Copper tubular terminal end for solderless crimping to copper conductors.

Solderless 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.

- iii) Cable lugs for control cable termination shall be insulated. These lugs shall be pin type/flat type/ring type / U type to suit the terminals provided in the panels.

5.09.00 Cable Clamps and Straps

5.09.01 Trefoil clamps for single core cables shall be pressure die-cast aluminium or fibre glass or nylon with necessary G I fasteners. Trefoil clamps shall have adequate mechanical strength to forces generated by peak value of maximum system short circuit current.

5.09.02 Cable clamps required for multicore cables on vertical run shall be made up of 25x3mm size aluminium strip. For clamping the multicore cables, self-locking, de-interlocking type fire-resistant nylon clamps/straps of sufficient strength shall be used.

5.10.00 Consumables and Hardware

5.10.01 The Contractor shall furnish all erection materials, hardware and consumables required to complete the installation.

5.10.02 The materials shall include but not be limited to the following:





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Consumables : Welding rods & gas, oil and grease, cleaning fluids, paints, electrical tape, soldering materials, etc.

Hardware : Bolts, nuts, washers, screws, brackets, supports, clamps, hangers, saddles, cleats, sills, shims, etc.

5.10.03 Supply of cement, sand, stone, etc. required for the execution of the contract shall be the responsibility of the Contractor.

5.11.00 Testing Equipment

5.11.01 The major testing equipment that are required to be provided by the Contractor are listed below:

- a) Insulation Tests
 - i) Power operated Meggar - 1 KV and 10 KV grade
 - ii) Hand operated Meggar - 1 KV grade
- b) Hand driven earth Resistance Meggar, range 0-1/3/30 ohms.
- c) High potential testing set - roller mounted type
- d) Tong testers of suitable ranges.
- e) Contact resistance measuring set for micro-ohms.
- f) Torque wrench of various sizes.
- g) Multimeters, test lamp, field telephone with buzzer set, different gauges, etc.

5.11.02 The list of equipment is indicative only. Any other test equipment required will be arranged by the Contractor.

6.00.00 METHODS AND WORKMANSHIP

6.01.00 All work shall be installed in a first class, neat workmanlike manner by mechanics/ electricians skilled in the trade involved.

6.02.00 The erection work shall be supervised by competent supervisors holding relevant supervisory license from the Government.

6.03.00 All details on installation shall be electrically and mechanically correct.

6.04.00 The installation shall be carried out in such a manner as to preserve access to other equipment installed.





7.00.00 INSTALLATION

7.01.00 General

- 7.01.01 Installation work shall be carried out in accordance with good engineering practices and also as per manufacturer's instructions/ recommendations where the same are available.
- 7.01.02 Equipment shall be installed in a neat workmanlike manner so that it is level, plumb, square and properly aligned and oriented.
- 7.01.03 Cable installation work shall mean erection of cable trays/racks, supports, hangers, junction boxes, conduits, laying of cables either in ground or on trays inside trenches tunnels/overhead trays in conduits, etc. dressing and clamping, jointing and termination inclusive of supply of necessary jointing/ termination kits, lugs, glands, ferrules, tapes, etc. and other accessories, grounding of cable armour. In case of direct laying in ground, all excavation work, necessary back-filling, supply of bricks and protective concrete slabs, removal of excess earth shall be part of the installation work.
- 7.01.04 Grounding installation work shall mean erection, jointing/ brazing/ welding, connection and painting, testing of ground conductors including supply of necessary steel/copper.
- 7.01.05 Lightning protection system installation work shall mean erection, jointing, welding, connection and painting, testing of air termination network, down conductors, shielding masts, connection to ground grid, electrodes, risers, horizontal conductors, etc. of lightning protection system.

7.02.00 Cable Trays

- 7.02.01 Pre-fabricated cable trays and accessories shall be assembled & erected at site. Adequate spaces will be provided to facilitate installation of cable system and to allow routine inspection and modification after installation.
- 7.02.02 Cable trays either inside concrete trenches or inside buildings and racks inside cable shafts shall be aligned and leveled properly. All tray runs shall be installed parallel to the trench/building walls and floors except otherwise noted in the approved drawings.
- 7.02.03 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.
- 7.02.04 The cable trays shall be supported in general at a span of exceeding 1.25 metres horizontally and 1.0 metre vertically.
- 7.02.05 Sufficient spacing not less than 250 mm shall be provided between trays and maintained to permit adequate access, for installing & maintaining the cables.





- 7.02.06 Complete cable tray support structure after installation shall be inspected/ tested for welding strength, straightness, accuracy, use of proper sizes and compliance to drawings.
- 7.02.07 Complete cable tray and accessory installation work shall be inspected/tested for proper alignment, leveling, use of proper accessories, high quality workmanship, etc.
- 7.02.08 The Contractor shall remove the RCC/steel trench covers whenever required and shall again place the same in their positions after the erection work in the particular area is completed or when further work is not likely to be taken up for some time.
- 7.02.09 Whenever any pipe/conduit/cable tray emerges out or enters into a building care should be taken to ensure that no water enters into the building.
- 7.02.10 Cable trays in areas subject to excessive coal dust, oil spillage, mechanical damage or accessible to personal contact shall be provided with raised sheet metal tray covers, installed on upper tray in horizontal run and front in vertical run.
- 7.02.11 Cable trays/racks shall be so arranged that they do not obstruct or impair clearances of passage way.
- 7.02.12 Cable tray/conduit system will be so designed as to accommodate maximum pulling tension and minimum bending radius of cable.
- 7.02.13 Cable tray/conduit system will be constructed to prevent drainage of water into equipment or building.
- 7.02.14 Cable tray/conduit system shall be electrically continuous and grounded.
- 7.02.15 Different voltage grade cables will be laid in separate trays when trays are run in tier formation. Power cables will normally be on top trays and control/instrumentation cable on bottom trays.
- 7.03.00 Cable and Conduits
- 7.03.01 The Contractor shall install, terminate and connect up all cable and conduits as per drawings and cable schedules.
- 7.03.02 The drawings shall be strictly followed except where obvious interference occurs. In such cases, the routing shall be changed as directed and/or approved by the Engineer.
- 7.03.03 Approximate lengths of cable and conduit runs will be shown by the contractor in the cable schedule for guidance only. Before commencement of work the Contractor shall take actual measurements and prepare his own cable-cutting schedule to reduce wastage to a minimum.





- 7.03.04 The Contractor shall also maintain and submit when requested, a record of cable insulation value when drawn from store, after laying, before and after termination/jointing.
- 7.03.05 Where direct heat radiation exists, heat isolating barriers, shall be adopted for cabling system.
- 7.03.06 Cabling/wiring in offices, laboratories, control rooms etc. shall be taken through concealed G.I. or rigid PVC pipes as directed by the owner's Engineer.
- 7.03.07 At certain places where hazardous fumes/gasses may cause fire to the cables, cable trenches after installation of cables shall be sand filled.
- 7.04.00 Conduit and Accessories
- 7.04.01 Conduit/pipes shall be used only in short lengths in certain areas where required and/or as directed by the Engineer.
- 7.04.02 The Contractor shall furnish all conduits complete with accessories as required.
- 7.04.03 Conduits shall be flexible type in general. However, rigid type steel conduit if required shall also be supplied by the Contractor.
- 7.04.04 Except for inside an enclosure wherever the cable enters or leaves the conduit, the conduit end shall be sealed by suitable sealing compound, having fire withstand capability.
- 7.04.05 The entire metallic conduit system, when embedded or exposed shall be electrically continuous and grounded.
- 7.04.06 Where it is possible for water or other liquids to enter conduits, sloping of conduit runs and drainage of flow points shall be considered.
- 7.04.07 Pull boxes will be installed between termination points where required to facilitate cable pulling, but at a maximum interval of 30 meters.
- 7.04.08 Conduits shall be firmly fastened within 900 mm of each junction box/pull box/cabinet/fitting, etc. Conduits shall be supported at least every 2000 mm.
- 7.05.00 Cables: Storage and Handling
- 7.05.01 Cable drums shall be stored on hard and well-drained surface so that they may not sink. In no case shall the drum be stored on the flat, i.e., with flange horizontal.
- 7.05.02 Rolling of drums shall be avoided as far as practicable, for short distance, 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 cable.

- 7.05.03 For unreeling the cable, the drum shall be mounted on jacks or on cable wheel. The spindle shall be strong enough to carry the weight without bending. The drum shall be rolled on the spindle slowly so that the cable should come out over the drum and not below the drum.
- 7.05.04 While laying cable, cable rollers shall be used at an interval of 2000 mm. The cables shall be pushed over the roller by a gang of people positioned in between rollers over a suitable distance. Care shall be taken so that kinks and twists or any mechanical damage does not occur in cables. Only approved cable pulling grips or other devices shall be used. Cables shall not be dragged on ground or along structure while laying out from cable drums. Cable shall not be pulled from the end without having intermediate pushing arrangement. Bending radius of the cable during installation shall not be less than what is specified by the manufacturer.
- 7.05.05 Empty cable drums shall be returned to the Owner.
- 7.06.00 Cable Laying
- 7.06.01 Cable shall generally be installed in ladder type prefabricated trays except for some short run in rigid/flexible conduit for protection or crossings.
- 7.06.02 Cables laid on trays and risers shall be neatly dressed and clamped with self-locking type fire resistant nylon ties at an interval of 750 mm. for horizontal and vertical runs, in case of both power, control and instrumentation cables.
- 7.06.03 Single core power cables for 3 Ph. AC circuits shall be laid in trefoil formation and suitably clamped with self-locking type fire resistant nylon ties at an interval of 750 mm.
- 7.06.04 L.T. multicore power cables with cross-sectional area of 95 sq.mm and above and all H.T. multicore power cables and shall be clamped individually by self-locking type fire resistant nylon ties.
- 7.06.05 L.T. power cables of cross sectional area less than 95 sq.mm and all control and Instrumentation cables shall be clamped in bunches with self-locking type fire resistant nylon ties. The number of cable in one bunch shall not exceed eight (8).
- 7.06.06 Prior to laying of cables inside the indoor and outdoor trenches, the contractor shall properly clean the trenches.
- 7.06.07 In outdoor areas, buried cables shall be laid and covered with sand/riddled earth and protected from damage by bricks at sides and precast slab at top.





- 7.06.08 When buried cables cross road/railway track, adequate protection shall be provided in the form of hume/galvanised iron pipes laid at a minimum depth of 1 meter below ground.
- 7.07.00 Cable Tags & Markers
- 7.07.01 Each cable and conduit run shall be tagged with numbers that appear in the cable and conduit schedules. Cables and conduits shall be tagged at their entrance, bends, every 30.0M and exit from any equipment, junction box. When a cable/conduit passes through a wall, tags shall be fitted on both sides of the wall.
- 7.07.02 The tags shall be of aluminium with the number punched on it and securely attached to the cable by not less than two turns of 16 SWG G.I. wire. For single core cable the wire shall be of non-magnetic material.
- 7.07.03 Location of cable joints, if any, shall be clearly indicated with cable marker with an additional inscription 'cable-joint'.
- 7.07.04 Contractor shall furnish and install all tags and markers stated above.
- 7.07.05 For buried cable, the marker shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change of direction.
- 7.08.00 Cable Termination and Connection
- 7.08.01 Termination and connection of cables shall be done strictly in accordance with manufacturer's instruction, drawings and/or as directed by the Engineer.
- 7.08.02 Work shall include all clamping, fitting, fixing, soldering, tapping, compound filling, cable jointing, crimping, shorting and grounding as required for the complete job. All equipment required for all such operations shall be of Contractor's procurement. Furnishing of all consumable materials such as soldering material, electrical tape, sealing material as well as cable jointing kits shall be included in the offer.
- 7.08.04 Cable joint kits for all cables shall be supplied by Contractor under this specification. Responsibility for proper termination shall lie on the contractor. Guarantee for termination shall also have to be given by Contractor.
- 7.08.05 The equipment will be generally provided with blank bottom plates for cable/conduit entry and cable end box for power cables.
- 7.08.06 The Contractor shall perform all drilling, cutting on the blank plate and any minor modification work required to complete the job.
- 7.08.07 If the cable end box or terminal enclosure provided on the equipment is found unsuitable and requires major modification, the same shall be carried out by the contractor.





- 7.08.08 Control/instrumentation cable cores entering control panel/ switchgear/ MCC, etc. shall be neatly bunched and served with PVC perforated tape to keep it in position at the terminal block.
- 7.08.09 The Contractor shall put ferrules on all control cable cores in all junction boxes and at all terminations. The ferrules shall carry terminal numbers as per drawings. All ferrules shall be coloured, plastic & interlocked type.
- 7.08.10 Spare cores shall be similarly ferruled, crimped with lug and taped on the ends. Spare cores shall be ferruled with individual cable number.
- 7.08.11 Termination and connection shall be carried out in such a manner as to avoid strain on the terminals.
- 7.08.12 All cable entry points shall be properly sealed and made vermin and dust 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.
- 7.08.13 Strips and special tools like manually or pneumatically driven gun/pistol for termi-point/equivalent connection shall be supplied by the Contractor.
- 7.09.00 Cable Joints
- 7.09.01 Cable shall be installed without joints as far as practicable.
- 7.09.02 If however jointing becomes necessary, it shall be made only by qualified cable jointer and strictly in accordance with manufacturer's recommendation.
- 7.10.00 Grounding
- 7.10.01 If supply and laying of the underground mat is included in the scope of the Contractor, the Contractor will plan and organize works to lay the grounding mat in the same sequence in which the building and equipment foundation is being done.
- 7.10.02 Underground mat will be made of mild steel rods laid underground in length and breadth of the area at a depth of minimum 1 metre below grade level. All crossings and straight run shall be arc welded for good electrical continuity. Ground conductors, when crossing underground trenches, directly laid underground pipe and equipment foundation, if any, shall be at least 300 mm below the bottom elevation of such trenches/pipes as shown in the relevant drawing.
- 7.10.03 Contractor shall carry out the interconnection among various peripheral earthing grids/mats, steel structures, lightning protection system as well as grounding of all electrical equipment, etc. The grounding work shall be carried out as per provisions of I.E. rules, Indian standards and Annexure-E: Notes & Details for Grounding & Lightning Protection System.





- 7.10.04 Grounding shall be done by conductors of adequate sizes (size shall be selected by the bidder with supporting calculation, if not specified) and the same shall be connected to the risers of main ground mat.
- 7.10.05 For fabricated cable trays, a separate ground conductor (50x6 mm G.S. flat) shall run along the entire length of each route of cable tray being suitably clamped on the cable tray. Individual cable trays of each section shall be connected to above ground conductor through 50x6 mm G.S. flat to maintain continuity of ground path.
- 7.10.06 All ground conductor connections shall be made by electric arc welding/ brazing unless otherwise specified. Ground connections shall be made from nearest available station ground grid risers. The rods/connection shall be coated with cold galvanizing /weather resistance anti corrosive paints.
- 7.10.07 All ground conductors shall be painted black for easy identification.
- 7.10.08 Equipment ground connections, after being checked and tested by the Engineer, shall be coated with anti-corrosive paint.
- 7.10.09 Whether specifically shown or not in Project drawings, all conduits, trays, cable armour and cable end box, electrical equipment such as motors, switchboards, panels, cabinets, junction boxes, lockout switches, fittings, fixtures, etc. shall be effectively grounded.
- 7.10.10 If there is no provision to ground the L.T. transformer neutral at transformer end, to make an effectively earthed 415V system the neutral bus of all 415V distribution boards shall be connected to ground grid at two different and distinct points.
- 7.10.11 Ground Electrode

Ground electrodes are to be fabricated and driven into the ground by the side of mat conductor. All connections to the conductors shall be done by arc welding process.

7.10.12 Risers

Risers are required for connecting the equipment and structures with the ground mat. These will be 1x40 mm dia (minimum) M.S. rod. laid from ground mat to above ground level properly clamped or supported along the outer edge of the concrete foundation. Connection to the ground mat shall be done by arc welding and the other end is to be kept free at least 300 mm above grade level/concrete floor level unless otherwise shown.

7.10.13 Column Grounding

All columns are required to be grounded by 1x40 mm dia (minimum) M.S. rod from ground mat. Laying, supporting along with foundation, connecting at ground mat are within the scope of this specification. At least 300 mm length





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of the above rods shall be left free above the grade level/concrete for connection with columns.

7.10.14 Electronic Equipment Grounding

Internal ground connection of electronic panels shall be insulated from the enclosure, frame, chassis and to be terminated to an insulated ground bus.

Insulated ground bus of all electronic panels shall be connected by insulated wire to an insulated common electronic ground bar.

All connection made above shall be in the form of a radial distribution system without any parallel ground paths.

Electronic equipment and systems, metal enclosures of all electronic panels shall be connected to a grounding system with which is isolated and separate from the electrical equipment grounding system. Separate Earth pit shall be made by 3M X 3M MS Rod.

7.11.00 Painting

Contractor shall paint steel fabrications at site with two (2) coats of red oxide primer and two (2) coats of battleship grey (shade no. 632 of IS:5) synthetic enamel paint. In case a different kind of primer or a finish shade is mentioned in the Lead/General Specification due to especially corrosive atmosphere, the same shall be followed.

7.12.00 Galvanizing

Galvanizing shall be uniform, clean, smooth, continuous and free from acid spots. Should the galvanizing of the samples be found defective, the entire batch of steel has to be re-galvanized, at Contractor's cost. The amount of zinc deposit shall not be less than 610 grams per square metre of surface area. Additionally, the thickness of the zinc deposit at any spot shall not be less than 75 microns. The Owner reserves the right to measure the thickness of zinc deposit by appropriate instrument and reject any component which shows thickness of zinc at any location less than 75 microns.

7.13.00 Excavation and Back Filling

7.13.01 Contractor shall perform all excavation and backfilling to the original level with good consolidation as required for buried cable and ground connections. Sheeting and shoring shall be done as necessary for protection of the work.

7.13.02 Contractor shall make his own arrangements for pumping out any water that may be accumulated in the excavation.

7.14.00 Steel Fabrication





- 7.14.01 All racks, trays, supports, hangers & brackets wherever necessary shall be fabricated by the Contractor.
- 7.14.02 Steel for fabrication shall be straightened and cleaned of rust and grease. All fabrication shall be free of sharp edge and burns so as not to cause any damage to personnel or cables.
- 7.15.00 Cleaning up of Work Site
- 7.15.01 The Contractor shall, from time to time, remove all rubbish resulting from execution of his work. No materials shall be stored or placed on passage or drive ways.
- 7.15.02 Upon completion of work, the Contractor shall remove all rubbish, tools, scaffoldings, temporary structures and surplus materials etc. to leave the premises clean and fit for use.

8.00.00 TESTS

8.01.00 Shop Tests

- 8.01.01 All equipment shall be completely assembled, wired, adjusted and routine tested as per relevant Indian Standards at manufacturer's works.
- 8.01.02 Tests on panels/junction boxes shall include:
- a) Wiring continuity tests.
 - b) High voltage and insulation tests.
 - c) Operational tests.

8.02.00 Site Tests

- 8.02.01 Contractor shall thoroughly test and meggar all cables, wires and equipment to prove the same are free from ground and short circuit.
- 8.02.02 If any ground or short circuit is found, the fault shall be rectified or the cable and/or equipment replaced.
- 8.02.03 All power cables after installation and prior to connections shall be subjected to High Potential tests. Also the insulation resistance values shall be measured both before and after Hipot test for comparison. The leakage current shall also be measured during the Hipot test at site.
- Cable cores shall be tested for :
- a) Physical damage
 - b) Continuity
 - c) Correctness of connections as per relevant wiring diagram
 - d) Insulation resistance to earth
 - e) Insulation resistance between conductors





- f) Proper earth connections of cable glands, cable boxes, cable armour, screens etc.

8.02.04 All equipment shall be demonstrated to operate in accordance with the requirements of this specification.

8.03.00 Test Certificates

8.03.01 Type test certificate on any equipment, if so desired by the Owner, shall be furnished. Otherwise the equipment shall have to be type tested, free of charge, to prove the design.

9.00.00 DRAWINGS, DATA & MANUALS

9.01.00 To be submitted with the Bid

9.01.01 Make, type and catalogue number of different electrical items and accessories along with technical leaflets, data sheets etc.

9.01.02 Typical General arrangement drawings showing constructional features, fixing arrangement of pre-fabricated cable trays.

9.01.03 Bill of Materials for cable trays and accessories, conduits & accessories.

9.01.04 Layout of Grounding system & lightning protection system showing connection and other details along with backup design calculations and detailed write up.

9.01.05 Bill of materials for grounding and lightning protection system.

9.01.06 Drawing showing details of equipment grounding.

9.02.00 To be submitted after Award of Contract

9.02.01 Make, type & catalogue number of cable termination kits, joints & accessories.

9.02.02 Detail dimensional drawings showing constructional features, grounding, fixing arrangement etc.

9.02.03 Bill of Materials for Pre-fabricated cable tray and accessories, Conduits & accessories.

9.02.04 Dimensional G.A. drawings and data sheets for different equipment and items supplied under this specification.

9.02.05 Layout drawing of Grounding system and Lightning protection system showing connection details along with backup design calculation and detailed write up.





- 9.02.06 Bill of material for grounding system and lightning protection system.
- 9.02.07 Drawing showing details of equipment grounding system.

Annexure-A**DETAILS FOR FIRE-PROOF CABLE PENETRATION SEALING SYSTEM****1.00.00 General**

- 1.01.00 The Fire proof sealing, fire stop system and fire protection coating system are required to prevent spreading of fire from one place to other place (or one zone to other zone) through the openings in wall / floor, cables laid in trays / racks and openings below Electrical Switchgear, MCC, DB,/ Cabinets, Panels etc.

- 1.02.00 The fire-proof cable penetration (FPCP) sealing system shall conform to the requirement of BS: 476 Part 20 (latest edition with all amendments).

2.00.00 Scope of Work

The scope of work includes but is not limited to the following items of supply and installation:

- i) Fire Stops in wall and floors
- ii) Fire stops below switchgear, MCC, Switchboards, DBs, junction boxes / panels / cabinets, etc. which are floor mounted type
- iii) Fire retardant coating to be applied for installed cables
- iv) Fire proof barrier walls
- v) Fire proof doors
- vi) Minor civil and structural works for installation of the entire work
- vii) Necessary erection materials, consumables and sundry items to complete the work for satisfactory and trouble free operation
- viii) Any special tools & tackles
- ix) Conducting the type test of fire proof sealing system in presence of Owner's Engineers
- x) All relevant Drawings, Data sheets and instruction manuals

3.00.00 Design Criteria**3.01.00 Fire Proof Cable Penetration Sealing System**

The material / components used for fire-proof sealing (FPCP) system shall be provided to meet the following requirements:





- i) The product shall be age tested for not less than 30 years.
- ii) Shall be free from shrinkage or cracking; should achieve smoke and gas tightness during fire and should be modifiable.
- iii) Not to generate toxic or corrosive gas and cause harm to the personnel handling the system.
- iv) Prohibition of production of acid or alkali during gas generation.
- v) Shall be repellant to pest / rodent / termite.
- vi) Expansion co-efficient - very low which is to be comparable with masonry concrete.
- vii) Not soluble / reactive to acid, water, alkali.
- viii) Thermal conductivity - low.
- ix) The material in contact with the cables in the FPCP sealing system shall be compatible with the material used for outer sheath of cables.
- x) It should not have any adverse effect on the cables and should not alter the current carrying capacity of the cables.
- xi) Retrofit in design to accommodate not less than 15% more addition of cables depending upon the size of cables, physically and chemically stable.
- xii) Capable of withstanding vibrations, drop-loads, foot traffics, mechanical loads, etc.
- xiii) The sealing system shall maintain its integrity and perform satisfactorily even after
 - a. Remaining in water for a long time.
 - b. Accelerated thermal aging.
 - c. Sustaining vibrations.
- xiv) The design and construction of FPCP sealing system shall specifically take into account the fact that under seismic disturbances, normal load, short circuit and fire conditions, the cable / cable trays will be subject to movement, expansion and oscillation and this shall not result in any damage or cause dislocation of the FPCP sealing system or the material constituting the FPCP sealing System.
- xv) Non-hygroscopic, non-inflammable and shall not get affected over a period of time due to humidity, moisture and ozone etc. and should not





contain volatile solvents which may cause a fire hazard during application.

- xvi) The fire sealing system to be installed at floor openings below C&I panels, control panels/boards etc. in Central Electrical Room, Central Control Room, Central Electronic Room shall have a fire rating of not less than two (2) hours. The fire sealing system to be installed at all other places like the rest of the wall and floor crossings of cables/cable trays, openings below Switchgears/Boards etc. shall have a fire rating of one (1) hour. The system shall be stable after application of water jet in the exposed side in order to extinguish fire.

3.02.00

Fire Protection coating to be applied on installed cables:

- A. The cables shall be coated with fire protection material of 2 mm dry thickness at the strategic locations as follows so as to limit the spread of fire:
- i) At fire stops in walls and floors on either side upto 500 mm length.
 - ii) At fire stop below Electrical Switchgears/ MCCs/ Panels/ Cabins, etc. on one side coating of 500 mm length, i.e., on the cable vault side / cable trench side.
 - iii) Length of 500 mm on all sides of the junction/crossing of cabling work in open cable routes/ cable trench.
 - iv) In fire risk areas and where specified at suitable intervals as decided upon site conditions in open cable routes.
 - v) Where necessary and specified at site intervals along cable routes in cable trenches.
 - vi) The coating shall be applied evenly on the cables only.
- B. The fire protection coating shall have the following properties/composition:
- i) Asbestos-free, non-volatile, not eatable by vermin, harmless and non-irritant to human skin.
 - ii) Not affecting the current carrying capacity of the cables and the properties of the installed cables.
 - iii) It shall delay fire damage to cables and prevent flame spreading meeting the requirement of IEC - 332.
 - iv) Coating material shall show no signs of cracking and peeling when the coated cable is bent to the radius of minimum 12 times the diameter of the maximum size cable at 180°C.
 - v) The limiting oxygen index of the material shall not be less than 60% as per ASTM D - 2863.





vi) Life expectancy equivalent to the cable installations.

3.03.00 The various openings in the cable vault, vertical, horizontal raceways of cables penetrating walls, floors and the bottom of Electrical switchgears, MCCs, distribution boards, Cabinets, Panels shall be provided with fire stop systems. Cables passing through the openings at various locations are laid on various tiers of the cable trays/ racks in the bunch formation. Bidder shall visit the site to assess and get acquainted with the type of cable installation where fire stops and fire protection coating are to be provided. In case steel frames are required to be fabricated and fixed in the openings, the fabrication of frame & fixing of the same shall have to be done by the Contractor without any extra cost. The necessary steel section for fabrication of frames shall be supplied by the Contractor without any extra cost. Any civil works required to be done in the openings shall be carried out by the Bidder. Bidder shall also include one set of tools & accessories required for addition or removal of cables after the seal is made.

3.04.00 The bidder shall quote the unit rates for provision of supply, installation, testing & commissioning of the fire proof seals as given in the specification. Bidder is requested to quote the unit rates per square metre (i.e., area) basis of the area of the fire sealing material.

4.00.00 Type Test on Penetration Seals

4.01.00 The type tests for fire proof/ penetration seal for floor and wall opening/ fire stop system for bottom of electrical switchgear/ MCC/ panel base are as under:

- i) Fire rating test
- ii) Hose Stream test
- iii) Accelerated aging test
- iv) Fire rating test on the penetration seal system built out of accelerated aged components followed by hose stream test
- v) Temp. rise test for cable in the fire stop
- vi) Water absorption test followed by fire rating test
- vii) Flame Resistance test for fire retardant coating material
- viii) Anti-rodent test

4.02.00 Fire Rating Test

This test shall be carried out to prove the guaranteed power rating duration of the system in respect of stability, integrity and insulation characteristics of the complete system. The penetration seal system as a whole conforming to ASTM 814 and as per BS:476 Part-8 shall be built with the necessary component. The fire test shall be built with the necessary component.





The test specimen of the penetration seal built with 9-10 nos. armoured cables of various sizes passing through the seal shall be fitted to the gas fired furnace and shall form the upper most face of the furnace. The gas fired furnace shall have provision to achieve standard time temperature characteristics for fire tests as mentioned in BS-476 Part-8, according to which the temperature required to be maintained are as under:

<u>Heating time (minute)</u>	30	90	120	150	180	210	240
<u>Furnace temp (°C)</u>	821	886	1029	1062	1090	1113	1133

The pressure inside the furnace at the time of test shall be more than 2 mm water gauge. The penetration shall be subjected to fire test with surface exposed to controlled fire in the furnace conforming to time / temperature characteristics as mentioned above. During the test, temperatures of both the faces of the penetration seal i.e. one which is exposed to fire and the other unexposed, shall be measured by calibrated thermocouples after regular interval of 5 minutes. At least 3 thermocouples shall be provided for temperature measurement of each face.

4.03.00 The results at the end of the tests shall be interpreted or failure criteria as under:

- i) The system is deemed to have failed to maintain stability if there is a total collapse of the penetration seal.
- ii) In case cracks are seen on the face of the penetration seal or cracks through the seal system through which the flame / or gas can pass, the system is deemed to have failed to maintain integrity. The development of crack is characterized by ignition cotton wool held near the seal on the unexposed surface at a distance of about 30 mm from the aperture.
- iii) In case the mean temperature rise of unexposed surface of seal exceeds 140°C above the initial temperature or temperature of unexposed surface exceeds 180°C, the system shall be deemed to have failed in respect of insulation characteristics.
- iv) Temperature measurement on the unexposed side of the penetration seal specimen shall be measured by the thermocouple on the surface of penetrating items and on fire stop material in accordance with ATME-814/UL 1479 at a distance of 25 mm from fire stop material and penetration items respectively.

4.04.00 Hose Stream Test:

The intention of the hose stream test is to ascertain whether the penetration seal assembly maintains its stability on application of water jet after withstanding the fire for 3 hours i.e. the guaranteed fire rating duration.





The test apparatus for this test shall be similar to the one used for carrying out the fire rating test. The penetration seal system shall be subjected to the action of hose stream at the nozzle pressure of 30 psi supplied for a duration of 1.5 sec./ sq.ft.. of exposed area. The hose stream shall be applied with 1.1/8" dia. nozzle at a perpendicular distance of approximately 17 ft. from the centre of the assembly on a line approximately 270 deg. from the line normal to the centre for the test assembly. The water stream shall be applied within 4 minutes and 30 seconds after completion of fire rating test.

However, this period shall not exceed more than 10 minutes in case of practical difficulties experienced by testing stations. The application of water stream shall be maintained throughout the test duration and shall traverse the complete fire stop system.

The fire stop assembly is deemed to have passed the hose stream test successfully if no through projection of water is noticed on the unexposed surface of the seal. Further on completion of hose stream test, the appearance of the penetration seal system shall not alter substantially indicating thereby that the stability of the system has been maintained.

4.05.00 Accelerated aging test

The intention of accelerated aging test is to ascertain whether the artificial aging of the systems and components thereof results into change in the mechanical properties or in the form. In order to simulate aging, artificial aging shall be resorted to.

For the purpose of subjecting the penetrations seal system components to accelerated aging, the system / components shall be stored for 336 hours in air furnace where the temperature of the inside air, shall be maintained at 100° C. However, for system component s in pliable form, system component shall be stored for 448 hours in air furnace where temp. of air inside the furnace shall be maintained at 75° C. It is assumed that the changes occurring during test period would roughly correspond to the effect on aging over a period of about 40 years.

After completion of 336 hours / 448 hours, the mechanical properties such as tensile strength element, elongation and hardness of the material (as may be applicable) shall be tested. These results shall be compared with corresponding values before subjecting to accelerated aging test.

The change in the form of system / components shall also be compared with the form before the tests to ascertain whether the system / components thereof have undergone any permanent change.

In case the mechanical properties before and after the accelerated aging do not indicate substantial change, the system shall be deemed to have passed the accelerated aging test. Similarly the variation in the form of the system components at the end of the test shall not indicate permanent deformation which is likely to affect the ceiling properties of the system.





4.06.00 Fire Rating test After Accelerated Aging:

Intention to this test is to ascertain whether the penetration seal built out of components already subjected to accelerated aging still passes the fire rating test for guaranteed fire rating duration.

The test apparatus for this test shall be similar to the one used for fire rating test mentioned above. The assembly or the penetration seal shall be carried out with the components which were subjected to accelerated aging test based on the test procedure mentioned above. In case there is a problem of co-ordination with the test station, the prototype assembly may be subjected to aging in manufacturer's works under the conditions mentioned above and live fire test should be carried out at manufacturer's works in presence of Owner's representative.

In live fire test, the temperature of fire shall be of the order of 1000° C at the end of 3 hours. The test shall be carried out at atmospheric pressure.

The interpretation of test results for failure shall be similar to those mentioned under fire rating test/live fire test above.

4.07.00 Temperature rise test for cable in the fire stop:

This test shall be carried out to ascertain whether due to inadequate dissipation of heat at the location of fire stop, the temperature of cable conductor or outer sheath in contact with the fire stop, rises beyond the acceptable limits due to which whether any derating is required for cables.

Fire stop systems shall be erected with, at least 8-10 armoured cables, specially power cables. While laying the cable through penetration seal, thermocouple shall be placed on the outer surface of cable in contact with the fire stop system. The location shall be selected where there exists possibility of inadequate dissipation of heat from cables to the atmosphere due to fire stop components. Two thermocouples shall also be located on the two surfaces of the fire penetration seal system. Similarly thermocouples shall also be placed on the other surface of cables where there exists contact of free air without any obstruction so as to enable adequate nature cooling.

In case the temperature of outer surface of the cable in contact or inside the fire stop system does not exceed 75° C, it is inferred that no derating of cable is required for cable when used in conjunction with the particular fire stop system.

Test shall be repeated with reduced current till the temperature of cable outer surface in contact with fire stop system is limited to 75°C. The rate of the current so guaranteed by the cable manufacturer as free air rating shall be the derating factor.

4.08.00 Water Absorption Test:





The test specimen shall be immersed in fresh clean water at a temp. of 20°C. The test specimen must be separated from the bottom and sides of the soak tank by at least 10 mm and it shall be covered by approximately 25 mm of water. At the end of the 24 hours soak period, the specimen shall be removed from the water and mopped up with a damp cloth.

Fire rating test after water absorption is to ascertain whether the penetration seal subjected to water absorption still passes the fire rating test for guaranteed fire rating duration.

Test apparatus for this test shall be similar to the one used for fire rating test. In case there is problem of coordination with test stations, the prototype assembly may be subject to water absorption test at manufacturer's works followed by live fire test which should be carried out at manufacturer's works in presence of Owner's representative. In line fire test, the temperature of furnace shall be of the order of 1000°C at the end of 3 hours. The test shall be carried out at atmospheric pressure.

4.09.00 Flame Resistance Test for fire Retardant Coating Material:

Sample strips shall be of ½ " wide, 12" long and approximately 70 mills in thick (without any reinforcement). Each strip shall be held vertically (clamped at the top) in a natural gas burner flame, (blue cone of flame touching bottom edge of sample) for 10 minutes. The flame shall then be removed and observation shall be recorded. In case, any flaming of the samples should cease after the removal of gas burner. White charred length of the sample should not exceed 1 & ½".

4.10.00 Anti-Rodent Test:

Physical tests:

- a) This test shall be carried out to ascertain the anti-rodent properties of the components of the Fire proof sealing system.
- b) This test shall be carried out at approved test station performing sealing system tests on pharmaceutical products. The complete Fire Proof sealing system shall be subjected to attack of insect / vermin such as rat for about 20 days.
- c) At the end of the test condition of the surface of Fire Proof sealing system the test material shall be compared with the surface condition before commencement of the test. The fire stop shall be deemed to have passed this test in case no marks of growth are seen on the surface.





5.00.00 Test Certificates

- 5.01.00 Certified copies of all tests carried out at works and at site shall be furnished in requisite number of copies.
- 5.02.00 Test reports shall be complete with all details and shall also contain limit valves specified in the relevant standards, wherever applicable, to facilitate review of Test Report/ Certificates.
- 5.03.00 The fire proof sealing system shall be installed only after receipt of approval of the test reports.





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SECTION-IV

TECHNICAL SPECIFICATION

CABLES





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SECTION - IV

CABLES

1.00.00 SCOPE OF SUPPLY

1.01.00 Cables shall be furnished in accordance with this specification and the following annexures :-

- a. HV. Power Cables : Annexure A
- b. LV. Power Cables : Annexure B
- c. Control Cables : Annexure C

1.02.00 Other cables including special cables, fire survival cables if any, which are necessary as per proven engineering practice for satisfactory & trouble free operation of the entire cable system of the main plant shall also be within the scope of supply. These shall include all such cables for electrical integral with mechanical equipment systems and sub-systems.

1.03.00 Special tools and tackle.

1.04.00 All relevant drawings, data and instruction manuals.

2.00.00 CODES AND STANDARDS

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

2.01.01 Cable 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 submitted along with the bid.

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

3.00.00 DESIGN CRITERIA

3.01.00 The Cables will be used for connection of power and control circuits of the auxiliary electrical systems.

3.02.00 Cables will be generally laid on ladder type trays or drawn through rigid PVC/GI /HDPE pipe/conduits or directly buried in ground depending on layout requirement.





- 3.03.00 For continuous operation at specified rating, maximum conductor temperature shall be limited to the permissible value as per relevant standard or this specification which one is more stringent.
- 3.04.00 The insulation and sheath materials shall be resistant to oil, acid and alkali and shall be tough enough to withstand mechanical stresses during handling.
- 3.05.00 The outer sheath of power and control cables shall have rodent and termite repulsion treatment.
- 3.06.00 Core identification for multicore cable shall be provided by colour coding.
- 3.07.00 For 3.3KV and above rating cables shall be dry cured in pressurized nitrogen atmosphere.
- 3.08.00 The allowable voltage drop at terminal of the connected equipment shall be maximum 2.5% at full load while choosing the conductor size and calculations shall be submitted for purchaser's approval. In case of squirrel cage induction motors, the cable size shall be so chosen that the motor terminal voltage does not fall below 80% of the rated voltage, at the time of starting.
- 3.09.00 Cable selection criteria
- 1> In cable sizing the following are to be taken into consideration.
 - a. Short circuit current and duration
 - b. Continuous current.
 - c. Installation conditions.
 - d. Voltage drop under normal running and starting condition.
 - e. Fault contribution of motor and expected time up to which motor contribution persists
 - 2> Apart from above, consideration shall also be given to limit the cable to some standard sizes instead of using too many types.
 - 3> The standard cable sizes, capacities, derating factors, etc. as given in IS will be generally followed.
 - a) For breaker protected circuits minimum size will be determined by short circuit rating.
 - b) For motor circuits the selection of size will be made ensuring that the cable shall withstand a short circuit fault directly following a second. For fuse protected circuit, the conductor size will depend on full load current subject to voltage drop not exceeding 2.5%.
 - 4> For practical purposes, the minimum size chosen is as below:
 - a) Aluminium : 16 Sq. mm.
 - b) Copper : 2.5 Sq. mm.
 All drives of small rating where terminations with 16 Sq. mm. cables are not feasible, shall have copper cable.



5> All control cables shall be 2.5 Sq. mm. copper cable.

4.00.00 SPECIFIC REQUIREMENTS

4.01.00 H.V. Power Cables

The type and quantity shall be furnished as indicated in Annexure -A

4.02.00 L.V. Power Cables

The type and quantity shall be furnished as indicated in Annexure -B

4.03.00 Control Cables

The type and quantity shall be furnished as indicated in Annexure -C

4.04.00 Separate cables for each type of following services / functions as applicable shall be used for each feeder. Same multicore cable using different services and different voltage class/grade shall not be acceptable:

- a) Power.
- b) Control, interlock and indication.
- c) Metering and measuring.
- d) Alarm and annunciation.
- e) C.T. Cables.
- f) V.T. Cables.

4.05.00 Double/ multi run cable termination at motor end shall be avoided.

4.06.00 Drum Length & Tolerance

The cables shall be supplied in non-returnable packing steel drum for HV power cables, wooden drums for LV power and control cables, each containing minimum 500 meters length of larger sizes of cable unless specifically asked for. For smaller sizes of cables, each drum shall contain 1000 meters length of cable. Allowable tolerance on individual drum length is $\pm 5\%$.

4.07.00 Total Quantity Variation

Total supplied quantity shall not vary by more than $\pm 2-1/2\%$ of total quantity for ordered length for all types of cables.

4.08.00 Non-Standard Length

Owner shall not accept any non-standard lengths of the total ordered quantity. Cable lengths shall not be less than 500 meters in any case.

4.09.00 Cable identification

Cable identification shall be provided by embossing on every meter on the outer sheath the following:





- a) Manufacturer's name or trade mark
- b) Voltage grade
- c) Year of manufacture
- d) Type of insulation, e.g. XLPE/PVC etc.
- e) No. of core and size of cables.
- f) Type of improved fire performance, e.g. FR/FR-LSH
- g) IS number

4.10.00 Packing

4.10.01 Cables shall be supplied in non-returnable drums. The drums shall be of heavy construction. All wooden parts shall be manufactured from seasoned wood. All ferrous parts used shall be treated with suitable rust preventive finish or coating to avoid rusting during transit or storage.

4.10.02 Cable shall be wound and packed on drums in such a manner that it will be properly sealed and firmly secured to the drum. The ends of each length shall be sealed before shipment.

4.10.03 The cable drums should carry the following details in printed form:

- a) Manufacturer's name or trade make
- b) Type of cable & voltage grade
- c) Year of manufacture
- d) Type of insulation e.g. XLPE
- e) No. of core and size of cables
- f) Cable code
- g) Length of cable on drum
- h) No. of length on drum, if more than one
- i) Direction of rotation, by arrow
- j) Approx. gross mass.
- k) IS number and ISI mark



4.11.00 Joints and Terminations

Materials of construction for a joint/termination shall perfectly match with the dielectric chemical and physical characteristics of the associated cables. The material and design concepts shall incorporate a high degree of operating compatibility between the cable and joints. The protective outer covering (jacket) used on the joints/terminations shall have the same qualities as that of the cable outer sheath in terms of ambient/operating temperature withstand capability and resistance to hazardous environments and corrosive elements.

5.00.00 TESTS

5.01.00 Shop Tests

The Cables shall be subject to shop tests in accordance relevant IS/IEC standards to prove the design and general qualities of the Cables as below: -

5.01.01 Routine tests on each drum of cables.

5.01.02 Acceptance tests on drums chosen at random on each type, size and batch for acceptance of the lot.

5.01.03 Type tests on each type of cable, size and batch inclusive of measurement of armour D.C. resistance of power cables.

5.02.00 Additional Tests

Following additional acceptance tests shall also be performed on each type of cables having outer sheath with improved fire performance (category C1, Type FR/ Category C2, Type FRLSH):

5.02.01 Oxygen index test (for both C1 & C2)

The Oxygen index shall not be less than 29

5.02.02 Temperature Index Test (for both C1 & C2)

The measured value of temperature index shall be 21 at a temperature of 250°C

5.02.03 Flame Retardance test on single cable and on bunched cables (for both C1 & C2)

After the test, there should be no visible damages on the test specimen within 300mm from its upper end.

After burning has ceased, the cables should be wiped clean and the charred or affected portion should not have reached a height exceeding 2.5 meter above the bottom edge of the burner, measured at the front and rear of the cable assembly.



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5.02.04 Halogen acid gas evolution test (for category C2).

The level of HCL evolved shall not exceed 20 per cent by weight

5.02.05 Smoke density test (for category C2)

The cables shall meet the requirements of light transmission of minimum 40% after the test.

5.02.06 test for specific optical density of smoke (for category C2)
(to be considered later)

5.02.07 Test for rodent & termite repulsion property

The test shall be carried out to note the presence of rodent and termite repelling chemical in PVC compound. Normal procedure is that a few chippings of the PVC compound are slowly ignited in a porcelain dish or crucible in a muffle furnace at about 600°C. The resulting ignited ash is boiled with a little ammonium acetate solution (10%). A drop of aqueous sodium sulphide solution is placed on a thick filter paper and it is allowed to soak. The spot is touched with a drop of above extract. A black spot indicates the presence of anti-termite & rodent compound.

5.03.00 Test Witness

Tests shall be performed in presence of Owner's representative if so desired by the Owner. The Contractor shall give at least thirty (30) days' advance notice of the date when the tests are to be carried out.

5.04.00 Test Certificates

5.04.01 Certified reports of all the tests carried out at the works shall be furnished in six (6) copies for approval of the Owner.

5.04.02 Test reports shall be completed with all details and shall also contain IS specified limit values, wherever applicable, to facilitate review

5.04.03 The cables shall be dispatched from works only after receipt of Owner's written approval of the test reports.

6.00.00 SPECIAL TOOLS & TACKLE

6.01.00 A set of special tools & tackle which are necessary or convenient for erection, commissioning, maintenance and overhauling of the equipment shall be supplied. These special tools and tackles shall include but not limited to:

a. Splice-cum-insulation remover for control cable	:	10 Nos
b. Hand operated compression tools with a set of dies for different cable sizes	:	4 Nos. + 4 Sets of dies for each size of cables
c. Hydraulically operated Compression tools with a set of dies for different cable sizes	:	4 Nos. + 4 Sets of dies for each size of cables
d. Wire-wrap gun with accessories for 0.5 Sq. mm. instrumentation cables	:	10 Nos





WBPDC

EPC Bid Document
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- e. Maxi-terminal connection gun with accessories : 10 Nos
for 0.5 Sq. mm. instrumentation cables

6.02.00 The tools shall be shipped in separate containers, clearly marked with the name of the equipment for which they are intended.

7.00.00 DRAWINGS, DATA & MANUALS

7.01.00 Drawings, Data & Manuals shall be submitted with the bid and in quantities and procedures as specified in General Conditions of Contract and/or elsewhere in this specification for approval & subsequent distribution after the issue of Letter of Intent.

7.02.00 To be submitted with the Bid :

- a. Manufacturer's catalogues giving cable construction details and characteristics.
- b. Cable current ratings for different types of installation, inclusive of derating factors for ambient temperature, grouping etc.
- c. Write-up on Manufacturer's recommended method of splicing, jointing, termination etc. of the cables.
- d. Type test reports on H.V. power cable.

7.03.00 To be submitted for Information (I) / Approval (A)

7.03.01 Guaranteed Technical Particulars(A)

7.03.02 Quality assurance plan.(A)

7.03.03 Shop Test reports(A)

7.03.04 Instruction manuals(I)

The manual shall clearly indicate method of laying, termination, check-ups and tests to be carried out before commissioning.

7.03.05 Any other relevant drawing or data necessary for satisfactory installation operation and maintenance (I) or as required by purchaser.

7.04.00 The Owner may review the documents marked (I) if thought necessary. The contractor shall note that the approval of drawings & documents by the Owner does not relieve him of his contractual obligation.

7.05.00 The bidder may note that the drawings, data and manuals listed herein are minimum requirement only. The bidder shall ensure that all other necessary write-up, information, etc required to fully describe the cable are to be submitted with the bid.

7.06.00 All drawings shall be prepared by using AutoCAD and documents shall be generated using Electronic version. The paper copy of the drawings &



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document shall be submitted for approval & reference. All final drawings and documents shall be submitted in CD in AutoCAD 2000 and MS office format as applicable for Owner's future reference.

**H.V. POWER CABLE**

- 1.0 3300/3300V & 11000/11000V (i.e. un-earthed grade) 90°C continuous rating under normal condition and 250°C under short circuit condition, X LPE heavy duty power cable suitable for use in 3300V and 11000 V non effectively earthed system conforming to following requirement and in line with IS 7098, IS 8130 & IS 5831 and IS 3975.
- 1.1 Conductor : Stranded and compacted aluminium conductor of grade H2 and class 2 conforming to IS:8130.
- 1.2 Conductor Screen : Extruded semi-conducting compound.
- 1.3 Insulation : Extruded cross linked polyethylene (XLPE) conforming to IS-7098(Part-2)
- 1.4 Insulation Screen : Extruded semi-conducting compound with a layer of non-magnetic metallic tape. For single core armoured cables, the armouring shall constitute the metallic part of screening. The semi-conducting tape shall be easily strippable. (Applicable for cables above 3300V/3300V)
- 1.5 Core Identification : By coloured strips applied on cores or by numerals.
- 1.6 Inner Sheath : Extruded PVC compound conforming to type ST2 of IS:5831 for three core cables. Filler shall be of same material as of inner sheath i.e. ST2. Single core cables shall have no inner sheath.
- 1.7 Armour : Galvanised single round steel wire armour for twin and multicore cables.

Non-magnetic hard drawn aluminum single round wire conforming to H4 grade for single core cables.
- 1.8 Overall Sheath : Extruded FRLS PVC compound conforming to type ST2 of IS:5831.
- | Category | Type |
|----------|--|
| C2 FRLSH | (Fire Retardant Low smoke and halogen evolution) |
- 1.9 Drum : Conforming to IS-10418 (Steel Drum)



LV POWER CABLE

- 1.0 1100 V grade, 90° C continuous rating under normal condition and 250°C under short circuit condition rating, XLPE heavy duty, power cable conforming to following requirement and in line with IS 7098. IS 8130 & IS 5831 and IS 3975.
- 1.1 Conductor : Stranded and compacted plain aluminium of grade H2 for cable sizes above 2.5 mm² and class 2 stranded high conductivity annealed plain copper for cable sizes upto 2.5 mm² conforming to IS:8130.
- 1.2 Insulation : Extruded cross-linked polyethylene (XLPE) conforming to IS:7098(Part-3)
- 1.3 Core Identification : By color coding
- 1.4 Inner Sheath : Extruded PVC compound conforming to type ST2 of IS:5831 for multicore cable. Single core cables shall have no inner sheath.
- 1.5 Armour : Galvanised single round steel wire armour for twin and multicore cables.
- Non-magnetic hard drawn aluminium single round wire conforming to H4 grade for single core cables.
- 1.6 Overall Sheath : Extruded FRLS PVC compound conforming to type ST2 of IS:5831. having improved fire performance category and type as stated below.
- | Category | Type |
|----------|--|
| C2 | FRLSH (Fire Retardant Low smoke and halogen evolution) |
- 1.7 Drum Conforming to IS-10418(Wooden Drum)

**CONTROL CABLES**

- 1.0 1100 V grade 70°C continuous rating under normal condition and 160°C under short circuit condition rating PVC Control cable (YWY) conforming to following requirement and in line with IS:1554, IS:8130, IS:5831 and IS:3975.
- 1.1 Conductor : Stranded non-compacted and circular, high conductivity annealed plain copper, generally conforming to IS:8130.
- 1.2 Insulation : Extruded PVC compound conforming to type A of IS : 5831.
- 1.3 Core Identification : By color coding and numbering at interval of 100mm or less
- 1.4 Inner Sheath : Extruded PVC compound conforming to type ST1 of IS:5831 for multi-core cables. Filler shall be of same material as of inner sheath i.e. ST1. Single core cables shall have no inner sheath.
- 1.5 Armour: : Galvanised single round steel wire for twin and Multi-core cables.
- 1.6 Overall Sheath : Extruded PVC compound conforming to type ST1 of IS 5831 having improved fire performance category and type as stated below.
- | Category | Type |
|----------|--|
| C2 FRLSH | (Fire Retardant Low smoke and halogen evolution) |
- 1.7 Drum : Conforming to IS-10418 (Wooden Drum)



Annexure-D

STANDARD CABLE SIZES

Sl. No.	Cable Size	Conductor	Insulation
1.0	H. T. CABLES		
1.1	1 core 630 Sq. mm. (3.3/3.3 KV & 11/11KV (UE)	AL X	LPE (FRLSH)
1.2	3 core 185 Sq. mm. (3.3/3.3 KV & 11/11KV (UE)	AL X	LPE (FRLSH)
1.3	3 core 240 Sq. mm. (3.3/3.3 KV & 11/11KV (UE)	AL X	LPE (FRLSH)
1.4	3 core 300 Sq. mm. (3.3/3.3 KV & 11/11KV (UE)	AL X	LPE (FRLSH)
1.6	1 core 70 Sq. mm. (3.3/3.3 KV & 11/11KV (UE)	AL X	LPE (FRLSH)
2.0	L. T. POWER CABLES		
2.1	3 core 2.5 Sq. mm.	Cu	XLPE (FRLSH)
2.2	3 core 6 Sq. mm.	Cu	XLPE (FRLSH)
2.3	2 core 16 Sq. mm.	Cu	XLPE (FRLSH)
2.4	2 core 16 Sq. mm.	AL	XLPE (FRLSH)
2.5	3 core 16 Sq. mm.	AL	XLPE (FRLSH)
2.6	4 core 16 Sq. mm.	AL	XLPE (FRLSH)
2.7	3 core 25 Sq. mm.	AL	XLPE (FRLSH)
2.8	2 core 35 Sq. mm.	AL	XLPE (FRLSH)
2.9	3 core 35 Sq. mm.	AL	XLPE (FRLSH)
2.10	4 core 35 Sq. mm.	AL	XLPE (FRLSH)
2.11	3 core 50 Sq. mm.	AL	XLPE (FRLSH)
2.12	4 core 70 Sq. mm.	AL	XLPE (FRLSH)
2.13	3 core 95 Sq. mm.	AL	XLPE (FRLSH)



WBPDC

SECTION 2

Sl. No.	Cable Size	Conductor	Insulation
2.14 3	1/2 core 95 Sq. mm.	AL	XLPE (FRLSH)
2.15	3 core 150 Sq. mm.	AL	XLPE (FRLSH)
2.16	3 core 185 Sq. mm.	AL	XLPE (FRLSH)
2.17 3	1/2 core 185 Sq. mm.	AL	XLPE (FRLSH)
2.18	3 core 240 Sq. mm.	AL	XLPE (FRLSH)
2.19 3	1/2 core 240 Sq. mm.	AL	XLPE (FRLSH)
2.20	3 core 300 Sq. mm.	AL	XLPE (FRLSH)
2.21 3	1/2 core 300 Sq. mm.	AL	XLPE (FRLSH)
2.22	1 core 630 Sq. mm.	AL	XLPE (FRLSH)
3.0 CONTROL CABLE			
3.1	2 core 2.5 Sq. mm.	Cu.	PVC (FRLSH)
3.2	3 core 2.5 Sq. mm.	Cu.	PVC (FRLSH)
3.3	5 core 2.5 Sq. mm.	Cu.	PVC (FRLSH)
3.4	7 core 2.5 Sq. mm.	Cu.	PVC (FRLSH)
3.5	9 core 2.5 Sq. mm.		PVC (FRLSH)
3.6	12 core 2.5 Sq. mm.	Cu.	PVC (FRLSH)
4.0 CABLES FOR ELECTRONIC EQUIPMENT GROUNDING			
4.1	1 core 35 Sq. mm.	Cu.	XLPE (FRLSH)
4.2	1 core 150 Sq. mm.	Cu.	XLPE (FRLSH)





FS POWER & CONTROL CABLE

1.1KV GRADE COPPER CONDUCTOR FS POWER CABLES

1100 V, copper conductor, heat resisting insulation, extruded inner sheath of low smoke and very low halogen content fire resisting material (for multi-core), single layer of copper wire armour for single core/ single layer of round galvanised steel wire for multicore, outer sheath of low smoke and very low halogen content fire resistant material, suitable for minimum temperature of 950 deg.C (Cat-C) for 3 hours. The cables shall be in compliance with BS 6387.

1.1KV GRADE COPPER CONDUCTOR FS CONTROL CABLES

1100 V, copper conductor, heat resisting insulation, extruded inner sheath of low smoke and very low halogen content fire resisting material (for multi-core), single layer of copper wire armour for single core/ single layer of round galvanised steel wire for multicore, outer sheath of low smoke and very low halogen content fire resistant material, suitable for minimum temperature of 950 deg.C (Cat-C) for 3 hours. The cables shall be in compliance with BS 6387.

[Note : For instrumentation signaling purpose, pair cable with screen on both inner sheath & outer sheath shall be used. For details refer section – VI of Vol.-IIE.]

**VOLUME: II-F/1****SECTION-VII**

**TECHNICAL SPECIFICATION
FOR
415V PMCC/MCC, 415V ACDB, 220V DCDB &
NON-SEGREGATED PHASE BUSDUCT**





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SECTION - VII

**415V PMCC/MCC, 415V ACDB AND 220V DCDB &
NON-SEGREGATED PHASE DUCT****1.00.00 SCOPE OF SUPPLY**

1.01.00 The following equipment shall be furnished complete with all accessories :

- a) 415V Power Control Centers
- b) 415V Motor Control Centers
- c) 415V Power-cum-Motor Control Centers
- d) 415V Distribution Boards and MCCB Boards
- e) DC Distribution Boards and MCCB Boards
- f) Solenoid valve boards
- g) DC starters
- h) 415V Non-segregated phase busduct

A list of various 415V boards that have been envisaged to be supplied under the main plant package of Sagardighi Thermal Power Project 1 x 660 MW Phase -III is given in Annexure - E. This list is only for general guidance of the Tenderers and the exact numbers shall be finalised by them.

1.02.00 Base channel frame of all boards along with necessary mounting hardware.

1.03.00 Set of accessories as listed below and shall be supplied for each PCC/PMCC/MCC:

- a) Breaker lifting and handling trolley
- b) Test cabinet with coupling cables for testing the breaker in drawout position
- c) Racking in/out handle for breakers
- d) Racking in/out handle for drawout MCC modules

1.04.00 Mandatory spares

1.05.00 All relevant drawings, data and instruction manuals.



SECTION 2**2.00.00 GENERAL NOTES**

In the context of the specification, the following definitions shall apply.

2.01.00 POWER CONTROL CENTER, hereinafter referred to as PCC, shall mean a continuous line-up of breaker panels, used to feed Motor Control Centers and motors rated above 90 KW up to and including 160 KW. All PCCs shall have duplicate incomers and a bus-section. Incomers, bus-section, and all outgoing feeders of a PCC shall be breaker controlled. Distribution of outgoing feeders shall be such as to ensure uniform loading on each section of the PCC.

2.02.00 MOTOR CONTROL CENTER, hereinafter referred to as MCC, shall mean a continuous line-up of vertical sections housing breaker panels, MCCB, contactor operated modules. All MCCs except emergency MCCs shall have duplicate incomers and a bus-section. Emergency MCCs shall have four incomers, two each from DG PCC and two each from Turbine PMCC. All incomers and Bus-sections shall be breaker controlled except few, which are castle key inter-locked. All outgoing feeders shall be breaker/ MCCB controlled, or contactor operated depending upon the rating and application. Distribution of outgoing feeders shall be such as to ensure uniform loading on each section of the MCC.

2.03.00 POWER-CUM-MOTOR CONTROL CENTER, hereinafter referred to as PMCC, shall mean a continuous line-up of vertical sections housing breaker panels, MCCB, and contactor-operated modules. All PMCCs shall have duplicate incomers and a bus-section. Incomers and bus-sections shall be breaker controlled. Depending upon the rating and application, outgoing feeders may be breaker controlled, MCCB controlled, or contactor operated. Distribution of outgoing feeders shall be such as to ensure uniform loading on each section of the PMCC.

2.04.00 DISTRIBUTION BOARD, hereinafter referred to as DB, shall mean a continuous line-up of vertical sections housing MCCB/switch-fuse modules only. All ACDB and DCDB shall have duplicate incomers and a bus-section. However Ventilation DB & Welding DB shall have single incomer. Wherever bus-sections are provided, distribution of outgoing feeders shall be such as to ensure uniform loading on each section of DB.

ACDB Incomer shall be ACB or MCCB as per rating. DCDB Incomers shall be ACB or Switch fuse as per rating. All ACDB and DCDB outgoing feeders shall be MCCB and switch-fuse respectively.

2.05.00 SOLENOID VALVE BOARD, hereinafter referred to as SVB, shall mean a continuous line-up of vertical sections housing MCCB modules and contactor operated modules. SVBs may have one incomer, which shall be MCCB controlled. All outgoing feeders shall be contactor operated.

2.06.00 MCCB BOARD, hereinafter referred to as MCCB Board, shall mean a continuous line-up of vertical sections housing MCCB only. MCCB Boards may be fed from DBs and may have one incomer. MCCB Boards shall be of two types - one with 415V, 4-wire, triple pole-and-neutral (TPN) outgoing feeders and the other with 240V, 2-wire, single-pole-and-neutral outgoing feeders. The incomers in either case shall be 415V, 4-wire, TPN type. Incomers and



outgoing feeders of DC MCCB shall be 220V, 2-wire type and 24 V 2-wire type. DC MCCB shall have proper arrangement to suppress resting voltage/arc suppression.

3.00.00 CODES AND STANDARDS

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

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

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

4.00.00 SYSTEM CONCEPT AND DESIGN CRITERIA

4.01.00 415V power distribution within the powerhouse shall be by means of PCCs, MCCs, DBs, SVBs and FBs. PMCCs shall not be used within the powerhouse.

In ESP control building, C.W. pump house; BOP and auxiliary buildings (like CHP, AHP, FGD etc.) use of PMCCs may be acceptable.

4.02.00 The PCCs/PMCCs shall be used to supply auxiliary power for normal and start up operation of generation units.

The MCCs/DBs/SVBs/FBs shall be used to provide power, control, and protection for A.C. and D.C. auxiliary services (motors and feeders) of generating units.

4.03.00 The equipment will be located in a hot, humid, and tropical atmosphere, heavily polluted at places with coal dust and/or fly ash.

4.04.00 Duty involves direct-on-line starting of large induction motors and also under certain emergency conditions, automatic transfer of loads from one source of supply to other. Motor starting current varies from 6 to 8 times of full load current.

4.05.00 Busbars of PCCs/PMCCs shall be sized to carry continuously the associated transformer secondary rated current plus a 20% margin.

Busbars of MCCs/DBs/SVBs/FBs shall be sized to carry continuously the total running load of the MCC, DB, SVB, FB (including anticipated future load, wherever applicable) plus a 20% margin.

Loads of outgoing feeders to Owner/other Packages wherever applicable shall also be considered while sizing the bus bars, equipment and components.



thereof coordinating with other package bidder. All busbars shall be capable of withstanding the mechanical forces and thermal stresses due to maximum short circuit current.

- 4.06.00 In-cubicle ratings of incomer and bus-section breakers/ switches shall be identical to the associated busbar rating.
- 4.07.00 Incomers rated up to and including 400 A, except for MCC and PMCCs, shall be MCCB/ switch controlled. Above 400A, all incomers and feeders shall be breaker controlled.
- 4.08.00 PCCs shall be used to feed MCCs and motors rated above 90 KW up to and including 160 KW. All motors rated above 90 KW up to and including 160 KW shall be breaker controlled. For motors rated higher than 90 KW, breaker shall be given with Numerical motor protection relay. The transformer rated above 90kVA shall be breaker controlled with numerical protection relay.
- 4.09.00 Motors rated up to and including 90 KW shall be contactor operated and shall be fed from MCCs. For all motors below 50 kW, MCCB shall be given. For motors between 50 kW to 90 KW, MCCB with E/F protection should be used.
- 4.10.00 For continuous operation at specified ratings, the temperature rise of various equipment/components shall be limited to the permissible values specified in relevant standards and/or this specification.
- 4.11.00 Circuit breakers shall not produce any harmful over voltage during switching off of induction motors. Surge protective devices (if required) shall be included to limit over voltages.
- 4.12.00 Incomer, Bus-sections, all outgoing motor feeders, transformer feeders of all MCC/PMCCs shall have provisions for remote operation from the respective control room through DCS and or PLC.
- 4.13.00 Each switchgear/PCC/PMCC/MCC/ACDB/DCDB/SVD/FB will have 20% spare outgoing feeder of each type & rating with a minimum one (1) no. of each type and rating. Additional two no active 160A feeders shall be provided in each switchgear/PCC/PMCC/MCC for customer future use.

5.00.00 **SPECIFIC REQUIREMENTS**

5.01.00 **Construction**

- 5.01.01 PCCs/PMCCs/MCCs/DBs/SVBs/FBs shall be indoor, air insulated, and metal-clad type.

The design construction shall be such as to permit extension at either end.

- 5.01.02 PCCs/PMCCs/MCCs/SVBs shall be drawout type.

DBs/FBs shall be fixed type.





5.01.03 PCCs/PMCCs/MCCs/DBS/SVBs shall be suitable for floor-mounting and FBs Boards shall be suitable for wall-mounting.

5.01.04 Generally, PCCs/DBs/SVBs shall be of single-front construction and PMCCs/MCCs shall be of single/double-front (if accepted by Owner) construction. Breaker panels of PMCCs shall be of single-front construction.

5.01.05 All frames and load bearing members shall be fabricated using mild steel structural sections or pressed and shaped cold rolled sheet steel of thickness not less than 2mm.

Frame shall be enclosed in cold rolled sheet steel of thickness not less than 2mm (CR). Doors and covers shall also be of cold rolled sheet steel of thickness not less than 1.6 mm. Stiffeners shall be provided wherever necessary. Removable gland plates of thickness 3mm (hot/cold rolled sheet steel) or 4 mm (non-magnetic material) shall be provided for all panels.

The design shall be such that the specified degree of protection is achieved even after a breaker control module has been taken out of the panel.

5.01.06 PCC/PMCC assemblies shall comprise of a continuous line-up of single/multi-tier cubicles. Installation of circuit breakers shall however be limited to the bottom two tiers only. Not more than two breakers shall be accommodated in one vertical section.

MCC/DB/SVB assemblies shall comprise of a continuous line-up of dead-front, free-standing vertical sections, housing the control modules in multi-tier formation.

All MCCs/DBs/SVBs shall be front-wired and front-connected.

5.01.07 PCCs/PMCCs/MCCs/SVBs/DBs shall be fully compartmentalised with metal/insulating partitions between compartments.

FBs Boards shall be non-compartmentalised.

Working height shall be limited between 450mm and 1800mm from floor level.

5.01.08 Each breaker/control module shall be housed in a separate cubicle, complete with an individual front access door having sufficient opening with concealed type hinges.

Each vertical section shall have a removable back cover.

All doors and covers shall be gasketed.

5.01.09 Breaker cubicles shall be so sized as to permit closing of the front access door when the breaker is pulled out to ISOLATED position. The breaker can be operated both in service & test position with the door closed.



- 5.01.10 For breaker panels, all switches, lamps, and indicating instruments shall be flush mounted on the respective compartment door whereas relays and other auxiliary devices shall be mounted in a separate compartment.
- For MCC/DB/SVB modules, all push-buttons, lamps, and indicating instruments shall be flush/semi-flush mounted on respective module compartment.
- 5.01.11 For single-front assemblies, a full-height vertical cable alley with cable supports shall be provided in each section to facilitate unit wiring.
- The alleys shall be liberally sized to accommodate all cables as per cable schedule and shall have removable cover at the front for access.
- 5.01.12 Wherever two breaker compartments are provided in the same vertical section, insulating barriers and shrouds shall be provided in the rear cable compartment to avoid accidental touch with the live parts of one circuit while working on the other.
- 5.01.13 A horizontal wire way extending the entire length of the assembly shall be provided at the top for inter-panel wiring.
- 5.01.14 Incomers shall be provided at the ends of an assembly and bus section, wherever required, shall be provided at the middle of the assembly.
- 5.01.15 Four (4) Nos. lifting lugs shall be for each section, two (2) nos. on either end of the section.
- 5.01.16 PCCs/PMCCs/MCCs/DBs/SVBs shall be supplied with base frames made out of structural steel sections along with all necessary mounting hardware required for bolting/ welding the base frames to the foundation. FBS Boards shall be supplied along with necessary hardware for mounting against wall.
- 5.01.17 After isolation of power and control circuit connections, it shall be possible safely carry out maintenance in a compartment with the busbar and adjacent circuit live. Necessary shrouding arrangement shall be provided for this purpose over the cable terminations located in cable alley.
- 5.01.18 The minimum clearance in air between phases and between phases and earth for the entire run of horizontal and vertical busbars shall be 25mm. For all other components, the clearance between two live parts, a live part and an earthed part, and isolating distance shall be at least 10mm throughout. Wherever it is not possible to maintain these clearances, insulation shall be provided by barriers. However, for horizontal and vertical busbars, the clearances mentioned above should be maintained even when these are sleeved or insulated. All connections from busbars shall be fully shrouded to minimize the risk of phase to phase and phase to earth shorts.

- 5.01.19 Unless otherwise stated, equipment rating and module size shall be as per Annexure - G. Module selection chart is specified for guidance of Bidder in respect to requirement of module space and component rating.
- 5.02.00 **Bus and Bus Taps**
- 5.02.01 All PCCs/PMCCs/MCCs/ACDBs/SVBs/ACFBs provided with three phase busbars and neutral busbar.
- All DCDBs and DCFBs shall be provided with two busbars.
- All busbar compartments shall be completely enclosed.
- 5.02.02 Horizontal and vertical busbars and bus connections shall be of high conductivity copper/aluminium/aluminium alloy.
- The maximum temperature of busbars and bus connections shall be limited to 55°C with silver plated joints and 40°C with all other types of joints over an ambient of 50°C.
- No diversity factor shall be allowed for temperature rise.
- 5.02.03 Vertical busbars shall be designed for a minimum current rating of 200 A.
- 5.02.04 All bus connections shall be provided with anti-oxide grease. Adequate contact pressure shall be ensured by means of two-bolt connection with plain and spring washers and locknuts.
- 5.02.05 Bimetallic connectors shall be provided for connections between dissimilar metals.
- 5.02.06 All busbars and bus connections shall be fully insulated for working voltage. Insulating heat shrinkable sleeves shall be provided for all busbars. All joints and tap-off points shall be shrouded.
- 5.02.07 Bus insulators shall be non-hygroscopic, flame retardant, track resistant, high strength, sheet moulded compound or equivalent polyester fibreglass moulded type. Separate supports shall be provided for each phase and neutral busbar.
- 5.02.08 Cross-section of the busbars shall be uniform throughout the length of the assembly. All busbars and bus connections shall be supported and braced to withstand the stresses due to maximum short circuit current and also to take care of any thermal expansion.
- 5.02.09 Busbars shall be colour coded for easy identification and so located that the sequence R-Y-B shall be from left-to-right, top-to-bottom, or front to rear when viewed from the front of the assembly.
- 5.02.10 Bolted disc connecting links shall be provided for all incoming and outgoing feeders for isolation of neutral, if necessary.



SECTION 2**5.03.00 MCC/SVB/DB Modules**

5.03.01 MCC/SVB modules shall have self-aligning power/control disconnects. All disconnects shall be silver-plated to ensure good contacts.

5.03.02 Modules of same size and type shall be physically and electrically interchangeable.

5.03.03 The design of drawout modules shall be such as to permit easy withdrawal/re-insertion of the unit with guide rails to ensure correct alignment.

5.03.04 Various module sizes should be multiples of one basic unit to facilitate modifications at site. Suitable provision for this purpose should also be incorporated in the vertical busbars.

5.03.05 Drawout modules shall have three distinct positions, namely, SERVICE, TEST and ISOLATED.

In the SERVICE position, both power and control circuits shall be engaged. It shall not be possible to open the module door when the module is in SERVICE position.

In the TEST position, the power circuits shall be disengaged but the control circuits shall be engaged. It shall be possible to close the module door when the module is in TEST position. Keeping the front access door of module in closed condition, the Breaker can be placed in ISOLATED, TEST or SERVICE position from outside.

In the ISOLATED position, both power and control circuits shall be disengaged.

5.03.06 Modules shall house the control components for a circuit such as switch, fuse, contactors, relays, push-buttons, lamps, meters, etc. Only the push-button actuators, lenses of indicating lamps, and transparent windows for meters shall be mounted on module door such that when the module is withdrawn, the cubicle door shall provide specified IP-54 degree of protection when the module door is closed.

5.03.07 Breaker operated incomers and bus sections shall be provided with one (1) LOCAL-REMOTE selector switch.

Contactor operated motor feeder modules shall be provided with one (1) MCC-NORMAL-TRIAL selector switch.

These selector switches shall be lockable type and shall be mounted on the panel.

Ethernet switches (if mounted in the switchgear itself) shall be mounted in a separate compartment/compartments in all switchgears provided with numerical relays. Inter-panel wiring of Ethernet cable for connection of numerical relays to Ethernet switches and required power supply to Ethernet switches shall be arranged in the switchgear.





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5.03.08 The equipment layout shall provide sufficient working space in between the components.

5.04.00 **Circuit Breaker**

5.04.01 Circuit Breakers shall be three pole, single throw, air break type with stored energy, trip free mechanism and shunt trip coil.

5.04.02 Circuit breakers shall be drawout type, having SERVICE, TEST & ISOLATED positions with positive indication for each position.

5.04.03 Circuit breakers of identical rating shall be physically and electrically interchangeable.

5.04.04 All incoming breakers, bus-section breakers, Outgoing and motor feeder breakers shall have motor wound spring charging mechanism.

5.04.05 Each breaker operated feeder shall be provided with protective devices as specified in Annexure-B.

5.04.06 All breakers with motor wound spring charging mechanism shall have facility of manual spring charging also.

5.04.07 For motor wound mechanism, spring charging shall take place automatically after each breaker closing operation. On the open-close-open operation of the circuit breaker shall be possible after failure of power supply to the motor.

5.04.08 Mechanical safety interlock shall be provided to prevent the circuit breaker from being racked in or out of the service position when the breaker is closed.

5.04.09 Automatic safety shutters shall be provided to fully cover the female primary disconnects when the breaker is withdrawn.

5.04.10 Each breaker shall be provided with an emergency manual trip, mechanical ON-OFF indicator, an operation counter, mechanism charge/discharge indicator, and electrical anti-pumping feature.

5.04.11 In addition to the auxiliary contacts required for normal breaker operation and indication, each breaker shall be provided with the following for interlocking purpose :

- a) Position/cell switch with minimum 4NO + 4NC contacts.
- b) Auxiliary switch, with minimum 6NO + 6NC contacts, mounted on the stationary portion of the breaker panel and operated mechanically by a sliding level from the breaker in SERVICE position.



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Alternatively, electrically reset-latching relay may be used for the purpose. The exact requirement contact of the position/cells switch, limit switch, auxiliary switch and latching relay shall be decided by the Tenderers taking into account the scheme requirements. Limit/auxiliary switches shall be convertible type, that is, suitable for changing N.O. contact to N.C. and vice-versa.

5.04.12 Spring charge limit switch shall be provided for breakers with motor wound spring charging mechanism. These limit switches shall be provided with minimum 2NO + 2NC contact.

5.04.13 Limit/auxiliary switches shall be convertible type, that is, suitable for changing N.O. contact to N.C. and vice-versa.

5.05.00 **Switches**

5.05.01 Switches shall be triple/double pole, air break type and designed for duties as specified in Annexure-A. Motor duty switches shall be capable of safely making and breaking the locked rotor current of the associated motor circuit.

5.05.02 The switch shall have a quick-make, quick-break mechanism operated by a suitable external handle, complete with position indicator. This handle shall have provision for padlocking in ON and OFF position.

5.05.03 The compartment door shall be interlocked mechanically with the switch such that the door cannot be opened unless the switch is in OFF position. Means shall be provided for releasing this interlock at any time.

5.05.04 Switches shall be capable of withstanding the let-through fault current of back-up fuses or circuit breakers.

5.05.05 Wherever two incoming switches and one bus-section switch/breaker are provided for an assembly, these shall be mechanically/key interlocked to ensure that only two out of the three can be closed at time.

Wherever two incoming switches are provided for an assembly, these shall be mechanically/key interlocked to ensure that one of the two can be closed at time.

5.06.00 **Fuses**

5.06.01 Fuses shall be HRC, preferably link type, with a minimum interrupting capacity equal to the short circuit current of the LT system.

5.06.02 Fuses shall be furnished complete with fuse bases and fittings of such design as to permit easy and safe replacement of fuse element.

Visible indication shall be provided on blowing of the fuse.

5.06.03 Motor fuse characteristics and ratings shall be chosen to ride over starting period without blowing. The fuse on incoming feeder wherever provided, shall be chosen to provide discrimination with motor/feeder fuses.



5.07.00 **A.C. Starter**

5.07.01 Contactors

- a) The contactors shall be three pole, air break type with non-bouncing silver/silver alloy contacts. The contactor shall be designed for duty as per Annexure-A attached.
- b) Each contactor shall be provided with minimum (2) normally open and two (2) normally closed auxiliary contacts rated 10A at 240V A.C. The exact requirement of contacts shall be decided by the tenderer taking into account the scheme requirements and spares.
- c) Contactors for forward and reverse direction of reversible drives shall preferably be both electrically and mechanically interlocked.
- d) Delayed dropout contactors, if required and provided for some essential auxiliaries, shall not dropout on power failure if the voltage is restored within three seconds
- e) Contactor starters shall comply with the requirements of IEC 60947-4-1 or IS 13947(Part4/Sec.1) in respect of co-ordination of the characteristics of contactor, overload relay, and MCCB. The type of co-ordination shall be Type-2 as per IEC/ IS.

5.07.02 Thermal Overload

- a) Thermal overload relays shall be three elements, positive acting, ambient temperature compensated with adjustable settings.
- b) Single phasing preventor shall be provided as an inbuilt feature of the thermal overload relay.
- c) Relays shall be manual reset type with 1 NO and 1NC contacts; Resetting of relays shall be possible with compartment door closed. Colour of the resetting button shall be BLACK.
- d) Relays may be direct acting or C. T. operated, depending on current rating. C.T.s shall be included in the scope of supply.
- e) Relays for fan motors having long starting time shall be saturable case C.T operated.

5.08.00 **D.C. Starters**

5.08.01 DC starters shall be complete with MCCB, contactors, resistors, relays, meters, push-buttons, lamps, etc.





5.08.02 Starters shall be furnished in totally enclosed floor-mounting, sheet steel cubicles complete with a hinged front access door. Minimum thickness of sheet steel shall be 2mm.

5.08.03 The cubicle enclosure shall provide dust and humidity protection, the degree of protection being not less than IP-54.

The resistor enclosure shall be provided with ventilating louvers and wire mesh guard and shall have a degree of protection IP-23.

5.08.04 Cubicle space heater shall be provided to maintain internal temperature above dew point. Heater shall be furnished with MCCB unit and thermostat control.

5.09.00 Control and Indication

5.09.01 Circuit breakers shall be wired up for local and remote operation. Each breaker cubicle shall be equipped with the following:

i) One(1) SW.GR.-REMOTE selector switch for In comer, O/G, Tie, B/C and Transformer feeders / One(1) SW.GR.-NORMAL-TRIAL selector switch for motor feeders. Selector switch shall be Lockable stay put type.

ii) Two (2) push buttons for TRIP and CLOSE

iii) For In comer/ Bus -coupler/ Motor feeder / Trafo. Feeder, Ten (10) indicating lamps on the front of the compartment :-

a.	Breaker Closed	:	Red
b.	Breaker Open	:	Green
c.	Spring Charged	:	Green
d.	Lock out Relay Operated	:	Amber
e.	Breaker in Service	:	Amber
f.	Breaker in Test	:	Amber
g.	Trip Circuit Healthy	:	White
h.	Control Supply Healthy	:	Blue
i.	Breaker Auto-trip	:	Amber
j.	Trip Relay Healthy	:	Blue

Other than above feeders Three (3) indicating lamps on the front of the compartment :

Breaker open & Spring charged	:	Green
Breaker closed	:	Red
Breaker tripped/trip circuit faulty	:	Amber

5.09.02 The general scheme of connections for control, interlock, and protection is shown in the enclosed drawings. Detailed requirements of individual circuits shall be developed by the Tenderers.

5.09.03 Push buttons shall be heavy duty, oil tight, push to actuate type with integral escutcheon plate marked with its function.





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5.09.04 Each push-button shall have minimum two (2) NO and two (2) NC contacts rated 10A at 240 V A.C.

5.09.05 Selectors switches shall be stay-put; rotary type with escutcheon plates marked to indicate the function and positions, and shall be lockable in each position. Selector switch contacts shall be rated for 10A at 240 V A.C.

5.09.06 Selector switches shall be provided with minimum three (3) contact blocks of 1 NO + 1 NC each.

The exact requirements of contacts shall be decided by the Tenderers taking into account the scheme requirement and spares.

5.09.07 Lamps shall be LED type. LED lamp shall be made in accordance with I nP Technology (Aluminium Indium Gallium Phosphide Technology). The body shall be made of Poly Carbonate Unbreakable Lens. LED shall be protected by inbuilt fuse with surge suppressor or leakage voltage glow protection. LED circuit shall be PCB mounted. Intensity shall be greater than 200 mcd. All Push Button lamp shall be as per LED indicating lamp.

5.09.08 For control supply, two (2) nos. adequately rated 415/240V control transformers with necessary taps shall be provided. Auxiliary bus bars shall be used to distribute 240V AC control supply. The control supply of different modules shall be tapped individually from the auxiliary bus bars. Transformer ratings shall be so selected to facilitate 100% standby arrangement with 20% spare capacity. A four position selector switch (A-I-B-O) i.e. . Transformer A- Independent-Transformer B- Off shall be provided to feed power from the secondary side of control transformer to two independent control bus (namely Bus-A & Bus-B)

The operation of this selector switch shall be as follows:

Position -I: Both the control buses i.e. Bus -A & Bus-B will receive its control power supply from their dedicated control transformer.

Position -A / Position -B: In case of outage of any one of the control transformer, both the control buses i.e. Bus-A & Bus-B will receive its control power supply from other healthy control transformer.

Position -OFF: No supply to control transformer.

The above philosophy is required to ensure smooth changeover & manual control of the control supply so that the control supply shall remain healthy in case of outage of any one (1) control transformer. Necessary protection, alarm & indication shall be provided as required.

5.09.09 DCDBs shall be provided with indication to monitor healthiness of the incoming DC supplies.





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5.10.00 Meters and Meter Selector Switches

5.10.01 All indicating instruments (96 x 96 mm) shall be switch board types, with 240 Deg. scale, anti-glare glass and accuracy class of $\pm 2\%$ full scale. Each meter shall have zero adjuster on the front.

5.10.02 Motor ammeters shall have an extended suppressed end-scale range to indicate starting current (6 to 8 times full-load current).

5.10.03 All breaker operated incomers and motor feeders above 30 KW up to 200 KW shall be provided with 3-phase electronic energy meter with pulse output for interfacing with EMS.

5.10.04 Meter selector switches shall be maintained contact, stay-put type, with knob handle. Ammeter and voltmeter selector switches shall be four position type. Ammeter selector switches shall have made before break contacts, to prevent open circuiting of CT secondary.

5.10.05 The energy meters shall be provided on LV side of each incoming transformer feeder of 415V buses as per the Central Electricity Authority (Installation and Operation of Meters) Regulations, 2006 and its amendments.

5.11.00 Current Transformer

5.11.01 Current Transformers shall be cast-resin type. All secondary connections shall be brought out to terminal blocks where wye or delta connection will be made.

5.11.02 Motor feeders rated 30 KW and above, up to and including 90 KW, shall be provided with CTs for metering. Above 90 KW, separate CTs shall be provided for metering and protection.

5.11.03 Accuracy class of the current transformers shall be :

- a) Class PS for differential and restricted earth fault
- b) Class 5P20 for other relaying
- c) Class 0.5 ISF < 5 for metering

5.11.04 Other CT particulars like ratio, burden knee-point voltage, excitation current and secondary resistance shall be decided by the Tenderers.

5.11.05 Feeders requiring remote metering and/or current monitoring shall be provided with current transducers with calibration for full-scale reading. The output shall be 4-20 mA DC of which 4-18 mA shall correspond to the normal range.

5.11.06 CT secondary shall be rated for 1 A for metering and either 5A or 1A for protection.



5.12.00 Voltage Transformer

5.12.01 Voltage transformers shall be cast -resin, drawout type and shall have an accuracy class of 0.5. Voltage transformer mounted on breaker carriage is not acceptable.

5.12.02 High voltage windings of voltage transformer shall be protected by current limiting fuses. The voltage transformer and fuses shall be completely disconnected and visibly grounded in fully drawout position.

5.12.03 Low voltage fuses, sized to prevent overload shall be installed in all ungrounded secondary leads. Fuses shall be suitably located to permit easy replacement while the switchgear is energised.

5.13.00 Relays**I. General- A**

- a) All relays & timers in the protection circuit shall be flush mounted with connection from inside. They shall have transparent, dust tight covers, removable from the front. They shall have built-in testing facilities. Except small auxiliary relays and timers all relays shall be drawout type.
- b) Relays shall be rated for operation on 1A secondary current and 110V secondary voltage to be decided by the bidder. Number and rating of relay contacts shall suit the job requirements.
- c) The Bidder shall furnish, install & co-ordinate all relays to suit the requirements of protection, interlock and bus transfer schemes as broadly indicated in the annexures and drawings. Application check shall be made on all motor protection relay motor characteristics furnished by the Owner. The result of such check shall be furnished for approval.
- d) It shall be the responsibility of the Bidder to fully co-ordinate the overload and short circuit tripping of the circuit breakers with the upstream and downstream circuit breakers / motor starters to provide satisfactory discrimination.
- e) All setting devices shall be accessible after removing the front cover. No relay shall be mounted on the rear side of PCC / PMCC panel.
- f) All relay coils and their auxiliary contacts (including un-enabled relays in Composite Numerical Relays, if any), including spare contacts will be wired up to the terminal blocks of respective panels for wiring to DCS and for future use. All unused terminals of relays shall also be fitted with screws.
- g) Parameterization and loading and downloading of data shall be possible from local HMI as well as from DCS.



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- h) All numerical relays shall have front communication port for parameterization, loading and downloading of data thru' Laptop.
- i) All numerical relays and multi-functional meters shall be hooked up and connected with HMI thru' Fiber Optic cable.

II.

General- B

- a) All protective relays shall be of numerical microprocessor based multifunctional type having communication facility as shown in enclosed Dwg. No. 12A05-DWG-E-3101 (Network Scheme of Numerical Relays).
- b) All relays shall conform to the requirements of IS: 3231 / IE C: 60255 standards. The Numerical relays shall have communication, Metering and monitoring facility.
- c) Vendor shall ensure availability of spare parts and maintenance support for the equipment for at least 15 years from the date of supply.
- d) Any foreign relay manufacturer through his Indian partner or subsidiary company in India shall provide application, testing, commissioning and other necessary support for minimum 15 years. They shall also maintain adequate inventory of each type of relay or spares to meet the requirement arising during project execution and plant operation.

III.

Technical Requirement

a)

Auxiliary Power Supply

Unless otherwise specified, relay shall be suitable to accept both AC / DC supplies with range 110V to 240V with tolerance of $\pm 20\%$. The auxiliary power supply shall preferably be site selectable requiring no additional hardware.

b) **Basic Requirement and Constructional Requirement**

- i) Relays shall be suitable for flush mounting on the front with connections from the rear. The enclosure shall be dust tight having degree of protection minimum as IP: 52.
- ii) Relay shall have draw out feature with plug in type PCB for easy replacement. In case of fixed type relay, the terminals shall be easily accessible for testing and commissioning.
- iii) Relay shall have self-diagnostic feature with indication of relay failure on relay front. However, while diagnostic circuit runs, it must not interfere in the main protective





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relay circuit and allow working of main protective circuit continuously. Relay faults (self-diagnostic) shall be communicated and annunciated to HMI.

- iv) Design of the relay shall be such that it must operate selectively and with proper discrimination. It must be immune to any kind of electromagnetic interference. Vendor to submit all related type test reports for the offered model along with the offer.
 - v) Necessary auxiliary relays, timers, trip relays, etc. required for complete scheme, interlocking, alarm, logging, etc. shall be provided. No control relay, which shall trip the circuit breaker when relay is de-energized, shall be employed in the circuits.
 - vi) Numerical Relays shall have appropriate setting ranges, accuracy, resetting ratio, transient overreach and other characteristics to provide required sensitivity to the satisfaction of the Owner.
 - vii) Time clock synchronization feature shall be provided for synchronization of clocks of numerical relay and metering LAN with data concentrator time clock. Required hardware and software interface to receive GPS/Time signal to achieve time synchronization shall be supplied by the contractor. The resolution of time synchronization shall be ± 1.0 millisecond or better throughout the entire system.
- c) Display & Indication
- i) All numerical relays shall have keypad / keys to allow relay settings from relay front. In addition, relay shall have front port for downloading / uploading of relay settings from the PC / Laptop. All hand-reset relays shall have reset button on the relay front. Relay to be self or hand reset shall be software selectable.
 - ii) All relays shall have LED / LCD display for settings, status, faults and events. LCD display shall be backlit and temperature compensated up to 65°C for contrast and legibility.
 - iii) As a minimum, the relay shall have LED indicating lamps for fault trip, relay healthy / unhealthy and control supply on.
 - iv) The relay shall have at least 6 programmable LEDs on relay front.





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d) Software Security

Relay shall be provided with password protection against unauthorized write access. However, viewing of metering data, settings, and status and event data as read only parameters should be without password protection. All software shall be user friendly and latest up to date version.

e) Disturbance, Event Recording & Data Storage

Status, disturbance data and events shall be stored in non-volatile memory or memory backed up by battery. It should be possible to store minimum 50 events with date and time stamp, last 5 fault records and last disturbance record. When auxiliary power fails, it should be possible to see the latest state of display when power is restored. Also, in case of power supply failure lock out status of the relay should be stored and kept in memory to allow the working of interlock logic properly on restoration of the supply.

f) Trip Circuit Supervision & Lock out function

i) Relay shall have built in lockout function. Lock out feature shall be self reset or hand reset and shall be software selectable.

ii) Relay shall have built in trip circuit supervision function.

g) Input / Output Interface, Filters and Galvanic Isolation

h) Relay shall have at least 4 NO contacts each shall separately be programmable for either hand reset or self-reset. The contact rating shall be minimum 5A at 250V AC / DC.

i) Relay shall be made immune to capacitance effect due to long length cables.

ii) All IOs shall have galvanic isolation. Analog inputs shall be protected against switching surges, harmonics etc.

i) Serial Communication

i) All numerical relay shall have communications on three ports; local front port communication to laptop and a dual port on IEC 61850 to communicate with the data concentrator through LAN and Ethernet switches.

ii) All relays should be able to communicate with DCS system. Data shall be available at the DCS on request.

iii) Protocol adapted for communication to DCS should facilitate easy interface with world wide used open protocol like Modbus or IEC 103 protocols.



- iv) It shall be also possible for Relay Parameterization as well Downloading of Disturbance Records from PC /Laptop provided in Unit & Engineering Workstations located in Central Control Room of each unit. Necessary user friendly and latest software to be provided for this purpose. Communication protocol shall be selected from relay to PC to provide all information.
- v) One (1) set of Laptop by each Switchgear manufacturer, loaded with common support software and which will allow easy settings of relays in addition to uploading of event, fault, disturbance records, measurements from relay front communication port. The Switchgear supplier shall furnish CD's for the above relay parameterization as well as download of disturbance recorder for all relays of his supplied switchgear. Accessories like table/chair/desk/power socket etc. as required for all PC/Laptop should be supplied.

Refer Section-I of Vol.-II-F/1 for Relay and Energy Management System.

5.14.00 Secondary Wiring

- 5.14.01 All boards shall be fully wired at the factory to ensure proper functioning of control, protection, transfer and interlocking schemes.
- 5.14.02 Fuse and links shall be provided to permit individual circuit isolation from bus wires without disturbing other circuits. All spare contacts of relays, switches and other devices shall be wired up to terminal blocks.
- 5.14.03 Wiring shall be done with flexible, 1100 V grade, PVC insulated switchboard wires with stranded copper conductors of 2.5 mm² for control, current and voltage circuits.
- 5.14.04 Each wire shall be ferruled by plastic tube with indelible ink print at both end having terminal block no., terminal nos., destination no. as per approved Drawing.
- 5.14.05 Wire terminations shall be made with crimping type connectors with solder as insulating sleeves. Wires shall not be spliced between terminals.

5.15.00 Terminal Blocks

- 5.15.01 Terminal blocks shall be 1100V grade box-clamp type 10-mm² minimum with marking strips. Terminals for C.T. secondary leads shall have provision for shorting.
- 5.15.02 Terminal blocks used for interface with DCS via termination cabinet shall be suitably sized to facilitate proper termination of interconnecting cables.



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- 5.15.03 Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20 % active terminals shall be furnished and these spare terminals shall be uniformly distributed on each terminal blocks. Minimum 150mm clearance shall be maintained between two rows of terminal blocks. The minimum clearance between the first row of terminal blocks and the associated cable gland plate shall be 250 mm.
- 5.15.04 Terminal blocks shall be located to allow easy access. Wiring shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.
- 5.16.00 Cable Termination
- 5.16.01 Generally, all assemblies shall be designed for cable entry from the bottom. Sufficient space shall be provided for all the cables as per cable schedule, for ease of termination and connection.
- 5.16.02 All provisions and accessories shall be furnished for termination and connection of cables as per cable schedule, including removable gland plates, cable support, crimp type tinned copper/aluminium lugs, double compression brass glands with tapered washer (Power cable only) and terminal blocks.
- 5.16.03 Gland plates shall be minimum 4 mm thick. The gland plate and supporting arrangement for 1/C power cables shall be non-magnetic type to minimise the flow of eddy current.
- 5.17.00 Bus Duct Connection
- 5.17.01 Bus duct connection, wherever provided, shall be furnished along with transition panel, if required. Bus duct connections shall be from the top.
- 5.17.02 All connecting bus work shall have the same continuous rating as associated PCC/PMCC/MCC/DB bus and shall be fully braced for the LT system short circuit current.
- 5.17.03 All provisions such as matching flanges and other accessories required for proper connection to bus duct shall also be supplied.
- 5.17.04 Automatic reserve closure (ARC) cover shall be provided for 415V unit & emergency auxiliary switchgear.
- 5.18.00 Ground Bus
- 5.18.01 A ground bus, rated to carry maximum fault current, shall be provided which shall extend the full length of the assembly.
- 5.18.02 The ground bus shall be provided with two-bolt drilling with G.I. bolts and nuts at each end and shall be suitable to receive 50 x 6 mm G.S. flat.
- 5.18.03 All stationary units including non-current carrying metal work of boards/panels shall be directly connected to the ground bus for effective grounding.



The frames of all circuit breakers and drawout V.T. units shall be grounded through heavy multiple conductors at all times except when the primary disconnecting devices are separated by a safe distance.

The frames of all other drawout modules shall be grounded at all times except when the power disconnects are separated by a safe distance.

5.18.04 Wherever the schematic diagrams indicate a definite ground at the switchgear; a single wire for each circuit thus grounded shall be run independently to the ground bus and connected thereto.

5.18.05 C.T. & V.T. secondary neutrals shall be earthed through removable links so that earth of one circuit may be removed without disturbing others.

5.18.06 All hinged doors shall be earthed by flexible copper braid.

5.19.00 Nameplates

5.19.01 Nameplates of approved design shall be provided on each cubicle, at the top of the assembly and on each instrument & device mounted on or inside the cubicle.

5.19.02 The material shall be lamicoide or approved equal. 3 mm thick with white letters on black background.

5.19.03 The name plates shall be held by self-tapping screws. Nameplate size shall be minimum 20 x 75 mm for instrument/devices & 40 x 50 mm for panels.

5.19.04 Caution notice on suitable metal plate shall be affixed both at the front and back of each vertical panel.

5.20.00 Space Heaters and Plug Sockets

5.20.01 Panel and motor space heaters, Plug socket, panel illuminations shall be fed from separate AC auxiliary busbars running throughout the switchboard. All the panel and motor space heaters shall be fed from these busbars through single pole MCB and neutral link.

The AC auxiliary bus shall be charged thru' 2X100%, 415/240V Space heater supply transformers with a "TRANSFORMER-A /TRANSFORMER-B selector switch. The 415V incoming supply to these aux. transformers shall be tapped before the respective Incoming breakers, so that in the event of 415V panel is not energized, the 240V aux. bus remains ready for supplying power to motor / panel space heaters, panel illumination. Necessary protection, alarm & indication shall be provided as required.

5.20.02 Each vertical section shall be provided with thermostat controlled space heater and 5A, 3 pin plug socket.

5.20.03 In addition, motor feeders rated 30 KW and above shall be wired-up for feeding the motor space heater through suitably rated breaker auxiliary NC contact and/or contactor.





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- 5.20.04 Cubicle heater. Motor heater, and Plug-socket circuits shall have individual MCCB units.
- 5.21.00 A.C./D.C. Power Supplies
- 5.21.01 Necessary AC and DC power supplies as required for control and service, shall be arranged by the Contractor. Duplicate feeder shall be arranged for both A.C & D.C. supply.
- 5.21.02 Isolating MCCB units shall be provided for the incoming supplies. These shall be 4-pole, single throw for 415V AC and 2-pole double throw with off position for 220V DC.
- 5.21.03 Bus-wires of adequate capacity shall be provided to distribute the incoming supplies for different cubicles. Isolating MCCB units shall be provided at each cubicle for A.C./D.C. supplies.
- 5.21.04 A.C. load shall be so distributed as to present a balanced loading on three-phase supply system.
- 5.22.00 Tropical Protection
- 5.22.01 All equipment, accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects & corrosion.
- 5.22.02 Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent entry of insects.
- 5.23.00 Painting
- 5.23.01 All assemblies shall be finished in light grey (IS shade * 631) with two coats of synthetic enamel paint. Painting process shall be of powder coating type.
- 5.24.00 Moulded Case Circuit Breaker
- 5.24.01 Moulded Case Circuit Breaker shall be three pole, single throw, air break type having trip free mechanism with quick make break contacts. Moulded Case Circuit Breaker for feeders of MCCs/MCCB Boards and for outgoing feeder from PCCs/PMCCs. MCCBs shall have door interlocks and padlocking facility.
- Moulded Case Circuit Breakers shall have current limiting design.
- Moulded Case Circuit Breakers of identical rating shall be physically and electrically interchangeable.
- Moulded Case Circuit Breakers shall be provided with 1 NO and 1 NO electrically separate auxiliary contacts.
- 5.24.02 MCCB for motor feeders shall have adjustable short ckt release. MCCB used for 50KW and above motor rating shall have additional E/F protection.
- For other feeders MCCB upto 100A rating shall be provided with built front adjustable releases (short ckt and overload). MCCB of rating above 100A shall



**SECTION 2**

be provided with microprocessor based inbuilt front adjustable releases (short circuit and overload) and shall have adjustable earth fault protection unit also.

5.25.00 Miniature Circuit Breaker

5.25.01 MCB shall be suitable for manual closing and opening and also automatic trip on overload and short circuit.

6.00.00 TESTS

6.01.00 The switchgear shall be completely assembled, wired, adjusted and tested at the factory as per the relevant standards.

6.02.00 Routine Tests

The tests shall include but not necessarily limited to the followings :

- a) Operation under simulated service condition to ensure accuracy of wiring, correctness of control scheme & proper functioning of the equipment.
- b) All wiring and current carrying parts shall be subjected to appropriate High Voltage Test.
- c) Primary current & voltage shall be applied to all instrument transformers.
- d) Routine test shall be carried out on all equipment such as circuit breakers, instrument transformers, relays, meters, contactors, MCCB, etc.

6.03.00 Type Tests

The following type tests shall be performed on a representative sample of the LV Switchgear assembly:

- a) Temperature rise Test
- b) Short time current test on main circuit and earth circuit.
- c) Verification of making and breaking capacity.

6.04.00 Type test certificates of any equipment shall be furnished if so desired by the Purchaser. Otherwise, the equipment shall have to be type tested, free of charge, to prove the design. Type tests performed before five (5) years are not acceptable.

7.00.00 DRAWINGS, DATA & MANUALS

7.01.00 To be submitted with the Bid



SECTION 2

- a) General arrangement and cross-sectional drawings showing constructional features, space required in front for withdrawals, power & control cable entry points etc.
- b) Bill of Materials
- c) Typical foundation plans
- d) Boardwise single line diagrams.
- e) Typical control schematics
- f) Drawings of matching flanges and terminals for bus termination
- g) Calculation for selection of CT and VT rating
- h) Bus bar sizing calculation
- i) Reports for all type tests of representative sections of panel assemblies.
- j) Technical leaflets of -
 - i) Circuit breaker
 - ii) Instrument transformers
 - iii) Relays, meters, switches, push-buttons, selector switches, etc.
 - iv) MCCB units
 - v) Contactors
 - vi) Glands/terminals blocks

7.02.00 To be submitted after Award of Contract for Information (I) / Approval (A)

- a) Outline dimensional drawings showing general arrangement, space requirements and bus duct/cable entry points (A)
- b) Cross-section with parts list (I)
- c) Foundation plan & loading (I)
- d) Board wise single line diagrams (A)
- e) Control schematics (A)
- f) Wiring diagrams (I)
- g) Consolidated Bill of Material (I)
- h) Relay setting calculation (A)





SECTION 2

i) Test Certificates (A)

- 7.03.00 The Contractor shall also submit all instruction manuals clearly indicating the installation method, check-up and tests that are to be carried out before commissioning the equipment.
- 7.04.00 Tenderers shall note that the drawings, data and manuals listed herein are minimum requirements only. The Tenderers shall ensure that other necessary write-ups, curves and information required to fully describe the equipment are submitted with their bids.





WBPDCL

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

SECTION 2

ANNEXURE-A

RATINGS & REQUIREMENTS

1.0 GENERAL

Type : Metal-clad, drawout (PCC/PMCC/MCC/SVB)
Metal-clad, fixed (DB)

Service : Indoor

Enclosure : As per Section – I of Volume.-II-F/1

1.1 System

AC DC

Voltage : 415V $\pm$ 10% 220V $\pm$ 10%

Phase : 3-phase and neutral -

Frequency : 50 Hz -3 to -5% -

Combined voltage and frequency variation : 10% (absolute sum) -

System grounding : Solidly grounded Ungrounded

1.2 Rated Current at 50°C ambient

Busbar : To be decided by the Tenderers

Circuit breaker : - Do -

Switches : 16A to 630A

1.3 Short Circuit Rating

AC DC

Interrupting : 50 KA 25* KA

Short Time for : 50 KA (3 second) 25* KA (1 second)

1.4 Hipot for 1 minute (min.) : 2.5 KV 1.5 KV

* Minimum only ; actual value to be decided by the bidder and to be substantiated by calculation .



**WBPDCL**

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

SECTION 2
1.5 A.C./D.C. Power Supply

Control Voltage for Circuit breaker	:	220 V DC $\pm$ 10%
DC power supply For C & I	:	24 V DC $\pm$ 10%
Control voltage for MCC modules	:	240 V AC $\pm$ 10%, 1 Ph, 50 Hz $\pm$ 5%
Service voltage	:	240 V AC $\pm$ 10%, 1 Ph, 50 Hz $\pm$ 5%

2.0 CIRCUIT BREAKER

2.1 Duty Cycle : 0-3'-CO-3'-CO

2.2 Breaking Current

A.C. Symmetrical : 50 KA

2.3 Making Current : 105 KA Peak

2.4 Auxiliary Voltage

Closing	:	220 V D.C. (85 - 110%)
Tripping	:	220 V D.C. (70 - 110%)
Spring Charging	:	220 V D.C. (85 - 110%)

3.0 CONTACTOR DUTY

AC	DC
:	Class III-Category AC3 for unidirectional drives and AC4 for bi-directional/inching duty drives
	Class I - Category DC2

4.0 SWITCH DUTY

Motor feeders	:	AC23	DC22
Other feeders	:	AC22	DC22





SECTION 2

ANNEXURE-B**PROTECTIONS**

1.0 The minimum protections to be provided for circuit breaker controlled feeders are listed below :

- a) Incoming Feeders : a) 3-Inverse time O/C relays (51) for phase faults
- b) 1-Inverse time O/C relay (51N) for Earth faults
- c) IDMTL Over Current (51 SN) for standby earth fault (for incomer from transformer only) – This protection will be part of upstream feeder.
- d) Restricted E/F (64) (for incomer from transformer only) – This protection will be part of upstream feeder.
- e) Under Voltage with time delay (27).
- f) VT Fuse failure.
- g) Circuit Breaker failure.
- h) Sensitive earth fault detectors shall be provided in DC system to annunciate earth faults

b) Motor Feeders : Microprocessor based Numerical Protection for LT Motor

Bidder shall quote suitable digital/microprocessor based numerical relay for motor protection with following minimum facility as indicated below :

- Thermal model with negative sequence current.
- Voltage compensated acceleration.
- Under voltage, over voltage protection.
- Overload protection.
- Short circuit & SC back-up.
- Current unbalance.
- Ground fault (through CBCT)
- Temperature monitoring (stator, bearing etc.).
- Phase reversal.



SECTION 2

Apart from above suitable provision for metering and monitoring such as voltage, current, power factor, watt-hr, event record etc. shall be provided.

The relay shall have facility for user interface capability, character display, keypad, LED indicator and communication port along with licensed version software.

- c) Lighting/Welding Transformer : 3-inverse time O/C relays with feeders high set instantaneous unit (50/51) for phase faults

1-inverse time O/C relay (51N) for earth fault

- d) Outgoing Feeders : - 2-Inverse time O/C relay (51) for phase fault
- 1-Inverse time O/C relay (51N) for Earth fault

All inverse time O/C relay shall be 1.3 sec version.

- 2.0 Apart from protection relays, each electrically operated breaker shall be provided with separate anti-pumping (94), trip annunciation (30), lock out (86) and trip circuit supervision (74) relays. Lockout relay shall be hand reset type.
- 3.0 Fuse failure relay shall be provided on the secondary side of voltage transformer to monitor H.V. & L.V. fuses.



ANNEXURE-C
SECTION 2

415V NON-SEGREGATED PHASE BUSDUCT

1.00.00 SCOPE OF SUPPLY

- 1.01.01 415V non-segregated phase bus duct with all necessary accessories : As required
- 1.01.02 Each set of 415V non-segregated phase bus duct will originate from 415V Switchgear (i.e PCC, PMCC etc) In comer panel terminals and will terminate at transformer terminals. The bus duct run shall be complete with all bends, flexible, bellows and terminal adaptor boxes, interconnection hardware etc. as required.
- 1.01.03 All supporting steel structures, fasteners and necessary hardware for complete bus-duct installation.
- 1.01.04 One set of special tools and tackles.
- 1.01.05 Mandatory Spare parts.
- 1.01.06 Recommended spare parts for three (3) years operation
- 1.01.07 All relevant drawings, data and instruction manuals.

2.00.00 CODES AND STANDARDS

- 3.01.00 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC except where modified and/or supplemented by this specification.
- 3.02.00 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 submitted along with the bid.
- 3.03.00 The electrical installation shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

3.00.00 DESIGN CRITERIA

- 3.01.00 The 415V non-segregated phase bus duct will serve as interconnection between the 415V Indoor Switchgear and outdoor/Indoor transformer terminals. It is also used for trunking connection between two separate switchgear panels, wherever applicable.
- 3.02.00 The 415V non-segregated phase bus duct shall be installed indoor / outdoor in a hot, humid and tropical atmosphere.
- 3.03.00 The portion of bus duct at the transformer end will be subjected to vibration normally prevalent for this type of installation in a power generating station/industrial plants. Suitable means shall be provided to isolate the transformer vibration from rest of the bus structure/ bus duct.





- 3.04.00 The current carrying capacity of the bus duct shall take into account the service conditions, including skin effect, ambient temperature, bus insulation and exposure to sunlight.
- 3.05.00 For continuous operation at specified ratings, temperature rise of the bus duct and auxiliary equipment shall be limited to the permissible values indicated in the annexure of this specification.
- 3.06.00 Bus duct shall be capable of withstanding the mechanical forces and thermal stresses of the short-circuit currents listed in the annexure without any damage or deterioration of material.
- 3.07.00 Bus duct and supporting structures shall be designed & constructed so as to withstand without damage the horizontal/ vertical ground accelerations due to earthquake.
- 3.08.00 The bus ducts shall be self cooled and shall not be equipped with blower or any other type of forced ventilation.

4.00.00 SPECIFIC REQUIREMENTS

4.01.00 General

- 4.01.01 The 415V bus duct shall be non-segregated phase enclosure, natural air cooled type.
- 4.01.02 All parts and accessories shall have appropriate match mark and part numbers for easy identification and installation at site.

4.02.0 Enclosures

- 4.02.01 Phases shall be enclosed in a weather & vermin proof, dust-tight enclosure without any barrier between phases. It shall preferably be rectangular in shape adequately rigid with stiffeners as required. Outdoor section of the busduct shall be completely rain proof.

Enclosure shall be of sheet steel fabricated type. Minimum Degree of protection of busduct enclosure shall be IP-54 for indoor and IPW-55 for outdoor section of the busduct.

The enclosure shall be made of sheet steel for rated continuous current up to and including 2000A at site condition. Above 2000A bus duct enclosure shall be made of Aluminum alloy. The thickness of enclosure material shall not be less than 3mm.

- 4.02.02 Circumferential neoprene rubber gaskets (jointless type) shall be provided for dust tight joints with adjacent enclosure section.
- 4.02.03 The bus enclosure shall have extended bellows or equivalent means to allow for temperature changes and vibrations. Flexible joints shall be provided in enclosures at all points where the bus duct terminates at equipment to withstand vibration, expansion/contraction and at suitable intervals in any straight run of the bus duct where expansion and contraction would otherwise result in stresses in the supporting structures.





SECTION 2

- 4.02.04 Horizontal runs of bus duct shall have suitably sloped enclosure top to prevent retention of water for both indoor and outdoor portions of the bus duct. For outdoor runs, the shipping sections shall be provided with flange protection hood to facilitate additional protection against rain water ingress through joints.
- 4.02.05 Suitable inspection openings shall be provided for access to support insulators, bus joints, transformer terminals, switch gear terminals etc. All inspection openings shall have reliable sealing arrangement with neoprene gaskets.
- 4.02.06 Filtered drains for drainage of condensate shall be provided at the lowest points and at such locations where accumulation of condensate can be expected.
- 4.02.07 Shipping length of the bus duct shall be not more than three (3) meters in length.
- 4.03.00 **Bus Conductor**
- 4.03.01 The bus conductor shall be of high conductivity electrolytic grade copper or aluminum alloy as indicated in the annexure, supported on fine glazed porcelain / cast resin / FRP insulators fixed to enclosure.
- 4.03.02 The bus conductor shall be designed for bolted connections throughout the run.
- 4.03.03 Flexible connections shall be provided between bus sections to allow for expansion and contraction of the conductor. Flexible connection shall also be provided at all equipment terminations.
- 4.03.04 All contact surfaces shall be silver plated to ensure an efficient and trouble-free connection. All connection hardware shall be non-magnetic and shall have high corrosion resistance.
- 4.03.05 Bus bars shall be color coded at regular intervals for easy identification. Markings on the bar shall be Red for R-phase, Yellow for Y-phase and Blue for B-phase.
- 4.03.06 All bolted joints shall be provided with high grade stainless steel nuts bolts, plain and Belleville washers.
- 4.04.00 **Insulators**
- 4.04.01 Bus support insulators shall be bus post type, interchangeable, high creep, high strength, flame retardant, non hygroscopic, wet processed, fine glazed porcelain. Alternatively good quality cast resin / FRP insulators may be offered.
- 4.04.02 Insulator shall be mounted in such a way so as to permit easy removal or replacement without disassembly of the bus and the bus duct installation. The insulator mounting plate shall be designed for cantilever loading to withstand the short circuit. Support span shall be taken into consideration.
- 4.04.03 The conductor shall be fastened on the insulator through fixed and slip joints so as to allow conductor expansion or contraction without straining the insulator.
- 4.04.04 Space heater shall be provided near each insulator to avoid moisture condensation within busduct.





4.05.00 **Connections & Terminations**

- 4.05.01 All matching flanges, gaskets, fittings, hardware and supports required for termination of the bus duct at the switchgears, transformers and other equipment shall be furnished.
- 4.05.02 In this connection the contractor is required to co-ordinate through the Engineer with the suppliers of the 415V Switchgears, transformers with regard to connection details, mechanical and thermal stresses.
- 4.05.03 Flexible connections both for conductor and enclosure shall be furnished :
- At all equipment termination to provide for misalignment upto 25 mm. (1") in all directions.
 - Between bus duct supported from building steel to prevent transmission of vibration.
- 4.05.04 The equipment terminal connections shall be readily accessible and shall provide sufficient air gap for safe isolation of equipment during testing.
- 4.05.05 If the material of bus conductor and that of the equipment terminal connectors are different then suitable bi-metallic connectors shall be furnished.

4.06.00 **Grounding**

- 4.06.01 A separately run Galvanized steel flat suitably clamped along the enclosure shall be used as the ground bus. All parts of the bus enclosure, supporting structures and equipment frames shall be bonded to above ground bus.
- 4.06.02 Ground pad shall be bolted type to accommodate 75x10 mm. Galvanized steel flats at two points at each end of termination, complete with suitable tapped holes, bolts and washers.

4.07.00 **Supporting Structures**

- 4.07.01 All supporting structures required for hanging and/or supporting the complete bus duct shall be furnished. These include all members, indoor/outdoor posts, bolts, shims, base plates, beams, hangers, brackets, bracings and hardware.
- 4.07.02 All buses shall be adequately supported and braced to successfully withstand normal operation, vibration, thermal expansion, short circuit forces and all specified design loads.
- 4.07.03 Support shall be designed to provide tolerance of ± 12 mm. (1/2") in the horizontal and vertical directions.
- 4.07.04 All steel members shall be hot-dip galvanized after fabrication. All hardware shall be of high strength steel with weather resistant finish.
- 4.07.05 For each shipping section, the enclosure shall be supported at minimum two positions. The enclosure supporting arrangement shall be such that the busduct load is not transmitted onto the terminations.





SECTION 2

4.08.00 Name Plate

- 4.08.01 Suitable name plate shall be furnished with each piece of equipment.
- 4.08.02 Materials for name plate shall be anodized aluminium, 3 mm thick, using white letters on black background.

4.09.00 Finish

- 4.09.01 Except for supporting steel structural and hardware which shall be hot-dip galvanized, all equipment shall be finished with a undercoat of high quality primer followed by two coats of synthetic enamel paints unless otherwise stated.
- 4.09.02 The interior surface of the bus duct enclosure shall be treated with matt black paint to enable efficient heat dissipation. The shade of exterior surface finish for indoor and outdoor portion shall be shade # 631 and shade # 632 respectively.
- 4.09.03 Pretreatment consisting of degreasing, derusting etc. shall be done on all fabricated parts before painting or galvanizing.
- 4.09.04 Paints shall be carefully selected to withstand heat and weather conditions. The paint shall not scale-off or crack or get removed by abrasion due to normal handling.
- 4.09.05 Sufficient quantities of all paints and preservatives required for touching up at sites shall be furnished.

5.00.00 TESTS**5.01.00 Routine Test**

Bus Duct shall be subjected to the following minimum tests :

- a. Visual inspection and verification of dimensions.
- b. Dry power frequency voltage withstand for 1-minute.
- c. Insulation resistance measurement. Milli-volt drop test.

5.02.00 Type Test

Certified copies of type test certificates (not less than five years old) for similar equipment supplied by the bidder shall be submitted otherwise type test shall be carried out by the bidder within the contracted price and delivery schedule. Type test certificate for the following test shall be furnished:

- a. Impulse voltage withstand on a typical section of bus duct including one bend.
- b. Heat run test on representative sections of 3 phase bus duct, including one bend and flexible joints.





- c. Short circuit test on representative sections of 3 phase bus duct, including one bend. The sections having longest span between support insulators shall be chosen.
- d. Degree of protection test (air and water) on a representative section of bus duct

5.03.00 All cubicles shall be completely wired up at the factory and subject to wiring check and power frequency withstand tests on control/secondary wiring.

5.04.00 Test Witness

Tests shall be performed in presence of Owner/Purchaser's representative if so desired. The Contractor shall give at least seven (7) days' advance notice of the date when the tests are to be carried out.

5.05.00 Test Certificates

5.05.01 Certified reports of all the tests carried out at the works shall be furnished in six (6) copies for approval of the Owner/Purchaser.

5.05.02 The equipment shall be dispatched from works only after receipt of Owner/Purchaser's written approval of the test reports.

5.05.03 Type test certificate on any equipment, if so desired by the Owner/Purchaser, shall be furnished. Otherwise the equipment shall have to be type tested, free of charge, to prove the design.

6.00.00 SPECIAL TOOLS & TACKLES

6.01.00 A set of special tools & tackles which are necessary or convenient for erection, commissioning, maintenance and overhauling of the equipment shall be supplied.

6.02.00 The tools shall be shipped in separate containers, clearly marked with the name of the equipment for which they are intended.

7.00.00 SPARES

7.01.00 The Bidder shall submit a list of recommended spare parts for three (3) years satisfactory and trouble-free operation, indicating the itemized price of each item of the spares. The final quantity shall be decided during placement of order.

7.02.00 The Bidder shall quote and supply mandatory spare parts as per the list. The final quantity shall be decided during placement of order.

7.03.00 Each list shall be complete with specification, make, identification number, unit rate, quantity etc.





8.00.00 DRAWINGS, DATA & MANUALS

8.01.00 Drawings, Data and Manuals shall be submitted with the bid and in quantities and procedures as specified in General Condition of Contract and/or elsewhere in this specification for approval and subsequent distribution after the issue of Letter of Intent.

8.02.00 To be Submitted with the Bid

8.02.01 General Arrangement Drawing - Plan and Sections.

8.02.02 Typical details of bus insulator assembly, conductor/enclosure connections rigid & flexible, etc.

8.02.03 Bill of Materials.

8.02.04 Technical leaflets/Write-ups on various pieces of equipment offered.

8.02.05 Type test reports on similar equipment. The type test certificates shall not be more than 5 years old.

8.03.00 To be Submitted for Information (I) /Approval (A)

8.03.01 Sizing of the busbars and calculation for temperature rise for bus conductor and enclosure (I).

8.03.02 Calculation for short circuit forces justifying the proposed arrangement (I).

8.03.03 Dimensional general arrangement drawings with cross-sections of Busduct layout (A).

8.03.04 Detailed material list with parts number. (I)

8.03.05 Details of bus insulator assembly, rigid and flexible connections of both bus conductor and enclosure, grounding provision, equipment termination arrangement etc. (A)

8.03.06 Foundation Plan and loading.(I)

8.03.07 Supporting steel structure and calculations. (A)

8.03.08 Set up layout of the busduct for carrying out type test (A).

8.03.09 Instruction manual for Busduct.(I)

The manual shall clearly indicate method of installation, check ups and tests to be carried out before commissioning of the equipment. The manual shall also indicate detail procedure of field welding of conductor and enclosure

8.03.10 Any other relevant drawing or data necessary for satisfactory installation, operation and maintenance or as required by purchaser.





- 8.04.00 The Owner/ Purchaser may also review the documents marked (I) if found necessary. The contractor shall note that the approval of drawings & documents by the Owner/Purchaser does not relieve him of his contractual obligation.
- 8.05.00 The bidder may note that the drawings, data and manuals listed herein are minimum requirement only. The bidder shall ensure that all other necessary write-up, curves, etc require to fully describe the equipment are to be submitted with the bid.
- 8.06.00 All drawings shall be prepared by using Auto CAD approved version and all documents shall be generated using MS Office. The paper copy of the drawings & document shall be submitted for approval & reference. All final drawings and documents shall be submitted in CD in Auto CAD (approved version) and MS office format as applicable for Owner/Purchaser's future reference.



ANNEXURE-D

**RATINGS AND REQUIREMENTS
FOR
415V NON-SEGREGATED PHASE BUSDUCT**

- 1.0 General
- Type : Non-segregated
- Service : Indoor/Outdoor
- Material enclosure : Sheet steel/aluminium
- Conductor : Aluminium/Aluminium alloy
- Thickness of enclosure : 2 mm for sheet steel 3mm for (min) aluminium
- 2.0 System
- Voltage : 415V AC $\pm$ 10%
- Phase : 3-Phase and neutral
- Frequency : 50 HZ +3 to - 5%
- Combined voltage and Frequency variation : 10% (absolute sum)
- 3.0 Service voltage (for space heater) : 240V AC $\pm$ 10%, 1-Phase.
- 4.0 Rated current at 50°C ambient : To be decided by the Tenderers.
- 5.0 Short time current rating for three (3) second : 50 KA
- 6.0 One (1) minute power frequency withstand voltage (minimum) : 2.5 KV (rms)
- 7.0 Temperature rise (maximum) (over 50°C ambient)
- a) Bus conductor
- i) With Silver Plated bolted joints : 55°C
- ii) With Plain or Tin joints : 40°C
- b) Bus enclosure and structure : 30°C
- 8.0 Shipping Section (Maximum) : 3M





ANNEXURE-E

TENTATIVE INDICATIVE LIST OF 415V PCCS/MCCS/PMCCS/DBS/SVBS (TO BE DECIDED BY THE BIDDER)

A. PC C/PMCC/MCC

i)	415 V Boiler PMCC	:	1 no
ii)	415 V Boiler MCC	:	1 no
iii)	415 V Aux. Boiler MCC	:	1 no
iv)	415 V Station Service PCC	:	1 no
v)	415 V Emerg. MCC	:	1 no
vi)	415 V Switchyard PMCC	:	1 no
vii)	415 V Switchyard PMCC	:	1 no
viii)	415 V ESP PCC/switchgear	:	4 nos.
ix)	415 V SCR MCC	:	1 no
x)	415 V Turbine PMCC	:	1 no
xi)	415 V Turbine MCC	:	1 no
xii)	415 V Coal Mill MCC	:	1 no
xiii)	415 V CPU MCC	:	1 no
xiv)	415 V FGD PMCC	:	1 no
xv)	415 V Soot Blower MCC	:	1 no
xvi)	415 V P/H AC MCC	:	1 no
xvii)	415 V Bunker Floor PMCC	:	1 no
xviii)	415 V P/H Vent. MCC	:	1 no
xix)	415 V Misc. Services MCC	:	1 no
xx)	415 V CW Plant PMCC	:	1 no
xxi)	415 V Chlorination Plant PMCC	:	1 no
xxii)	415 V ESP Vent & A/C MCC	:	1 no
xxiii)	415 V ESP Aux. MCC	:	1 no
xxiv)	415 V ETP MCC	:	1 no
xxv)	415 V Crusher House PMCC	:	1 no
xxvi)	415 V Wagon Tippler PMCC	:	1 no
xxvii)	415 V Vacuum Pump House PMCC	:	1 no
xxviii)	415 V Chemical House MCC	:	1 no

B. 415V ACDBS

i)	Station ACDB	:	1 no.
ii)	Boiler ACDB	:	1 no.
iii)	Turbine valve ACDB	:	2 no.
iv)	Boiler valve ACDB	:	2 no.
v)	Boiler Damper ACDB	:	2 no.
vi)	Cooling Tower ACDB	:	2 no.
vii)	CHP area ACDB	:	1 no.
viii)	CW area ACDB	:	1 no.





SECTION 2

C. 220V DCDBS

i)	Power house main DCDB	:	1 no
ii)	Switchyard DCDB	:	1 no
iii)	Vacuum Pump House DCDB	:	1 no
iv)	CHP area DCDB	:	1 no
v)	AHP area DCDB	:	1 no
vi)	FGD area DCDB	:	1 no

D. SV BS

i)	DC SVBS	:	As required
ii)	AC SVBS	:	As required

E. DC Starters : 1 No. for each D.C drive

F. 415V Non Segregated Phase Bus Duct : As required.

NOTE 1 : This list is an indicative one, based on standard practice. The exact number of boards shall be finalized by the tenderers. In case additional boards are required which have not been included in this list, the same shall also be included by the tenderers in their scope.

NOTE 2 : Additional feeders may be required to provide power supply in some of the Owners/other package equipments/MCC/ PMCC. Exact details shall be furnished to successful bidder in the event of order for incorporation of necessary feeders as required.





MODULE SELECTION

MOTOR FEEDER

Type	Motor Rating	MCCB Rating	Contactor	Cable size
AU/AR	0 - 5.5 KW	32A	16A	3/C – 6 Sq.mm - Cu
BU/BR	5.6 - 11 KW	63A	32A	3/C - 16 Sq.mm - Al
CU	11.1 - 22 KW	63A	63A	3/C - 35 Sq.mm - Al
DU	22.1 - 50 KW	100A	100A	3/C - 95 Sq.mm - Al
EU	50.1 - 75 KW	200A	160A	3/C - 185 Sq.mm - Al
FU	75.1 - 90 KW	400A	300A	2 x 3/C - 185 Sq.mm - Al

NOTE :

1. MCCB, thermal overload relay, Contactor are to be coordinated (Type-2) with motor rating by the Contractor.
2. “U” stands for Unidirectional and “R” for Reversible drives.
3. MCCB with E/F protection to be considered for motors of rating 50 KW and above.
4. Following Indication Lamps shall be provided on Motor module-
ON : Red, OFF : Green, Trip : Amber, MCCB OFF : Blue.





OUTGOING FEEDER

Type	MCCB Rating	Cable Size
AF	32A	4/C – 16 Sq.mm - Cu
BF	63A	4/C – 35 Sq.mm - Al
CF	100A	3.1/2 – 95 Sq.mm - Al
DF	200A	3.1/2 – 300 Sq.mm - Al
EF	400A	4 x 1/C – 630 Sq.mm - Al

MODULE SELECTION (For DC SYSTEM)

Type	Switch Rating	Fuse Rating	Cable Size
DAU	16A	16A	2/C-2.5 Sq.mm. Cu.
DAF	32A	32A	2/C-2.5 Sq.mm. Cu.
DBF	63A	63A	2 x 2/C-16 Sq.mm - Al
DCF	100A	100A	4/C-35 Sq.mm - Al
DDF	200A	200A	2 x 4/C-35 Sq.mm - Al
DEF	400A	400A	2 x 1/C-630 Sq.mm - Al

NOTE :

- Following Indication Lamps shall be provided on MCCB module-
ON : Red, OFF : Green, Trip :Amber.
- ON indication Lamp shall be provided on DC module.



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

523866/2021/PS-PEM-MSE

	TITLE: TECHNICAL SPECIFICATION COLTCS 1X660 MW SAGARDIGHI, PHASE-III (UNIT-5) STANDARD TECHNICAL REQUIREMENTS	SPEC. NO.: PE-TS-445-165-N002	
		SECTION: II	
		SUB-SECTION: IIC	
		REV. NO. 0	DATE 23.09.2021
		SHEET 1	OF 1

SUB-SECTION - IIC

STANDARD TECHNICAL SPECIFICATION (C &I)



SPECIFICATION FOR LOCAL PANELS

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

VOLUME II B

SECTION D

REV. NO. 03

DATE : 16-09-2013

SHEET 1 OF 6

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 3.0 mm for load bearing sections (Mounted with instruments)
2.0 mm for doors and Not less than 2.0 mm for others

Panel Height: Not less than 2365 mm (Refer data sheet-A (No. PES-145A-DS1-0)

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.

	SPECIFICATION FOR LOCAL PANELS	SPECIFICATION NO.: PE-SS -999- 145 -054A	
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3.1.7 The class of protection shall be in accordance with IP-55 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
GREEN	Motor ON / Valve OPEN	BLACK	Lamp test

Left Hand Side
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
RED	Motor ON / Valve OPEN condition	WHITE	Normal / healthy

Left Hand Side
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

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, corrosion, incidental damage due

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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

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	TITLE: TECHNICAL SPECIFICATION COLTCS 1X660 MW SAGARDIGHI, PHASE-III (UNIT-5) STANDARD TECHNICAL REQUIREMENTS	SPEC. NO.: PE-TS-445-165-N002	
		SECTION: III	
		SUB-SECTION:	
		REV. NO. 0	DATE 23.09.2021
		SHEET 1	OF 1

SECTION III

DOCUMENTS TO BE SUBMITTED BY BIDDER

	TITLE : SCHEDULE OF PERFORMANCE GUARANTEES FOR CONDENSER ON LOAD TUBE CLEANING SYSTEM (COLTCS) 1X660 MW SAGARDIGHI TPP, PHASE-III (UNIT-5)	SPEC. NO. PE-TS- 445-165-N002
		SECTION: III
		Sheet 1 of 1 Date- 23.09.2021

S.NO.	DESCRIPTION	UNITS	GUARANTEED VALUE
1.	Pressure drop across the ball collecting Strainers (i.e. between inlet & outlet nozzle) under clean condition and Normal flow condition	MWC	
2	Percentage of ball recovery	%	
3	Life of sponge rubber balls	Weeks	

Note: In addition to the above, Bidder to comply the guarantee performance requirements specified under ‘General Performance requirement’ indicated in clause no. 3.2 of Section 1A of this specification.

I bidder / authorized representative confirm that all the performance requirements indicated above and at clause no. 3.2 of section 1A have been read and shall be complied during contract.

PARTICULARS OF BIDDER/ AUTHORISED REPRESENTATIVE				COMPANY SEAL
NAME	DESIGNATION	SIGNATURE	DATE	

	COMPLIANCE CERTIFICATE FOR COLTCS 1X660 MW SAGARDIGHI TPP, PHASE-III (UNIT-5)	SPEC. NO.	PE-TS- 445-165-N002
		DATE:	23.09.2021
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COMPLIANCE CERTIFICATE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate 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 with regard to same.
- b) There are no other deviations w.r.t. specification 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/Customer's Consultant approval and 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. Charges for 3rd party inspection (TUV/ equivalent) for imported components wherever required shall be included by bidder in the base price itself.
- d) Any drawing/ document/ data-sheet/ calculation/ Quality plan/ Instrumentation etc. submitted along with the offer shall be considered for reference only, same shall be subject to BHEL/ Customer/Customer's Consultant approval in the event of order.
- e) The offered materials shall be either equivalent or superior to those specified in the specification. 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 including balls shall be supplied on 'As Required Basis' and to be supplied at the time of commissioning of COLTCS system & prices for same included in the base price itself.
Prices for special tools & tackles, if any, shall also be included in the base price.
Recommended spares for 3 years shall be quoted separately with price indicated separately.
- g) Charges for Installation Checks, Commissioning of equipments, Trial runs and Performance Testing at site shall be included by bidder as per the price format.
- h) The main flanges for Ball separator shall be suitable for the forces and moments as per the specification.
- j) Injection nozzles – 2/4 numbers of stubs of 100 NB or size as informed by bidder shall be provided by BHEL. The injection nozzles, counter flanges for the stubs along with nuts, bolts and gaskets shall be supplied by the bidder.
- k) Number of balls (Normal as well as abrasive) for COLTCS shall be as specified i.e Number of balls per charge shall be @ 10% of no. of tubes per condenser section.
- l) The hydrostatic test pressure shall be 1.5 times the design pressure.
- m) All sub - vendors shall be subject to BHEL/ Customer/Customer's Consultant approval in the event of order.
- n) The Performance guarantees of equipments shall stand valid till the satisfactory completion of performance testing & its acceptance by BHEL/ Customer/Customer's Consultant.
- o) The orientation of piping around COLTCS shall be finalised during detailed Engg.

	COMPLIANCE CERTIFICATE FOR COLTCS 1X660 MW SAGARDIGHI TPP, PHASE-III (UNIT-5)	SPEC. NO.	PE-TS- 445-165-N002
		DATE:	23.09.2021
		SHEET	2 OF 2

p) Electrical/ C&I :

- All selected motor ratings have minimum 15 % margin over maximum continuous demand of the driven equipment including voltage and frequency variations, temperature rise and other factors.
- Supply of electrical viz. LT power cables, instrumentation and control cables, cable glands, lugs, cable trays etc. shall be as per specification. Their erection shall be done by BHEL
- The junction boxes for termination of DPT/ DPS/ Actuator LS/ solenoid valves/ Ball oversize monitor/ Ball recirculating monitor are included in bidder's scope. The instrumentation cable and cabling from instruments/ actuators to junction boxes is also included in bidder's scope.
- Valve actuators and controls shall be provided as specified in Data Sheet-A and Project specific requirements as specified in Sub-Section IB & Section IC.
- Alarms/ annunciations/ instruments shall be finalised during detailed engineering in the event of order which shall be subject to BHEL/ Customer/Customer's Consultant approval and shall be without any commercial implications to BHEL.

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	Title DATA SHEET - B CONDENSER ON LOAD TUBE CLEANING SYSTEM (SPONGE RUBBER BALL TYPE)		SPECIFICATION NO. PE-TS-999-165-N001			
			SECTION III			
			SHEET 1 OF 13			
INSTRUCTION TO BIDDER						
1. This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB. 2. Items which deviate from Specification shall be marked with an asterisk (*)						
SL.NO.	ITEM					UNIT
PARTICULARS						
1.0	General :					
1.1	Number of Tube Cleaning System sets being supplied.	Nos.				
1.2	Type					
1.3	Liquid handled					
1.4	Manufacturer					
1.5	Country of origin					
2.0	Design :					
2.1	Design Pressure	Bar (g)				
	a) Ball Separator					
	b) Ball Recirculating Pump					
	c) Ball Collector					
	d) Piping					
	e) Valves					
	f) Distributors					
	g) Injection Nozzles					
2.2	Design Temperature	°C				
2.3	Operating pressure at condenser inlet	Bar (g)				
2.4	Design differential pressure	Bar (g)				
2.5	Flow rate through ball separator	M ³ /hr				
	a) Normal					
	b) Maximum allowable					
2.6	Flow rate through ball collector	M ³ /hr				
	a) Normal					
	b) Maximum allowable					
Name of Bidder/ Vendor						
Revision Number	0	1	2	3	4	
Signature of Bidder/ Vendor Authorised Representative						
Date :						

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			SECTION III			
			SHEET 2 OF 13			
INSTRUCTION TO BIDDER						
1. This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB. 2. Items which deviate from Specification shall be marked with an asterisk (*)						
SL.NO.	ITEM			UNIT		
PARTICULARS						
3.0	Guaranteed Performance					
3.1	Whether condenser back pressure/ overall heat transfer coefficient is guaranteed that it will be permanently maintained as long as the tube cleaning system is in operation.			YES/NO		
3.2	Pressure drop across the ball separator (i.e., between inlet and outlet connections) :					
	a) Normal flow condition					
	b) Maximum allowable flow condition					
3.3	Power consumption by ball recirculating pump during :		KW			
	a) Normal operation					
	b) Ball collection operation					
	c) Ball sorting operation					
3.4	Quantity of cleaning balls required per set for an operating period of one year		Nos.			
4.0	Operation :					
	Whether tube cleaning system is designed for the following operation modes :					
4.1	Automatic start-up initiated by push button.			YES/NO		
4.2	Automatic shut-down with ball collection effected by :					
	a) Push button			YES/NO		
	b) Adjustable timer			YES/NO		
	Ball monitoring system			YES/NO		
Name of Bidder/ Vendor						
Revision Number	0	1	2	3	4	
Signature of Bidder/ Vendor Authorised Representative						
Date :						

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			SHEET 3 OF 13			
INSTRUCTION TO BIDDER						
1. This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB. 2. Items which deviate from Specification shall be marked with an asterisk (*)						
SL.NO.	ITEM					UNIT
PARTICULARS						
4.3	Automatic backwashing of ball separator with ball collection effected by :					
	a) Differential pressure measuring system					YES/ NO
	b) Adjustable timer					YES/ NO
	c) Push button					YES/ NO
4.4	Automatic emergency backwashing of ball separator effected by differential pressure measuring system.					YES/ NO
4.5	Automatic flushing of differential pressure measuring system.					YES/NO
4.6	Automatic ball sorting initiated by push button.					YES/NO
4.7	Whether provision for manual operation of the complete tube cleaning system is made in case of control system failure.					YES/NO
5.0	Ball Separator :					
5.1	Make					
5.2	Nos. provided per set			Nos.		
5.3	Code/ Standard					
5.4	Body outer diameter			mm		
5.5	Body thickness			mm		
5.6	Manhole type & size			mm		
5.7	Whether sight glass is provided					
5.8	No. of screens/ strainers provided per each ball separator			Nos.		
5.9	Type of arrangement provided to prevent lodging of the debris at the entrance of ball extraction pipes.					
Name of Bidder/ Vendor						
Revision Number	0	1	2	3	4	
Signature of Bidder/ Vendor Authorised Representative						
Date :						

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	Title DATA SHEET - B CONDENSER ON LOAD TUBE CLEANING SYSTEM (SPONGE RUBBER BALL TYPE)		SPECIFICATION NO. PE-TS-999-165-N001			
			SECTION III			
			SHEET 4 OF 13			
INSTRUCTION TO BIDDER		1. This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB. 2. Items which deviate from Specification shall be marked with an asterisk (*)				
SL.NO. PARTICULARS	ITEM		UNIT			
5.10	Clearance between screen/ strainer bars.	mm				
5.11	Materials : a) Body/ Housing b) screen/ Strainer section c) Screen/ Strainer shaft d) Hardware for fixing the screen/ Strainer e) Other internal hardware f) External hardware					
5.12.	Lining material (if applicable)					
6.0	Ball Recirculating Pump :					
6.1	Make					
6.2	Nos. provided per set	Mos.				
6.2	Design discharge flow	M ³ /hr				
6.4	Design discharge pressure	Bar				
6.5	Design pump Speed	RPM				
6.6	Design pump efficiency	%				
6.7	Seal for the pump					
6.8	Materials : a) Casing b) Impeller c) Shaft					
7.0	Ball Collector :					
7.1	Nos. provided per set	Nos.				
Name of Bidder/ Vendor						
Revision Number	0	1	2	3	4	
Signature of Bidder/ Vendor Authorised Representative						
Date :						

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INSTRUCTION TO BIDDER						
1. This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB. 2. Items which deviate from Specification shall be marked with an asterisk (*)						
SL.NO.	ITEM					UNIT
PARTICULARS						
7.2	Code/ Standard					
7.3	Whether inspection window/ sight glass is provided.					YES/ NO
7.4	Materials :					
	a) Shell/ Body					
	b) Internals					
7.5	Lining material (if applicable)					
7.6	Whether provision for separating and collecting the undersized balls, is made					YES/ NO.
8.0	Differential Pressure Measuring System:					
8.1	Differential Pressure Switch/ Transmitter					
	a) Type					
	b) Make and Model					
	c) Range					
	d) Accuracy					
	e) Material of sensing element					
	f) No. of contacts					
	g) Contact rating					
	h) Enclosure					
	i) Mounting					
8.2	Whether differential Pressure gauge is provided for manual observation.					
8.3	Diffrential Pressure Gauge :					
	a) Type					
	b) Make and Model					
	c) Range					
Name of Bidder/ Vendor						
Revision Number	0	1	2	3	4	
Signature of Bidder/ Vendor Authorised Representative						
Date :						

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			SECTION III			
			SHEET 6 OF 13			
INSTRUCTION TO BIDDER						
1. This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB. 2. Items which deviate from Specification shall be marked with an asterisk (*)						
SL.NO.	PARTICULARS	ITEM		UNIT		
	d) Accuracy e) Material of sensing element f) No. of contacts g) Dial size h) Enclosure i) Mounting		Nos. mm			
8.4	Whether the contacts for differential pressure gauge and switch/ transmitter are independent.			YES/ NO		
9.0	Timer for Backwashing					
9.1	Timer make					
9.2	Range of duration setting					
9.3	Range of frequency					
10.0	Ball Monitoring System :					
10.1	Type					
10.2	Maake & Model					
10.3	Whether ball monitoring system is designed to perform the following functions : a) Continuously counting the balls in circulation and giving an alarm calling for investigation of ball losses, when the number of circulating balls falls below a set value a) Continuously measuring the size of the balls in circulation and initiating the shut-down of the tube cleaning system with alarm calling for replacement of balls, when the number of oversized balls falls below a set value.			YES/ NO		
Name of Bidder/ Vendor						
Revision Number		0	1	2	3	4
Signature of Bidder/ Vendor Authorised Representative						
Date :						

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			SHEET 7 OF 13				
INSTRUCTION TO BIDDER		1. This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB. 2. Items which deviate from Specification shall be marked with an asterisk (*)					
SL.NO.	ITEM	UNIT					
PARTICULARS							
10.4	Whether electronic processor of the ball monitoring system is provided with the following a) Indicators for ♦ Required basic ball charge ♦ Recirculating Ball quantity ♦ Oversized ball quantity b) Time counters for ♦ Total cleaning system operating hours ♦ Cleaning system operating hours with sufficient number of oversized balls c) Recorder for ball consumption					YES/ NO YES/ NO YES/ NO YES/ NO. YES/NO YES/NO	
10.5	Whether provision for Self-testing and Self Calibration are made					YES/NO	
11.0	Cleaning Balls :						
11.1	Type						
11.2	Size					mm	
11.3	Specific gravity						
11.4	Material						
11.5	Hardness						
11.6	Total Ball recirculation quantity per set					Nos.	
11.7	abrasive coated ball recirculation quantity per set - (if any)					No.s	
12.0	Piping :						
12.1	Ball Extraction Piping						
Name of Bidder/ Vendor							
Revision Number		0	1	2	3	4	
Signature of Bidder/ Vendor Authorised Representative							
Date :							

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	Title DATA SHEET - B CONDENSER ON LOAD TUBE CLEANING SYSTEM (SPONGE RUBBER BALL TYPE)		SPECIFICATION NO. PE-TS-999-165-N001			
			SECTION III			
			SHEET 8 OF 13			
INSTRUCTION TO BIDDER						
1. This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB. 2. Items which deviate from Specification shall be marked with an asterisk (*)						
SL.NO.	ITEM			UNIT		
PARTICULARS						
12.2	a) OD x thicknes b) Material c) Length of piping being supplied Ball Transport Piping	mm x mm M				
12.3	a) OD x thicknes b) Material c) Length of piping being supplied Differential pressure measuring system flushing piping.	mm x mm M				
12.4	Any other					
13.0	Valves (Indicate Type of Valves)					
13.1	Sizes	: mm				
13.2	Nos. provided per set	Nos.				
13.3	Materials					
	a) Body b) Disc/ Trim c) Shaft					
14.0	Distributors					
14.1	Nos. provided per set	Nos.				
14.2	Materials :					
	a) Body b) Sight glass c) Sight glass flanges d) Internal parts					
Name of Bidder/ Vendor						
Revision Number		0	1	2	3	4
Signature of Bidder/ Vendor Authorised Representative						
Date :						

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	Title DATA SHEET - B CONDENSER ON LOAD TUBE CLEANING SYSTEM (SPONGE RUBBER BALL TYPE)		SPECIFICATION NO. PE-TS-999-165-N001				
			SECTION III				
			SHEET 9 OF 13				
INSTRUCTION TO BIDDER		1. This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB. 2. Items which deviate from Specification shall be marked with an asterisk (*)					
SL.NO.	ITEM	UNIT					
PARTICULARS							
14.3	Lining material (if applicable)						
15.0	Injection Nozzles :						
15.1	Nos. provided per each CW inlet pipe	Nos.					
15.2	Size of the stubs to be provided in CW inlet pipe for installing the injection nozzles.	mm					
15.3	Material						
15.4	Lining material (if applicable)						
16.0	Actuators :						
16.1	Actuators for ball separator :						
	a) Nos. provided per ball separator	No.s					
	b) Type & make						
	c) Motor rating	KW					
16.2	Actuators for ball collector						
	a) Nos. provided per ball collector	No.s					
	b) Type & make						
	c) Motor rating	KW					
16.3	Actuators for Valves:						
	a) Nos. provided per set	No.s					
	b) Type & motor						
	c) Motor rating	KW					
16.4	Any other						
Name of Bidder/ Vendor							
Revision Number	0	1	2	3	4		
Signature of Bidder/ Vendor Authorised Representative							
Date :							

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	Title DATA SHEET - B CONDENSER ON LOAD TUBE CLEANING SYSTEM (SPONGE RUBBER BALL TYPE)		SPECIFICATION NO. PE-TS-999-165-N001			
			SECTION III			
			SHEET 10 OF 13			
INSTRUCTION TO BIDDER						
1. This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB. 2. Items which deviate from Specification shall be marked with an asterisk (*)						
SL.NO.	ITEM					UNIT
PARTICULARS						
17.0	Electric Drive Motors					
17.1	Drive motor for recirculating pump :					
	a) Type and make					
	b) Rating			KW		
17.2	Drive motor for differential pressure measuring system flushing pump (if applicable)					
	a) Type and make					
	b) Rating			KW		
17.3	Any other.					
18.0	Control Panel					
18.1	Type					
18.2	Model & Manufacturer					
18.3	Operating Voltage/ frequency			V/ Hz		
18.4	Control Voltage/ frequency			V/ Hz		
18.5	Materials of housing and door					
18.6	Protections/ interlocks provided for :					
18.7	Class of Protection					
18.8	Control Hardware					
18.8	Alarms/ Annunciations provided for :					
18.9	Indicators provided for :					
18.10	Whether interconnecting control and power cabling between the control panel and various drive is included in the offer.					
19.0	Pressure gauges :					
19.1	Manufacturer & Type, Model					
Name of Bidder/ Vendor						
Revision Number	0	1	2	3	4	
Signature of Bidder/ Vendor Authorised Representative						
Date :						

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	Title DATA SHEET - B CONDENSER ON LOAD TUBE CLEANING SYSTEM (SPONGE RUBBER BALL TYPE)		SPECIFICATION NO. PE-TS-999-165-N001			
			SECTION III			
			SHEET 11 OF 13			
INSTRUCTION TO BIDDER						
1. This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB. 2. Items which deviate from Specification shall be marked with an asterisk (*)						
SL.NO.	ITEM			UNIT		
PARTICULARS						
19.2	Nos. provided per set	Nos.				
19.3	Location					
19.4	Dial size	mm				
19.5	Range & Accuracy					
19.6	Materials of construction :					
	a) Sensing element					
	b) Movement					
	c) Casing					
19.7	Enclosure					
19.8	Mounting					
20.0	Counter Flanges :					
20.1	Whether counter flanges complete with gaskets, bolts and nuts etc. for all terminal points are included in the offer.			YES/ NO		
20.2	Type					
20.3	Rating					
20.4	Materials					
	a) Flanges					
	b) Bolts and Nuts					
	c) Gaskets					
20.5	Code/ Standard					
21.0	Whether lifting arrangement is provided for various equipments.			YES/ NO.		
22.0	Whether ball recirculating pump, ball collector with interconnecting piping and valves are mounted on a single frame.			YES/ NO		
23.0	Whether supports (wherever necessary) complete with foundation plates, bolts, nuts, inserts etc. are included in the offer.			YES/ NO		
Name of Bidder/ Vendor						
Revision Number	0	1	2	3	4	
Signature of Bidder/ Vendor Authorised Representative						
Date :						

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	Title DATA SHEET - B CONDENSER ON LOAD TUBE CLEANING SYSTEM (SPONGE RUBBER BALL TYPE)		SPECIFICATION NO. PE-TS-999-165-N001				
			SECTION III				
			SHEET 12 OF 13				
INSTRUCTION TO BIDDER		1. This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB. 2. Items which deviate from Specification shall be marked with an asterisk (*)					
SL.NO.	PARTICULARS	ITEM		UNIT			
24.0	Shop Inspection and Tests						
24.1	Whether all the tests and inspections as detailed in the specification/ quality plan are carried out.			YES/ NO			
24.2	Hydrostatic Test :						
	a) Test Pressure		Bar (g)				
	◆ Ball Separator ◆ Recirculating Pump ◆ Ball Collector ◆ Distributors ◆ Injection nozzles ◆ Piping & Valves						
	a) Test duration		Minutes				
24.3	Lekage Test :						
	a) Test Pressure		Bar (g)				
	b) Test duration		Minutes				
25.0	Painting :						
25.1	External Surfaces :						
	a) Surface Preparation						
	b) Primer						
	c) Finish						
25.2	Internal Surfaces :						
	a) Surface Preparation						
	b) Primer						
	c) Finish						
26.0	Weights :						
26.1	Empty Weight		Kg.				
	a) Ball Separator						
Name of Bidder/ Vendor							
Revision Number		0	1	2	3	4	
Signature of Bidder/ Vendor Authorised Representative							
Date :							

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	Title DATA SHEET - B CONDENSER ON LOAD TUBE CLEANING SYSTEM (SPONGE RUBBER BALL TYPE)		SPECIFICATION NO. PE-TS-999-165-N001			
			SECTION III			
			SHEET 13 OF 13			
INSTRUCTION TO BIDDER		1. This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB. 2. Items which deviate from Specification shall be marked with an asterisk (*)				
SL.NO. PARTICULARS	ITEM			UNIT		
	b) Recirculating pump c) Ball collector d) recirculating unit					
26.2	Operating weight		kg			
	a) Ball Separator b) Recirculating pump c) Ball collector d) recirculating unit					
26.3	Weight of the heaviest equipment/ assembly to be handled.		kg.			
27.0	Overall Dimensions					
27.1	Ball Separator					
27.2	Recirculating Unit					
28.0	Other information (if any)					
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Name of Bidder/ Vendor						
Revision Number	0	1	2	3	4	
Signature of Bidder/ Vendor Authorised Representative						
Date :						