THE WEST BENGAL POWER DEVELOPMENT CORPORATION LTD (WBPDCL)

SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III

TECHNICAL SPECIFICATION FOR MILL REJECT SYSTEM (PNEUMATIC TYPE)

SPECIFICATION NO.: PE-TS-445-160-A001

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR- PROJECT ENGINEERING MANAGEMENT
NOIDA
INDIA

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SECTION-I

SPECIFIC TECHNICAL REQUIREMENT

SUB-SECTION IA	**SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)**
SUB-SECTION IB	**SPECIFIC TECHNICAL REQUIREMENT (ELECTRICAL)**
SUB-SECTION IC	**SPECIFIC TECHNICAL REQUIREMENT (CONTROL & INSTRUMENTATION)**

SUB SECTION-IA

SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)

SCOPE OF ENQUIRY / INTENT OF SPECIFICATION

1.1.1 This specification includes, but not limited to, design, engineering, manufacturing, inspection and testing, painting, supply/delivery duly packed at project site including freight , unloading, storage and handling at site, erection and commissioning, trial run at site, performance guarantee test and handing over to the customer in line with drawings/ documents/ test procedures approved by BHEL/Customer for **Mill Reject System (Pneumatic type)** including mandatory spares, erection and commissioning spares and maintenance tools and tackles.

1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the responsibility of providing such facilities to complete the supply, erection and commissioning.

1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.

1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing.

1.5 The general terms and conditions, instructions to tenderer and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.

1.6 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Vol-III of the specification. In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser/Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of

pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.

1.7 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.

1.8 Deviations, if any, should be very clearly brought out clause by clause in the deviation schedule along with cost of withdrawal; otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification.

1.9 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.

1.10 In the event of any conflict between the requirements of two clauses of this specification documents or requirements of different codes and standards specified, more stringent requirement as per the interpretation of the Owner shall apply.

1.11 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.

1.12 Unless specified otherwise, all through the specification, the word contractor shall have same meaning as successful bidder /vendor and Owner/Customer/ Purchaser/Employer will mean BHEL and /or Customer including their consultant as interpreted by BHEL in the relevant context. For details refer the relevant clause in GCC.

1.12 Manufacturing Quality Plan for reference is included in this specification to enable the bidder to understand the extent of inspection and testing requirements to execute this project package. The successful bidder has to follow the quality plan's minimum requirement during manufacturing and testing. Further all checks and tests indicated in Quality Assurance Requirement as detailed in Customer's specification etc have to be followed.

1.0 SCOPE OF WORK

Design, engineering, manufacture, inspection and testing at vendor's/ sub-vendor's works, painting, forwarding, proper packing, shipment and delivery at site, unloading, handling & transportation at site, Erection & Commissioning, structural work, minor civil works as required, trial run, Performance Guarantee test and handing over of Mill Reject System(Pneumatic Type) including supply of mandatory spares, erection and commissioning spares and tools & tackles as per details in different sections of this specification.

Detailed system write-up & control philosophy shall be furnished by the successful bidder during detail engineering & the same shall be subject to customer approval during detail engineering.

1.1 SCOPE OF SUPPLY

Scope of supply shall comprise of but not necessarily limited to the following:

a) Stack up assembly of pyrite hopper and conveying vessel below each mill shall comprise of following items.

- 1 no. pneumatic cylinder operated knife gate valve with solenoid valve along with deflection cone, open and close limit switches at mill outlet/pyrite hopper inlet.
- 1 no. of pyrite hoppers complete with sizing grid, flexible/expansion joint at its inlet, rupture disc, by pass chute, oversize material chute, water spray nozzles & supporting structures.
- RF type level switches with probes per pyrite hopper for High level and High-high levels.
- Temperature switch per pyrite hopper as per flow diagram.
- 1 no. of pneumatically operated knife gate valve at pyrite hopper outlet for pyrite hopper isolation with solenoid valve, open and close limit switches for interlock.
- 1 no. of pneumatically operated knife gate valve at oversize discharge chute of pyrite hopper provided with solenoid valve, open & close limit switches for interlock with pyrite hopper inlet knife gate valve.
- 1 no. of pneumatically operated knife gate valve at by pass chute of pyrite hopper provided with solenoid valve, open & close limit switches for interlock with pyrite hopper inlet knife gate valve.
- 1 no. of transporter vessel complete with pneumatically operated inlet valve, Alloy CI outlet bend, local control panel etc.
- 1 set of MS ERW pipe for mill reject conveying from transporter vessel to Mill Reject Storage bunker.
- 1 lot of Alloy CI bends

b) Terminal boxes (qty. as per layout) with up stand on bunker top for terminating the reject conveying pipes.

c) 2 nos. mill reject bunkers, i.e., one no. mill reject bunkers per mill bay along with structure, liner and pneumatic operated bunker discharge gate with canvas chute at

bunker outlet, staircase up to mill reject bunker roof top, operating & maintenance platform, hand railing, bag filter with differential pressure switch, RF type level switch, pressure relieve valve, chain pulley block with traveling trolley and monorail arrangement etc.

d) 2 nos. (1 working & 1 standby) oil free screw type air compressors with drive motors, local control panels, instruments, portable vibration analyser, tachometer and all other accessories.

e) 1 no. air receiver for Mill Reject System per mill bay complete with auto drain traps, safety relief valve, instruments and all accessories.

f) 1 no. air receiver (0.75m3 at one end of feeder floor EL 25.3m) per mill bay complete with auto drain traps, safety relief valve, instruments and all accessories. Piping tapped from MRS conveying line to be routed and connected to the receivers (consumption shall be approx. 1 to 1.8 m3/min FAD) with isolation valve. One no tapping with isolation valve and piping shall also be provided from the nearest service air header (BOP EL 8.5 m at 1st column of mill bay) to the air receiver as an alternative source. For details refer Flow scheme.

g) 1 no. non clogged fixed, submersible type sump pump along with local control panel per mill bay complete with suction & discharge piping for pumping out water from drain sump to nearest plant drain, instruments and all other accessories.

h) 1 lot of piping, fittings, valves & instruments for conveying air, instrument air, cooling water for transporter vessel inlet valve top plate (if applicable), cooling water quenching in the pyrite hopper, cooling water for air compressor etc.

i) 1 lot of Local Control Panel/pneumatic panels and JBs (1 no. for each pyrite hopper) properly mounted on rack along with required Stainless steel impulse/pneumatic tubing.

j) 1 lot of insulation & cladding, if required, to maintain surface temperature of pyrite hopper within 60°C.

k) All structures required for supporting of various pipes is in bidder's scope. Bidder may take support from existing mill bunker bay structures wherever possible. The mill reject conveying pipes shall be routed above the level of maintenance platform (at EL + 13.0 m, refer floor plan arrangement drg) in single tier arrangement. Any additional platform/s , walkways required for access to the piping shall be provided by the bidder. Flanged joints and bends shall be necessarily located near to accessible zones for ease of maintenance. The conveying pipes between the mill bay and bunkers (terminal box) shall be without flange connection.

l) All insert plates, embedment plates, anti-vibration pads below conveying vessel if applicable foundation bolts/ anchor bolts etc. required for bidder's equipment.

m) Charge of all lubricants and fluids as per GTR

n) Electrical and C&I scope as per enclosure elsewhere in the specification.

o) One (1) set of Mandatory Spares as per the list attached in specification.

p) One (1) set of Erection & Commissioning spares as required for the complete system.

q) One (1) set of Maintenance tools and tackles as per the list attached in specification.

r) All counter- flanges with nuts, bolts and gaskets at all the terminal points.

s) Relevant scope of supply as per GTR, GCC & SCC.

t) Any other instrument, item required for making the installation complete in all respect within battery limits and for satisfactory operation of the system, unless specifically EXCLUDED from scope under Clause No. 2.0 below.

1.2 SCOPE OF SERVICES

Scope of services shall include but not necessarily limited to

a) Unloading, Storage, handling and transportation at site

b) Minor civil work like penning, chipping of foundation, grouting etc.

c) Pre-Commissioning work such as flushing, hydraulic testing etc. Necessary instrumentation for pre-commissioning, trail run, and performance guarantee test shall be arranged by the successful bidder at their own cost.

d) Erection & Commissioning of complete scope.

e) Inspection & testing, trial run, performance guarantee & handing over to end client

f) Painting of all equipment within the battery limit

g) Electrical scope of services as per enclosure elsewhere in the specification

h) Preparation of Civil input drawings & documents for foundation details (including load data, GA, foundation pocket details etc.) of storage bunkers, compressors, air receivers, pipe rack and pit / trench details for transporter vessel and reject conveying pipes.

i) Review of Civil drawings prepared by BHEL based on civil input drawing furnished by the successful bidder.

j) Relevant scope of services as per GTR, GCC, ECC & SCC.

k) Any other service required for making the installation complete in all respect within battery limits and for satisfactory Erection & Commissioning of the system, unless specifically EXCLUDED from scope under Clause no. 2.0 below.

2.0 EXCLUSION

a) Civil work for Mill Reject system including
   i) Road approach for various facilities.
   ii) Transporter vessel foundation
   iii) Drain Sump & Trench/Hume pipe as required in mill bay.
   iv) Foundation of Compressor and Air receivers.
   v) Mill Reject bunker foundation.
   vi) Various cable trenches, pipe pedestals & pipe rack foundation.
   vii) Trucks for unloading mill reject from storage bunkers and further disposal of mill rejects.
   viii) Trolley for manual disposal of Rejects.
   ix) MRS compressor house and single girder crane.

However, location, sizing and loads and any other input related to above as applicable shall be given by the successful bidder within 8 weeks of placement of LOA.

b) Fire Protection system for MRS compressor house.
c) Lighting of Mill bay, MRS compressor house & Bunker area.
d) Electrical exclusion as per Electrical scope sheet enclosed in the specification.
e) Relevant exclusion as per GTR, GCC, SCC & ECC.

3.0 SERVICES TO BE PROVIDED BY THE CUSTOMER

As per Utility Requirement – Section III D.

4.0 TERMINAL POINT

Mill Reject inlet towards pyrite hopper side	Mill reject spout (tramp iron) as per details indicated in enclosed GA of Mills.
Mill Reject outlet towards road tanker	Mill reject bunker outlet with canvas chute.
Equipment cooling Water, Instrument Air and Service Water tappings	As mentioned in Utility Requirement – Section III D.

5.0 PERFORMANCE / DEMONSTRATION GUARANTEES

The following minimum and details mentioned elsewhere in specification shall be performed.

a) PERFORMANCE GUARANTEE TESTS AT SITE.

a) Maximum noise level shall not exceed 85 dB (A) when measured at 1.0 m away from the noise emission source as per Clause no 16.02.00, Volume: II-A, Section: V General Technical Requirements.
b) Continuous effective discharge and guaranteed conveying of mill rejects.
c) SMP Level <30mg/Nm^3 of vent air from bag filter.

b) TESTS AT SHOP

a) Following shall be demonstrated for each air compressor:
Power consumption, capacity, discharge pressure.
b) Following shall be performed for each air compressor:
Rotating components shall be statically and dynamically balanced. Dynamic balancing tests shall be carried out. Test procedure and acceptance limit shall be guided by the relevant testing standard and shall be enclosed in the QAP.

6.0 ERECTION, PRE-OPERATIONAL TESTING/STARTUP & COMMISSIONING PROCEDURE

This shall be as furnished by the successful bidder during detail engineering for Customer's review and acceptance.

7.0 PAINTING/CORROSION PROTECTION REQUIREMENT shall be as per clause no. 14.00.00 Volume: II-A, Section: V General Technical Requirements of Customer's specification.

Successful bidder shall furnish detailed Painting Schedule for Mill Reject System (based on painting specification attached with specification) for Customer's approval during detail engineering.

8.0 LAYOUT REQUIREMENTS

Piping and equipment installation shall be according to the regulations and recommendations of recognized Indian / International Standards, Codes and Statutes, as and where applicable, practice in vogue (to be supported with back up document to the satisfaction of Customer).

9.0 EQUIPMENT DESIGN CRITERIA

9.0.1 The minimum design criteria to be followed for various equipment shall be as per requirements indicated under specific and standard technical specifications for Mill Reject System.

In case of *any contradictory requirement* in specification of particular equipment, the requirement given in Section I shall prevail over those indicated in Section-II. Further, in case of any contradictory requirement within the same section and clarifications not having been sought by the bidders w.r.t. the same within the stipulated period, the most stringent requirement as per interpretation of the Customer will prevail. Successful bidder will furnish detailed data sheets/ specifications/design calculations for various equipment for customer/consultant's approval during detail engineering. All comments made by customer/ consultant shall be incorporated by the successful bidder without any commercial and delivery implication.

10.0 QUALITY PLANS, INSPECTION & TESTING ROCEDURE (Reference Annexures)

All QPs / CLs shall be submitted by the bidder for Customer/Consultant's review and approval. All comments made by customer/ consultant shall be incorporated by the successful bidder without any commercial and delivery implication.

11.0 DRAWINGS/DOCUMENTS REQUIRED WITH THE BID (Refer Section-III)

The drawings and documents to be submitted with the bid shall strictly be the list. Any document other than those indicated therein will not be reviewed and will not form part of contract.

12.0 DRAWINGS/DOCUMENTS REQUIRED DURING DETAIL ENGINEERING (Refer Annexures)

The tentative list of drawings and documents required during detail engineering shall be as per the list. The list, however, will be finalized with the successful bidder prior to start of detail engineering.

13.0 DRAWING/DOCUMENT DISTRIBUTION SCHEDULE (Refer Annexures)

Drawing/document distribution schedule shall be as per Annexures enclosed elsewhere in the specification.

14.0 DOCUMENT MANAGEMENT SYSTEM (DMS)

Bidder to note that the successful bidder, during detail engineering, will submit the drg/doc through web based Document Management System (DMS). Bidder would be provided access to DMS for drg/doc approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end:

BHEL reserves the right for drawing/document submission through web based Document Management System. Bidder would be provided access to the DMS for drawing/document approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end.

- Internet explorer version – Minimum Internet Explorer 7.
- Internet speed – 2 Mbps (Minimum preferred).
- Pop ups from our external DMS IP (124.124.36.198) should not be blocked.
- Vendor's internal proxy setting should not block DMS application's link (https://www.bhelpem.com/wrenchweb).

DMS user manuals to be used by BHEL PEM vendors for uploading, viewing, revising, commenting and tracking documents on PEM's DMS have been uploaded on PEM internet website (www.bhelpem.com) under the Vendor section. For quick access bidder may refer the link http://bhelpem.com/DMSManuals/DMSManuals.html

15.0 DRAWINGS ENCLOSED WITH THE SPECIFICATION (Refer Annexures)

Bidder to note that the flow diagram of Mill Reject System shows the minimum requirement including instruments for the system. Any additional equipment/instruments required for safe, efficient & reliable operation of the system within the battery limit shall also be considered as included in bidder's scope without any commercial/ cost implication to BHEL.

16.0 OTHER REQUIREMENTS

i) Site Visit before submission of offer

Bidders shall make Site visit in order to familiarize themselves with the existing facility and condition of site before submitting the bid in order to make their offer complete. BHEL shall not entertain any cost implication for making the system complete for any lack of input data during detail engineering.

ii) Technical Requirements

- Operation philosophy and control philosophy shall be submitted by the vendor during detail engineering stage for BHEL / CUSTOMER /CONSULTANT approval and approved document shall be adhered and the system shall be provided accordingly for which no commercial implication shall be entertained by BHEL.

- All possible efforts shall be made by the bidder to get the approval of drawings and documents from BHEL / customer / consultant at the earliest and the documents prepared / generated by them or their sub-vendors shall be checked by their competent authority before submission to BHEL.

- Mill Reject System design shall also consider the presence of occasional burning coal particles along with the rejects, which would increase the reject temperature.

- Revision made by the bidder in any drawings and documents shall be highlighted by indicating the no. of revisions in a triangle without fail so that the minimum time is required by BHEL to review the drawings and documents.

- Civil works will be provided by BHEL / Customer. Hence, bidder has to furnish the civil inputs in time. Bidder has to carry out the rectification in the civil works in the event of any changes in the civil input data furnished by them or delay in submission of input data by them. Bidder to furnish the civil foundation drawing along with the loading data for approval during detailed engineering stage showing / indicating the followings :-
  a) Scope of work by BHEL / Customer and bidder shall be indicated with different legend or in the form of note.
  b) Civil loads shall be furnished showing detailed calculation.
  c) Details of pockets as required for anchor bolts.

- Bidder to depute competent designer (s) at BHEL's/ CUSTOMER /CONSULTANT office during detailed engineering stage to discuss drawings and other technical documents as and when required by BHEL. However, minimum 7 days notice shall be served for the same.

- All the drawings which are required to be furnished to BHEL during detailed engineering stage shall include technical parameters, details of paints, BOQ / BOM etc in tabular form indicating all components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.

- All drawings and documents including general arrangement drawing, data sheet, calculation etc. shall be furnished to BHEL during detailed engineering stage and shall include / indicate the following details for clarity w.r.t. inspection, construction, erection and maintenance etc.:-
  a) All drawings and documents shall bear BHEL's title block and drawing / document number.

  b) All drawings and documents shall indicate the list of all reference drawings including general arrangement.

  c) All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view, all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.

- Bar chart, list of drawings and documents including data sheet, manual calculation, quality plan, field quality plan, performance guarantee test procedure, list of sub – vendors (mechanical, C & I and erection and commissioning), technical specification

and material of construction, painting specification / schedule, dispatch schedule etc. of various items as required by BHEL / customer / consultant shall be submitted to BHEL / customer / consultant during detail engineering stage for approval and the approved drawings / documents shall be adhered by the bidder without any commercial implication.

ANNEXURE IA : EQUIPMENT DESIGN/SELECTION CRITERIA FOR MILL REJECT SYSTEM: To be read in conjunction with "Technical Data sheet" of Customer's specification , Vol: II-H2.

Mill Data		
a	No. of mills (working & standby) at Coal consumption with Worst Coal firing at 100% TMCR.	7 working + 1 standby
b	Type of Mills	Vertical spindle bowl mill /HP 1103 (DC)
c	Elevation of Mill Reject Spout (Tramp iron spout)	3.5m from (FFL)
d	Mill Arrangement	Side mill arrangement with 8 mills(each mill bay shall house 4 mills)
Reject Data		
e	Reject Temperature (Normal/Design)(deg.C)	Around 180 ^{o}C / 200 ^{o}C
f	Max/Normal Size of mill rejects to be handled	50 mm (5% of total reject) max size, 25 mm (normal size).
g	Bulk Density for a) Volumetric calculation b) Load calculation	 1600 Kg/m^3 2400 Kg/m^3
System Data		
a	Type of mill reject system	Pneumatic conveying system , Continuous duty
b	System capacity	850 kg/hour/mill
Equipment Data		
1.	**Pyrite Hopper**	
a	No of Pyrite Hopper	One (1) no. per mill
b	Number of outlet	Three (3) nos.
c	Capacity	The Pyrite Hopper shall be designed for 2-3 cycles of conveying with minimum effective capacity of 20 Cu. ft. (approx.) to act as buffer holding capacity. Valley angle of the truncated pyramid of the pyrite hopper with the horizontal shall be minimum 50^0 approx.
d	Pyrite Hopper Accessories	
e	Temperature switch	As per flow diagram. Material suitable for minimum 500°C.
f	RF type level switch	As per flow diagram. Material suitable for minimum 500 °C.
g	Water Spray quenching system with solenoid operated spray nozzle	One (1) no. per hopper
h	Rupture disc	One (1) no. per hopper. Suitable for 350 °C to 400 °C.
i	Flexible joint	One (1) no. per hopper

j	Oversize reject chute	One (1) no. per hopper
k	Bypass Chute	One (1) no. per hopper
l	Material of construction	
m	Pyrite hopper body	MS as per IS 2062, Grade A, 8 mm thick
n	Grid	Flat and bars minimum 10mm of MS:2062 Grade A. Sizing grid shall be provided in mill reject pyrite hopper to remove mill reject of size >50mm. The mill reject systems shall be designed for input size of 50mm.
o	Supports, Platform	MS as per IS 2062 Gr A
p	Provision of inspection & poking doors in pyrite hopper	Circular shaped for general inspection and rectangular shaped across the complete width on one side of hopper for maintenance.
q	Pressure Gauge at each service water and instrument air line to pyrite hopper	One (1) no.
2.	**Knife Gate Valve (Metal to metal seated)**	
	Type & Quantity	
a	Knife gate valve at Mill outlet – (KGV-1)	One (1) no. 200 NB Pneumatic cylinder operated per hopper
b	Knife gate valve at Over size discharge chute of Pyrite Hopper (KGV-2)	One (1) no. 200 NB Pneumatic cylinder operated per hopper
c	Knife gate valve at By Pass Chute of Pyrite Hopper (KGV-3)	One (1) no. 200 NB Pneumatic cylinder operated per hopper
d	Knife gate valve at Pyrite Hopper outlet (KGV-4)	One (1) no. 200 NB Pneumatic cylinder operated per hopper
e	Deflection cone	Provided before the pyrite hopper inlet knife gate valve
f	Method of operation	Solenoid valve with manual override facility.
g	Each knife gate valve (KGV-1 to KGV-4) shall be provided with open and close limit switch for interlock and control purpose with indication in OWS of DDCMIS based control system and local control panel/pneumatic panel.	
3.	**Transporter Vessel**	
a	No. of transporter vessel envisaged	One (1) no. per hopper
b	Capacity of transporter vessel	Transporter vessel of capacity minimum 8 Cu.ft shall be provided. Vessel shall operate on level probe mode with timer back-up.
c	Dedicated pneumatic panel with minimum features as mentioned. One (1) no. per stack up assembly	• One “Power On” indication • Push button for Probe override operation • Push button for Purge operation (Purge or equivalent system as per vendor’s proven practice shall be decided during detail engineering) • Local indication of limit switches of pneumatically operated KGV’s and vessel inlet valve.
d	Conveying velocity	Conveying velocity shall be 3.5 to 6 m/s.

e	Number of cycle per hour	Not more than 6 per hour.
4.	**Reject conveying pipe**	
a	Reject conveying pipe size	Conveying line pipe size shall be 150 NB.
b	Quantity	As per layout requirement
c	Type of joint in pipe line	Flanged
d	Distance over which material is to be conveyed and the lift	As per layout requirement
5.	**Bunker & Its Accessories**	
a	Number required	One (1) no. for each mill bay.
b	Effective Capacity	75 MT considering 24 hours' storage volume for the mill reject based on worst coal firing at 100% BMCR.
c	Number of outlet	One (1) no. per bunker
d	Material of Construction and Thickness	
f	Bunker Plates	Refer Technical Data sheet" of Customer's specification , Vol: II-H2
g	Liners	Refer Technical Data sheet" of Customer's specification , Vol: II-H2
h	Discharge gate	Refer Technical Data sheet" of Customer's specification , Vol: II-H2
i	Pressure Relief Valve	One (1) no. per bunker
j	Level Transmitter	One (1) nos. per bunker
k	Terminal Boxes with Up stand on bunker top for terminating the reject conveying pipes	Refer "Technical Data sheet" of Customer's specification, Vol: II-H2. Impacting surface shall be provided with SAIL HARD/TISCRAL liner.
l	Clear access/headroom underneath MRS bunker for a road tanker/truck	4.5 m, suitable chute work under the silo for the Road Tanker/Trucks receive the rejects shall also be provided.
6.	**Bag Filter on Bunker top with associated instruments**	
	Type & Number	Reverse pulse jet type / One per bunker
	Material of filter cloth	Polyester needle felt of antistatic type
	Air to cloth ratio (at maximum air flow)	Refer "Technical Data sheet" of Customer's specification , Vol: II-H2
	Bag cage and filter body	Bag filter body - MS IS 2062 Gr A, 3 mm thick with stiffeners. Bag Cage - 18SWG, IS 7089, galvanized.
	Outlet air quality (SMP level) at bag filter discharge;	Less than 30 mg/Nm3 or as per Environmental norms (whichever is more stringent.)
	Differential Pressure Gauge and Differential Pressure Switch	One (1) no. per bag filter
	Hand operated Chain Pulley Block with geared trolley over bag filter	• No. of CPB – 1 no per bunker top. • Service condition – Class II outdoor as per IS 3832. • Capacity of Chain Pulley Block shall be selected considering a minimum margin of 25% over the maximum weight of the heaviest equipment/component to be handled but in no

		case the capacity shall less than 1T. • Performance test shall be duly certified by govt. approved agency. • For details refer "Miscellaneous Hoists" of Customer's specification , Vol: IIK.
7.	**Compressors with drive motor and all other accessories**	
	No. and type of compressors	2x100% capacity (1 working + 1 Standby) continuous duty Oil free rotary screw type air compressors.
	Location	Housed in MRS Compressor House (Refer Plot plan for location of MRS compressor house)
	Pressure	As per supplier's proven practice
	Service	Conveying air
	Type of Drive	Electric Motor
	Compressor selection criteria	• Minimum temperature : 5°C • Maximum temperature : 50 °C • Design condition (temperature & Relative humidity) : 50°C & 100% RH at atmospheric pressure. • Height above MSL (m) : 34m • Cater to the compressed air requirements of mill reject handling system working simultaneously for the worst coal condition. • Noise level- As per functional guarantees. • The maximum velocity to be considered in compressed air and cooling water piping shall be as mentioned elsewhere in this Technical Specification. • Compressor capacity shall be minimum 13.8 m^3/minute (FAD) at 7 kg/cm^2.
	Materials of construction	Refer "Technical Data sheet" of Customer's specification, Vol: II-H2.
	Instrumentation	As per manufacturer's standard practice & redundancy requirement as per attached C & I specification.
	Conveying air compressor system shall be designed to supply the air to operate each dense phase pneumatic conveying system of both bays simultaneously. The rated pressure of the compressors shall be selected and regulated accordingly. The Mill Reject System compressors shall also be intermittently utilized to fill 1 no. air receiver (0.75m3 capacity kept at one end of feeder floor EL 25.3 M) per mill bay with total consumption approx 1 to 1.8 m3/min FAD. Refer Flow scheme.	
8.	**Air receiver with isolation valves, instruments & accessories**	
	Quantity	Two (2) no. per bay
	Design Code	ASME Section-VIII or IS: 2825 Class II vessel. A corrosion allowance of 1.5 mm (minimum) shall be provided. It shall be designed for 1.5 times the compressor discharge pressure.

	Capacity	Each air receiver capacity of Mill Reject System shall be selected to convey one complete cycle with a minimum margin of 25% provided over and above the calculated air capacity. Minimum capacity of each receiver shall be 15 m^3. Additionally 1 no. air receiver (0.75m3 at one end of feeder floor EL 25.3m) per mill bay.
	Shell/ Body	Refer "Technical Data sheet" of Customer's specification , Vol: II-H2
	Safety relief valve, fusible plugs, pressure gauges, pressure switch, temperature gauge, flanged pipe connections, inspection manholes with automatic drain traps	One (1) no. per air receiver Pressure gauges shall be provided at each air inlet line to air receiver in addition to pressure gauge on air receiver
	Auto drain & Y type Strainer	One (1) no. per air receiver
	Structural platform for maintenance of safety relief valves and instruments	To be provided by supplier. The air receivers will be vertical self-supporting cylindrical vessels with supporting legs for resting. Operation & maintenance platform along with access ladder shall be provided. Fixing of air receivers should be done with anchor fasteners.
9.	**Pipe work for Conveying Air, Service Air to Air receiver -0.75m^3, Instrument Air, Cooling Water for Inlet Valve top plate of Transporter Vessel (if applicable), Cooling water for Quenching in Pyrite Hopper, Cooling water for air compressor.**	
	Quantity	One (1) lot
	Material of construction	Refer "Technical Data sheet" of Customer's specification , Vol: II-H2 & "Low Pressure Piping, Valves" , Vol II- J1
	Instruments	As per flow diagram for MRS & flow scheme for 0.75m3 air receiver.
10.	**Type and no. of sump pumps with local control panel**	One (1) no. fixed type sump pump for each mill bay.
	Material of construction	
	Casing, suction bell and impeller	Refer "SUMP PUMPS, DRIVES AND ACCESSORIES" of Customer's specification , Vol: IIK.
	Shaft/Sleeves	
	Capacity	
	Head discharge	
11.	**Impulse tubing**	Shall be of SS 304 type
12.	**Control System**	DDCMIS based control system with a dedicated OWS to be located in CPU regeneration control room (BHEL scope)
13.	**Lines for various services** **Valves for Air & Water Lines** **Fittings, Flanges, Fasteners & Gaskets** **Velocities**	Refer "Low Pressure Piping, Valves, Volume II-J1" of Customer's specification.

Notes : For the instruments quantity and redundancy refer Flow diagram and C & I specification.

VOLUME: II

TECHNICAL SPECIFICATIONS

VOLUME : II-A

LEAD SPECIFICATION

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VOLUME : II-A **LEAD SPECIFICATION**

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SECTION-I

INTENT OF SPECIFICATION

SECTION-I

INTENT OF SPECIFICATION

1.00.00 This specification is intended to cover design, engineering, manufacture, inspection and testing at manufacturer's works, packing and shipment and delivery at site, unloading, storage and handling at site of all equipment and materials, all necessary civil/structural/ architectural works, erection of all mechanical / electrical / control& instrumentation equipment and materials, site testing, commissioning, trial run, performance and guarantee tests and other services including supply co-ordination, engineering and project management related to the equipment/systems comprising 1 x 660 MW Unit, as specified hereinafter and in accordance with the requirements, conditions, annexures, drawings etc. stated in Volume-I and Volumes II-B to II-L which shall be considered as a part of this volume as completely as if bound herewith.

The specification consists of Volumes-I, II, III detailed index of which has been furnished elsewhere. This specification shall be read and construed in conjunction with the drawings and annexures to determine the scope of work. The quantities shown on drawings and annexures are indicative. Any variation arising during detailed engineering stage will be taken into account by the Contractor without any extra cost and time to the owner.

The Bidder shall be responsible for providing all material, equipment and services, specified or otherwise which are required to meet the intent of this specification, ensuring high degree of reliability and ease of operation and maintenance. The equipment and system/sub-systems shall conform to all aspects of high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation, in a manner acceptable to the Owner and shall also be in line with the current practice for reliable and efficient functioning of the plant.

Owner shall interpret the meaning of the specification, drawings, requirement of operation, maintenance, redundancy etc., and shall have a right to reject or accept any work or material which in his assessments is not technically complete to meet the requirements of this specification and/or applicable National and International standards mentioned elsewhere in this specification.

Bidder is required to carefully examine and understand the specifications and seek clarifications, if required, to ensure that he has understood the specifications as intended by the Owner. In the absence of any specific clarifications made by the Owner during bidding stage, the interpretation of Owner shall be final. The Bidder's offer should not carry any sections like clarifications, interpretations and/or assumptions. All such points are required to be clarified during bidding stage.

In the event of conflict between requirements of any two clauses of this specification/documents or requirements of different codes/standards, specified, the more stringent requirement as per the interpretation of the Owner shall apply.

In case all the above requirements are not complied with, the offer may be considered as incomplete and liable to be treated as non-responsive.

2.00.00 Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific items mentioned shall be understood as establishing type, function and quality desired.

SECTION-II

NOT USED

SECTION-III

PROJECT SYNOPSIS AND GENERAL INFORMATION

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SECTION-III

PROJECT SYNOPSIS AND GENERAL INFORMATION

1.00.00 INTRODUCTION

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

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

2.00.00 APPROACH TO SITE

Sagardighi Super Thermal Power Station site is located at Manigram village, 13 KM north of Sagardighi town by the side of the SMGR (Sagardighi-Manigram-Gankar-Raghunathganj) Road at a distance 20 KM from National Highway 34 in Murshidabad District, West Bengal and around 240 KM from Kolkata, India. The nearest rail station is Manigram adjacent to the site on Bandel - Barhawara branch line and 6.5 KM from Sagardighi Railway Station on Sainthia - Azimgunj line of Eastern Railway. From Sagardighi railway station a railway line will branch off to the site for material unloading and coal marshalling. The equipment will be normally transported by rail only and under exceptional cases by road. The material consignments shall be as per the restrictions of rail and road transportation prevailing in the country.

Nearest Airport – Kolkata.

Nearest Seaport –Haldia.

3.00.00 LAND

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

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

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

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

4.00.00 SOURCE OF COAL

The Power plant shall receive coal from ECL mines. Coal is planned to be transported in rake loads through the existing Pakur- Tildanga-Dhulian-Monigram broad gauge line or through Pakur- Nalhati (proposed)–Takipara-Gosaingram-Poradanga-Monigram broad gauge line. The coal would be carried in rake loads of BOBR/BOX-N wagons.

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

5.00.00 SOURCE OF WATER

The source of water for this project is the River Bhagirathi (5 km) through the proposed intake pump house under implementation for Phase-II station. The water from the River Bhagirathi will be transferred and stored in the five (5) nos. Plant Raw Water Reservoirs by augmentation of the Intake water transportation system for phase - II for meeting the requirement of Phase-III Sagardighi TPS.

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

6.00.00 ASH DISPOSAL AREA

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

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

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

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

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

8.00.00 SALIENT DESIGN DATA

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

a)	Location	:	Manigram village, Sagardighi, Raghunathganj sub-division, Murshidabad District, West Bengal.
b)	Latitude and Longitude	:	24^0 22' 13.7" N, 88^0 6' 15.8" E (Topo sheet No.78/D/3)
c)	Nearest Towns	:	Ajimganj, Jangipur, Raghunathganj.
d)	District Head Quarters	:	Berhampore - 40 km.
e)	Approach Road	:	20 km from National Highway (NH-34)
f)	Nearest Railhead	:	Manigram railway station on Bandel-Barhawara branch line 1 km from site.
g)	Source of Water	:	Bhagirathi River - 5 km
h)	Source of Coal	:	Pachwara (North) mine block in Jharkhand.
i)	Fuel Transportation	:	By rail in rake loads of BOBR/BOX-N wagons.
j)	Surrounding Habitations	:	Villages - Manigram, Chhamugram, Karaia, Thakurpara on the south; Bhumhar, Khasittor, Ekrakhi on the west;

			Dhalo, Bagpara, Santoshpur on the north and Harirampur, Chandparam, Dogachhi on the east.
k)	Level	:	Within 34.5 m contour. Land is above HFL (highest flood level) of the area.
l)	Soil	:	Less fertile alluvial soil.
m)	Land Use	:	Within existing plant boundary of WBPDCL.

Meteorological data of site is given below:

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

SECTION-V

GENERAL TECHNICAL REQUIREMENTS

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SECTION-V

GENERAL TECHNICAL REQUIREMENTS

1.00.00 CODES AND STANDARDS

1.01.00 Except where otherwise specified, the Plant shall comply with the appropriate Indian Standard or an agreed internationally accepted Standard Specification as listed in the annexure to this Section and mentioned in detailed specifications, each incorporating the latest revisions at the time of tendering. Where no internationally accepted standard is applicable, the Bidder shall give all particulars and details as necessary; to enable the Owner to identify all of the Plant in the same detail as would be possible had there been a Standard Specification.

1.02.00 Where the Bidder proposes alternative codes or standards he shall include in his tender one copy (in English) of each Standard Specification to which materials offered shall comply. In such case, the adopted alternative standard shall be equivalent or superior to the standards mentioned in the specification.

1.03.00 Wherever specified or required the Plant shall conform to various statutory regulations such as Indian Boiler Regulations, Indian Electricity Rules, Indian Explosives Act, Factories Act etc. Wherever required, approval for the plant supplied under the specification from statutory authorities shall be the responsibility of the Successful Bidder.

1.04.00 In the event of any conflict between the codes and standards referred above, and the requirements of this specification, the requirements, which are more stringent, shall govern.

1.05.00 In case of any change of code, standards and regulations between the date of purchase order and the date the Successful Bidder proceeds with manufacturing the Owner shall have the option to incorporate the changed requirements. It shall be the responsibility of the Successful Bidder to advise Owner of the resulting effect.

2.00.00 RESPONSIBILITY FOR DESIGN

2.01.00 The Bidder shall assume full responsibility for the design of the whole and every portion of the Plant, whether or not the design work was undertaken specifically in relation to the Contract and whether or not the Successful Bidder was directly involved in the design work.

2.02.00 Notwithstanding the Owner's wish to receive the benefits of new, advanced and improved technologies, a prime requirement is that all the systems and components proposed shall have been already adequately developed and shall have demonstrated good reliability under similar, or more arduous conditions elsewhere, at least for continuous 2 years in two different power station.

2.03.00 The Bidder shall carry out optimization studies for selection of pipe size and equipment wherever required. The result of such studies shall be included as part of bid proposal.

The successful Bidder shall have to carry out surge analysis and other transient condition studies as may be necessary and as required by the Owner as per proven engineering practice.

2.04.00 The Bid shall include a detailed discussion on the development status of and the reasons for any changes made in proposed systems or components for the Plant, as compared with similar items previously supplied in other installations cited by the bidder as reference plants.

2.05.00 The Bidder may also make alternate offers, provided such offers are superior in his opinion in which case adequate technical information, operating feedback, etc. are to be enclosed with the offer, to enable the Owner to assess the superiority and reliability of the alternatives offered. In case of each alternative offer, its implications on the performance, guaranteed efficiency, auxiliary power consumptions, etc. shall be clearly brought out to the Owner to make an overall assessment. In any case, the base offer shall necessarily be in line with the specifications i.e. Base offer shall be as per the technical specifications and the same will be considered for techno-commercial evaluation.

3.00.00 NAME PLATES (RATING PLATES)

3.01.00 Instruction plates, nameplates or labels shall be permanently attached to each main and auxiliary item of plant in a conspicuous position. These plates shall be engraved with the identifying name, type and manufacturers serial number, together with the loading conditions under which the item of plant has been designed to operate.

3.02.00 Items such as valves, etc. which are subject to hand operation, shall be provided with nameplates so constructed as to remain clearly legible throughout the life of the plant giving due consideration to the difficult climatic conditions to be encountered. Nameplates shall be securely mounted where they will not be obscured in service by insulation, cladding, actuators or other equipment. Direction of flow is also to be engraved.

3.03.00 All trade nameplates and labels shall be in English language. All measurements shall be in M.K.S. Units.

3.04.00 The size and location of nameplates shall be subject to Approval of the Owner/Owner's Engineer.

4.00.00 SAFETY AND SECURITY

4.01.00 The design shall incorporate every reasonable precaution and provision for the safety of all personnel and for the safety and security of all persons and property. The design shall comply with all appropriate statutory regulations relating to safety. All structures and equipment shall be designed and constructed to withstand every foreseeable static and dynamic loading condition, including loading under earthquake conditions, with an adequate margin of safety.

4.02.00 Ready and safe access with clear headroom shall be provided to all parts of the plant for operation, inspection, cleaning and maintenance.

4.03.00 Escape routes and clear ways shall be provided to allow speedy evacuation of the plant in the event of fire or explosion, and the plant layout shall allow for ease of access to all parts of the Works by rescue and fire fighting teams. The Plant layout shall be designed to localize and minimise the effects of any fire or explosion. The recommendations of NFPA, OSHA, and TAC etc. as necessary shall be followed in all respects.

4.04.00 The use of corrosive, explosive, toxic or otherwise hazardous materials shall be kept to a minimum during construction and the design of the plant shall minimise the requirement for such materials during operation and maintenance. Where such materials must be used, all necessary precautions shall be taken in the design, manufacture and layout of equipment to minimise the resulting hazard, and all equipment necessary for the protection and first-aid treatment of personnel in the event of accidents shall be provided. Particular attention is drawn to avoid the use of materials containing asbestos in any form.

5.00.00 **GUARDS**

5.01.00 Effective guards and fences must be provided to prevent injury to operators through accident or malpractice.

5.02.00 Mesh guards which allow visual inspection of equipment with the guard in place are generally preferable. The guards shall be constructed of mesh attached to a rigid framework of mild steel rod, tube, or angle and the whole galvanised to prevent loss of strength by rusting or corrosion. The guards shall be designed to facilitate removal and replacement during maintenance.

5.03.00 All drive belts, couplings, gears, sharp metallic edges and chains must be safely guarded. Any lubricating nipple requiring attention during normal running must be positioned where they can be reached without moving the guards.

5.04.00 Guards for couplings and rotating shafts shall be in accordance with BS 5304-1975 or similar approved standard. All rotating shafts and parts of shafts must be covered.

5.05.00 Suitable fencing shall be provided to enclose all openings or doorways used for the hoisting and lowering of machinery etc. This fencing must be securely fixed but quickly detachable when required. A secure handhold must be provided on each side of the opening or doorway.

6.00.00 **LOCATION AND LAYOUT REQUIREMENTS**

The majority of plant and equipment shall all be of indoor installation. A broad list of buildings housing such equipment is given In Vol-II-G2 Section I. Layout shall facilitate access for operation-maintenance and inspection of any one or more equipment/components at a time without disturbing the operation or installation of rest of the plant. Further, Bidder should comply with the criteria given under the various equipment and system specifications as well as those stipulated in Annexure-II attached to this section.

Enclosed General Layout and other tender layout drawings enclosed in Vol-II-L show the location of major installations and auxiliary buildings. The Bidder

shall try to retain these locations as far as practicable. The layout of equipment within the power house as shown in the tender drawings is indicative. The Bidder may, subject to Owner's acceptance alter the same to suit the space requirement of the equipment offered.

While developing the layout of buildings the following criteria shall be given effect:

a) The minimum width of clear access corridors around equipment shall be 1.2 meters.

b) Each building shall have an identified vacant space for equipment unloading and maintenance and preferably a separate bay altogether in buildings housing heavy equipment. Provision for handling equipment by monorail hoist and/or overhead crane shall be made as required.

c) The plinth level with respect to the existing grade level shall be as indicated elsewhere in Vol-II-A Section-V/Annexure-II.

d) The minimum clear height available between two consecutive floor slabs shall not be less than five (5) meters. A clear head room of 2.2 meters shall be maintained between the floor and any overhead piping/cables or other obstruction. Adequate provision for natural ventilation and illumination shall be made as per good engineering practices.

e) There shall be at least two (2) nos. main access doors, one on either side of each building, of which one shall be minimum 3 meters wide with rolling shutters for equipment entry. For multistoried buildings, at least two (2) nos. regular staircases diagonally opposite to each other shall be provided connecting all the floors and roof. These minimum requirements shall be augmented as required depending on the floor area, statutory requirements and TAC recommendations.

f) All buildings shall have provision for toilet and associated effluent discharge system together with facility for drinking water. The criteria for ventilation, fire protection and illumination of building spaces shall be as specified in Vol-II-A Section-V/Annexure-II.

g) All rail/road crossings for pipe/cable racks shall be constructed with minimum 8 meters headroom from top of rail/road to bottom of rack. Similarly top cover over underground pipes/cables shall be minimum one (1) meter. For other detail refer to Annexure-II of this section.

h) Cubicle for operating personnel shall be located at safe place near the equipment.

i) Pipe rack, cable rack and Pipe cum Cable rack shall have hand railings (not less than 1200 mm high) in walkways (min. 800 mm wide) on both sides at appropriate heights.

7.00.00 OPERATION AND MAINTENANCE CONSIDERATIONS

7.01.00 Space for ease of operation and maintenance including equipment removal, tube bundle/cartridge/rotor pulling etc. shall be provided. All valves, gates, dampers and other devices shall be located and oriented in such a way that they are accessible from operating floor levels. Where this cannot be adhered to, platforms and walkways with access ladders shall be provided to facilitate operation and maintenance.

7.02.00 Lifting devices i.e. hoists, chain pulleys, jacks, etc. shall be provided for handling of any equipment and/or part having weight in excess of 100 Kg during erection and maintenance activities. Suitable beams, hooks etc. for this purpose shall be provided in the buildings and clear space provided below to a platform or floor which will allow normal risk free transport means to be used.

Lifting tackles, slings, etc. to be connected to hook of the hoist/crane shall also be provided by the Bidder for lifting the various equipments and accessories covered under this specification.

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

8.00.00 MATERIALS

8.01.00 In selecting materials of construction of equipment, the Bidder shall pay particular attention to the atmospheric conditions existing at the Site and the nature of material/fluid handled.

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

8.02.00 Materials used for various components shall be those which have already proven operating experience in similar type of applications.

8.03.00 All parts which could deteriorate or corrode under the influence of the atmospheric, meteorological or soil conditions at the Site, or under the influence of the working conditions shall be suitably and effectively protected so that such deterioration or corrosion is a minimum over the life of the plant.

8.04.00 Prohibited Materials

The use of the following materials is prohibited:

a) High alumina cement in structural elements

b) Wood wool slabs in permanent framework to concrete

c) Calcium chloride in mixtures for use in concrete works

d) Naturally occurring aggregate for use in reinforced concrete that does not comply with the applicable codes and standards.

e) Cast iron for any oil service

f) Carcinogenic material and suspected carcinogenic materials by World Health Organization.

g) Asbestos or any other fibrous form of hydrated magnesium silicate

h) Any other material generally known to be deleterious if used or incorporated in such project like the facility.

9.00.00 **LUBRICATION**

9.01.00 Provision shall be made for suitable efficient lubrication where necessary to ensure smooth operation free from undue wear.

9.02.00 Non ferrous capillary tubing shall be used throughout.

9.03.00 Gear boxes and oil baths shall be provided with filling and drain plugs, both of adequate size. An approved means of oil indication including level switches and temperature indication shall be provided.

9.04.00 All high speed gears shall be oil bath lubricated. Low speed gears shall be lubricated by means of soft grease. Removable and accessible drip pans shall be provided to collect lubricant, which may drop, from operating parts.

9.05.00 All lubrication points shall be conveniently situated for maintenance purposes. It must be possible to carry out lubrication from a gangway or landing and without the removal of guarding or having to insert the hand into it. Where accessibility to a bearing for oiling purposes would be difficult a method of remote lubrication shall be fitted.

9.06.00 The Bidder shall supply grease gun equipment suitable to service each type of nipple fitted.

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10.00.00 **LUBRICANTS, SERVO FLUIDS AND CHEMICALS**

10.01.00 The Bidder shall provide a detailed and comprehensive specification for all lubricating oils, greases and control fluids required for the entire plant. A sufficient supply of these shall be provided by the Successful Bidder for initial commissioning, first fill and till completion of facilities and handing over of respective units.

10.02.00 The Bidder shall supply a detailed schedule giving the lubricant testing, cleaning and replacement procedures. All equipment and facilities necessary for the testing, cleaning and changing of lubricants and control fluids shall be provided. The Successful Bidder shall endeavor to reduce the verities and grades of required lubricants and control fluids to a minimum, matching them where possible to those already in use in the generating station in order to simplify procurement and minimise storage requirements. All lubricants and control fluids shall be of internationally recognized standards and shall be easily

obtainable from a large number of Indian suppliers. Bidder shall also indicate the equivalent Indian Standard for the above for easy procurement in future.

10.03.00 No lubricant or control fluid shall have toxic or other harmful effects on personnel or on the environment.

11.00.00 PLANT LIFE AND MODE OF OPERATION

The complete plant including all the equipment and systems individually and collectively shall be designed for continuous operation for an economic service life of thirty (30) years under the prevailing site conditions and for the type of duty as specified in relevant sections of the specification.

The critical components of the Steam Generator, Turbine-Generator and Auxiliary equipment, the life of which is limited by time and temperature dependent mechanisms such as thermal stress, creep and low cycle fatigue, are to be designed considering expected (hot, warm and cold) start-up, shut-down and cyclic load variations. (Details are specified in the Volume IIB – Specification of Steam Generator and Auxiliaries and Volume IIC – Specification of Steam Turbine and Auxiliaries and)

The units would be operated on base load with cyclic load variation. The load variation is expected to be as per schedule depending on power demand.

12.00.00 PACKAGING & MARKING

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. While packing the materials, the limitations from the point of view of availability of railway wagon sizes in India should be taken account of. The details of various wagons normally available with Indian Railways for transportation of heavy equipment shall be considered by the Bidder. The Bidder shall be responsible for all loss or damage during transportation, handling and storage due to improper packing.

Bidder shall conduct his own route survey and transportation logistics for transportation of the equipments to project site by road/rail/sea and indicate the same in his proposal.

Each package shall have identification marking indicating the name and address of the consignee shall be clearly marked in indelible ink on two opposite sides and top of each of the packages. In addition the Bidder shall include in the marking gross and net weight, outer dimension and cubic measurement. Each package shall be accompanied by a packing note (in weather proof paper) quoting specifically the name of the Bidder, the number and date of contract and names of the office placing the contract, nomenclature of contents and Bill of Material.

13.00.00 PROTECTION

Equipment having antifriction or sleeve bearings shall be protected by weather-tight enclosures. Coated surfaces shall be protected against impact, abrasion, discoloration and other damages. Surfaces that are damaged shall be repainted.

Electrical equipment, controls and insulations shall be protected against moisture and water damages. All external gasket surfaces and flange faces, couplings, rotating equipment shafts, bearings and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other suitable covering to ensure their full protection. All exposed threaded parts shall be greased and protected with metallic or other suitable protectors.

All piping, tubing and conduit connections on equipment and other equipment openings shall be closed with rough usage covers or plugs shall be sealed and taped. Male threaded openings shall be closed with rough usage covers or plugs shall be sealed and taped. Female threaded openings shall be closed with forged steel plugs.

Returnable containers and special shipping devices shall be returned by the Bidder.

14.00.00 PAINTING

14.01.00 General

All exposed metallic and wooden surfaces subject to corrosion shall be protected by shop application of suitable coatings. Surfaces not easily accessible after shop assembly shall be treated before-hand and protected for life of the equipment. Surfaces to be finish painted after installation shall be shop painted with at least two (2) coats of primer. Steel surfaces, which are not to be painted, shall be coated with suitable rust preventive compound subject to the acceptance of the Owner.

All paints shall be used in accordance with the manufacturer's instructions. No thinners or other substance shall be added to the coating material without the prior notification and specific acceptance of the Owner. The quality and vendor of the paints shall require acceptance of the Owner.

Procedure for painting of any item, if not indicated in the relevant specification, shall be developed by the Bidder. This procedure and quality of paint shall be subject to Owner’s acceptance

All paints shall be applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.

All primers shall be properly applied on to the surface and the first priming coat shall be applied as soon as possible after cleaning, within four hours maximum. The paint shall be applied by brush, roller or airless spray, according to the manufacturer's instructions. Spray painting shall be carried out by operators trained and thoroughly experienced in the use of the spray painting equipment.

If the drying interval between successive coats of paint or primer exceeds the manufacturer’s recommendations, the paint already applied shall be completely and uniformly abraded with fine abrasive paper before putting on the next coat.

Paint spraying on large surfaces shall not be done indoors, without the prior notification and specific acceptance of the Owner. Spray guns shall not be used outdoors in windy weather nor near unprotected surfaces of a contrasting colour and under no circumstances shall spray guns be used where spray may be carried into or onto exposed electrical equipment or unprotected humans.

The Bidder shall provide suitable protection for adjacent plants from air borne materials during cleaning and spraying to the satisfaction of Owner

Paint containers shall not be opened until required and the paint shall be mechanically mixed thoroughly before use, and agitated occasionally during use.

Electrical equipment shall be shop finished with one or more coats of primer and two coats of high-grade oil resistant enamel. The interior of all panels' cabinets and enclosures shall be finished with gloss white enamel. For detail please refer relevant electrical sub-section Volume II F1 & F2.

The Bidder shall furnish sufficient touch-up paint for one complete finish coat on all exterior factory surfaces of each item of equipment. The touch-up paint shall be of the same type and colour as the factory applied paint and shall be carefully packed to avoid damage during shipment. Complete painting instructions shall be furnished.

Shop primer for steel and iron surfaces which will have a continuous operating temperature below 35°C shall be selected by the Bidder, in accordance to the relevant standard. Special high temperature primer shall be used on surface exposed to operating temperature above 35°C.

The colour scheme shall be submitted during execution of contract for acceptance by the Owner.

14.02.00 **Surface Preparation**

The grade of surface preparation shall be classified as indicated in Annexure-I of this section.

Sl. No.	Type of Preparation	Reference Standards		
		SSPC	SIS	BS 4232
1.	Solvent cleaning	SP1	-	-
2.	Hand Tool Cleaning	SP2	St-2	-
3.	Power Tool Cleaning	SP3	St-3	-
4.	Flame cleaning of new steel	SP4	-	-
5.	White metal blast cleaning	SP5	Sa-3	First Quality
6.	Commercial blast cleaning	SP6	Sa-2	Third Quality
7.	Brush-off blast cleaning	SP7	Sa-1	-
8.	Pickling	SP8	-	-

9.	Weathering followed by blast cleaning	SP9	-	-
10.	Near white blast cleaning	SP10	Sa-2.5	Second Quality

Oil and grease shall be removed from the surface by washing with a suitable detergent, rinsing with clean water, and drying.

The abrasive to be used shall be metal grit.

The surface preparation of all steel surfaces to be coated shall be free from all mill scales, rust corrosion products, oxides, paints, oil or other foreign matter.

All welded areas and appurtenances shall be given special attention for removal of welding flux in crevices. Welding splatter, slivers, laminations and underlying mill scale exposed during shot blasting shall be removed or repaired.

No acid/solvents/other cleaning solutions shall be used on surfaces after they have been blasted.

14.03.00 **Application of Primer and Paint**

Primer shall be applied immediately after surface preparation has been completed.

Brushing, spraying, roller coating or other suitable method shall be adopted for application of primer and paint and the work shall be carried out strictly as per the recommendation given by the paint manufacturer.

Primarized surfaces shall be faultless and shall not have mudcracking, dripping over thickness and dry sprays.

Before application of paint/primer, the following shall be particularly checked for conformance to this specification and recommendation of the paint manufacturer:

a) Surface preparation profile.

b) Catalysis ratio for two component paints.

c) Pot life.

d) Minimum and maximum top coating times.

e) Type and quantity of thinners (if required)

f) Viscosity

g) Soundness of previous coating.

h) Ambient conditions (temperature, humidity, etc)

Depending on the degree of contamination by foreign matters, the surfaces primed at shop shall be washed as follows to the satisfaction of the Owner:

a) With clean water under a pressure of a least 7 Kg/cm2 (g) using suitable nozzles. During washing broom of corn brushes shall be used.

b) With suitable solvents, (such as Carbon Tetrachloride, Trichloroethylene etc.) if necessary, to remove traces of grease, oil etc.

Coated parts shall be carefully handled using hemp ropes, cloth belts, pendulum conveyors or suitable means as instructed by the Owner.

Surfaces which cannot be painted after fabrication shall be primed and provided with suitable rust preventive oil before boxing up.

Paints shall be stored in well-ventilated rooms, far away from heat sources, open flames, sparks and protected from sun. Outdoor storage is not permitted. Storage life shall be clearly indicated on the container. Paints, which have thickened or gelled or contained in non-original containers or in unsealed containers shall not be used. Owner's decision in this regard shall be final and binding.

The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as per Table I & II of this section.

For detail painting on building & structural steel elements refer Section-IIG/1 & IIG/2 of this specification.

14.04.00 **Damaged Paintwork**

Any damaged paintwork shall be made good as follows:

a) The damaged area, together with an area extending 25mm around its boundary, shall be cleaned down to bare metal.

b) A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50mm around the perimeter of the original damage.

c) The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming.

14.05.00 Surface preparation and painting work shall not be carried out under the following weather conditions:

a) When the surface is wet or expected to become wet before the paint/primer has dried up due to impending rain, fog or mist.

b) High winds.

c) Ambient temperature below 5deg.C or surface temperature less than 3 deg.C above dew point.

d) Relative Humidity is more than 85%.

14.06.00 **Inspection and Testing of Painting**

The following inspection and testing shall be performed during and on completion of paint systems.

- Shot blasting profile shall be checked using a suitable profile-meter. Acceptable profile shall be 25-30 microns.

- Check of time of top coating and drying, in accordance with the recommendation of paint manufacturer.

- Check of Dry Film thickness by suitable Non Destructive Equipment. The painting shall be rejected if any of the spot measurement shows thickness to be less than 80% of the specified thickness.

- Check of adhesion of Paint Material by "Chequering" or another suitable method.

- Check of porosity of coating for internals, by the use of a suitable instrument.

- Visual inspection of appearance and uniformity of the surfaces painted.

If during above inspection, painting defects are observed, the Bidder shall carry out rectification to bring the faulty surface to the acceptable degree.

The areas where defective or damaged coatings have been repaired or replaced shall be re-inspected to the original requirements.

Surface temperature and humidity readings shall be taken prior to application of each coat. The work shall not proceed if the ambient temperature parameters are outside the requirements of this specification. If more stringent, the coating manufacturer’s requirement shall dictate.

The dry film thickness shall be tested with a micro test film gauge or an accepted equivalent. The testing method shall be in accordance with SSPC – PA 2.

15.00.00 **COLOUR CO-ORDINATION & FINISH**

15.01.00 Exterior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and with the surrounding landscape.

15.02.00 Interior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and which will be conducive to; the comfort, well-being and high productivity of the operators. Operating plant and services provided shall be colour coded for ease of identification.

15.03.00 All finishes shall be durable and as far as possible maintenance free. Finishes shall be easily cleaned.

15.04.00 Final colours and finishes shall be to the acceptance of the Owner.

16.00.00 **ENVIRONMENT PROTECTION AND NOISE LEVEL REQUIREMENT**

16.01.00 **Environment Protection**

The plant shall be designed for installation and operation in harmony with the surrounding environment and all measures of pollution control shall be ensured by the Bidder to restrict pollution from the liquid effluent and stack emission within the limits as given below with due consideration of Environment (Protection) Rules 1986 as amended till date.

The Plant shall be designed meeting the latest environmental requirement issued by MoEF, GOI. In the event of Ministry of Environment & Forest stipulate any other conditions not specified hereunder, the Bidder shall comply with those requirements.

16.01.01 **Liquid Effluent Discharge**

a) Provision laid down in schedule-I for Thermal Power Plants and also in Schedule-VI. General Standards for discharge of Environmental pollutants Part-A: Effects of Environmental (protection) Rules 1986, as amended till date.

b) Any specific requirement of State Pollution Authorities over and above the above stipulation.

16.01.02 **Air Quality Emissions**

a) Suspended Particulate Matter at chimney outlet - Maximum 30 mg/Nm^3

b) Oxides of Nitrogen (NO_x) - 100 mg/Nm^3 .

c) Sulphur di-Oxide(SO_2) - 100 mg/Nm^3

d) Mercury (Hg) - 0.03 mg/Nm^3

e) The Efflux velocity from boiler stack(s) shall not be less than 25 m/sec.

g) Outlet dust emission level of bag filter installed in AHP and CHP shall be restricted to 30 mg/NM^3.

h) For The Coal Handling Plant, areas covered under Dry Fog Dust Suppression (DFDS) shall be designed to control the dust emission level in the working area measured at distance of 2m from the dust generation sources, over and above the atmosphere background dust level to shall be within 5 mg/NM3

The Bidder shall include in his scope all necessary equipment and measuring instruments to comply with above requirements. Location and accessibility of the instruments shall be properly coordinated.

16.02.00 **Noise Level Requirement**

The plant shall be designed, constructed and provided with suitable acoustic measures to ensure the noise level criteria as per the following stipulations.

a) Maximum noise level shall not exceed 85 dB (A) when measured at 1.0M away from the noise emission source.

b) Maximum noise level from its source within the premises shall not exceed 70 dB (A) as per Environment (Protection) Rules 1986, Schedule-III, `Ambient Air Quality Standards' in respect of noise.

c) Any statutory changes in stipulations regarding noise limitation that may occur in future according to State Pollution Control Board or Central pollution Control Board or Ministry of Environment & Forest regulation during tenure of the contract, the Successful Bidder shall comply with the requirement.

17.00.00 **INSPECTION AND TESTING**

17.01.00 Inspection and Tests during Manufacture

17.01.01 The method and techniques to be used by the Successful Bidder for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner prior to the Award of Contract.

17.01.02 The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.

17.01.03 Before any item of plant or equipment leaves its place of manufacture the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.

17.01.04 Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Successful Bidder may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results.

The Successful Bidder shall forthwith forward to the Owner's Engineer duly certified copies of the Test Certificates in Three (3) copies for approval.

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

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

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

17.01.07 All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the Purchaser. The certificates shall include tests for mechanical properties and chemical analysis of representative material.

17.01.08 All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than one hour.

17.01.09 All necessary non-destructive examinations shall be performed to meet the applicable code requirements.

17.01.10 All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination magnuflux and ultrasonic testing shall be employed wherever necessary/ recommended by the applicable code. At least 10% of all major butt welding joints shall be radiographed. Statutory payments in respect of IBR approvals including inspection shall be made by the Successful Bidder. Successful Bidder's scope and responsibility shall also include preparation of all necessary documents in the specific formats stipulated by the statutory bodies, coordination and follow up for above approvals.

17.02.00 **Performance Tests at Site**

17.02.01 The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected System shall be tested by the Successful Bidder on site under normal operating conditions. The Successful Bidder shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.

17.02.02 The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.

17.02.03 The Successful Bidder shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection, pre-commissioning to tests on completion and commissioning of the complete system/equipment.

17.03.00 For details of specific tests required on individual equipment refers to respective section of this specification.

18.00.00 TRAINING OF OWNER'S PERSONNEL

The Successful Bidder shall extend all possible assistance and co-operation to the Purchaser regarding the transfer of technology and developing expertise in the area of engineering operation and maintenance of the Plant.

Number of man-days of training as mentioned below shall be included in his Tender.

18.01.00 Training at Successful Bidder's Premises

The Successful Bidder shall conduct training of Sixty Five (65) engineers of the Purchaser on engineering, operation and maintenance of the Plant at the Successful Bidder's or Associates or Sub Vendor's premises where adequate training facilities are available during the design and manufacturing stage of the successful Bidder.

The total man-months for training of engineers shall be maximum sixty (60), having following indicative break-up:

Discipline	No. of Engineers	No. of Man-month
Operation	25 heads	25
Maintenance Boiler, Turbine,	25 heads	25
Electrical Maintenance	5 heads	5
Control & Instrumentation	10 heads	5
	65 heads	60

However, the details of the training programme will be discussed and finalised with the successful Bidder.

The training may also be arranged by the Successful Bidder in any Plant where the equipment manufactured by the Successful Bidder or his Associates is under installation, operation or testing to enable the trainees to become familiar with the equipment being furnished by the Successful Bidder. All expenses inherently related to the training shall be borne by the Successful Bidder and shall include but not limited to travel expenses in case of off-shore training (international and inland fares), lodging and per diem charges as well as medical insurance, instructors fee, programme and miscellaneous cost to be incurred during the training.

The training programme shall be adequate for the trainees to acquire the necessary expertise and competence in the area of engineering, operation and maintenance and as trainers for in-house technology transfer programme of the Purchaser.

The Successful Bidder shall be responsible for the development of the Training Module and Programme Schedule, which shall be submitted to the Purchaser for approval.

The components of the training modules shall include but not be limited to the training procedures/methodology, instructional materials such as audio visual materials, CDs and slides and manuals for each trainee.

Three (3) sets of the materials included in the training modules shall be handed over to the Purchaser upon completion of the training. An evaluation shall be jointly undertaken by the Successful Bidder and the Purchaser's representative on the adequacy, appropriateness and relevance of the training and the programme effectiveness after the training. The training material shall be in English language only.

The content of the training programme shall include but not be limited to :

1. Coal fired thermal plant principles in management and practice for operators, technicians and maintenance personnel.

2. Plant operation and systems training for operators including simulator training as applicable.

3. Maintenance training programme covering electrical, mechanical and instrumentation and control.

Said training programme shall be submitted to the Purchaser for approval.

The timing of the training should be such that the participants will be conversant with sufficient know-how to participate in the pre-commissioning and commissioning tests of the Plant.

The Successful Bidder shall provide qualified English speaking instructors and training coordinator(s) during the tenure of the training programme.

18.02.00 **Operation and Maintenance Training at Site**

The Successful Bidder shall provide a comprehensive training programme related to design application, plant management, operation and maintenance, including trouble shooting, of the Successful Bidder's supplied system and equipment at the Site starting from Start of Commissioning and thereafter up to the Final hand over of the Unit..

The following instructors shall be at the Site continuously during the training :

a) One (1) for Steam Generator and Auxiliaries

b) One (1) for Turbine Generator and Auxiliaries

c) One (1) for Electrical Works

d) One (1) for Instrumentation and Control (Boiler and Auxiliaries)

e) One (1) for Instrumentation and Control (Turbine and Auxiliaries)

18.03.00 **On-the-Job Training**

During the period of pre-commissioning, commissioning and trial operation, the Purchaser shall provide operation and maintenance personnel to assist the Successful Bidder in the operation and maintenance of his supply and work under the direction of the Successful Bidder for the purpose of on-the-job training.

The Purchaser shall have the right to send to the Site his employees later intended to operate and maintain the equipment supplied under this Contract. The successful Bidder shall, without additional cost, use his site staff to instruct these employees on the operation and maintenance of the equipment. All instructions shall be in the English language.

ANNEXURE-I

LIST OF STANDARDS FOR REFERENCE

a) International Standards Organisation (ISO).

b) International Electro-technical Commission (IEC).

c) American Society of Mechanical Engineers (ASME).

d) American National Standards Institute (ANSI).

e) American Society for Testing and Materials (ASTM).

f) American Institute of Steel Construction (AISC).

g) American Welding Society (AWS).

h) Architecture Institute of Japan (AIJ).

i) National Fire Protection Association (NFPA).

j) National Electrical Manufacturer's Association (NEMA).

k) Japanese Electro-technical Committee (JEC).

l) Institute of Electrical and Electronics Engineers (IEEE).

m) Federal Occupational Safety and Health Regulations (OSHA).

n) Instrument Society of America (ISA).

o) National Electric Code (NEC).

p) Heat Exchanger Institute (HEI).

q) Tubular Exchanger Manufacturer's Association (TEMA).

r) Hydraulic Institute (HIS).

s) International Electro-Technical Commission Publications.

t) Performance Test Code (PTC).

u) Applicable German Standards (DIN).

v) Applicable British Standards (BS).

w) Applicable Japanese Standards (JIS).

x) Electric Power Research Institute (EPRI).

y) Standards of Manufacturer's Standardization Society (MSS).

z) Bureau of Indian Standards Institution (BIS).

aa) Indian Electricity Rules.

bb) Indian Boiler Regulations (IBR).

cc) Indian Explosives Act.

dd) Indian Factories Act.

ee) Tariff Advisory Committee (TAC) rules.

ff) Emission regulation of Central Pollution Control Board (CPCB).

gg) Pollution Control regulations of Ministry of Environment & Forests, Govt. of India.

hh) Central Board of Irrigation and Power (CBIP) Publications.

ii) National Building Code (NBC).

jj) Indian Road Congress (IRC).

kk) Latest guidelines of Railway Authority.

ANNEXURE-II

CRITERIA FOR LAYOUT

PLOT PLAN LAYOUT REQUIREMENTS

The guidelines shall be applied in general, unless otherwise stated in other technical Volumes. In addition to these guidelines, Bidder shall refer the attached Plot Plan, drawing no. **12A05-DWG-M-003A,** for tentative arrangement of the various facilities under this package.

	ITEM	SPECIFICATION REQUIREMENT
A.	**Site conditions to be considered**	
1.	Prevalent wind direction during summer (for deciding Cooling Tower orientation)	Refer wind-rose in plot plan.
2.	Prevalent wind direction(s) during dry seasons (for deciding the location of coal stock pile and ash dump/ unloading areas, minimising the pollution effect due to dust)	Refer wind-rose in plot plan .
3.	**Location of:**	
a)	Water intake point.	Towards South.
b)	Water discharge point.	-.
c)	Plant drainage outfall point(s).	Towards East.
d)	Railway entries & exits.	Towards South.
e)	Road entries & exits.	Towards North & North-East.
f)	Electrical power transmission grid system.	Towards East.
g)	selected ash dump area.	Towards North.
h)	Nearest residential area.	Towards South.

ITEM		SPECIFICATION REQUIREMENT
B.	**Layout Requirements**	
1.	**Maximum permissible slope in**	
a)	Rail track	1 in 400
b)	Road	1 in 30
c)	Sides of unpaved embankment	1 in 2
2.	**Required road width**	
a)	Main roads	8.0 Metres with 2.5m wide shoulders on either side.
b)	Auxiliary interconnections	4.0 Metres with 1.0m wide shoulders on either side.
c)	Road to the power house unloading bay :	
	• Only for entry to the unloading bay • To pass through the unloading bay	Yes. No.
3.	**Required minimum horizontal distance between the nearest points of**	
a)	Plant boundary and the boundary of residential area	(Local municipality/factory rule)
b)	Electrical transformer and any other building/facility	As per the Tariff Advisory Committee Rules.
c)	Fire water supply installation and any building/facility subject to fire risk.	As per the Tariff Advisory Committee Rules.
d)	Inflammable liquid (fuel oil, etc.) storage & handling installation and their fencing and other buildings/facilities.	Rules of the Indian Explosive (Indian Explosives Act) and Indian Petroleum Code.
4.	**Required minimum vertical clearance**	
a)	Under pipes/cable racks at road crossings	8.0 Metres.
b)	Soil coverage over underground pipes	1.0 Metre (minimum).
c)	Pipe/Cable trench	No Trench. Pipe/Cable Racks shall be used exclusively.

	ITEM	SPECIFICATION REQUIREMENT
5.	Railway Wagon clearance	As per the rules of the Indian Railways.
6.	Minimum Clearance between any road edge and building/structure/ any fixed installation.	3 Metres.
7.	**Required level, above the local developed grade level, of**	
a)	top of all roads	150 mm.
b)	all outdoor paved areas	150 mm.
c)	Temporary storage areas, workshops, offices, residence etc. required at the time of erection work.	Yes.

BUILDING/ EQUIPMENT LAYOUT REQUIREMENTS

	ITEM	SPECIFICATION REQUIREMENT
A.	**Minimum clear space required at all working and walking areas for operating & maintenance personnel**	
1.	**Horizontal, in all directions**	
a)	Adjacent to any electrical equipment, electrical cables, running (rotating/reciprocating) equipment, safety valve or vent/drain pipe outlet, pipe/ equipment of surface temperature exceeding 60°C.	1200 mm.
b)	Adjacent to any other plant facilities (including walls/structures)	1000 mm.
2.	**Vertical (head-room clearance)**	
a)	Under any pipe/equipment surface of temperature exceeding 60°C and any electrical cables or other electrical items.	2.2 Meters.
b)	Under any other plant facilities (including structures, pipes etc.)	2.2 Meters.
3.	**For all areas** where any equipment (including trucks, trolleys and other material handling equipment) will move or maneuver.	Minimum 500 mm clear in all direction from the outer edges of the equipment.
4.	**Minimum clear hand space required for**	
a)	The application of thermal insulation	100 mm
b)	Welding work	150 mm
c)	Bolt tightening	150 mm

B. **Floors, platforms, staircase, ladders, walls, doors & windows**

1.	**Statutory Requirement**	As per the regulations of OSHA, Tariff Advisory Committee, Indian National Building Code, Indian Factories Act, Local Municipal Rules, etc.
2.	**Operation & Maintenance Requirement**	
a)	Adequate floor space shall be kept to permit dismantling, temporary storing and in-situ maintenance of plant & equipment parts, satisfying the clear space requirements stated above. A separate unloading bay for such purpose is required.	Yes
b)	Floors or fixed/portable platforms with stairs/ ladders shall be provided for easy approach to any plant item, including valves, instruments, etc. to be operated, observed and/or to be frequently (more than once a month) maintained.	Yes
3.	**Plinth level** of all buildings, above the Finished Ground Level (FGL)	300 mm. However, 500 mm for power house building.
4.	**Minimum access** opening required (with rolling shutter)	3.5 m wide x 4 m high or, more wherever entry of loaded truck is envisaged, depending upon the equipment size to be handled.

C. **Other Maintenance Requirement**

C. Other Maintenance Requirement

1.	Generator stator handling In case the Generator stator cannot be handled by the turbine house crane, all provisions for its overhauling, including the arrangement to slide the stator on the turbine house floor, the foundation work for stator jacking /lowering assembly, dismantling of building end walls/structures etc. shall be kept.	Yes

2.	Maintenance of the internals/impellers of all important equipment, like boiler feed pumps, feed water heaters, Surface Condenser, fans of the boiler draft plant, Intake and circulating water pumps, cooling water pumps, coal mills, air compressors, blowers, heat exchangers, fuel oil pumps, filters etc.	Shall be possible without disconnecting or dismantling any piping/ducting.
3.	Overhauling and handling of the casings for the above items	Shall be possible without disturbing/dismantling any piping/ducting not directly connected to them.
4.	Crane Approach	
	Wherever required the unobstructed approach of the crane hook/other hoisting equipment hook to various plant & equipment shall be possible.	Yes
D.	Central Control Room	
	All electronic equipment other than those directly associated with control, operation or presentation of displays shall be mounted external to the control room in air conditioned control equipment room.	Yes
	The bidder shall describe in his bid the proposed layout philosophy of the Central Control Room and Control Equipment Room and the arrangement of equipment best suited for the system offered by him and as per good ergonomically consideration.	
	However, as a guide line, following features are given :	
a)	False ceiling and false flooring shall be provided.	
b)	Uniform height, colouring schemes for cabinets etc. shall be available.	
c)	The total area of floor space covered by Control Consoles/Panels in the Control Room shall not exceed 15% of floor area.	
d)	No opening shall be provided from Boiler side.	
e)	Two double leaf doors, suitably located for entering the Control room shall be provided with opening towards the turbine floor.	

f) Cable entry for the panels/consoles shall be from bottom and suitable openings shall be provided.

g) The Control Room lighting shall be designed to provide a glare free uniform illumination. The level of illumination shall be minimum 400 LUX.

h) Necessary Air Conditioning shall be provided for Central Control room, Control Equipment Room and SWAS room etc.

i) Basic amenities like toilet, Tiffin rooms, wash basins, rest rooms etc. shall be provided near the Control Room.

D. **Toilet and drinking water facility**

Required in all buildings and on all floors wherever operating personnel are to be deployed.

SECTION-VI

PROJECT MANAGEMENT AND SITE SERVICES

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SECTION-VI

PROJECT MANAGEMENT AND SITE SERVICES

1.00.00 PROJECT MANAGEMENT SERVICES

1.01.00 Responsibility

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

a) Planning and Monitoring

b) Owner's Engineering Management

c) Contracts Management

d) Quality Assurance, Inspection & Expediting

e) Construction Management

f) Spares Management

g) Commissioning Management

Detailed responsibilities in the above areas are discussed below :

1.02.00 **Organisation**

1.02.01 **Headquarters**

The project management team shall be stationed at the organizational headquarter and headed by a senior level executive designated as the Project Manager who shall be responsible to Owner for the execution of the project. . He should have adequate financial power and authority to give decision.

Separately, designated leaders shall be identified for each of the areas mentioned under 1.01.00, who, in turn, will report to the Project Manager for all matters related to this contract.

1.02.02 **Central Co-ordination Cell**

The central coordination/ cell shall be based in Kolkata and shall have sufficient technical personnel to coordinate technical matters and to quickly resolve day to day queries or references made by Owner and his Consultants without having the need to refer to his headquarters each time.

1.02.03 **Site Organisation**

The site should have a competent construction manager for all site operations with adequate financial power and sufficient level of authority to take site decisions. The organisation chart for site should indicate the various levels of experts to be posted for supervision in the various fields in civil construction, erection, commissioning etc.

1.02.04 **Organisation Chart**

The Bidder shall furnish a detailed organisation chart for the project management team, clearly identifying the key personnel in each of the areas mentioned at 1.01.00 above. The expected number of executives at different levels shall also be indicated, separately for headquarters, central coordination cell and site organisation.

1.03.00 **Implementation Schedule**

The following milestones shall be followed by the Contractor against each activity as detailed below:

1.	Letter of Award (LOA)	Zero Date
2.	Supply Completion	36 months from LOA
3.	Synchronization	38 months from LOA
4.	Completion of Trial Operation	42 months from LOA
5.	System & Completion of all facilities as per contract and handing over	45 months from LOA After rectifying all jobs as identified in the Punch List to the satisfaction of the Owner.
6.	P. G. Test	To be completed within three (3) months after Completion of all facilities and handling over.
7.	Guarantee/Warranty Period	For a period of 18 months from the date of completion of the facilities or twelve (12) months from the date of operation acceptance (or any part thereof), whichever occurs first and any suitable extension of time for completion of rectified job granted by Employer
8.	Final Acceptance	After the expiry of defect liability period

1.03.01 **Owner's Engineering Schedules**

These schedules shall cover various design submissions indicating different Owner's Engineering activities to be performed. Such schedules shall be furnished by the Bidder for each and every plant/systems/ equipment/ item covered in the scope of this specification.

1.03.02 **Manufacturing Schedule**

The Contractor shall submit to the Owner's Engineer his manufacturing and delivery schedules for all equipment within thirty (30) days from the date of issue of the Letter of Award (LOA). Such schedules shall be in line with the detailed network for all phases of the work of the Contractor. Such schedules shall be reviewed, updated and submitted to the Owner's Engineer, once in every two months thereafter, by the Contractor. Schedules shall also include the materials and equipment purchased from outside suppliers.

1.03.03 **Erection Schedules**

In order to achieve the overall completion schedule, the Contractor shall provide the Owner all the information covering erection sequence, testing and commissioning activities. These schedules may be based on the recommended erection procedures and will be subject to discussions/agreements with the Owner subsequent to the award of contract.

1.03.04 The successful Bidder shall have to provide all the above schedules (i.e. 1.03.01, 1.03.02 & 1.03.03) in a tabular form in addition to that in the form of L2 & L3 networks and these shall necessarily include information not limited to the earliest and latest dates for various activities/submissions and also any related constraints. However, the Bidder shall include in his proposal a Level-1 (L-1) network showing the major activities and various milestones to achieve the above mentioned completion schedule.

1.03.05 The Contractor shall provide the Owner the original disc/software for all such schedules along with requisite no. of copies (as required by the Owner) within an agreed time schedule. This time schedule will be agreed between Owner/Bidder at the time of award of Contract. The Contractor's project management software shall be compatible with that of the Owner and the input data shall be furnished to the Owner in a manner compatible with Owner's project management software, Primavera.

1.04.00 **Detailed Responsibilities**

1.04.01 **Planning & Monitoring**

a) **Planning**

The Bidder shall prepare a Master Network Schedule in the form of PERT network consisting of at least 500 activities.

The network shall be prepared on a Work Breakdown Structure for the project which sub-divides the project into a set of manageable systems/sub-systems. The master network will identify milestones of key events for each system/package in the areas of Owner's Engineering, procurement, manufacture and despatch and erection and commissioning. The master network shall represent the Level-I plan and will form the basis for development of detailed second and third tier execution plans. The master network shall conform to the overall schedule prescribed by Owner.

The master network should be submitted along with the bid, which would be mutually discussed and finalised before the Award of Contract. This master network would clearly indicate the responsibility of the Bidder and project management team. This master network would form a part of the contract. The master network shall also identify a complete list of inputs to be furnished by the Owner which may be required for proper interfacing and tie-up. Scheduled dates for providing such inputs shall also be indicated, which will be mutually discussed and finalised.

b) **Monitoring & Progress Reporting**

The progress reports would be emanated every month, one from the head office of the Contractor and another from the site office. The progress report emanating from the head office should necessarily include the following sections:

i) Report on key milestones.

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

iii) Action needing attention of the Owner/Consultant.

iv) Detailed package wise status of Owner's Engineering submissions, quality plan submissions and approval, procurement manufacture and despatch.

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

i) Report on key milestones.

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

iii) Action needing attention of the Owner/Consultant.

iv) This report would also cover the areas pertaining to the receipt of the equipment at the port, port clearance, transport, receipt at site, erection and commissioning.

In addition to the above, as the project execution progresses, the Contractor shall also be responsible for generating more frequent reports in the form of fax/e-mail information on progress in critical areas so that actions can be expedited. The exact format of the progress report shall be finalised after award of Contract.

1.04.02 **Owner's Engineering Management**

Based on the master network for the project (L-1) the Contractor will prepare an exhaustive list of Owner's Engineering activities for the equipment/systems covered in his scope and a detailed programme of accomplishing the same within the time frame specified in the master network. This schedule will form the Level-2 (L-2) network for Owner's Engineering activities.

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

Detailed (L-2) and (L-3) networks would be submitted sequentially by the Contractor within two months from the date of issue of Letter of Award and finalised within one (1) month thereafter.

All such networks shall be provided in MS PROJECT software.

The Owner's Engineering management team should also co-ordinate all interface Owner's Engineering activity between the Contractor and the equipment sub-vendors so as to ensure the correctness and completeness of related Owner's Engineering documentation before the same is submitted to the Owner.

1.04.03 **Contracts Management**

Based on the master network, the Contractor shall submit L-2 programmes of manufacture and despatch. In addition, the master network shall also include periods considered for site activities viz. erection, commissioning etc. These L-2 programmes would be submitted in 2 months time from the date of award of contract and finalised within one (1) month thereafter. The Contractor will also submit site mobilisation plan. This programme would be submitted at the time of finalisation of award of contract and agreed immediately thereafter so that immediate development of the various activities at site could take place.

The Contractor should also submit L-3 programmes for the manufacturing, despatch of the various items. These networks shall also show the customer hold points (CHP) which have to be cleared by Owner or their authorised representative(s) before further manufacturing can take place. These L-3 programmes for the manufacture and despatch would clearly identify responsibilities of the Contractor, sub-Contractor and Owner. These networks

shall be submitted within one (1) month of the date of finalisation of the various sub-contracts by the Contractor.

In case all the manufacture is being done by the Contractor then the L-2 programmes would be themselves amplified to cover details of the manufacture, inspection, clearance by Owner and despatch.

The Contractor shall also submit the programme for procurement of bought out items, detailed shipping schedule and cash flow statement for Owner's approval.

1.04.04 **Quality Assurance, Inspection and Expediting**

The Contractor shall submit the list of manufacturers/sub-vendors from whom the equipment are expected to be procured and the quality assurance plans thereof for the manufacture shall be approved by the QA group of Owner before the manufacturing is commenced. The list of major suppliers would be submitted along with the bid and this shall be mutually discussed and approval will be given by the Owner during contract negotiation meeting prior to placement of Letter of Award. This approved list will be binding to the bidder. In the said list, Owner reserves the right to include reputed/reliable vendors of his own choice. Regarding the various other sub-vendors, the list would be submitted within six (6) months of the award of the contract that shall be scrutinized by the Owner to accord approval. In such list Owner reserves the right to include vendors of his own choice. No further vendor approval will be given after six (6) months. On the quality plans, the customer hold points will also be identified based on which Owner would give clearance for the manufacture to proceed further.

Quality assurance/Inspection group of Owner or its representative would issue a material despatch clearance certificate (MDCC) after the inspection clearance which will enable the Contractor to despatch the equipment and claim the payment. In the despatch programme, the Contractor shall indicate a schedule of estimated programme, tonnages specifically identifying various oversize dimensioned consignments (ODC). Further the Contractor will also be required to ensure at all stages of shipment that packing of all shipments despatched are suitable for ocean freight to India, handling at the port of entry, inland transportation and preservation at site up to erection. All despatch details & item lists shall be made available to both Owner & site immediately after shipping.

The Contractor shall also expedite all despatches from their own works/works of their sub-vendors, so as to match with the various activities mentioned at 1.04.03 above.

1.04.05 **Construction Management**

Based on the L-1 Master Network Programme, within two (2) months of the issue of Letter of Award, the Contractor shall submit a programme of construction/erection/commissioning, either in continuation with the manufacture and despatch or separately for the implementation. These

programmes would be amplified showing when the civil drawings shall be released by him and construction of civil works shall be completed by him to facilitate start of erection and subsequent activities and shall form the basis for site execution and detailed monitoring. The three monthly rolling programme with the first month's programme being tentative based on the site conditions would be prepared based on these L-3 programmes. The Contractor shall also be involved along with the Owner to tie up detailed resource mobilisation plan over the period of time of the contract matching with the performance targets.

The L-3 programme would be jointly finalised by the site in-charge of the Contractor with the Owner's project coordinator as well as the site planning representative. The erection programme will also identify the sequential erectable tonnages that are required for various equipment which should be taken care of in the despatch programmes.

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

1.04.06 **Spares Management**

Along with the proposal for the plant and equipment, the Contractor shall also submit proposals/schedule for the following:

a) Mandatory spares

b) Recommended spares

While the award for mandatory spares will be finalised at the time of the award of contract, recommended spares will be finalised within twelve (12) months thereafter.

1.05.00 **Project Progress Review Meetings**

Keeping in mind the overall responsibility of the Contractor it is intended that periodic progress reviews on the entire activities of execution in respect of Sagardighi Thermal Power Plant unit #5 will be held initially at least once in two (2) months at Kolkata/site. During peak period it may be held once in a month. These meetings will be attended by reasonably higher officials of the Contractor and their leading sub- contractors and will be used as a forum for discussing all areas where progress needs to be speeded up. Actions will be placed on the concerned agencies and decisions will be taken to expedite/speed up the progress. Minutes of such meetings will be issued reflecting the major discussions and decisions taken and circulated to all concerned for reference and action. The Contractor shall be further responsible for ensuring that suitable steps are taken to meet various targets decided upon such meetings.

In addition to the above, and to streamline the construction and erection at site, a suitable frequency and forum of periodic meetings between the Contractor and the Owner will be decided upon as part of erection coordination procedure. Site co-ordination meeting may be held on weekly basis.

1.06.00 **Owner's Consultant**

The Owner would appoint a consultant to assist him in some of the areas mentioned at 1.01.00 above. The details of interaction and procedures for coordination between Owner/Owner's Consultant and Contractor/Contractor's project management team shall be finalised during contract negotiations.

1.07.00 **Commissioning Management**

1.07.01 For commissioning of the various equipment/system covered under the scope of contract, Owner will form an organisation structure which may consist of the following committees. The Contractor shall nominate his representative on one or more of the committee as decided by the Owner:

a) Commissioning Teams.

b) Testing Teams.

1.07.02 Commissioning documents shall be prepared by the Contractor in the following manner and submitted for Owner's approval :

a) Paper of Principle

This document shall be prepared for the various equipment/ systems under commissioning and shall have the following objectives to fulfill and shall be submitted for Owner's approval at least six (6) months before their actual commissioning :

i) Establish design data against which Plant Performance will be compared.

ii) Set-out the testing objectives and proposals.

iii) Define the documentation required.

b) **Testing/Commissioning Schedule**

These shall be prepared for the various equipment/systems under consideration and shall contain sections like detailed testing method, programme, safety, individual responsibility and results.

c) **Standard Check Lists**

Standard checklists are intended for use at the completion of erection to ensure correct erection, testing and to a limited extent operation for repetitive items.

1.07.03 **Test Reports**

After the completion of commissioning activity of equipment/ systems, the Contractor shall prepare the test reports which shall include all the relevant information related to various commissioning checks, tests carried out, any deviations/commissions noticed with respect to the intended design requirements, sequence of various commissioning activities as actually adopted vis-à-vis as recommended in the procedures, programme schedules achieved and any other such information as required. These test reports shall be submitted in requisite number of copies to the Owner and this should be duly signed jointly by the Owner/Consultant and the Contractor/Equipment supplier, who are involved during the commissioning activities.

2.00.00 **SITE SERVICES**

These services shall be rendered by the Bidder as part of the overall project management service. The services shall broadly include but not be limited to the following :

2.01.00 Arranging material despatch from the shop by rail/road and/or sea as applicable.

2.02.00 Monitoring movement of materials & follow-up as necessary with Railways, road transport, port clearance etc. from the time of despatch F.O.R. works/F.O.B. port of shipment by Contractor till receipt of the same at site.

2.03.00 Unloading of materials at Railway Station/Railway Siding inside project area, transportation to site store, assessment of lost/damaged items in transit and arranging insurance claims and replacement of lost/damaged items. The Contractor shall submit to the Owner's Engineer a report detailing all the receipts during the week.

2.04.00 Issuing materials from site store/open yard from time to time for erection as per the construction programme. The Contractor shall be the custodian of all the materials issued till the plant is officially taken over by the Owner after complete erection and successful trial run & commissioning.

2.05.00 Transportation of materials to their respective places of erection and erection of the complete plant & equipment as supplied under this specification.

2.06.00 Trial run and commissioning of individual equipment/sub-systems and the plant as a whole to the satisfaction of the Owner, including supply of temporary equipment & services for chemical cleaning, steam blowing as well as performance guarantee tests.

For Coal Handling Plant, satisfactory operation of the system, amongst others, shall consist of operation without spillage or choking anywhere even during monsoon.

Provision for preservation of individual equipment after trial run and commissioning e.g. Nitrogen blanketing etc. as necessary shall also be in the scope of the Bidder.

2.07.00 Supply and application of the final paints lubricating oils and all consumable till completion of facilities and hand over..

2.08.00 For the purpose of erection and commissioning the Contractor's scope of work shall include but not be limited to the following :

2.08.01 Deployment of all skilled and unskilled manpower required for erection, supervision of erection, watch & ward, commissioning and other services to be rendered under this specification.

2.08.02 Deployment of all erection tools & tackle, construction machinery, transportation vehicles and all other implements in adequate number and size, appropriate for the erection work to be handled under the scope of this specification.

Supply of commissioning spares.

2.08.03 Supply of all chemicals and consumables, e.g. Regeneration chemicals, alum, lime, polyelectrolyte, resin, welding electrodes, cleaning agents, diesel oil, grease, lubricant etc. as well as materials required for temporary supports, scaffolding etc. as necessary for such erection commissioning work till completion of facilities and hand over, except those listed under exclusion elsewhere in this specification.

2.08.04 Construction of all civil/structural/architectural works, including construction of foundation for all equipment supplied as required, grouting of equipment on foundation after alignment, and all other incidental civil activities as detailed elsewhere.

2.08.05 All structural steel fabrication and erection work as detailed elsewhere in the specification.

2.08.06 Providing support services for the Contractor's erection staff e.g. construction of site offices, temporary stores, residential accommodation and transport to work site for erection personnel, insurance cover, watch & ward for security and safety of the materials under the Contractor's custody etc. as required.

2.08.07 Maintaining proper documentation of all the site activities undertaken by the Contractor as per the proforma mutually agreed with the Owner; submitting monthly progress reports as also any such document as and when desired by the Owner; taking approval of all statutory authorities e.g. Boiler Inspector, Factory Inspector, Inspector of Explosives etc. for respective portions of work under the jurisdiction of such statutes or laws.

2.08.08 The Contractor shall provide `Industrial Relations' unit and `Medical' unit to take care of his erection staff and the Owner shall have no obligation in this regard.

2.09.00 **Site Organisation**

The Contractor shall maintain a site organisation of adequate strength in respect of manpower, construction machinery and other implements at all times for smooth execution of the contract. This organisation shall be reinforced from time to time, as required, to make up for slippages from the schedule without any commercial implication to the Owner. The site organisation shall be headed by a competent construction manager having sufficient authority to take decisions at site.

On award of contract, the Contractor shall submit to the Owner a site organisation chart indicating the various levels of experts to be deployed on the job. The Owner reserves the right to reject or approve the list of personnel proposed by the Contractor. The persons, whose bio-data have been approved by the Owner, will have to be posted at site and deviations in this regard will not generally be permitted.

The Contractor shall also submit to the Owner for approval a list of construction equipment, erection tools, tackle etc. prior to commencement of site activities. These tools & tackle shall not be removed from site without written permission of the Owner.

2.10.00 **General Guidelines for Field Activities**

2.10.01 The Contractor shall execute the works in a professional manner so as to achieve the target schedule without any sacrifice on quality and maintaining highest standards of safety and cleanliness.

2.10.02 The Contractor shall co-operate with the Owner and other Contractors working in site and arrange to perform his work in a manner so as to minimise interference with other Contractors' works. The Owner's Owner's Engineer shall be notified promptly of any defect in other Contractor's works that could affect the Contractor's work. If rescheduling of Contractor's work is requested by the Owner's Owner's Engineer in the interest of overall site activities, the same shall be complied with by the Contractor. In all cases of controversy, the decision of the Owner shall be final and binding on the Contractor without any commercial implication to owner.

2.10.03 The Owner's Engineer shall hold weekly meetings of all the Contractors working at Site at a time and a place to be designated by the Owner's Engineer. The Contractor shall attend such meetings and take notes of discussions during the meeting and the decisions of the Owner's Engineer and shall strictly adhere to those decisions in performing his Work. In addition to the above weekly meeting, Owner's Engineer may call for other meetings either with individual contractors or with selected number of contractors and in such a case the Contractor, if called will also attend such meetings.

2.10.04 Time is the essence of the Contract and the Contractor shall be responsible for performance of his Work in accordance with the specified construction schedule. If at any time the Contractor is falling behind the schedule, he shall

take necessary action to make good of such delays by increasing his work force or by working overtime or otherwise accelerate the progress of the work to comply with the schedule and shall communicate such action in writing to the Owner's Engineer, satisfying that his action will compensate for the delay. The Contractor shall not be allowed any extra compensation for such action.

2.10.05 The Owner's Engineer shall however not be responsible for provision of additional labour and or materials or supply or any other services to the Contractor except for the co-ordination work between various Contractors as set out earlier.

2.10.06 The works under execution shall be open to inspection & supervision by the Owner's Owner's Engineer at all times. The Contractor shall give reasonable notice to the Owner before covering up or otherwise placing beyond the reach of inspection any work in order that same may be verified, if so desired by the Owner.

2.10.07 Every effort shall be made to maintain the highest quality of workmanship by stringent supervision and inspection at every stage of execution. Manufacturer's instruction manual and guidelines on sequence of erection and precautions shall be strictly followed. Should any error or ambiguity be discovered in such documents, the same shall be brought to the notice of the Owner's Owner's Engineer. Manufacturer's interpretation in such cases shall be binding on the Contractor.

2.10.08 The Contractor shall comply with all the rules and regulations of the local authorities, all statutory laws including Minimum Wages, Workmen Compensation etc. The contractor shall engage maximum number of local unskilled and semi skilled labours for construction works. All registration and statutory inspection fees, if any, in respect of the work executed by the Contractor shall be to his account.

2.10.09 All the works such as cleaning, checking, leveling, blue matching, aligning, assembling, temporary erection for alignment, opening, dismantling of certain equipments for checking and cleaning, surface preparation, edge preparation, fabrication of tubes and pipes as per general Owner's Engineering practice at site, cutting grinding, straightening, chamfering, filling, chipping, drilling, reaming, scrapping, shaping, fitting-up bolting/welding, etc., as may be applicable in such erection and are necessary to complete the work satisfactorily, are to be treated as incidental and the same shall be carried out by the Contractor as part of the work.

2.10.10 In case of any class of work for which there is no such specification as laid down in the contract such as, blue matching, welding of stainless steel parts, etc., the work shall be carried out in accordance with the instructions and requirements of the Owner's Engineer.

2.10.11 It may sometimes be necessary to remove some of the erected structural members to facilitate erection of bigger/pre-assembled equipment. In such cases, the removal and re-erection of such members, which are essential, and if so agreed by the Owner's Engineer, will have to be done by the Contractor.

2.10.12 Attachment welding of necessary instrumentation tapping points, thermocouple pads, root valves, condensing vessels, flow nozzles and control valves etc., both for regular measurement and performance testing to be provided on equipment, its auxiliaries or pipelines covered within the scope of this tender, will also be the responsibility of the Contractor and the same will be done as per the instructions of Owner's Engineer. The erection and welding of all above items will be the Contractor's responsibility, even if :

a) Product groups under which these items are re-leased are not covered in the scope of this tender.

b) Items are supplied by an agency other than the Contractor.

2.10.13 Preservation of all materials/equipment under custody of the Contractor during storage, pre-assembly & erection, commissioning etc., shall be the responsibility of the Contractor. All necessary preservatives and consumables like paints, etc., shall be arranged by the Contractor. Necessary touch up painting, periodic application of preservatives/paints on pressure parts/other equipment even after erection until completion of work shall be carried out by the Contractor. The Contractor shall fabricate piping, install lub oil systems and carry out the acid cleaning of fabricated piping. The Contractor shall also service the lub oil system, carryout the hydraulic test of oil coolers, etc.

2.10.14 It is responsibility of the Contractor to do the alignment etc. if necessary, repeatedly to satisfy Owner's Engineer, with all the necessary tools & tackles, manpower, etc. The alignment will be complete only when jointly certified so, by the Contractor's Owner's Engineer & Owner. Also the Contractor should ensure that the alignment is not disturbed afterwards.

2.10.15 Additional platforms for approaching different equipment as per site requirement, which may not be indicated in drawings, shall be fabricated and erected by the Contractor. The materials required for these works shall be supplied by the Contractor and he will have to fabricate them to suit the requirement.

2.10.16 Equipment and material, which are wrongly installed, shall be removed and reinstalled to comply with the design requirement at the Contractor's expense, to the satisfaction of the Owner/ Consultant.

2.10.17 Before erection of any equipment on a foundation, the Contractor shall check and undertake if necessary rectification of foundation bolts, reaming of holes, drilling of dowels, matching of bolts and nuts, making new dowel pin, etc.

2.10.18 Assistance for calibrating/testing the power cylinders, valves, gauges, instruments, etc., and setting of actuators coming under various groups shall be provided by Contractor.

2.10.19 It shall be the responsibility of the Contractor to provide ladders on columns for initial works till such time stairways are completed. For this, the ladder should not be welded on the column and should be prefabricated clamping type. No

temporary welding on any structural member is permitted except under special circumstances with the approval of Owner.

2.10.20 Structural materials required for the supporting/operating platforms required for the valves at various levels for the safe operation of valves will be arranged by the Contractor.

2.10.21 For civil, structural and architectural works, volume IIG/1 & IIG/2 may be referred. For Instrumentation and Electrical works Vol. IIE and Vol. IIF1 & F2 may be referred.

2.11.00 Safety

2.11.01 Safety and overall cleanliness of work site shall be given top priority. The Contractor shall ensure the safety of all workmen, materials and equipment either belonging to him or to others working at site. He shall observe safety rules & codes applied by the Owner at site without exception.

2.11.02 The Contractor shall notify the Owner of his intention to bring to site any equipment or material which may create hazard. The Owner shall have the right to prescribe the conditions under which such equipment or material may be handled and the Contractor shall adhere to such instructions. The Owner may prohibit the use of any construction machinery, which according to him is unsafe. No claim for compensation due to such prohibition will be entertained by the Owner.

2.11.03 Storage of petroleum products & explosives for construction work shall be as per rules and regulation laid down in Petroleum Act, Explosive Act and Petroleum and Carbide of Calcium Manual. Approvals as necessary from Chief Inspector of Explosives or other statutory authorities shall be the responsibility of the Contractor.

2.11.04 The Contractor shall be responsible for safe storage of his and his sub-contractor's radioactive sources.

2.11.05 All requisite tests & inspection of handling equipment, lifting tools & tackle shall be periodically done by the Contractor. Defective equipment shall be removed from service. Any equipment shall not be loaded in excess of its recommended safe working load.

2.11.06 All combustible waste and rubbish shall be collected and removed from the worksite at least once each day. Use of undercoated canvas paper, corrugated paper, fabricated carton, plastic or other flammable materials shall be restricted to the minimum and promptly removed.

2.11.07 The Contractor shall provide adequate number of fire protection equipment of the required types for his stores, office, temporary structures, labour colony etc. Personnel trained for fire-fighting shall be made available by the Contractor at site during the entire period of the Contract.

2.11.08 All electrical appliances used in the work shall be in good working condition and shall be properly earthed. No maintenance work shall be carried out on live equipment. The Contractor shall maintain adequate number of qualified electricians to maintain his temporary electrical installation.

2.11.09 All workmen of the Contractor working in construction site shall wear safety helmets, safety boots and safety belts. The Contractor shall take appropriate insurance cover against accidents for his workmen as well as third party.

2.11.10 All the worksites shall be provided with adequate lighting facilities e.g. flood lighting, hand lamps, area lighting etc. by the Contractor for proper working environment during night times.

2.11.11 Adequate number of temporary toilets/urinals (men & women separate) shall be provided at work places with soak pits. Adequate drinking water facilities and rest rooms shall be provided for workers to take food and rest.

2.11.12 All safety precautions shall be taken for welding and cutting operations as per IS-818.

2.11.13 All safety precautions shall be taken for foundation and other excavation marks as per IS-3764.

2.12.00 Taking Delivery & Storage

2.12.01 The Contractor shall arrange issue of all equipment and materials to be erected under the contract from the stores/open yard at site by signing on standard indent forms. After completion of work, detailed auditing of the materials so issued shall be submitted to the Owner.

2.12.02 The Contractor shall arrange for proper and safe storage of materials till the same are taken over by the Owner as per terms of the contract. Manufacturer's instructions for preservation shall be strictly followed.

2.12.03 All empty containers, packing materials, gunny bags, transport frames and also surplus and unused materials reconciliation prior to completion of contract shall be the property of the Owner and returned to the Owner by the Contractor.

2.13.00 Site Welding & Heat Treatment

2.13.01 Welding shall be done in accordance with IS-813, IS-816, IS-9595 & other relevant IS/International standards and as per instructions of Contractor. Only those welders, who are qualified as per IS-817 for ordinary welds and as per IBR/ASME Section-IX for high pressure welds, shall be employed in the job.

2.13.02 All welders shall be tested and approved by Owner’s Engineer before they are actually engaged on the work even though they may possess the requisite certificates. The Owner reserves the right to reject any welder without assigning any reason. The welder identification code as approved by the Owner’s Engineer shall be stamped by the welder on each joint done by them. The

Contractor will be responsible for the periodic renewal, re-testing of the welders as demanded by Owner.

2.13.03 The Owner's Engineer is entitled to stop Contractor's any welder from his work if his work is unsatisfactory for any technical reason or there is a high percentage of the rejection of joints welded by him, which in the opinion of Owner's Engineer will adversely affect the quality of welding even though the welder has earlier passed the tests. The welders having passed the tests do not relieve the Contractor from his contractual obligations, to check the performance of the welders.

2.13.04 All charges for testing of welders including destructive and non- destructive tests if conducted by Owner or by the inspection authority at site shall have to be borne by the Contractor. The necessary test materials and consumables will have to be arranged by the Contractor and all testing facility made available, as required.

2.13.05 All welded joints shall be subject to acceptance by Owner's Engineer. Inspection of welds shall be in accordance with IS-822 or equivalent code.

2.13.06 Preheating/post-heating and stress relieving after welding are part of fabrication and erection work and shall be performed by the Contractor in accordance with the instruction of Owner's Engineer. Contractor shall arrange to supply heating equipment with automatic recording devices. Also the Contractor shall have to arrange for the labour, heating elements, thermocouples, compensating cables, insulation materials like mineral wools, asbestos cloth, ceramic beads, asbestos rope, etc. required for the heat-treatment and stress relieving works. During pre- heat/stress relieving operations, the temperature shall be measured at one or more points as required by attaching thermocouples and recorded on a continuous printing type recorder. All the record graphs for the heat treatment works carried out shall be got signed by the Owner's Engineer prior to the commencement of each cycle and handed over to Owner's Engineer on completion. The graphs will be the property of Owner. The Contractor has to provide thermo-chalks temperature recorders, thermocouple attachments, units, graph sheets, etc. required for the job and maintain them in good condition.

2.13.07 All electrodes shall be baked and dried in the electric/electrode drying oven to the required temperature and for the period specified by the Owner's Engineer before they are used in erection work. The electrodes used shall be as per IS-814, IS-815, IS-1442, IS-7280 and other codes as applicable, and shall be of approved reputed manufacture. The electrodes shall meet the requirement of the pipe material. No electrode manufactured more than 12 months ago and the type covered under certificate issued after conducting tests more than 6 months ago shall be used. All electrodes shall be preserved at works and at site as per manufacturer's recommendations.

2.13.08 Oxy-acetylene flame or Exothermic chemical heating for stress relieving is not permitted. Heating shall be by means, of electric induction coil or electric resistance coil.

2.13.09 It may become necessary to adopt inter layer radiography/MPT/UT depending upon the site/technical requirement necessitating interruptions in continuation of the work and making necessary arrangement for carrying out the above work.

2.13.10 Gas tungsten arc welding process (TIG) shall be adopted for all root pass welds except for structural works until 4.75 mm thickness is deposited. Subsequent welding after root pass can be carried out by manual metal arc welding with coated electrodes. For pipes of thickness less than 6 mm the entire welding has to be carried out by TIG welding.

Fillet weld shall be made by shielded metal arc process as per applicable codes.

However, the Owner's Engineer will have the option of changing the method of welding as per site requirement. The method adopted for manual arc welding shall be weaving technique and the width of weaving shall not exceed 1.5 times of the dia. of the electrode.

In case of deviation from welding process and electrodes, the Contractor shall take approval of the Owner prior to adoption of same.

2.13.11 The root pass for butt joints shall be such as to achieve full penetration with complete fusion of root edges.

2.13.12 Each pass shall be cleared and freed of slag before the next pass is deposited.

2.13.13 On completion of each run, craters, weld irregularities, slag etc. shall be removed by grinding or chipping.

2.13.14 Each layer of welding shall have an even and smooth appearance.

2.13.15 Welding sequence shall be adjusted in such a way that distortion due to welding shrinkage is minimised. Further any movement, shock or vibration during welding shall be avoided to prevent weld cracks.

2.13.16 Proper protection of welders and the work shall be taken during periods of rain. No welding shall be carried out when surfaced to be welded are wet from any cause.

2.13.17 Following will be stages of inspection during welding:

a) Two pieces to be joined shall be individually checked for the weld edge preparation and profile dimensionally and to the template. Dye penetrant check shall be carried out on edge prepared surfaces at random. The percentage will depend upon on criticality as specified by Owner's Engineer.

b) Joint fit up will be a stage of inspection. Misalignment after fit up may vary from 0.3 mm to 1.6 mm depending on outside diameter and thickness.

c) All joints shall be offered for visual inspection after root run. Subsequent welding should be made only after the approval of root run.

2.13.18 All welded joints shall be painted with anti-corrosive paint immediately on completion of radiography and stress-relieving.

2.14.00 For further details on procedures of work at site on civil, architectural, electrical and instrumentation & control services, refer Volume: II-E, II-F1 & F2 and II-G/1 G/2 & G/3 of this specification.

3.00.00 **PROTECTION AND CARE**

3.01.00 All construction and erection activities for this project are to be carried out in the plant premises.

3.02.00 Generator Stator Lifting may be considered by either of the two options as mentioned below:

a) With the help of two (2) nos. turbine room cranes.

b) With the help of separate lifting arrangement to be provided by the Bidder from outside the TG building A-row column before the construction of A-row building wall.

The West Bengal Power Development Corporation Limited

(A Government of West Bengal Enterprise)
Corporate Identity No.: U40104WB1985SGC039154
Registered & Corporate Office: Bidyut Unnyan Bhavan,
Plot – 3/C,LA – Block, Salt Lake City, Sector – III, Kolkata – 700 098
Phone: 033-2335-0445/2335-0571/2339-3100
Fax: 033-2339-3286/2335-0516
website: www.wbpdcl.co.in. E-mail: wbpdcl@wbpdcl.co.in

Ref. No. WBPDCL/Corp./SGMP03/AV/8/047 Date: 16.06.2020

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

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

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

Dear Sir,

Please find the reviewed Vendor List for the captioned Project.

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

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

a)	Mechanical Aux.Packages	:	Annexure-A
b)	Mechanical Equipment List	:	Annexure-B
c)	FGD Plant Equipment List	:	Annexure-C
d)	CHP Equipment List	:	Annexure-D
e)	AHP Equipment List	:	Annexure-E
f)	Electrical Equipment List	:	Annexure-F
g)	C&I Equipment List	:	Annexure-G
h)	FPA Equipment List	:	Annexure-H
i)	HVAC System	:	Annexure-I
j)	PSER Erection Vendors	:	Annexure-J

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

Thanking you,

Yours faithfully

16.6.2020

Kalyanbrata Chakrabarty
GM (Projects)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

		POLYCAB WIRES PVT. LTD., Daman	Approved

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Sagardighi Extn. U#5 (PROJ3)
Electrical Equipments
Ref: SGMPO3/AV/8/047

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

SAGARDIGHI THERMAL Power EXTENSION PROJECT PHASE-III, UNIT#5 (1 x660 MW)			
Sl No	Item	Vendor Name	Status
1	Severe Service Control Valve for BFP Re-Circulation / SH & RH Attemperation Control Valve	DRESSER VALVE INDIA PVT. LTD, Coimbatore	Approved
		CONTROL COMPONENTS INC.	Approved
		KSB MIL CONTROLS LIMITED	Approved but only for 9000 Series Valves
2	Oil Trip Valves (FUEL OIL SYSTEM)	INSTRUMENTATION LTD., KERALA	Approved
		KSB MIL CONTROLS LIMITED, THIRISSUR DIST	Approved
		Kuehme Armaturen GmbH,Germany	DR
		SAMSON CONTROLS PRIVATE LIMITED	Approved
		MASCOT VALVES PVT. LTD, AHMEDABAD	Approved
3	NORMAL SERVICE CONTROL VALVE	DRESSER VALVE INDIA PVT. LTD, Coimbatore	Approved
		EMERSON PROCESS MANAGEMENT CHENNAI LIMITED, Chennai	Approved
		INSTRUMENTATION LTD., PALAKKAD	Approved
		Koso India Private Limited, Nashik	Approved
		PARCOL S.P.A.	Approved
		SEMPELL GmbH.	Approved
		DAUME REGELARMATUREN GMBH	DR
		KSB MIL CONTROLS LTD. Thrissur	Approved
		Valvitalia S.P.A. , Italy	Approved
		WALDEMAR PRUSS ARMATURENFABRIK GMBH, Germany	Approved
4	Severe Service Control Valve for AUX PRDS	Control Component India Pvt. Ltd. Chitoor	Approved
		Daume Regelarmaturen GmbH, Isernhagen, Germany	Approved
		HOLTER REGELARMATUREN GmbH & CO., HOLTESTUKENBR OCK	Approved
		Koso India Private Limited, Nashik	Approved
		PARCOL S.p.A Canegrate MI, ITALY	Approved
5	VALVE:SOOT BLOWER PR	DRESSER VALVE INDIA PVT. LTD, Coimbatore	Approved
		CONTROL COMPONENTS INC.	Approved
		KSB MIL CONTROLS LIMITED	Approved
6	LP STARTUP CONTROL VALVES	CONTROL COMPONENT INDIA PVT LTD	Approved
		INSTRUMENTATION LTD.,	Approved
		EMERSON PROCESS MANAGEMENT CHENNAI	DR
		WELLAND & TUXHORN AG	Approved
		KOSO INDIA PRIVATE LIMITED.	Approved
		KSB MIL CONTROLS LIMITED	Approved

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

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

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

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

Sl No	Item	Vendor Name	Status
		YOKOGAWA INDIA LIMITED, BANGALORE	Approvec
31	H_2 GAS ANALYSER CABINET	SIEMENS LTD.	Approved
		YOKOGAWA INDIA LIMITED	Approved
		ABB INDIA LTD	Approved
32	GI Pipes	BALDOTA VALVE AND FITTINGS PVT LTD,MUMBAI	Approved
		BHUWALKA PIPES LIMITED,BANGALORE.	Approved
		FLOWTECH, KOLKATA	Approved
		JINDAL INDUSTRIES LIMITED,NEW DELHI	Approved
		METPRESS ENGINEERING WORKS, KOLKATA	Approved
		NATHMAL DAGA & CO, BANGALORE	Approved
		PIPE CORPORATION PVT LTD, BANGALORE	Approved
		PRECISION ENGG INDUSTRIES,MUMBAI	Approved
		SURYA ROSHNI LTD,BAHADURGARH,HARYANA.	Approved
		V.K.INDUSTRIES, BANGALORE	Approved
		VIKAS INDUSTRIAL PRODUCTS, NOIDA	Approved
		SANDEEP INDUSTRIES,JALANDHAR,PUNJAB	Approved
		MKK METAL SECTIONS PVT LTD,VELLORE,TAMILANADU	Approved
		RIDDHI STEEL AND TUBE LIMITED,AHMEDABAD	Approved
		INDUS TUBES LTD,GHAZIABAD,UP	Approved
33	Impulse Pipes(Alloy steel)	BHARAT HEAVY ELECTRICALS LTD, TIRUCHIRAPALLI,TAMILANADU	Approved
		EVERGREEN SEAMLESS PIPES & TUBES PVT LTD,BANGALORE	DR
		GANPAT METALS PVT. LTD.,MUMBAI	DR
		JINDAL SAW LTD,CHENNAI	Approved
		RIDHI SIDDHI STEEL CORPORATION,MUMBAI	DR
		TROUVAY CAUVIN,GULF	Approved
		SUMITOMO CORPORATION,JAPAN.	Approved
		TPS TECHNITUBE ROHREN WERKE	Approved
		BHARAT HEAVY ELECTRICALS LTD, TIRUCHIRAPALLI,TAMILANADU.	Approved
		EVERGREEN SEAMLESS PIPES & TUBES PVT LTD,BANGALORE	DR
		GANPAT METALS PVT. LTD.,MUMBAI	DR
		HEAVY METAL AND TUBES LTD,AHMEDABAD/MUMBAI	DR

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

SECTION-VII

ENGINEERING SERVICES

CONTENTS

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8.00.00	CONTRACT STAGE DOCUMENT SUBMISSION AND APPROVAL PROCEDURE	6

SECTION-VII

OWNER'S ENGINEERING SERVICES

1.00.00 GENERAL

1.01.00 As part of the overall project management activity, the Successful Bidder shall be responsible for proper Owner's Engineering and co-ordination of activities during various phases of execution of the contract. The Successful Bidder shall identify a person, designated as Project Manager, with whom the Owner, the Consulting Owner's Engineer or the Review Consultant shall interact on matters related to Owner's Engineering as well as execution of the contract. The Project Manager shall be the single-point contact person on behalf of the Successful Bidder and shall be responsible for all Owner's Engineering co-ordination. The Owner /Consultant /Review Consultant shall interact with the Project Manager only on all matters of co-ordination between the Owner and the Successful Bidder or on matters involving the Successful Bidder, his manufacturing units and sub-vendors. For the purpose of expediting the Owner or his representative may sometimes interact with the manufacturing units or sub-vendors of the Successful Bidders. However such interaction will not, under any circumstance, dilute the responsibility of the Successful Bidder to provide a fully Owner's Engineered and coordinated package under this contract.

1.02.00 On finalization of the contract, a procedure for exchange of Owner's Engineering information will be mutually agreed and finalized between the Owner and the Successful Bidder.

2.00.00 DESIGN COORDINATION MEETING

The Successful Bidder and his sub-vendors will be called upon to attend design co-ordination meetings with the Owner's Engineer, other Successful Bidders and the Consultants of the Owner during the period of execution of contract. The Successful Bidder including his sub-vendors shall attend such meetings at their own cost at Owner's or Consultant's office in Kolkata/ or at mutually agreed venue as and when required and fully cooperate with such persons and agencies involved during those discussions.

3.00.00 CO-OPERATION WITH OTHER CONTRACTORS AND CONSULTING OWNER'S ENGINEERS

The Successful Bidder shall agree to cooperate with the Owner's other Contractors and Consulting Owner's Engineers and freely exchange with them such technical information as is necessary to obtain the most efficient and economical design and to avoid unnecessary duplication of efforts. The Owner's Engineer shall be provided with copies of all correspondences addressed by the Successful Bidder to other Sub- Vendors and Consulting Owner's Engineers in respect of such exchange of technical information.

4.00.00 GUIDELINES FOR OWNER'S ENGINEERING SERVICES

4.01.00 Prior to commencement of the Owner's Engineering work as part of design submissions, all aspects of design viz., criteria for selection and sizing of all equipment and systems, design margins etc. including that for structural steel and civil work shall be outlined and these shall form the basis for the detailed Owner's Engineering work.

4.02.00 Owner's Engineering work shall be performed on modern and proven concepts and internationally accepted good Owner's Engineering practices but fully compatible with the Indian environments. Owner shall have the right to review and approve the Owner's Engineering work by themselves and/or through consultant and ask for any clarifications and changes/modifications to the work performed by Successful Bidder.

4.03.00 At any stage during the performance of assignment, the Successful Bidder may be required to make certain changes/modification/improvements in design/ drawing/other documents, which in the opinion of the Owner could result in better improved design, layout, operability, plant availability, maintainability, reliability or economy of the plant and its systems/sub-systems in view of revised and more accurate information/data available at a later date(s) or feedback(s) received during execution/operation of similar units. Such changes/ modifications/improvements required could be identified by Owner and/or consultant and mutually discussed. Owner requires the Bidder to incorporate such action in the subject assignment appropriately without any additional cost liability and time implication to the Owner and same shall be within the responsibilities and Scope of the Successful Bidder.

4.04.00 During the course of review of detailed Owner's Engineering stages, it may be essential in the opinion of Owner to obtain certain classified data for review purposes only. In case Owner so desires, the Bidder shall submit such data to Owner.

4.05.00 During the course of review of detailed Owner's Engineering, it may be essential in Owner's opinion to obtain data and information on similar equipment and plants Owner's Engineered by the Bidder. In case Owner so desires the Bidder shall submit such data and information to the Owner.

4.06.00 It is not the intent to give details of every single task covered in the total Owner's Engineering work to be carried out by Successful Bidder, however, all Owner's Engineering work required for the satisfactory completion of the plant/systems as specified shall be carried out by the Successful Bidder. Broadly, the following are the minimum requirements in respect of scope of major items of work:

4.06.01 Preparation, updating and finalisation of scheme drawings, control and interlock diagrams, detailed and fully dimensioned layout drawings (plant layout and equipment layout detailed plan, elevation and cross-sectional drawings at different elevations/ floor levels) covering all mechanical, electrical, C&I, civil and structural items, equipment, systems and facilities. Drawings and Schedules prepared by the Successful Bidder from time to time, as detailed

designs are developed, shall be submitted for Owner's/ Consultant's approval before the work is taken up. Revisions, corrections, additions to drawings and schedules shall not be considered to change the scope of work.

4.06.02 Preparation of detailed technical specifications including data sheets, tender drawings and bill of material for all bought out items, as also finalisation of corresponding sub-Vendors.

4.06.03 Review of sub-Vendor's data, drawings, design calculations, schedules, bill of materials, instruction manuals etc. for all equipment, before forwarding them to Owner/Consultant for approval.

4.06.04 Preparation of civil construction drawings for all equipment showing foundation details and full details regarding equipment loads, floor openings, details of embedments, etc. required for preparation of civil construction drawings and also as referred at relevant sections of Scope & Exclusions. These documents shall be preceded by appropriate design calculations, static and dynamic analysis as necessary.

4.06.05 Preparation and finalisation of process piping and instrumentation diagrams and schematics, complete in all respects for all systems/packages of the power plant.

4.06.06 Preparation of consolidated schedules and bills of materials, including line numbers, tag numbers, source of supply, service conditions, specifications, materials, types and connections details, quantities for items of the plant including dampers, steam traps, strainers, instrumentations, ducting.

4.06.07 Sizing of all piping and equipment as per the stipulated design criteria; carrying out of flexibility analysis/dynamic analysis as necessary; hangers & support Owner’s Engineering.

4.06.08 Final revision of all documents including preparation and compilation of Instruction Manuals for installation, commissioning, operation and maintenance for all equipment and systems. Refer clause 5.00.00 for the specific requirement in this regard.

4.06.09 Certification and submission of final as-built drawings for all areas.

4.06.10 Preparation and compilation of all drawings, schedules and instructions which may be required at site, whether separately mentioned or not.

4.06.11 All erection and assembly drawings which may be required at site.

5.00.00 INSTRUCTION MANUALS

5.01.00 The Bidder shall provide all necessary instruction manuals for the Owner’s review, comment, and final acceptance as required in the contract. The instruction manual shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The instruction manual shall be submitted in the form of one (1) soft copy in CD and 15 hard copies.

5.02.00 **Erection Manuals**

5.05.01 The erection manuals shall be submitted at least three (3) months prior to commencement of erection activities of particular equipment/system. The manuals shall contain the following as a minimum:

a) Erection strategy.

b) Sequence of erection.

c) List of tools, tackles, heavy equipments like cranes, dozers etc required for erection.

d) Bill of Materials.

e) Safety precautions to be followed during erection.

f) Erection instructions.

g) Critical checks and permissible deviation/tolerances.

h) Check-list for pre-commissioning activities

i) Check-list for commissioning of the system.

j) Procedure for initial checking, testing and acceptance norms.

5.03.00 **Operation & Maintenance Manuals**

5.03.01 The operating and maintenance instructions together with drawings of the equipment, as completed, shall be in sufficient detail to enable the Owner to operate, maintain, dismantle, reassemble, and adjust all parts of the equipment. They shall outline a step-by-step procedure for all operations likely to be carries out during the life of the plant/ equipment. Each manual shall include a complete set of drawings together with performance/ rating curves of the equipment and test certificates wherever applicable.

5.03.02 If after commissioning and initial operation of the plant, the manuals require any modification/ additions in the view of the Owner or Bidder, the same shall be incorporated and the updated final manuals shall be submitted to the Owner.

5.03.03 The manuals shall include the following:

a) List of spare parts along with their drawing and catalogue and Pro-forma for ordering spares.

b) Location and identification guide for bearings of various equipments and lubrication schedule including charts showing lubrication checking, testing and replacement procedure.

c) Wherever applicable, fault location charts shall be included to facilitate fault detection.

d) Detailed specification for all consumables (including lubricating oils, greases, chemicals etc.) required for each equipment.

6.00.00 PLANT HANDBOOK

The Bidder shall provide the plant handbook to the Owner as per provision of the contract.

The Plant Handbook shall contain the following as a minimum:

a) Design and performance data

b) Process & instrumentation diagrams

c) Single line diagrams

d) Sequence & Protection interlock schemes

e) Alarm and trip values

f) Performance curves

g) General layout plan and layout of Balance of Plant building and auxiliary buildings

h) Important Do's and Don'ts.

7.00.00 TENDER STAGE DOCUMENT SUBMISSION

7.01.00 The Bidder shall submit along with his bid all documents/drawings as specified in RFP and respective sections of the Technical Specifications in Vol-II and Vol-III. The documents shall include but not be limited to the following:

a) All Bid proposal sheets duly filled up.

b) Detailed experience list and financial resources of the Prime Bidder his collaborators/associates in this bid as well as the sub-vendors proposed.

c) Scheme drawings indicating scope of supply and service as offered by the Bidder indicating clearly exclusions, if any.

d) List of terminal points of the package offered together with quality and quantity of various input (i.e. water, air, electricity etc.) as required from the Owner at such interfaces.

e) Equipment GA, Layout, Design Calculations, interlock and other write-up, catalogues/literature etc. as required for clear understanding of the bid submitted.

f) High level project schedule network indicating target dates for intermediate milestones and final commissioning of plant systems; This network shall be supplemented by a detailed write-up on proposed sequence and method of execution for project implementation, deployment schedule for Key personnel with their bio-data, schedule of construction machinery etc.

8.00.00 CONTRACT STAGE DOCUMENT SUBMISSION AND APPROVAL PROCEDURE

8.01.00 Owner's Engineering schedule shall be submitted by the Bidder as indicated in the RFP. Owner's Engineering schedule shall be developed in format as desired by the Owner/consultant.

The documents shall be divided into two categories: a) for approval and b) for information/further Owner's Engineering and co-ordination by the Consultant.

In preparing this schedule, the Bidder shall allow one (1) week from date of receipt for review and comments by the Consultant for each submission of a document.

This document submission schedule shall require acceptance by the Owner/Consultant.

Bidder shall also develop and submit a Master drawing list to the Owner/consultant.

8.02.00 All contract documents shall be marked with the name of the Owner, the Project, the specification title and number and the unit designation.

All dimensions shall be in metric units.

All notes, markings etc. shall be in English.

8.03.00 Documents/Drawings, submitted during tender stage, shall be revalidated or revised as required and submitted as certified contract document for approval/information of the Owner/Consultant.

8.04.00 Unless specified otherwise, the following categories of documents/drawings would require approval of the Owner/Consultant:

a) System scheme and Process & instrumentation Diagrams (P & IDs).

b) Design basis documents / memoranda / calculations justifying sizing and selection of equipment, vessels, tanks, piping, valves & specialities as well as the process parameters.

c) Equipment data sheets and general arrangement drawings.

d) Materials of construction.

e) General Arrangement and Layout drawings.

f) Typical control schemes, circuit diagrams, drive/ feeder-wise control scheme showing all external interfaces.

g) Control System Configuration

g) Shop Inspection and Testing Procedures, Test Set-up & Instrumentation, Acceptance Criteria and Codes / Standards followed, correction curves / charts, etc.

h) Performance Test Procedures, Instrumentation, Acceptance Criteria and Codes / Standards followed, correction curves / charts, etc.

i) Schedules covering equipment delivery schedules, erection, testing and commissioning schedules at L1 and L2 levels.

8.05.00 Unless specified otherwise, the following categories of documents / drawings would be treated for information/further Owner's Engineering by the Owner/Consultant. The Bidder shall, however, incorporate all additional information and clarifications in these documents/ drawings as and when desired by the Owner/ Consultant.

a) Equipment foundation drawings.

b) Equipment cross-section drawings, product literature etc. which are of proprietary nature.

c) Predicted performance curves of equipment.

d) Various bills of quantity, schedules etc.

e) Piping fabrication drawings, isometrics etc.

f) Panel wiring diagrams.

g) Instruction/Operation manuals.

h) Service manuals and trouble shooting guide for C & I system including field instruments.

i) Operation logic diagrams.

j) Cable schedule and interconnection chart.

In essence, the Bidder is solely responsible for corrections and adequacy of design & Owner's Engineering for documents under this category.

8.06.00 Upon review, the Consultant shall put his remarks and one of the following action stamps on the drawing / document:

a) Approved.

b) Approved except as noted, forward final drawing

c) Approved except as noted, resubmission required.

d) Disapproved.

e) For information/reference only.

For action stamps in category (c) & (d), documents must be resubmitted for review by the Owner/Consultant. For action stamp in category (b), further review by Owner/Consultant would not be necessary provided the Bidder agrees & incorporates the minor comments made on the document.

Except for action stamp under category (c) & (d), the Bidder can proceed with manufacturing and other sequential activities for those areas of a drawing/document which do not have any review comment by the Owner/ Consultant.

The Consultant may accord approval in category (c) or (d) in more than one submission of a document till he is satisfied that the intent of the specification has been fully complied with. The Bidder shall be responsible for delay in such cases and no extension of time shall ordinarily be allowed on such grounds.

The Bidder's work shall be in strict accordance with the finally approved drawings and no deviation shall be permitted without written approval of the Consultant.

8.07.00 Except key plan/general yard plan, any layout drawing requiring scrutiny shall not be drawn to a scale less than 1:50.

8.08.00 For review by the Consultant, the Bidder shall furnish three (3) prints of each drawing (only for first submission). There upon all transaction of drawings including reviewed comments and stamping shall be done in soft. All transaction of drawings shall be accompanied by a reference letter mentioning the date, revision no. and document status. Only on receiving the Approval Stamping, bidder shall distribute 6 sets of drawings (2 at WBPDCL corporate office and 4 sets at WBPDCL site office).. The Bidder shall furnish three (3) CDs of all as built/final drawings for Owner/Consultant site.

8.09.00 In case of contradiction between the stipulations above and those stated elsewhere in the specification, the stipulations herein shall prevail.

SECTION-VIII

QUALITY ASSURANCE REQUIREMENTS

CONTENT

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SECTION-VIII

QUALITY ASSURANCE REQUIREMENTS

1.00.00 QUALITY ASSURANCE PROGRAMME

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

a) His organisation structure for the management and implementation of the proposed quality assurance programme.

b) Documentation control system.

c) Qualification data for Bidder's key personnel.

d) The procedure for purchase of materials, parts, components and selection of Sub-Vendor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.

e) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.

f) Control of non-conforming items and system for corrective actions.

g) Inspection and test procedure both for manufacture and all site related works.

h) Control of calibration and testing of measuring and testing equipments.

i) System for quality audit.

j) System for indication and appraisal of inspection status.

k) System for authorising release of manufactured product to the Owner.

l) System for handling storage and delivery.

m) System for maintenance of records.

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

2.00.00 GENERAL REQUIREMENTS - QUALITY ASSURANCE

2.01.00 All materials, components and equipment covered under this specification shall be procured, manufactured and tested at all the stages, as well as Services provided for erection, commissioning and testing shall be as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the Bidder for some of the major items is given in the respective technical specification. This is however, not intended to form a comprehensive programme as it is the Bidder's responsibility to draw up and implement such programme and reviewed by by the Owner/Consultant. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder, separately in the format attached at Annexure-I and will be submitted to Owner/Owner’s representative for review. Schedule of finalisation of such quality plans will be finalised before award.

2.02.00 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Bidder's Quality Control organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing.

2.03.00 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Bidder's site Quality Control organisation, during various stages of site activities from receipt of materials/equipment at site.

2.04.00 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality plans and reference documents/standards etc. will be subject to Consultant's approval without which manufacture shall not proceed. In these approved quality plans, Owner/Authorised representative/Consultant shall identify Customer Hold Points (CHP), test/checks which shall be carried out in presence of the Owner/Consultant/Owners Owner’s Engineer or his Authorised Representative and beyond which the work will not proceed without consent of Owner/Authorised representative/Consultant in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner/Authorised Representative/Consultant for acceptance and dispositioning.

2.05.00 The Bidder shall provide adequate notice to the Owner for inspection before the material is dispatched as per the provisions of the Contract. No material shall be despatched from the manufacturer's works before the same is accepted subsequent to pre-despatch final inspection including verification of records of

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3.00.00 QUALITY ASSURANCE DOCUMENTS

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

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

b) The inspection plan with verification, inspection plan check points, verification sketches, if used and methods used to verify that the inspection and testing points in the inspection plan were performed satisfactorily.

c) Non-destructive examination results /reports including radiography interpretation reports.

d) Factory tests results for testing required as per applicable codes and standards referred in the specification.

e) Welder identification list listing welder's and welding operator's qualification procedure and welding identification symbols.

f) Sketches and drawings used for indicating the method of traceability of the radiographs to the location on the equipment.

g) Stress relief time temperature charts.

h) Inspection reports duly signed by QA personnel of the Owner and Bidder for the agreed inspection hold points. During the course of inspection, the following will also be recorded :

i) When some important repair work is involved to make the job acceptable.

ii) The repair work remains part of the accepted product quality.

i) Letter of conformity certifying that the requirement is in compliance with finalised specification requirements.

4.00.00 **INSPECTION, TESTING AND INSPECTION CERTIFICATES**

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

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

4.03.00 When the factory tests have been completed at the Bidder's or sub-Vendor's works, the Owner/Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Owner/ Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Bidder's test certificate by the Owner/Inspector. Failure of the Owner/Inspector to issue such a certificate shall not prevent the Bidder from proceeding with the works. The completion of these tests, or the issue of the certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract.

4.04.00 The Bidder shall furnish quarterly inspection programme indicating schedule dates of inspection at customer hold point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.

FORMAT OF QUALITY ASSURANCE PROGRAMME

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

FIELD WELDING SCHEDULE

PROJECT : FWS NO :

CONTRACTOR : REV NO. :

PACKAGE : FIELD WELDING CODE :

SYSTEM : PAGE NO. :

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

The Field Welding Schedule should be submitted for :

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

SECTION-IX

PERFORMANCE GUARANTEES AND TESTS

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SECTION-IX

PERFORMANCE GUARANTEES AND TESTS

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

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

a) Those, which attract liquidated damages, as listed below (Category-"A"). The Bidder shall furnish signed declarations in the manner prescribed in the bid proposal schedules for these guarantees.

b) Those, which do not attract liquidated damages, as listed below (Category-"B"). This guarantee list indicated in this section is not exhaustive and the Owner reserves the right to call upon the Bidder to demonstrate any parameter, operation, etc. of any equipment as specified and as required to meet the duty conditions.

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

i) reject the equipment and recover the payment already made or engage other agencies for making good all the deficiencies, the cost to be borne & recovered from the contractor or accept the equipment only after levying liquidated damages upto a ceiling 10% of contract price as identified in this section for those guarantees which are covered under category "A".

ii) reject the equipment and recover the payment already made or engage other agencies for making good all the deficiencies, the cost to be borne & recovered from the contractor or accept the equipment only after assessing and deducting from the contract price an amount equivalent to the deficiency of the equipment/system as assessed by the Owner, for those guarantees which are covered under Category-B.

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

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

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

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

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

1.06.00 **Performance/Acceptance Tests**

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

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

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

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

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

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

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

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

2.02.01 **Inspection and Checking of the Unit**

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

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

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

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

2.02.02 **Initial Operation, Reliability Run/Trial Run**

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

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

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

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

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

2.02.03 **Performance and Guarantee Test**

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

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

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

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

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

c) All special test grade instruments, equipment, tools and tackles, required for the successful completion of the Performance and Guarantee Tests shall be brought for the purpose of test, free of cost by the Contractor.

d) The guaranteed performance figures of the equipment shall be proved by the Contractor during these Performance and Guarantee Tests. The Contractor shall submit a detailed test report in the manner, already agreed to within one (1) month time of completion of the test, for Owner's approval. Should the Owner's assessment of these tests show any deterioration from the guaranteed values the Contractor/Owner shall modify the equipment as required to enable it to meet the guarantees to the satisfaction of the Owner. In such case, the Performance and Guarantee Tests shall be repeated within one (1) month, from the date the equipment is ready for retest and all costs for modifications including labour, materials and the cost of additional testing to prove that the equipment meets the guarantees, shall be borne by the Contractor.

e) The specific tests to be conducted on equipment have been brought out in the technical specifications. The procedure to be submitted by the Contractor should include the detailed methodology to conduct these tests/verify the guarantees offered by the Contractor notwithstanding whether these attract liquidated damages or not.

f) Instrument accuracies shall be in accordance with the relevant test codes. All instrument in-accuracies if applicable shall be computed as per the code and values will be corrected to the advantage of the Owner. No negative tolerance will be allowed. For example, if the inaccuracy of instrumentation has been worked out to be 1%, the measured values will be assessed to be 1% inferior for purpose of LD.

g) The Bidder shall establish the following modes of operation to the satisfaction of the Owner before acceptance test :

   i) Operation of each system by remote manual control.

   ii) Operation of the entire system in integrated manner on auto control.

   iii) Operation of the entire plant with auto-control loops fully implemented including different modes of load control with the help of control system.

h) Ten (10) copies of the test reports are to be furnished by the Contractor to the Owner backed up with jointly signed data sheets.

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3.00.00 SCHEDULE OF GUARANTEES WHICH ATTRACT LIQUIDATED DAMAGES [CATEGORY-A]

Sl. No.	Package System	Parameter for Performance Guarantee	Liquidated Damages
~~3.01.00~~	~~**Steam Generator**~~		
~~3.01.01~~	~~Capacity~~	~~Capacity in T/HR of steam at rated steam parameters at superheater outlet with combination of mills working as per Owner's choice and the coal being fired within range specified.~~	~~For deficiency in Steam Generator capacity for every 1T/hr. Rs. 32,580,000/-~~
~~3.01.02~~	~~Efficiency~~	~~Efficiency in percentage corresponding to 100% and 80% turbine loads under rated steam parameters at Super-heater & reheater outlet, under rated Condenser Vacuum and zero make up with combination of mills working as per Owner's choice.~~	~~For every 0.1% decrease in weighted average efficiency - Rs. 206,980,000 /-~~
~~3.02.00~~	~~**Turbine** Generator~~		
~~3.02.01~~	~~Heat Rate~~	~~Heat rate in kCal/ kWh corresponding to 100% and 80% turbine loads under rated steam parameters, design condenser vacuum with zero percent make up.~~	~~Rs. 110,520,000/- for every kCal/ kWh increase in weighted average heat rate over guaranteed value.~~
~~3.02.00~~	~~Output~~	~~Output in kW under rated steam conditions and CW temp. of 33ºC with 1% make up and all heaters in service~~.	~~Rs. 270,000/- for every one (1) kW shortfall in output from guaranteed value.~~
3.03.00	Total Auxiliary Power Consumption	Total Auxiliary power consumption (in kW) of the unit under rated steam conditions at 100% Turbine loads with zero make-up.	Rs. 462,000/- for every one (1) kW excess weighted average auxiliary power consumption over guaranteed value on the basis of Figures declared by the bidder in Attachment-8 and shall be submitted in the Guaranteed Data Declaration Sheet against Sl. No. 9.00.00, Sch-IIIA/4:4 of Vol-IIIA.

~~The test for TG test capacity shall be carried out along with the heat rate test. Instrumentation and other details shall comply as above.~~

~~6.04.06~~ ~~**Condenser**~~

~~Performance test for the condenser shall be conducted in accordance with the latest edition of ASME PTC-12.2. The condenser pressure shall be measured at 300 mm above the top row of tubes under VWO condition, estimated make-up and design CW flow and CW inlet temperature of 33 Deg. C. The cleanliness factor shall be determined in accordance with the latest edition of ASME PTC-12.2.~~

~~6.04.07~~ ~~**Feed Water Heaters and Drain Cooler**~~

~~Performance test for feed water heaters shall be conducted in accordance with the latest edition of ASME PTC-12.1.~~

~~6.04.08~~ ~~**Deaerator**~~

~~Performance test for deaerator shall be conducted in accordance with the latest edition of ASME PTC-12.3.~~

~~The dissolved oxygen content in feed water at outlet of deaerator shall be determined by ASME-D 888. Reference Method A and any recognised modification thereof.~~

~~Free carbon dioxide content of deaerator effluent shall be measured by APHA method.~~

6.05.00 **Remaining Plant and Equipment**

For other equipment, plants and systems, the performance test shall be carried out as per the respective equipment specification and the applicable codes.

SECTION-X

REQUIREMENTS OF SPARES, TOOLS & TACKLES

CONTENTS

CLAUSE NO.	DESCRIPTION	PAGE NO.
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2.00.00	SPARES	1

ATTACHMENT

ANNEXURE-I	MANDATORY SPARES LIST
ANNEXURE-II	LIST OF TOOLS & TACKLES

SECTION-X

REQUIREMENTS OF SPARES, TOOLS & TACKLE

1.00.00 TOOLS & TACKLE

The Bidder shall supply with the equipment one complete set of special tools and tackles required for the erection, assembly, dis-assembly & proper maintenance of the plant and equipments and systems (including software). These special tools shall also include special material handing equipment, jigs & fixtures for maintenance and calibration/ re-adjustment, checking & measurement aids etc. A list of such tools & tackles shall be submitted by the Bidder along with the offer. Detailed description of each tool/tackles, its function along with the equipment/part for which it is meant for, shall also be indicated in the offer. These tools & tackles shall be separately packed and sent to site before the first unit commissioning. The Bidder shall also ensure that these tools are not used for erection, commissioning and initial operation. For this period, the Bidder shall bring his own tools and tackles. All the tools and tackles shall be of reputed make acceptable to Owner.

2.00.00 SPARES

2.01.00 General

The Bidder shall indicate and include in his scope of supply all the necessary start-up, commissioning and recommended spares in addition to mandatory spares as specified elsewhere in the specification. The Bidder shall also state for each item of spares both mandatory and recommended, the normal expected service life.

2.01.01 All spares supplied under this contract shall be strictly interchangeable with the parts for which they are intended to replace. The spares shall be treated and packed for long storage under the climatic conditions prevailing at the site, e.g. small items shall be packed in sealed transparent plastic bags with dessicator packs as necessary.

2.01.02 Each spare part shall be clearly marked or labelled on the outside of the packing with the description. When more than one spare part is packed in a single case, a general description of the contents shall be shown on the outside and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purposes of identification.

2.01.03 All cases, containers or other packages are liable to be opened for examination as may be considered necessary by the Owner.

2.01.04 The Bidder shall also guarantee supply of spare parts, which shall be made, based on manufacturer's drawings on special order from the Owner for 30 years after commissioning of the plant.

2.01.05 Warranty period for all kinds of spares shall be six thousand (6000) hours of operation.

2.01.06 Design & Engineering details of all spares (make, model, rating, drawing, data sheet etc.) shall be submitted to the Owner prior to dispatch from manufacturers' works.

2.02.00 **Recommended Spares**

2.02.01 The Bidder shall provide a list of recommended spares for 3 years of normal operation of the plant for spares of indigenous origin, and for 5 years of normal operation for spares of non-indigenous origin. This list shall take into consideration the mandatory spares specified elsewhere in the specification and should be a separate list.

2.03.00 **Start-up Commissioning Spares**

2.03.01 Start-up commissioning spares are those spares which may be required during the start-up and commissioning of the equipment/system. The list of commissioning spares to be brought by the Bidder to ensure smooth commissioning of the plant shall be subject to the Owner's approval. All spares used until the plant is handed over to the Owner shall come under this category. Said spares, properly marked, shall be supplied together with the main equipment and shall be used by the Bidder, if needed, during erection & commissioning stage. All such spares which remain unused till issuance of Taking Over Certificate by the Owner, along with an equipment-wise quantitative consumption report shall be returned to the Owner during time of handover.

2.04.00 **Mandatory Spare Parts**

2.04.01 The Owner considers some of the spares are essential for running the equipment irrespective of whether they are included in the list of recommended spares by the Bidder as mentioned above.

Since the components involved can not be foreseen at the bidding stage, only broad requirements of the Owner in this respect are outlined hereinafter. The bidder shall include his proposal, on the basis of these guidelines, an item-wise list of all components recommended as mandatory spares with the quantity. This list shall be separate from the list of recommended spares and shall be used for bid evaluation purposes. Any clarification in this respect may be obtained by the Bidder at the pre-bidding stage. During finalization of detailed engineering if some component, equipment, system, sub-system found to undergo change, then the Owner/Consultant shall revise the list for compliance by the Bidder without any implication to the Owner.

2.04.02 For Mandatory Spares refer Annexure-I of this section.

Sl. No.	Equipment/Package Name	Quantity to be supplied for the Package
1.31.05	Other Electrical Spares as applicable as per the Electrical List	Applicable Item & Quantity same as indicated in Electrical list Sl. No. 7.08.00, 7.21.00.
1.31.06	MMI Spares	Applicable Item & Quantity same as indicated in C&I list Sl. No.8.03.00
1.32.00	Mill Reject Handling System	
1.32.01	Pneumatic Conveying System	
(i)	Pneumatic Main Valves	4Sets of each type
(ii)	Pneumatic/Solenoid Two/ Three Position Control Valve	4Sets of each type
(iii)	Plate/Dome (including seals) Valve with Actuator	4Nos.
(iv)	Plate/Dome valve seals	6Sets
1.32.02	Compressor	Applicable Spares as Sl. No. 6.05.00
1.32.03	Other Electrical Spares as applicable as per the Electrical List	Applicable Item & Quantity same as indicated in Electrical list Sl. No. 7.08.00, 7.13.00 & 7.21.00.
1.32.04	PLC System	Applicable Item & Quantity same as indicated in C&I list Sl. No.8.03.00
1.32.05	Other C&I Spares as applicable as per the C&I List	Applicable Item & Quantity same as indicated in C&I list Sl No.8.04.00 & 8.07.(Refer Section IC
~~1.33.00~~	~~Flue Gas Desulphurization System~~	
~~1.33.01~~	~~Gates/dampers in Flue Gas System~~	
~~(i)~~	~~Seals~~	~~1 set of each type gates and actuator (Set means complete replacement required)~~
~~(ii)~~	~~Actuator 1 no. of each type~~	~~1 no. of each type of gates and actuator~~
~~1.33.02~~	~~Air Pre Heaters~~	
~~(i)~~	~~Radial seals~~	~~1 set~~
~~(ii)~~	~~Axial Seals~~	~~1 set~~
~~(iii)~~	~~Circumferential or bypass seals~~	~~1 set~~
~~(iv)~~	~~Rotor post seals~~	~~1 set~~
~~(v)~~	~~Heating Element~~	~~1 set~~
~~(vi)~~	~~Air Motor~~	~~1 no.~~
~~(vii)~~	~~clutch assembly~~	~~1 no. of each type~~
~~(a)~~	~~Support Bearing~~	~~1 no.~~
~~(b)~~	~~Guide Bearing~~	~~1 no.~~
~~(vii)~~	~~Complete Speed reducer~~	
~~(a)~~	~~Speed reducer Gears, pinions& shaft~~	~~1 set~~
~~(b)~~	~~Speed reducer Bearings~~	~~1 set~~
~~(c)~~	~~Speed reducer Seals & gaskets~~	~~1 set~~
~~(d)~~	~~Speed reducer Clutch assembly~~	~~1 no~~
~~(e)~~	~~Couplings with inserts & fasteners~~	~~1 no.~~
~~(f)~~	~~Solenoid valves~~	~~1 no of each type and rating~~
~~(viii)~~	~~GGH Cleaning Device~~	
~~(a)~~	~~Lance and Nozzle~~	~~1 no.~~
~~(b)~~	~~Drive assembly including Gearbox and motor~~	~~1 no.~~
~~(c)~~	~~Valve assembly with actuator~~	~~1 no.~~
~~(d)~~	~~Pump assembly (if applicable)~~	~~1 no.~~
~~(ix)~~	~~GGH Electric Motor~~	~~1 no.~~
~~(x)~~	~~Lubricating system of support & Guide Brg.~~	

Sl. No.	Equipment/Package Name	Quantity to be supplied for the Package
6.04.05	Electrical Spares as applicable as per the Electrical List	Applicable Item & Quantity same as indicated in Electrical list Sl. No.7.08.00,7.12.00 & 7.21.00
6.04.06	C&I Field Instruments & PLC as applicable as per the C&I List	Applicable Item & Quantity same as indicated in C&I list Sl. No. 8.03.00, 8.04.00 & 8.10.00
6.05.00	Compressed Air System	
6.05.01	Dry Air Intake Filter	5Nos.
6.05.02	Complete set of Loading- unloading valve assembly	2Sets (one set means complete replacement for one compressor)
6.05.03	Low Pressure Compressor element (Screw) with Drive end & Non-drive end Bearings for Male & Female Elements	2Sets (one set means complete replacement for one compressor)
6.05.04	High Pressure Compressor element (Screw) with Drive end & Non-drive end Bearings for Male & Female Elements	2Sets (one set means complete replacement for one compressor)
6.05.05	Plug for Inter cooler Tube Bunch	15Nos
6.05.06	Plug for After Cooler Tube Bunch	15Nos
6.05.07	Automatic Purge Drain Valve for Inter cooler and After cooler	2Sets (one set means complete replacement for one compressor)
6.05.08	Air Outlet Check Valve	2Nos.
6.05.09	Air Outlet Compensator	1Set (one set means complete replacement for one compressor)
6.05.10	Lub oil filter	5Nos.
6.05.11	Lub oil Pressure Regulating valve	1No.
6.05.12	Different oil seals/O-ring for Lub oil system	4Sets (one set means complete replacement for one compressor)
6.05.13	Cooling water Inlet and Outlet connection bellows	2Sets (one set means complete replacement for one compressor)
6.05.14	Gear Box Unit Complete	1Set (one set means complete replacement for one compressor)
6.05.15	Gear Box Component	
(i)	Different Oil Seals/O-ring	2Sets (one set means complete replacement for one compressor)
(ii)	Set Of Bearings	1Set (one set means complete replacement for one compressor)
(iii)	Breathing Unit	2Nos
6.05.16	Component of L.P Cylinder	
(i)	Gear sets	1Set (one set means complete replacement for one compressor)
(ii)	Set of bearings	1Set (one set means complete replacement for one compressor)
(iii)	Mechanical Seal & O-ring	1Set (one set means complete replacement for one compressor)
6.05.17	Component of HP Cylinder	
(i)	Gear sets	1Set (one set means complete replacement for one compressor)
(ii)	Set of bearings	1Set (one set means complete replacement for one compressor)
(iii)	Mechanical Seal & O-ring	1Set (one set means complete replacement for one compressor)
(iv)	Different Safety Valves	1Set (one set means complete replacement for one compressor)

Sl. No.	Equipment/Package Name	Quantity to be supplied for the Package
(v)	Coupling	
(a)	Complete Set of Coupling (Motor to Compressor)	1Set (one set means complete replacement for one compressor)
(b)	Flexible Rubber for Coupling	4Nos.
6.05.18	Drain Moisture Trap	2Sets (one set means complete replacement for one compressor)
6.05.19	Safety Valve's Springs & Gasket for LP Stage	1Set (one set means complete replacement for one safety valve)
6.05.20	Safety Valve's Springs & Gasket for HP Stage	1Set (one set means complete replacement for one safety valve)
6.05.21	Oil Pump & Motor Complete Assembly	1Set
6.05.22	Drive Motor	1No.
6.05.23	Other Spares as applicable as per the Electrical List	Applicable Item & Quantity same as indicated in Electrical list Sl. No.7.08.00, 7.12.00 & 7.21.00
6.05.24	Compressed Air Line Valves	As applicable as per Sl. No.5.05.02
6.05.25	C&I Items	
(i)	PLC with MMI System	Applicable Item & Quantity same as indicated in C&I list Sl. No. 8.03.00
(ii)	Field Instruments & Others as applicable as per the C&I List	Applicable Item & Quantity same as indicated in C&I list Sl. No. 8.04.00, 8.07.00 & 8.10.00
6.05.26	Air Drying Plant (HOC Type)	
(i)	Pre-filter Elements	2Sets (one set means complete replacement for one drier filter)
(ii)	After-filter Elements	2Sets (one set means complete replacement for one drier filter)
~~6.06.00~~	~~Ventilation System~~	
~~6.06.01~~	~~Centrifugal Fans~~	
~~(i)~~	~~Set of Bearings for Air Washer Fans~~	~~1Set for each Type of Fan~~
~~(ii)~~	~~Set of Bearings for U.A.F. Fans~~	~~1Set for each Type of Fan~~
~~(iii)~~	~~Impeller for the Fan~~	~~1Set for each Type of Fan~~
~~(iv)~~	~~Drive Motor~~	~~1No. for each Type of Fan~~
~~(v)~~	~~Electrical Spares as applicable as per the Electrical List~~	~~Applicable Item & Quantity same as indicated in Electrical list Sl. No. 7.21.00~~
~~6.06.02~~	~~Centrifutal Pumps~~	
~~(i)~~	~~Set of Bearings for Air Washer Pumps~~	~~1Set for each Type and rating of Pump~~
~~(ii)~~	~~Set of Bearings for U.A.F. Pumps~~	~~1Set for each Type and rating of Pump~~
~~(iii)~~	~~Gland Packing, Shaft Sleeve & Casing Wearing Ring~~	~~1Set for each Type and rating of Pump~~
~~(iv)~~	~~Impeller for the Pump~~	~~1Set for each Type and rating of Pump~~
~~(v)~~	~~Electrical Spares as applicable as per the Electrical List~~	~~Applicable Item & Quantity same as indicated in Electrical list Sl. No. 7.21.00~~
~~6.06.03~~	~~Spray Nozzles~~	
~~(i)~~	~~Spray nozzles for air washer unit~~	~~1Set (one set means complete replacement for one air washer)~~
~~(ii)~~	~~Spray nozzles for U.A.F. unit~~	~~1Set (one set means complete replacement for one UAF)~~
~~6.06.04~~	~~SS Filters~~	
~~(i)~~	~~SS Filters for Air washer~~	~~1Sets (one set means complete replacement for one air washer)~~
~~(ii)~~	~~SS Filter for Unitary air filtration unit~~	~~1Sets~~ (one ~~set means complete replacement for one UAF)~~

Sl. No.	Equipment/Package Name	Quantity to be supplied for the Package
(d)	Voltmeter Selector Switch	3 nos of each type.
(xvii)	Isolation switch for the control supply (AC Supply On / Off Switch, DC Supply On / Off Switch, Motor Heater On /Off Switch etc.)	3 nos of each type.
(xviii)	Operating mechanism rod for each rating	3 nos
(xix)	Set of gaskets of each rating	2 sets
(xx)	Ammeter of each type & range	2 no of each type & range
(xxi)	Voltmeter of each type & range	1 no of each type &range
(xxii)	Circuit breaker aux. contact assembly:	10% (ronded off to the next higher integer)of total nos. or minimum 5 nos whichever is higher for each type and rating used in each switchgear
(a)	52 a & b	
(b)	52 c & d	
(xxiii)	Indicating Lamps	
(a)	Indicating lamps (Red, amber, green, white, blue)	5% (ronded off to the next higher integer)of total nos. for each type
(b)	Indicating lamp covers of all colours, lamp resistors & holders	5% (ronded off to the next higher integer)of total nos. for each type and rating used in each switchgear
(xxiv)	Fuse base and holder of each type & rating	6 nos. of each type.
(xxv)	MCB & Fuse of each type & rating	12 nos of each.
(xxvi)	Maintenance tools and accessories for maintenance (bidder to list)	1 set.
(xxvii)	Carbon brushes for spring charging motor (if applicable)	20 sets
(xxviii)	Breaker jaw contact (Bus end & breaker end) assembly	2 sets (1 set consists of 3 nos.)of each rating
(xxix)	Terminal blocks	12 nos. of each type and rating
(xxx)	Arc chute (if applicable for each rating)	3 nos.
(xxxi)	DC Supply Source Selector Switch (3-position)	3 nos.
(xxxii)	Bearings for spring charging motor	6 sets
(xxxiii)	Multiple pin plug contact assy. with cables (male & female)	6 sets
(xxxiv)	Guide for moving contact set	6 sets (complete)
(xxxv)	Interphase barrier	3 nos. for each type
(xxxvi)	Contactors with HRC fuses	10 % (ronded off to the next higher integer)of each type and rating
(xxxvii)	Aux. contactors	10 % (ronded off to the next higher integer)of each type and rating
(xxxviii)	Control supply transformers (If applicable)	1 no of each type.
(xxxix)	Dash pot complete assembly	1 no. with each type
(XL)	Surge Arrester	5 nos. of each type and rating
(XLI)	Transducer	2 nos. for each type and Rating
(XLII)	Energy Meter	1 no of each type and rating
(XLIII)	HT fuse of PT	3 nos. of each type and rating
7.08.00	415V System	
7.08.01	11/0.415KV Transformer (for Each make, type and rating of Transformer)	
(i)	Door Limit Switch complete set	1 set (1 set means total requirement for one

Sl. No.	Equipment/Package Name	Quantity to be supplied for the Package
		Transformer)
(ii)	Neutral CT	1 no of each type and rating
(iii)	Temperature scanner	1 no.
(iv)	bhy	3 No
(v)	LV Bushing with metal parts, connectors and gaskets	3 No
(vi)	LV neutral Bushing with metal parts, connectors and gaskets	1 No
(vii)	Post Insulator	1 set (1 set means total requirement for one Transformer)
(viii)	Limb of complete LT & HT of temperature sensing devices	1 Set (1 set means total requirement for one Transformer)
7.08.02	415V Air Circuit Breaker (for Each make, type and rating of ACB)	
(i)	Trip Coil	20% of total nos. or minimum 5 nos whichever is higher for each type and rating used in each switchgear (PCC/PMCC/MCC/ACDB)
(ii)	Closing Coil	20% of total nos. or minimum 5 nos whichever is higher for each type and rating used in each switchgear (PCC/PMCC/MCC/ACDB)
(iii)	Spring Charging Motor	2 nos.
(iv)	Spring Charging Motor with complete Mechanism	2 nos.
(v)	Spring Charged Limit Switch	5 nos.
(vi)	Thermal Overload for Spring Charging Motor	2 nos.
(vii)	Main Contact (Fixed and moving) assembly	5 sets (1 set consists of 3 nos.) for each type and rating
(viii)	Arcing Contact (Fixed and moving) assembly	5 sets (1 set consists of 3 nos.) for each type and rating
(ix)	Breaker Jaw Contact (Bus-end & Breaker- end) assembly	5 sets (1 set consists of 3 nos.) for each type and rating
(x)	Sliding Contact (Fixed & Moving)	3 sets.
(xi)	Breaker Auxiliary Contact Block	5 nos.
(xii)	Arcing Chute	2 sets (1 set consists of 3 nos.) for each type and rating
(xiii)	Plug Socket with Prefab cable	3 nos
(xiv)	Position Limit Switch	5 sets
7.08.03	415V PCC, PMCC, MCC, ACDB, DCDB, Elect. Control Panel (For each PCC, PMCC, MCC, ACDB, DCDB and Elect. Control Panel) (applicable items of PCC, PMCC, MCC, ACDB, DCDB and Elect. Control Panel shall be considered)	
(i)	Indicating Lamps complete assembly	
(a)	Red	3 nos of each make and type.
(b)	Blue	3 nos of each make and type.
(c)	Green	3 nos of each make and type.
(d)	White	3 nos of each make and type.
(e)	Amber	3 nos of each make and type.
(ii)	CT	2 nos. for each make, type and Rating

Sl. No.	Equipment/Package Name	Quantity to be supplied for the Package
(iii)	Transducer	2 no for each make, type and Rating
(iv)	Trip / Neutral / close Control Switch	2 nos. for each make, type and Rating
(v)	Switch gear or MCC / Trial / Normal selector switch	2 nos. for each make, type and Rating
(vi)	Local/Remote selector switch	2 nos. for each make, type and Rating
(vii)	AC Supply On / Off Switch	1 no. for each make, type and Rating
(viii)	DC Supply On / Off Switch	1 no. for each make, type and Rating
(ix)	Motor Heater On /Off Switch	1 no. for each make, type and Rating
(x)	DC Supply Source Selector Switch (3-position)	1 no. for each make, type and Rating
(xi)	Ammeter Selector Switch	1 no. for each make, type and Rating
(xii)	Voltmeter Selector Switch	1 no. for each make, type and Rating
(xiii)	Voltmeter	2 no. for each make, type and Rating
(xiv)	Ammeter	2 no. for each make, type and Rating
(xv)	Auxiliary Control Contactor	
(a)	Auxiliary Control Contactor complete assembly	10% of total nos for each make, type and Rating.
(b)	Auxiliary Control Contactor spare kits	10% of total nos. for each make, type and Rating.
(c)	Auxiliary Control Contactor Coils	10% of total nos for each make, type and Rating.
(xvi)	Power Contactor	
(a)	Power Contactor Complete Assembly	10% of total nos for each make, type and rating
(b)	Power Contactor spare kits	10% of total nos for each make, type and Rating.
(c)	Power Contactor Coils	10% of total nos for each make, type and Rating.
(xvii)	MCCB	5% of total nos. for each make, type and rating.
(xviii)	MCB	5% of total nos. for each make, type and rating.
(xix)	Switch Fuse Unit (DC)	10% of total nos. for each make, type and rating.
(xx)	Power Fuse	5% of total nos. for each make, type and rating.
(xxi)	Control Fuse	5% of total nos. for each make, type and rating.
(xxii)	Thermal Overload Relay	5% of total nos. for each make, type and rating.
(xxii)	Sliding contact (Fixed and moving) Complete assembly	2 sets of each make, type and rating
(xxiii)	Busbar to module Lira Contact assembly	2 sets of each make, type and rating (1 set means all 3 ph+ neutral)
(xxiv)	Control and Aux. Transformer	1 no of each make, type and rating
(xxv)	Delay Timer	2 no of each make, type and rating
(xxvi)	Power Terminal Block	2 sets for each make, type and rating
(xxvii)	Control Terminal Block	2 sets for each make, type and rating
(xxviii)	End plate for Power and Control terminal block	2 sets for each make, type and rating
(xxix)	Energy meter	1 no for each make, type and rating
(xxx)	Relays (Other than numerical relay):	
(a)	Conventional (Electromagnetic/Static type) Relay	2 no for each make, type and rating
(b)	Aux. relays & Lock out relays & TIMERS	2 nos for each make, type and rating
(xxxi)	MCCB Status (On/off) Monitoring Switch/Contact	2 nos for each make, type and rating
(xxxii)	Push Button (On/Off) Complete Assembly	2 nos for each make, type and rating
(xxxiii)	Annunciation Facia with lamps complete	1 set for each make, type and rating

Sl. No.	Equipment/Package Name	Quantity to be supplied for the Package
~~7.11.06~~	~~UPS Battery (Ni-Cad Type)~~	
~~(i)~~	~~Battery Cell (Uncharged, Dry)~~	~~10Nos. each type~~
~~(ii)~~	~~Inter connecting cell strips~~	~~10Nos. each type~~
~~(iii)~~	~~Vent cap~~	~~10Nos. each type~~
~~(iv)~~	~~Hydrometer~~	~~1No.~~
~~(v)~~	~~Rubber gloves~~	~~1Pair~~
~~(vi)~~	~~Voltmeter for measuring cell voltage (Center zero type)~~	~~1No.~~
~~(vii)~~	~~Funnel~~	~~1No.~~
~~(viii)~~	~~Jug~~	~~1No.~~
~~(ix)~~	~~Appron & Goggles~~	~~1Set~~
~~(x)~~	~~Cell lifting puller~~	~~1No.~~
~~(xi)~~	~~Insulated socket spanner with handle~~	~~1No.~~
~~(xii)~~	~~Terminal screw with Belleville washer~~	~~5% of total quantity used~~
~~(xiii)~~	~~Plastic filling bottle~~	~~1No.~~
~~(xiv)~~	~~Thermometer~~	~~1No.~~
~~7.11.06~~	~~Other Electrical Items~~	~~For other applicable items Sl No.7.12.00 & 7.08.00 of this document shall be followed.~~
~~7.12.00~~	~~Control Panel/Desk Mounted Items~~	
~~7.12.01~~	~~Push Button Complete assembly~~	~~10Nos for each colour~~
~~7.12.02~~	~~Push Button Contact Element (1NO + 1NC) Block~~	~~20Nos.~~
~~7.12.03~~	~~Selector Switch~~	~~10Nos. for each type and rating~~
~~7.12.04~~	~~Meter (Analog and Digital)~~	
~~(i)~~	~~Ammeter~~	~~2Nos. for each type and range~~
~~(ii)~~	~~Voltmeter~~	~~2Nos. for each type and range~~
~~(iii)~~	~~Frequency~~	~~2Nos. for each type and range~~
~~(iv)~~	~~MW~~	~~2Nos. for each type and range~~
~~(v)~~	~~MVAR~~	~~2Nos. for each type and range~~
~~(vi)~~	~~Power Factor~~	~~2Nos. for each type and range~~
~~(vii)~~	~~Synchroscope~~	~~1No. for each type and range~~
~~(viii)~~	~~Synchrocheck Relay complete set~~	~~1No. for each type and range~~
~~(ix)~~	~~Transducer~~	~~1No. for each type and range~~
~~7.12.05~~	~~Indicating Lamps complete assembly~~	~~20Nos. for each Colour and type~~
~~7.12.06~~	~~Mimic Lamps~~	~~10Nos. for each Colour and type~~
~~7.12.07~~	~~MCB~~	~~5Nos. for each type and rating~~
~~7.12.08~~	~~Door Limit Switch~~	~~5Nos.~~
~~7.12.09~~	~~Annunciation system~~	
~~(i)~~	~~Lamp Box with Facia & Lamps (LED type)~~	~~25Nos.~~
~~(ii)~~	~~Hooter~~	~~1No.~~
~~(iii)~~	~~Each type of PCB (for non-PLC driven system)~~	~~1(one) no.~~
7.13.00	Actuator	
7.13.01	Complete set of Actuator	2Nos. for each type, make and rating, 1 no. for H2 cooler Temperature controller and 1 no. for stator water temperature controller
7.13.02	Power Unit for Modulating Actuator	4Nos. of each type

Sl. No.	Equipment/Package Name	Quantity to be supplied for the Package
7.13.03	DC-DC Power Pack Unit	4Nos. of each type
7.13.04	Electronic cards	4Nos. of each type
7.13.05	Position Feed Back Transmitters	4Nos. of each type
7.13.06	Control Unit	4Nos. of each type
7.13.07	Limit Switch Assembly	2 Nos each type and rating
7.13.08	Torque Switch Assembly	2 Nos each type and rating
7.13.09	Power Contactor	5Nos. for each type and rating
7.13.10	Auxiliary Contactor	5Nos. for each type and rating
7.13.11	Thermal Over Load Relay	2Nos. for each type and rating
7.13.12	Motor	1No. each type and rating
7.13.13	Complete Seal kit	2Sets for each type and rating
7.13.14	Complete O-Ring Set	2Sets for each type and rating
7.14.00	Illumination	
7.14.01	Lighting fixtures without light	20 Sets for each make, type and rating
7.14.02	MCCB	5 Nos. for each make, type and rating .
7.14.03	MCB	20 Nos. for each make, type and rating .
7.14.04	Power and Control Contactor	5 Nos. for each make, type and rating
7.14.05	Switches	5 Nos. for each make, type and rating .
7.14.06	Receptacles with plug	5 Nos. for each make, type and rating
7.14.07	Rotary switches	2 Nos. for each make, type and rating .
7.14.08	LED light	50 nos. for each make, type and rating .
7.14.09	Clock switch type Time Switch	2 nos. for each make, type and rating .
7.14.10	Lighting Transformer	1 no. for each make, type and rating .
7.15.00	Cable	
7.15.01	11KV Grade HT Power Cable	2 (Two) Kms. of each type, size & rating of Cables
7.15.02	3.3KV Grade HT Power Cable	2 (Two) Kms. of each type, size & rating of Cables
7.15.03	LT Power Cable	2(Two)Kms of each type, size & rating of Cables
7.15.04	Control Cable	2(Two)Kms. of each type, size & rating of Cables
7.15.05	Fire Survival Cable	1(One)Km of each type, size & rating of Cables
7.16.00	Neutral Grounding Registor	
7.16.01	NGR complete with all accessories	1 set of each make, type and rating
7.16.02	Insulator	2 nos for each make, type, rating and size
7.16.03	Neutral CT(if applicable)	1 no of each type and rating
7.17.00	DG Set	
7.17.01	Diesel Engine	
(i)	Element Corrosion Resistor	8Nos.
(ii)	Element lub oil Filter	8Nos.
(iii)	Element lub oil by pass Filter	8Nos.
(iv)	Element Fuel Filter	16Nos.
(v)	Plate corrosion Resistor	16Nos.
(vi)	Element Air cleaner outer	2Nos.
(vii)	Element Air cleaner Inner	2Nos.
(viii)	Fuel Oil Pump	1No.

Sl. No.	Equipment/Package Name	Quantity to be supplied for the Package
(viii)	Voltmeter for measuring cell voltage (Center zero type)	1No.
7.18.02	Float -cum- Boost Charger (For each make, Type and Rating)	
(i)	Electronic Module, PCB, Cards of each type and rating (with all components mounted)	2 Set
(ii)	Fuses of each type and rating	100% of total quantity.
(iii)	SCR of each type and rating	2 Nos.
(iv)	Blocking Diode of each type and rating	5 Nos. of each type
(v)	Potentiometer of each type and rating	1 Set
(vi)	Pulse transformer	1 Set of each type
(vii)	Main and Aux. transformer	1 no of each type and rating
(viii)	Capacitor	2 no of each type and rating
(ix)	Meters	1 No of each type
(x)	Transducer	1 No of each type
(xi)	Selector Switch	1 no of each type
(xii)	Control Switch	1 no of each type
(xiii)	Current transformer(if applicable)	1 no of each type and rating
(xiv)	Push button complete set	1 no of each type
(xv)	Annunciation window	1No.
(xvi)	Indicating Lamps complete assembly	2 Nos of each type.
7.19.00	24V DC System	
7.19.01	Battery	
(i)	Battery Cell (Uncharged, Dry)	10Nos
(ii)	Inter connecting cell strips	10Nos
(iii)	Vent plug	5Nos
(iv)	Teak wood cable clamps with hardware	2Nos
(v)	Hydrometer	1No.
(vi)	Rubber gloves	1pair
(vii)	Voltmeter for measuring cell voltage (Center zero type)	1No.
(viii)	Insulated socket spanner with handle	1No.
(ix)	Thermometer	1No.
7.20.02	Float -cum- Boost Charger	
(i)	Fuses & fuse links	100% of total quantity for each type, rating of fuses used in the system
(ii)	SCR	100% Used in the System
(iii)	Diode	100% Used in the System
(iv)	Indicating lamps	100% Used in the System
(v)	All types of Electronic Module/ PCB/Card	2Nos. each type used in the system
(vi)	pulse transformer	1 set
7.20.03	Othe DCDB Spares items as applicable as per the Electrical List	Item & Quantity same as indicated in Electrical list Sl. No.7.09.00
7.20.04	Other Electrical Spares as applicable as per the Electrical List	Item & Quantity same as indicated in Electrical list Sl. No.7.08.00 & 7.12.00
7.21.00	Motor	
7.21.01	11 KV & 3.3 KV Motor	
(i)	Motor of each type and rating (Note :	10% of the installed quantity or minimum 1

Sl. No.	Equipment/Package Name	Quantity to be supplied for the Package
	motors covered in mechanical spare items need not to be included here again)	number whichever be higher
(ii)	Neutral End Terminal Bushing with Fasteners	1 no. for each type and rating of Motor
(iii)	Bearing Temperature Gauge Driving & Non-Driving End	1 set for each type and rating of Motor
(iv)	Phase segregated terminal boxes	2 Nos. for each type and rating of Motor
(v)	Heaters	2 sets for each type and rating of Motor
(vi)	Complete Set of Coupling	1 set for each type and rating of Motor
(vii)	Bearings (DE) for each type and rating of motors	2 sets for each type and rating of Motor
(viii)	Bearings (NDE) for each type and rating of motors	2 sets for each type and rating of Motor
(ix)	Cooling Fan Internal & External	1 set for each type and rating of Motor
(x)	Neutral CT for differential protection (For motor rating >1000 KW)	2 no of each type and rating.
(xi)	End Termination kits	2 Nos. of each type and rating
(xii)	Indicating Instruments/gauges other then Bearing temperature gauge (as applicable)	1 set for each type and rating of Motor
(xiii)	Phase side Bushing and Insulator	1Set for each type and rating of Motor
(xiv)	Oil Seal Ring (as applicable)	1Set for each type and rating of Motor
7.21.02	415 Volt Motor	
(i)	Motor of each type and rating (Note : motors covered in mechanical spare items need not to be included here again) 10% of the installed quantity or minimum 1 number whichever be higher	10% of the installed quantity or minimum 1 number whichever be higher
(ii)	End Shield Cover Driving & Non-Driving End	1 set for each type and rating of Motor
(iii)	Heaters	2 sets for each type and rating of motor
(iv)	Bearings (DE and NDE) for each type and rating of motor	2 sets
(v)	Cooling Fan for all type and rating of LT motors	One (1) set
(vi)	Dust seals and gaskets for each type of motors	1 Set
(vii)	Motor Terminal Block	1 no. for each type and rating of Motor
(viii)	Complete Set of Coupling	1 set for each type and rating
7.21.04	DC Motor	
(i)	Motor of each type and rating (Note : motors covered in mechanical spare items need not to be included here again)	10% of the installed quantity or minimum 1 number whichever be higher
(ii)	Carbon brushes	2 sets for each type and rating of Motor
(iii)	Brush assemblies	2 sets for each type and rating of Motor
(iv)	Terminal blocks	1 set for each type and rating of Motor
(v)	Heaters	1 set for each type and rating of Motor
(vi)	Complete Set of Coupling	1 set for each type and rating of Motor
(vii)	Bearings (DE and NDE) for each type and rating of motor	1 set for each type and rating of Motor
(viii)	Cooling Fan	1 set for each type and rating of Motor
7.22.00	Local Control Station	

LIST OF TOOLS & TACKLES

1. Steam Generator & Auxiliaries

Sl. No.	Description	Quantity Required
A.	**PULVERISER**	
1.	Box wrench trunion shaft end cap	3 Nos.
2.	Drive cap for journal shaft	2 Nos.
3.	Sampling device assembly	1 no.
4.	Oil dip stick	3 Nos.
5.	Spring pre-load fixture/ JOURNAL ROLL SPRING PRE-LOAD FIXTURE	2 Nos.
6.	Grinding roll removal fixture/ JOURNAL GRINDING ROLL LIFTING LUG	2 Nos.
7.	Grinding roll wear measurement gauge	1No.
8.	Spanner wrench grind roll lock nut	3 Nos.
9.	Single open end jaw spanner	3 Nos.
10.	Trip torque arrangement	1 no.
11.	BOWL & BOWL HUB HOISTING FIXTURE	1 No.
12.	GEARBOX WITHDRAWAL FIXTURE	1 No.
13.	MULTI POINT ROTARY PROBE	1 No.
14.	PLANETARY GEARBOX ALIGNMENT ADJUSTING BLOCKS	1 Set
15.	JOURNAL TILT OUT APPLICATION & FIXTURE	1 No.
16.	JOURNAL STOP BOLT WRENCH	1 No.
17.	HYDRAULIC TORQUE WRENCH	1 No.
18.	HYDRAULIC STUD TENSIONER	1 No.
19.	DIRTY AIR PITOT	4 No.s
20.	ANCHOR BOLT TEMPLATE	1 No.
21.	TRUNNION SHAFT ECCENTRIC ADJUSTMENT TOOL	1 No.
22.	ELECTRICAL OPERATED MILL HANDLING EQUIPMENT	1 Set.
B.	**GRAVIMETRIC FEEDERS**	
1.	Checking bar	2 Nos.
2.	Pulley lift bar assembly	1 no.
3.	Pulley removal tool	1 no.
4.	Feeder calibrating instrument kit	2 Nos.
5.	Rail extension (LG & RH)	1 set
6.	Digital tachometer	1 no.
7.	Shims for calibration	2 Nos.
C.	**GRAVIMETRIC FEEDER CONTROLS (MICROPROCESSOR BASED)**	
1.	Calibration probe and cables	2 sets
2.	Digital tachometer	1 no.
D.	**FANS**	

1.	Bearing cum coupling puller assembly	2 Nos.
2.	Mounting and dismounting tool for impeller	1 no.
3.	Torque wrench 20 – 200 NM	1 no.
4.	Torque wrench 75 – 400 NM	1 no.
E.	**AIR HEATERS**	
1.	Hydraulic lifting cylinder set (Pump with Hoses etc.)	4 Nos.
F.	**ELECTROSTATIC PRECIPITATOR**	
1.	Stretching device for mounting emitting electrode	2 Nos.
2.	Alignment jig for support insulator replacement	2 Nos.
3.	Lifting tool for support insulator replacement	4 Nos.
4.	Form tool for correcting collecting electrode profile	1 no.
5.	Shaft insulation removal tool	1 no.
G.	**LAPPING TOOLS FOR VALVES**	
1.	Lapping tools for safety valve	1 set
2.	Lapping tools for other IBR valve	1 set
3.	Ring caps	1 set
4.	Grinding stones	1 set
H.	**SOOT BLOWERS**	
1.	Soot blower valve lapping tool	1 no.
2.	Soot blower valve spring tool	1 no.
3.	Soot blower special key	1 no.
4.	Nozzle setting fixture	1 no.
5.	Pressure sealing tool	1 no.
6.	Packing tampering tool	1 no.
I.	**OIL SYSTEM**	
1.	Burner vice assembly	3 sets
2.	Maintenance trolley	2 sets
J.	**LIFTING TACKLES**	
a)	Hoist for Fans and air heaters – electrically operated	
	i) FD fan – rotor	2 Nos.
	ii) FD fan – motor	2 Nos.
	iii) PA fan – rotor	2 Nos.
	iv) PA fan – motor	2 Nos.
	v) ID fan motor and impeller	1 No.
b)	Air heater (for basket removal from operating floor to ground level)	1 No.

	Air heater (from AH top to operating floor)	2 Nos. (manually operated)
c)	Electricity Operated Cranes for Mill Motor and Mill component handling	2 Nos. (one no. of each side of boiler)
	Electricity Operated Cranes for Mill component handling (in between mills)	10 Nos. (arranged on both sides)
d)	Electrical hoist for ESP components handling	2 Nos.
K.	**BOILER FEED PUMP SET**	
1.	Cartridge Assembly and Disassembly Tools	1 No.
2.	Cartridge Withdrawal Gear Arrangement	1 No.
3.	Mounting bracket Assy.	1 No.
4.	Mounting Wheel Assy. (MDBFP)	1 No.
5.	Mounting Wheel Assy. (TDBFP)	1 No.
6.	Extension sleeve Assy. (1st stage)	1 No.
7.	Extension sleeve Assy. (Inter stage)	4Nos.
8.	Support jack Assy.	1 No.
9.	Support column (Motor driven)	2 Nos.
10.	Support column (Turbine driven)	2 Nos.
11.	Withdrawal Plate Thrust Collar	1 No.
12.	Withdrawal Plate DE Gland Sleeve	1 No.
13.	Withdrawal Plate Balancing Drum Assembly	1 No.
14.	Withdrawal Plate Gland Sleeve Assembly	1 No.
15.	Tube Spanner (Balancing Drum Nut) Assembly	1 No.
16.	Tube Spanner (Shaft Nut Thrower) Assembly	1 No.
17.	Tube Spanner (Shaft Lock Nut NDE) Assembly	1 No.
18.	Tube Spanner (Coupling Nut) Assembly	1 No.
19.	Tube Spanner (Shaft Lock Nut DE) Assembly	1 No.
20.	Hook Spanner	3 Nos.
21.	Hydraulic Stud Tensioner	1 No.
22.	Support Frame	1 No.
23.	LEVER ASSY,INNER CASING WITHDRWL	2 Nos
24.	PULL OUT ATTCH ASSY ,WTHDRWL	2 Nos
25.	BOLT INNR CASNG M30x3.5 ,WITHDRWL	2 Nos
26.	PR.PLATE M16 ,INNR CASNG WITHDRWL	2 Nos
27.	PIN 16 RND HD ,INNR CASNG WTHDRWL	2 Nos
28.	CASING STUD EXTN M56x4 ,WITHDRWL	2 Nos
29.	CAP NUT M115x3 / M56X4	2 Nos
30.	SUPPORT JACK ASSY, COUP. SIDE	1 No.
31.	SHAFT,SUPPORT JACK ASSY	1 No.
32.	SPACER NO.1,SUPPORT JACK ASSY	1 No.
33.	SPACER NO.2,SUPPORT JACK ASSY	1 No.
34.	SPACER NO.3,SUPPORT JACK ASSY	3 Nos

35.	SPACER NO.4,SUPPORT JACK ASSY	1 No.
36.	SPACER NO.5,SUPPORT JACK ASSY	3 Nos
37.	SPANNER, COUPLING NUT	1 No.
38.	THRUST DISC TOOL	1 No.
39.	THRUST DISC PULL OUT TOOL	1 No.
40.	TORQUE WRENCH ADPTR,TH.NUT	1 No.
41.	S.ROW DEEP GR BALL BRG 6305-2Z,VAR.20	2 Nos
42.	BOLT HEATER,BFP CSG BOLTS	4 Nos
43.	HEX SOC HD CAP SCRU HTS M36x80,VAR.NO.07	2 Nos
44.	BOLT HEX M20X80 P8.8 ELEGAL	1 No.
45.	BOLT HEX M20X180 ELEGAL	1 No.
46.	NUT HEX P M20-8	1 No.
L.	**CONDENSATE EXTRACTION PUMP**	
1.	Thrust Bearing Withdrawal and Assembly Tools	1 No.
2.	Impeller withdrawal and fitting Assembly	1 No.
3.	Set of 'C' Spanners set	1 No.
4.	Hook Spanner	1 No.
5.	Tie rods	3 Nos.
6.	TIE ROD ASSY-EN6J40/500 TB WTHDWL TOOLS	1 No.
7.	TIE ROD M16X500-EN6J40/500 TB WTHDWL	2 Nos
8.	STRONG BACK-EN6J40/500 TB WTHDWL	1 No.
9.	STRONG BACK-EN6J40/500 1ST IMP WTHDWL	1 No.
10.	SCRU ROD M12X330-EN6J40/500 1ST IMP TOOL	2 Nos
11.	NUT HEX P M12 -8	2 Nos
12.	NUT HEX P M16-8	4 Nos
13.	WASHER MCD 17-ST	2 Nos
14.	WASHER (M24 BOLT)	1 No.
15.	C SPANNER VAR NO 12	1 No.
16.	C SPANNER VAR.NO.13 ASSLY	1 No.
17.	NUT HEX P M24-8	1 No.
M.	**Boiler Feed Pump Drive Turbine**	
1.	Spanner for Stop Valve Assembly	1 No.
2.	Pin Spanner for Over –speed Governor	1 No.
3.	Ring Spanner for Turbine Casing	1 No.
4.	Single Ended Open Jaw Spanner for Stop Valve	1 No.
5.	Double Ended Open Jaw Spanner for Stop Valve	1 No.
6.	Single Ended Box Spanner for Bearing Housing	1 set
7.	Eye Bolts for Bearing Hosing	1 set
8.	Lifting Equipment for Rotor	1 No.
9.	Transport Equipment for Turbine Casing	1 set
10.	Hook Spanner for Governing Valves	1 No.
11.	Press for Governing Valves Spindle Packing Assembly	1 set
12.	Circlip Pliers for Governing Assemblies	1 set
13.	Blowing Down Fixture for Steam Blowing	1 No.

	Bolt Heating Equipment (Electrical)	1 No.
For Blowing Down Equipment		
	Flange and Pipe Assembly	1 No.
	Plate	1 No.
	Spindle	1 No.
	Washer	1 No.
	Packing Dia 600 X Dia 400 X 2	1 No.
	Plate 5 IS 2062 GRE250(FE410W)QLTY-A	1 No.
Special Tools for Governing System		
	Pin Spanner Assembly	1 No.
	PRESS ASSEMBLY	1 No.
	HOOK SPANNER 69	1 No.
	PRESS ASSEMBLY (PRESS FOR PACK)	1 No.
	GUIDE BUSH (PRESS FOR PACKING)	1 No.
	CLAMPING DEVICE	1 No.
	ASSLY.FIXTURE FOR ESV SEAT N250	1 No.
	EXT.CIRCLIP PLIER ST.NOSE 8MM	1 No.
	CIRCLIP PLIER INTERNAL STRAIGHT 8MM	1 No.
	INT.CIRCLIP PLIER ST.NOSE 19MM	1 No.
	EXT.CIRCLIP PLIER ST.NOSE 19MM	1 No.
	EXT.CIRCLIP PLIER ST.NOSE 10MM	1 No.
	PULLER FOR F.P.BUSH	1 No.
	MOUNTING FIXTURE	1 No.
	GUIDE BUSH	1 No.
Special Tools for Drive Turbine		
	RING SPANNER AF 90	2 No.
	SPECIAL RING SPANNER AF 105	2 No.
	ROD DIA 12X250 for spanner	4 No.
	FORCING OFF SCREW M30	1 No.
	HEX SCREW WITH DOG POINT M36	1 No.
	SHORTEND S.E.RING SPANNER AF 75MM	1 No.
	SHORTEND S.E.RING SPANNER AF 85MM	1 No.
	SHORTEND S.E.RING SPANNER AF 90MM	1 No.
	SHORTEND S.E.RING SPANNER AF 95MM	1 No.
	SHORTEND S.E.RING SPANNER AF 105MM	1 No.
	S.E.O.J.SPANNER AF 85MM	1 No.
	S.E.O.J.SPANNER AF 90MM	1 No.
	S.E.O.J.SPANNER AF 95MM	1 No.
	S.E.O.J.SPANNER AF 105MM	1 No.
	S.E.O.J.SPANNER AF 115MM	1 No.
	EYE BOLT CS M24 COL DIA 48 EYE ID 48 CP	2 No.
	EYE BOLT CS M30 COL DIA 56 EYE ID 56 CP	2 No.

	EYE BOLT CS M36 COL DIA 67 EYE ID 67 CP	2 No.
	EYE BOLT CS M42 COL DIA 80 EYE ID 80 CP	2 No.
	SCREW DRIVER FOR RECESS HEAD	1 No.
	ENGINEER'S SCREW DRIVER 100MM	1 No.
	ENGINEER'S SCREW DRIVER 150MM	1 No.
	ENGINEER'S SCREW DRIVER 250MM	1 No.
	S.E.SOLID BOX SPANNER AF 46MM	1 No.
	S.E.SOLID BOX SPANNER AF 55MM	1 No.
	INT.CIRCLIP PLIER ST.NOSE 19MM	1 No.
	CIRCLIP PLIER INTERNAL STRAIGHT 8MM	1 No.
	EXT.CIRCLIP PLIER ST.NOSE 8MM	1 No.
	CARRIER FOR BEARINGS	1 No.
	DEE SHACKLES GR:30 CS SWL 1TON EYE&COLLR	1 No.
Lifting Equipment of Rotor		
	LIFTING EQUIPMENT OF ROTOR	1 No.
	WIRE ROPE SLING GALV ROPEDIA20 SLING 5M	2 No.
	WIRE ROPE SLING GALV ROPEDIA20 SLING 2M	2 No.
	SPECIAL TOOL FOR TDBFP	
	SUPPORT JACK ASSY,COUP SIDE	1 No.
	SHAFT	1 No.
	SPACER NO.1	1 No.
	SPACER NO.2	1 No.
	SPACER NO.3	2 Nos
	LEVER ASSY,INNER CASING WITHDRWL	1 No.
	PULL OUT ATTCH ASSY ,WTHDRWL	1 No.
	BOLT INNR CASNG M30x3.5 ,WITHDRWL	1 No.
	PR.PLATE M16 ,INNR CASNG WITHDRWL	1 No.
	PIN 16 RND HD ,INNR CASNG WTHDRWL	1 No.
	CAP NUT M110x3 / M56x4 ,WITHDRWL	1 No.
	CASING STUD EXTN M56x4 ,WITHDRWL	1 No.
	THRUST DISC PULL OUT TOOL	1 No.
	SPANNER, COUPLING NUT	1 No.
	TORQUE WRENCH ADAPTER,THR NUT	1 No.
	THRUST DISC TOOL	1 No.
	S.ROW DEEP GR BALL BRG 6305-2Z,VAR.20	2 Nos
	BOLT HEATER,BFP CSG BOLTS	4 Nos
	HEX BOLT M42X4.5X90, VAR.NO.16	1 No.
	BOLT HEX M20X80 P8.8 ELEGAL	1 No.
	BOLT HEX M20X180 ELEGAL	1 No.
	NUT HEX P M20-8	2 Nos

2. Steam Turbine Generator & Auxiliaries

A. List of Tools & Tackles for Turbo Generator

Sl. No.	For Equipment	Description	Quantity Required
1.	Mounting of shaft seal	Wrench	1 No.
2.	Mounting of shaft seal	Extension 8.5 inch.	1 No.
3.	Mounting of shaft seal	Extension 17 inch.	1 No.
4.	Mounting of shaft seal	Cross handle 20 inch	1 No.
5.	Mounting of shaft seal	Eye bolt M24	2 No.
6.	Mounting of bearing shell	Wrench B41 x 46	1 No.
7.	Mounting of bearing shell	Eye bolt M20	2 No.
8.	Tightening seal ring bolts	Pin Spanner	1 No.
9.	Bracket for seal ring holder	Bracket	1 No.
10.	Bracket for oil catcher/inner	Bracket	1 No.
11.	Bracket for compressor, seal body, seal ring & bearing.	Mounting Bracket	1 No.
12.	Assy. Of baffle ring, baffle ring carrier for compressor	Bracket	2 No.
13.	Assy. Device for HV terminal bushing	Mounting Device	1 No.
14.	Assy. of seal body	Half Ring	2 No.
15.	Rotor insertion	Skid Plate	1 No.
16.	Rotor insertion	Assy. fixture	1 Set
17.	Rotor insertion	Guide pulley	1 No.
18.	Rotor insertion	Skid shoe	2 No.
19.	Rotor insertion	Slide pedestal	1 No.
20.	Rotor insertion	Cross beam for rotor Insertion TE	1 No.
21.	Rotor insertion	Cross beam for rotor Insertion EE	1 No.
22.	Rotor insertion	Grates for rotor lifting	2 No.
23.	Rotor slinging	Wire rope dia 42x18 M	2 No.
24.	Rotor insertion	Copper sheet	1 No.
25.	Rotor insertion	Press board 3x450x500	1 No.
26.	Rotor insertion	Pulling device TU 32	1 No.
27.	Rotor insertion	Wire rope dia 16x20 M	1 No.
28.	Rotor insertion	Hand level for pulling device (suitable for d16x20)	1 No.
29.	Rotor insertion	Socket head cap screw M36x120	2 No.
31.	Rotor insertion	Eye nut M36	2 No.
32.	Rotor insertion	Dee shackle C4	1 No.
33.	Rotor insertion	Press board 3x770 x 1150	3 No.
34.	Mounting of shaft seal	Eye nut M24	1 No.

Sl. No.	For Equipment	Description	Quantity Required
35.	Mounting of shaft seal	Dee shackle	1 No.
36.	Mounting of shaft seal	Cross beam for bearing shell	1 No.
37.	For use during stand still	Dry air blower	1 No.
38.	Stator alignment	Hydraulic equipment	1 Set
39.	Bearing Oil Flushing (Prior to commissioning)	Oil purging system	1 Set
40.	Stator alignment	Aligning bracket (left)	2 No.
41.	Stator alignment	Aligning bracket (right)	2 No.
42.	Coupling bolt assembly (Exciter)	Guide bolt	2 No.
43.	Coupling bolt assembly (Exciter)	Round bar	1 No.
44.	Coupling bolt assembly (Exciter)	Hexagonal set screw	2 No.
45.	Exciter stator assembly	Top bolt	2 No.
46.	Diode wheel assembly	Torque spanner	1 Set
47.	Coupling bolt assembly	Wrench 58	1 No.
48.	Diode wheel assembly	Wrench	1 No.
49.	Diode wheel assembly	Wrench	1 No.
50.	Diode wheel assembly	Screwed pin M 5x8	2 No.

B. List of Tools & Tackles offered for Steam Turbine

Sl. No.	Assembly where used	Description	Quantity Required
1.	IP Casing	Dummy shaft for IPC (Alignment Shaft for IP Turbine)	1no.
2.	IP Rotor, LP Rotor	Shaft lifting device for IP(F), LP(F&R)	1 Set
3.	HPT & IPT	Stud heating & measuring device	1no.
4.	IP Rotor	IP Shaft support	1no.
5.	LP Rotor	LP Shaft support	1no.
6.	LP Shaft sealing	Lifting device for LP shaft seal casing	1no.
7.	IP & LP rotors, LP outer Casing(U/H)	Lifting beam	1no.
8.	LP Turbine	LP joint covering	1no.
9.	Lifting of IP & LP rotors,	Grommet sling	1pair

Sl. No.	Assembly where used	Description	Quantity Required
	LPC outer casing		
10.	HPT Assembly	Assembly fixture for HPT	1set
11.	HP inlet Assembly	Breech nut heating device	1no.
12.	LP Turbine	Device for shaft sealing compensators	1no.
13.	LP Rotor	Device for axial adjustment	1no.
14.	HPT Assembly	Turning over device for HPT	1no.
15.	HPT Assembly	Casing support	1no.
16.	IP Rear Bearing	Mounting frame for bearing shell	1no.
17.	HP rear bearing, IP rear bearing & LP rear bearing	Assy. Device for bearing shell D 250/D 380/D 500,	1 set
18.	HPT overhaul	Valve support	1no.
19.	Emergency Governor, ESV&CV, IV&CV	Pin spanner set	1no.
20.	ESV, IV & LP Bypass Valve	Steam blowing device set	1set
21.	Valve	Packing device for valves	1set
22.	Valve	Assy. device for valves	1set
23.	Governing Rack	Transport device for Governing Rack	1no.
24.	Rack	Transport device for Protection Rack	1no.
25.	ESV, IV	Hydraulic Test device (MS pipe/HRH pipe),	1 set
26.	Hydraulic Accumulator	Falling & Gauging device (as required)	1 Set
27.	Throttle Valve	Flush part for oil throttle valve	1no.
28.	Control Fluid system	Control Fluid piping flush & pressure testing device	1no.
29.	ESV & CV, IV, IPCV	Pipe spanner set	1no.
30	IV	Spacer	4no.
31.	ESV&CV,IV,IPCV,ESV&IV Servo, Gen.	Eye bolt, Eye bolt collard/non-collard,	1 set
32.	Frame for suspension	Lifting lug	3set
33.	MOP, suspension of IV, General	Spanner set	1set
35.	General	Hook spanner	1no.
		Engineer's, set	1set
		SGL Ended open Jaw SPNR-	1 Set
		DBL Ended open Jaw SPNR-	1 Set
		Single ended ring spanner,	1 set
		Double ended ring spanner,	1 set
		Double ended tubular box spanner,	1 set
		Torque wrench	1 set
		Impact ring	1no.
		Guide column l = 750	2no.
		Pin	2no.
		Threaded bolt	1no.

Sl. No.	Assembly where used	Description	Quantity Required
		Hex key set	1no.
		Screw set hex.	1 Set
		Off set screw driver	1 set
		Hydraulic Cylinder (Sl. – 50, 100)	1 set
		Rod m5 x 250, m8x500,	1 set
		Screw CAP SOC P 12-9 M5-65	4no.
		Mounting tool,	1 set
		Mounting ring	1no.
		Packing puller with cover	2no.
		Bushing,	1 set
		Draw bar	2no.
		Screw grub slt m20 x 310	2no.
		Tubular Soc. Pipe Spanner 470 x 1040x65	1no.
60.	General Governing System	Bolt Press out BM Set	1set
		Stret. Device for Breech Block	1 No.
		Forced Cooling Device for IPV	2 No.
		Forced Cooling Device for HPV	2 No.
		Tools for Governing System	1 No.
		Steam Blowing Device O/L Valve	1 No.
		HP Steam Pipes Hyd. Test Device	2 No.
		IP Steam Pipes Hyd. Test Device	2 No.
		Lifting slings for HP Turbine	1 No.
		Lifting slings for IP Turbine	1 No.
		Lifting slings for LP Turbine	1 No.
		Lifting Slings for HP Turbine	1 No.
		Lifting Slings for IP Turbine	1 No.
		Lifting Slings for LP Turbine	1 No.
		Lifting Device C-Hook	1 No.
		Dev. Axial Holding of LP Shaft	1 No.
		Grating Covering for LP	1 Set
		Assembly Device for HP SV & CV	1 No.
		Assembly Device for IPCV	1 No.
		Turning Over Device for HPT	1 No.

Note : The List is tentative &the bidder shall include in the offer any additional items that shall be required for the system in offer as well any item description that may undergo specific technical changes.

SECTION-XI

PROTECTIVE COATING AND PAINTING

CONTENTS

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SECTION-XI

PROTECTIVE COATING AND PAINTING

1.00.00 INTENT OF SPECIFICATION

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

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

2.00.00 CODES & STANDARDS

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

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

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

3.00.00 **GENERAL REQUIREMENTS**

3.01.00 The steel surface preparation prior to actual commencement of coating shall conform to SSPC SP 10 / NACE 2 / Sa2½ (near white metal) with sand blasting.

3.02.00 The contractor shall submit a detailed written description in the form of a manual covering coating equipment, procedures, materials inspection test, and repair etc. to Owner/Consultant for approval.

3.03.00 The contractor shall also provide copies of test reports from NABL approved laboratory (like National Test House, Kolkata) in support of the paint/primer materials to be used shall conform to the specification requirement.

3.04.00 The contractor shall also provide certificates from paint/primer manufacturer mentioning the batch numbers, date of manufacture and shelf life etc. of the materials to be used. In addition to that Manufacturing Quality Plan (MQP) and Field Quality Plan (FQP) shall also be submitted prior to commencement of supply of material and field application.

3.05.00 Paint/coating application work at site shall be done either by paint manufacturer or by their authorized applicator. The authorized applicator shall have proper training & certification from manufacturer. Applicator shall possess all the necessary specialized equipment and manpower experienced in similar job.

3.06.00 Applied coating shall be tested for dry film thickness, holiday (electrical inspection for continuity) and adhesion as per relevant standard such as SSPC PA 2, NACE RP 0274 and ASTM D 4541.

3.07.00 If necessary, the material may be heated and applied by airless spray / plural component spray system.

3.08.00 Manufacturer's specific recommendation, if any, shall be followed during application of lining / paints.

3.09.00 In areas where there is danger of spotting automobiles or other finally finished equipment or building by wind borne particles from paint spraying, a Purchaser approved method shall be adopted.

3.10.00 The colour scheme of the entire Plant, covered under this specification shall be approved by the Purchaser in advance before application.

3.11.00 All indoor and outdoor piping, insulated as well as uninsulated will have approved colour bands painted on the pipes at conspicuous places throughout the system, as approved by Purchaser.

3.12.00 Inside surfaces of vessels / tanks shall be protected by anticorrosive paints or rubber lining as required / specified elsewhere in the specification. External surfaces of all vessels / tanks shall be protected by anti-corrosive painting.

3.13.00 For vessels / tanks requiring lining and epoxy painting all inside surface shall be blast cleaned using non-siliceous abrasive after usual wire brushing.

3.14.00 Natural rubber lining shall be provided on the inside of vessels / tanks as required / specified elsewhere in the specification, in three layers resulting in a total thickness not less than 4.5 mm.

3.15.00 Surface hardness of rubber lining shall be 65 +/- 5 deg. A (shore).

3.16.00 After the lining is completed, the vessels / tanks shall not be subjected to any prolonged exposure to direct sunlight in course of its transportation, erection etc. They shall not be stored in direct sunlight. No further lining or burning shall be carried out on the vessel, after application of the lining.

3.17.00 All lining projecting outside of the vessel shall be protected adequately from mechanical damages during shipment, handling storage etc.

3.18.00 Suitable warnings, indicating the special care that must be taken with respect to these lined vessels shall be stenciled on their outside surface with the letters at least 12 mm high.

3.19.00 All insulated piping shall have aluminium sheet jacketing.

4.00.00 EQUIPMENT, MATERIAL AND SERVICES TO BE FURNISHED BY THE BIDDER

4.01.00 After erection at site, the outside surfaces of all equipment having a shop coat shall be given further priming coat and finished coats of paint as detailed in following clauses. However, if the painting system is such that the shop coat and primer coat to be applied at site are not compatible, then shop coat has to be removed from the surface of equipment before application of primer coat with prior blasting.

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

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

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

4.02.00 **Surface Preparation**

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

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

4.03.00 **Painting**

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

a) Surface preparation shall be done by means of sand blasting, which shall conform to SSPC SP10/NACE 2/Sa2½ Standard.

b) Primer Coat shall consist of one coat (minimum DFT of 100 microns) of epoxy resin based zinc phosphate primer.

c) Intermediate Coat (or Under Coat) shall consist of one coat (minimum DFT of 100 microns) epoxy resin based paint pigmented with Titanium Dioxide.

d) Top Coat shall consist of one coat (minimum DFT of 75 microns) of epoxy paint of approved shade and colour with glossy finish. Additional one coat (minimum DFT of 25 microns) of Finish Coat of polyurethane shall be provided.

e) Total DFT of paint system shall not be less than 300 microns.

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

a) Surface preparation by means of sand blasting and shall conforms to SSPC SP10/NACE2/ Sa2½.

b) External surface of the pipe, fittings, specialties etc. handling raw water/ clarified water/filter water shall be painted with one coat of two part chemically cured polyurethane primer of min 50 micron dry film thickness followed by three or maximum four coats of two part solvent less polyurethane to build up coating of dry film thickness of 1500 micron including primer coat.

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

a) Surface preparation by means of sand blasting which shall 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 /

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 that
50°C.

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

c) Application of epoxy coating system :

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

5.03.00 **Application of PU Coating**

a) PU coating shall be applied when the pipe surface temperature at least 3°C above dew point temperature (when R.H is more than 85%).

b) Material preparation and application shall be done as per manufacturer recommendation.

6.00.00 **TEST REQUIREMENTS**

6.01.00 **Measurement of dry film thickness**

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

6.01.01 **Apparatus / Instrument**

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

6.01.02 **Procedures**

a) **Number of measurements**

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

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

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

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

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

Area measurement must be within specified range.

6.02.00 **Electrical Inspection (Holiday) Test**

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

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

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

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

Testing Voltage V = 7900 √T ± 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 ASTMD 4541.

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

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

6.03.02 **Prepare the test surface**

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

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

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

6.03.04 **Select an adhesive**

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

6.03.05 **Attach the dolly to the surface**

a) Using a wooden stick, apply an even layer of adhesive to the entire contact surface area of the dolly.

b) Carefully remove the excessive adhesive by using a cotton swab. Allow the adhesive to fully cure before performing the adhesion test.

c) Attach the dolly to the coated surface and gently push downward to displace any excessive adhesive.

d) Push the dolly inward against the surface, then apply tape across the head of the dolly.

6.03.06 **Adhesion Test Procedure**

a) Attach the adhesion tester to the dolly by rotating the hand wheel counter clockwise to lower the jaw of the device.

b) Slide the jaw completely under the head of the dolly. Position the three legs of the instruments so that they are sitting flat on the coated surface.

c) Slide the dragging indicator pin on the black column to zero by pushing it downward.

d) Firmly hold the base of the instrument in one hand and rotate the hand wheel clockwise to raise the jaw of the device that is attached to the head of the dolly. The dragging indicator pin will move upward on the black column as the force is increased and will hold the reading. Apply the tension using a moderate speed. Continue to increase the tension on the head of the dolly until (a) the minimum PSI/MPa/Kg/cm² required by project specification is exceeded and the test is discontinued, (b) the maximum PSI/MPa/Kg/cm² of adhesion tester has been achieved and dolly is still attached, (c) The force applied by the adhesion tester causes the dolly to dislodge.

e) Read the scale and record the adhesion value.

6.04.00 **Coating Repair**

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

6.04.01 **Surface Preparation**

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

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

6.04.03 **Coating Application**

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

6.04.04 Repair Inspection:

Repaired portion shall be electrically inspected using a holiday detector.

6.05.00 **Welded Field Joints**

6.05.01 **Preparation**

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

6.05.02 **Electrical Inspection**

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

7.00.00 **INFORMATION/DATA REQUIRED**

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

SECTION-XII

SALIENT DESIGN DATA

[TABLE-I TO TABLE-VIII]

CONTENT

TABLES	DESCRIPTION	PAGE NO.
TABLE-I	ANALYSIS OF COAL	1
~~TABLE-II~~	~~ANALYSIS OF ASH~~	~~2~~
~~TABLE-III~~	~~HEAVY FUEL OIL ANALYSIS~~	~~3~~
~~TABLE-IV~~	~~LIGHT DIESEL OIL ANALYSIS~~	~~4~~
TABLE-V	DESIGN RAW WATER ANALYSIS	5
TABLE-VI	DESIGN CLARIFIED WATER ANALYSIS	6
~~TABLE-VII~~	~~CHEMICAL ANALYSIS OF LIMESTONE~~	~~7~~
TABLE-VIII	DESIGN DM WATER ANALYSIS	8

PROXIMATE ANALYSIS OF COAL (As received Basis)					
Sl. No.	Description	Symbol	Design Coal	Worst Coal	Best Coal
1	Total Moisture	TM%	15.00	18.00	12.00
2	Ash	A%	40.00	46.00	36.00
3	Volatile Matter	VM%	19.00	18.00	22.00
4	Fixed Carbon	FC%	26.00	18.00	30.00
ULTIMATE ANALYSIS (As Received Basis)					
1	Carbon	C%	29.73	23.08	37.32
2	Hydrogen	H2%	3.70	3.54	3.92
3	Nitrogen	N2%	1.80	1.45	1.60
4	Oxygen (by difference)	O_2%	8.66	6.70	8.32
5	Sulphur.	S%	0.50	0.60	0.40
6	Carbonates	C03%	0.58	0.60	0.40
7	Phosphorous	P_2%	0.03	0.03	0.04
8	Total Moisture	TM%	15	18	12
9	Ash	A%	40	46	36
10	Total	%	100	100	100
11	Gross Caloric Value (as received basis)	GCV Kcal/Kg	3300	2800	4000
12	Hard grove index	HGI	55	50	60
13	YGP index	mg/Kg	95	110	80

DESIGN RAW WATER ANALYSIS

SL.NO.	Different Characteristic	Results
1.	Calcium (Ca^{++}) as $CaCO_3$	86
2.	Magnesium (Mg^{++}) as $CaCO_3$	52
3.	Sodium & Potassium (Na^{+} & K^{+}) as $CaCO_3$	138
	Total Cations	**276**
4.	Bicarbonates (HCO_3) as $CaCO_3$	200
5.	Carbonates (CO_3) as $CaCO_3$	-
6.	Hydroxyde (OH) as $CaCO_3$	-
7.	Sulphate (SO_4) as $CaCO_3$	35
8.	Chloride (Cl) as $CaCO_3$	41
9.	Nitrate (NO_3) as $CaCO_3$	-
10.	Phosphate (PO_4) as $CaCO_3$	-
	Total Anions	**276**
11.	Total Hardness (as $CaCO_3$)	138
12.	Permanent Hardness (as $CaCO_3$)	-
13.	Temporary Hardness (as $CaCO_3$)	138
14.	Methyl Orange Alkalinity (as $CaCO_3$)	200
15.	Phenolphthalein Alkalinity (as $CaCO_3$)	-
16.	Iron (Original) (as Fe)	-
17.	Iron (in solution) (as Fe)	1.0
18.	Manganese (as Mn)	-
19.	Ammonia, free (as NH_3)	-
20.	Carbon Dioxide free (as CO_2)	-
21.	Silica (in solution (as SiO_2)	20.0
22.	Dissolved Oxygen (O_2)	-
23.	Suspended Solids	-
24.	Dissolved Solids	438
25.	pH at 25 °C	7.5 – 8.0
26.	Organic Matter (in terms of Oxygen absorbed from acid permanganate solution in 4 hours)	2.0
27.	Appearance	Turbid
28.	Odour	Nil
29.	Turbidity	500 NTU

DESIGN CLARIFIED WATER ANALYSIS

CONSTITUENTS	As	CONTENT
Calcium	$CaCO_3$	105 ppm
Magnesium	$CaCO_3$	52 ppm
Sodium and Potassium	$CaCO_3$	138 ppm
Hydrogen (FMA)	$CaCO_3$	--
TOTAL CATIONS	$CaCO_3$	295 ppm
Bicarbonate	$CaCO_3$	196.5 ppm
Carbonate	$CaCO_3$	-
Chloride	$CaCO_3$	41 ppm
Sulphate	$CaCO_3$	57.5 ppm
Nitrate	$CaCO_3$	-
TOTAL ANIONS	$CaCO_3$	295 ppm
M.O. Alkalinity	$CaCO_3$	196.5 ppm
P. Alkalinity	$CaCO_3$	
Total Hardness	$CaCO_3$	157 ppm
Carbon-di-oxide	CO_2	3.5
Dissolved Silica	SiO_2	20 ppm
Total Iron	Fe	1 ppm
pH Value	-	7.9 – 8.0
Turbidity, NTU	-	20
Organic Matter Content in terms of Oxygen in absorbed from ($KMnO_4$ (4 Hrs.)		5 ppm

DESIGN DM WATER ANALYSIS

Sl. No.	Description	Max. Limit
1.00	Total Electrolyte	0.1 ppm, max.
2.00	Total SiO_2	0.01 ppm, max.
3.00	Iron as Fe	Nil
4.00	Free CO_2 ppm as CO_2	Nil
5.00	Total Hardness	Nil
6.00	pH value at 25 Deg.C	6.8 – 7.2
7.00	Conductivity, micro mho/cm	Less than 0.1 at 25 Deg. C

VOLUME: II-H2

SECTION-II

MILL REJECT SYSTEM

CONTENT

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4.00.00	PERFORMANCE REQUIREMENT	2
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SECTION-II

MILL REJECT SYSTEM

1.00.00 INTENT OF SPECIFICATION

This section presents design, constructional features, operation philosophy, inspection and testing of Mill Reject Handling System to be used for handling of coal rejects from coal mills of 1 x 660 MW of Sagardighi Thermal Power Station (Phase-III).

2.00.00 SYSTEM DESCRIPTION

Pneumatic conveying system will be employed for handling of the mill rejects. Each mill will be provided with collection and transportation equipment consisting of one no pyrite hopper with water spray arrangement, knife gate valves at inlet & outlet and a conveying vessel. The conveying vessel will operate on level probe control with timer back up.

Each conveying vessel will be connected to a storage bunker via conveying pipeline and a terminal box installed on top of storage bunker. Bag filters of adequate capacity will be provided on top of bunker for separating dust from air. The bunker will be provided with pneumatic operated discharge gate with manual operation (operated manually from local push button station) at its outlet to discharge mill rejects into a truck for onward disposal.

Screw type compressor will be used for supplying compressed air for conveying.

3.00.00 SCOPE OF SUPPLY

3.01.00 Conveying Air System

3.01.01 Two (2) nos. oil free water cooled screw compressors (01 working + 01 standby) with drive shall be provided in a separate building to supply compressed air for conveying of mill rejects from Unit-5 only.

3.01.02 One (1) no. compressor of Phase-III will act as stand-by for Phase-III Unit i.e two (2) nos. oil free water-cooled screw compressors (1 working + 1 standby) shall be provided for mill rejects conveying.

3.01.03 The rating of proposed compressor of Phase-III will be in such a way that the equipment capacity shall meet the requirements of Unit-5 only.

3.01.04 DELETED.

3.01.05 The compressed air system shall have air receivers (one no per mill bay), necessary pipe work and each air receiver will be equipped with isolation

valves, pressure gauge, pressure switch, solenoid operated auto drain trap (timer operated), pressure relief valve, etc.

3.02.00 Pyrite hoppers & accessories, conveying vessels, mill reject storage bunker with terminal box, vent filter, discharge gate, interconnected distribution piping system with valves, controls, instruments and all other accessories.

3.03.00 Instrument Air System

Instrument air shall be provided from the plant instrument air distribution pipe network of Phase-III for supplying instrument air / purging air to actuate pneumatic cylinder operated plate valves, conveying vessel local pneumatic panel and bag filter, etc.

3.04.00 Cooling & Spray Water System

3.04.01 DMCW cooling water for MRS compressors of Phase-III shall be solely catered from Phase-III DMCW system.

3.04.02 Cooling water requirement for water cooled valve and spray water for mill reject shall be sourced from plant service water network of Phase-III.

3.05.00 The pipes in mill bay area will be supported from mill bay columns wherever possible and pipes from / to compressors shall be taken on pipe rack.

3.06.00 Rain water and floor water will be collected in drain sump through common drain trench provided in each mill bay. One (1) no (1W) submersible fixed type sump pumps of adequate capacity for each drain trench, will be provided to evacuate the stored drain water from drain sump to nearest plant drain.

4.00.00 PERFORMANCE REQUIREMENT

4.01.00 Performance requirement for the plant and equipment shall be guided by 'Design and Construction' clause.

4.02.00 The performance requirement for the mill reject handling plant shall be defined by the rate (TPH.) of handling as specified within guaranteed power and water consumption of the system operation within stipulated time.

5.00.00 DESIGN AND CONSTRUCTION

5.01.00 Mill Reject Handling System of pneumatic type meeting the following requirement shall be provided:

Number of mills	REFER ANNEXURE I : EQUIPMENT DESIGN/ SELECTION CRITERIA

Percentage of mill reject generation (Design)	1% of the maximum coal consumption rate per mill (A margin of min. 5% over & above the reject generated to be considered.)
Guaranteed conveying rate (overall continuous basis)	Bidder to consider maximum mill loading at 100% BMCR with design / worst coal vis-à-vis number of mills operating in corresponding condition.
Bulk density of mill rejects	
(For volumetric flow, bunker volume sizing and conveying)	1600 kg/ m3
(For structural load calculation)	2400 Kg/m3
Max. particle size of mill rejects	50 mm (5% of total reject) max size, 25 mm (normal size).
Average conveying velocity	To be indicated by Bidder as per proven practice
Temperature (Normal / Maximum)	Max. 180 / 200 Deg.C
Discharge from each mill	As per mill manufacture's data (Minimum 3.5 meter headroom shall be provided below mill outlet.)
General margin on selection of equipment and compressor.	10% margin on selection of equipment and compressor capacity.

5.02.00 Velocities

Service	Pipe sizes		
	Less than 50 NB	50 NB to 150 NB	200 NB & Above
Water pump suction	0.6-0.9	1.2-1.5	1.2-1.5
Water pump discharge	0.9-1.8	1.5-2.4	1.5-2.5
Compressed Air below 2 Kg/cm2 (g)	15 - 20	20 - 30	25 - 35
Compressed Air at 2 Kg/cm2 (g) & above	20 - 30	25 - 40	35 - 45

5.03.00 The maximum expected pressure in the system should be computed by considering 10% over-pressure above the rated discharge pressure of the air compressor.

5.04.00 Conveying vessels would be conveying one after another in a predefined sequence. If system of one mill goes out of order or is in line block condition, the system will shift on to the next mill automatically.

5.05.00 Tie In points

Sl. No.	System	Description	Location
~~1~~	~~Conveying Air~~	~~Interconnection arrangement between common discharge headers of Phase-II & III shall be provided so, that any two compressors of Phase-II & III can be operated to meet conveying air requirement of Phase-II & III.~~	~~Existing plant air compressor house (Common for Phase-II &III)~~
2	DM Water	DMCW cooling water for MRS compressors of Phase-III shall be solely catered from Phase-III DMCW system.	80NB tapping at inlet and outlet header at 5 m distance from MRS compressor house.

5.06.00 Technical Data Sheet

1	**Pyrite Hopper**		
a	No. of Pyrite Hopper	One (1) no. per mill	
b	Capacity	Effective capacity will be more than three times of conveying capacity / 2-3 cycles to act as buffer holding capacity.	
c	Material of construction		
	Pyrite hopper body	MS-IS: 2062, Gr. A	Min. 8 MM thickness
	Grid	MS-IS: 2062, Gr. A	
	Supports, Platform	MS-IS: 2062, Gr. A	
d	Accessories		
	Rupture disc	One (1) no. per hopper	
	Flexible joint	One (1) no. per hopper	
	Oversize reject chute	One (1) no. per hopper	
	Bypass Chute	One (1) no. per hopper	
	Sizing Grid	One (1) no. per hopper	MS:2062 Bars and flats with opening suitable to allow 50 MM (max) particle
	Spray nozzles	One (1) no. per hopper	Water Spray quenching system with solenoid operated spray nozzle

	Hopper movement	As per mill manufacture's data	
	Flange details	As per mill manufacture's data	
	Elevation	As per mill manufacture's data	Min. 3.5 meter headroom shall be provided below mill outlet.
	Temperature Switch	One (1) no. per hopper	
	RF (radio frequency) type level switch	Two (2) nos. per hopper	For high level and high-high level
2	**Conveying Vessel**		
a	Design Code	As per ASME (unfired pressure vessels) or IS2825	The conveying vessel will be supported independently on steel columns.
b	Quantity	One (1) no. per hopper	
c	Location	Below Pyrite hopper	
d	Material	Mild Steel as per IS 2062 Gr. A	
e	Outlet bend	Alloy CI (Min. 450BHN)	
f	Pneumatic Panel	One (1) no. per conveying vessel	Pneumatic panel shall consist of vessel high & low pressure switch
3	**Storage Bunker**		
a	Quantity	One (1) no. per mill bay	
b	Effective Capacity	24 hrs storage volume for the mill reject based on worst coal firing at 100% BMCR.	
c	Free board	Minimum 300 MM	
d	Material of Construction		
	Bunker Plates	MS plate	Min. 10 MM thick.
	Liners	SS 304	Min. 6 MM thick. for conical portion
e	Accessories		
	Number of outlet	One (1) no. per storage bunker	
	Pneumatic operated twin sector discharge with provision for manual operation	One (1) no. per storage bunker	CI as per IS 210 FG 260 / MS as per IS 2062 with TISCRAL / SAIL HARD liner
	Pressure Relief Valve	One (1) no. per storage bunker	
	RF Type Level Switch	One (1) no. per storage bunker	For high level in bunker
	Terminal Box	One (1) set per	Mild Steel as per IS 2062

		storage bunker	Gr. A
4	**Bag Filter**		
a	Type	Reverse pulse jet type	
b	Quantity	One (1) no. per storage bunker	
c	Air to cloth ratio	1.5 with isolation of 10% bags	
d	Material of Construction		
	Filter cloth	Polyester needle felt	
	Filter bag cage	MS, IS 2062, Gr.A	Minimum 3 mm thick, Galvanized
	Filter housing	MS	
e	SMP level of vent air from bag filter	Less than 30 mg/NM3	
f	Differential pressure switch		One (1) no. across each bag filter
5	**Plate Valve**		
a	Quantity	As per flow diagram for mill reject handling system	
b	Material of construction		
	Body	Cast Iron (IS 210 Gr. FG 260)	
	Knife Gate	ASTM A 240 type 304 (Edge hardened to 400 BHN)	Minimum 10 MM thickness
6	**Inlet Valve**		
a	Quantity	As per flow diagram for mill reject handling system	
b	Material of construction		
	Body	Cast Iron (IS 210 Gr. FG 260)	
	Dome	Alloy CI (Min. 350 BHN)	
	Seat	Alloy CI or SS smooth finished with Min. 250 BHN hardness	Replaceable type
c	Method of operation	Solenoid operated pneumatically actuated with provision for manual override facility.	
7	**Conveying Pipe**		
a	Pipe Size	As per system requirement	To be decided by system supplier. However, pressure drop sizing calculation shall be provided by Bidder during detail engineering

			stage.
b	Design Pressure	110% of discharge pressure of rated compressor	
c	Quantity	As per layout requirement	
d	Material	Mild Steel ERW as per IS 1239 (Heavy Gr.) upto150NB and Min. 6.35 MM Thick.(>150 NB)	
e	Type of joint	Flanged	
f	Bends & Fittings	Alloy CI (Min. 450BHN)	The radius of bends shall not be less than 3D.
8	**Conveying Air Compressor**		
a	General		
	Quantity	Two (2) nos	
	Type	Single stage, water cooled, oil free rotary screw type	
	Design parameters	50 DegC & 100 % RH	
	Fluid to be compressed	Air	
	Location	Indoor	
b	Material of construction		
	Compressor casing	Cast Iron	
	Rotor	EN8 \ EN8M \ EN8D	
	Rotor housing	Cast Iron	
	Gears	Low Alloy Steel	
	Drive shaft	EN8 \ EN8M \ EN8D	
	Oil cooler	Plate type – SS 304	
	Cooler casing	CI / MS	
	Inlet throttle valve & housing	Aluminum / SS	
c	Air intake filter		
	Quantity	Two (2) nos	Two stage centrifugal type
	Filtering media	Cellulose based Paper	
	Particle size of Intake Filter	10 Micron	
	Particle removing efficiency	99.9%	
d	Note:	The materials of construction, suggested above are the minimum requirement and for general reference only. MOC as provided by OEM shall be final.	

9	**Air Receiver**		
a	Quantity	One (1) no. per mill bay	
b	Design Code	IS 2825	
c	Capacity	As per IS 7938	Min. capacity 15 CMH
d	Material	MS: IS 2062 Gr. A	Head thickness = 2 mm higher than shell thickness.
e	Accessories		
	Safety valve	One (1) no per air receiver	
	Pressure switch	One (1) no per air receiver	
	Pressure gauge	One (1) no per air receiver	
	Auto drain & Y type Strainer	One (1) no per air receiver	Timer based solenoid operated Auto Drain Type
10	**Service Water Pipes**		
a	Up to & including150 NB	MS, ERW pipes to IS:1239 Heavy grade	Thickness - Heavy grade.
b	200 NB to 450 NB	MS ERW to IS 3589. FE 410 grade.	Min 6.35 MM thick for 200 NB to 400 NB, Min. 7.14 mm thick for 450 NB
11	**Instrument Air and DMCW Pipes**		
a	Material	ASTM-A-312 Gr. 304	As per ASME-B-36.19

6.00.00 OPERATION AND CONTROL SYSTEM

For Control & Instrumentation refer VOLL-E, SEC-V.

7.00.00 INSPECTION AND TESTING

Inspection and testing will be carried out as per relevant standard and as per good engineering practice including the following.

7.01.00 Rotating components shall be statically and dynamically balanced. Dynamic balancing tests shall be carried out. Test procedure and acceptance limit shall be guided by the relevant testing standard and shall be enclosed in the QAP. The Owner shall have to be intimated prior to the test for witnessing the test at works.

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SECTION: VI

TECHNICAL SPECIFICATION
FOR
LOW PRESSURE PIPING, VALVES AND SPECIALTIES

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SECTION-VI

LOW PRESSURE PIPING, VALVES AND SPECIALTIES

1.00.00 GENERAL INFORMATION

This section covers all the low-pressure piping up to 400mm NB size, associated valves and specialties that include but is not limited to the following systems.

1.01.00 Service Air System - shall consist of distributions terminated at hose valves for general house-keeping on the different floors of Power House Building, boiler floors, mill reject system and other auxiliary buildings of Main Plant. Distribution scheme shall also include some continuous and intermittent requirement of boiler and Turbine-generator islands and other BOP area buildings such as CW-ACW pump house, Vacuum pump house, CW treatment building, FGD & SCR areas. Both service air and instrument air will be supplied from the existing compressor house, where new compressors of Phase-III shall be installed.

1.02.00 Instrument Air System - shall comprise of distribution of instrument quality air to pneumatically operated instruments/ valves/dampers of the Main Power House Building, boiler, mill reject system and other auxiliary buildings inside plant area.

1.03.00 Demineralised Water -supply system including hot well make-up water piping from condensate storage tank, suction to different pumps and distribution to different consumption points.

1.04.00 Demineralised Water closed cycle cooling system.

1.05.00 Service water (clarified quality) - including supply to overhead Service Water (SW) tank in Power house from Tie-in-Point near unit#4 power house building and from tank to different distribution points of the Main Power house and other auxiliary buildings.

1.06.00 Potable water system (filtered & chlorinated water) including supply to overhead potable tank of Power House building, from Tie-in-Point near unit#4 power house building and from tank to different distribution points of the Power House Building and other auxiliary buildings.

1.07.00 Air Preheater wash water system including supply of Clarified water from Tie-in-Point near unit #4 to APH wash point of Unit #5, Phase-III and one pipe line (250 NB) from existing APH wash pump discharge header in clarified water pump house in PT area of Phase-I to enable operation of both existing APH wash pumps. This pipe shall be run on existing pipe rack.

1.08.00 Any other low pressure piping as found necessary during detail engineering shall also be included.

2.00.00 **CODES AND STANDARDS**

2.01.00 In addition to the requirements spelt out in Volume IIA, the design, manufacture, inspection and testing of the piping, fittings, valves and specialties covered under this specification shall conform, in general, to the standards and codes (latest edition) mentioned below:

2.01.01	IS-1239 [Part-I & II]	:	Mild steel tubes, tubular and other wrought steel fittings.
2.01.02	IS-3589	:	Electrically welded steel pipes for water, gas and sewage (150 to 2000 mm nominal diameter)
2.01.03	IS-554	:	Dimensions for pipe threads where pressure tight joints are required on the threads.
2.01.04	IS-1363 [Part-I & II]	:	Hexagonal head bolts, screws and nuts (size range M5 M36)
2.01.05	IS-1364	:	Precision and Semi-precision hexagon bolts, screws, nuts and lock nuts (diameter range 6 to 39 mm)
2.01.06	IS-3138	:	Hexagon bolts & nuts (M42 to M150)
2.01.07	IS-5312	:	Swing check type reflux (non-return) valves.
2.01.08	IS-2379	:	Colour code for the identification of pipelines.
2.01.09	IS-2016	:	Plain washers
2.01.10	IS-2712	:	Compressed asbestos fibre jointing
2.01.11	ANSI B-16.5	:	Steel pipe flanges and flanged fittings
2.01.12	ANSI B-16.9	:	Wrought steel Butt welding flanged
2.01.13	ANSI B-16.11 ANSI B-36.10	: :	Forged steel fittings, Socket-welding and Threaded. Steel pipes thickness
2.01.14	API-600	:	Steel gate valves
2.01.15	BS-2633	:	Class I Arc welding of ferrite steel pipe work for carrying fluids.
2.01.16	BS-534	:	Specification for steel pipes and specials for water and sewage.
2.01.17	BS-5351	:	Specification for Ball valves.

2.01.18 AWWA-C-504 : Specification for Butterfly valves.

2.01.19 AWWA-C-208 : Dimension for fabricated steel water pipe fittings.

2.02.00 Other international codes and standards may also be offered by bidder. However, same may be subject to acceptance by the Purchaser.

3.00.00 **SCOPE OF WORK**

3.01.00 The equipment and materials to be supplied shall include but not be limited to the following:

a) Supply of all low pressure piping including bends, elbows, tees, branches, laterals, crosses, reducing union, couplings, caps, saddles, shoes, flanges, blank flanges, Y-pieces etc. as required for the piping system under the scope of this section.

b) Matching pipes, matching pieces like reducers/enlargers etc., counter flanges with bolts, nuts, washers, temporary and permanent gaskets, threaded union etc.

c) Supply and machining work of flanges, pipe spools and matching pipes to connect flow measuring orifices/nozzles with the main pipe work.

d) All isolating and regulating valves, non-return valves, steam/air traps, relief/safety valves (wherever applicable), strainers, pressure reducing orifices etc. complete with the counter flanges and matching connecting pieces as required within the entire low pressure piping system.

e) Anchors, hangers and supports, etc. as required. Any platform necessary for maintenance and operation of valve and equipment located 1.5 m above any permanent floor or platform including access ladders, supporting structures etc.

f) All secondary structural steel members required for pipe supports from building steel structures and from embedded steel wherever provided including pipe supports in trenches. However, trench piping should be avoided to the extent possible.

g) Funnels, tundishes for drips and drains including all miscellaneous drain piping and drain piping from tundish outlet up to drain points. All drain and vent lines shall be conveniently terminated to floor drain points/permanent drain trenches.

h) Flanges, counter flanges, blank flanges, bolts, nuts, washers, temporary and permanent gaskets, fasteners caps etc. as required for interconnecting piping, valves & fittings.

i) Cleaning and Painting of all piping, valves & specialties at manufacturer's shop.

3.02.00 Following general requirements shall however be provided:

a) Instrument Connections including instruments, root valves, sensing lines etc.

b) Pipe stubs and blanking plates etc. required for chemical cleaning and hydro testing.

For conducting acceptance test, the required pressure, temperature, flow measurement points shall be provided.

3.03.00 All miscellaneous instruments as per approved P &ID during detail engineering stage.

3.04.00 **Tie-in Points with Phase-II**

Tie-in points for different systems will be as indicated below:

i) DM Water Transfer System

DM Water Transfer pump discharge line, capable of feeding both Phase-II & Phase-III is extended upto Condensate Storage tanks (CST) of unit #3 & #4 of Phase-II. The discharge line is terminated with an isolation valve. Suitable extension of piping from this tie-in point to inlet of CST of Phase-III will be done.

ii) Potable Water System

Potable water pump discharge line, capable of feeding both Phase-II & Phase-III is extended upto Potable water storage tanks on power house of unit #4 of Phase-II. The discharge line is terminated with an isolation valve. Suitable extension of piping from this tie-in point to the inlet of potable water storage tank of Phase-III will be done.

iii) Service Water System

Service water pump discharge line, capable of feeding both Phase-II & Phase-III is extended upto Service water storage tanks on power house of unit #4 of Phase-II. The discharge line is terminated with an isolation valve. Suitable extension of piping from this tie-in point to the inlet of service water storage tank of Phase-III will be done.

iv) APH wash System

APH Wash pump discharge line, is extended upto Air pre-heater of unit #4. The discharge line is terminated with an isolation valve. Suitable extension of piping from this tie-in point to be done upto APH of Phase-III. Another extension pipe line (250 NB) from existing APH

wash pump discharge header in clarified water pump house in PT area of Phase-I to APH of Phase-III to be implemented.

v) Instrument Air System

Instrument air line of Phase-III shall be interconnected with instrument air header of Phase-II near existing plant air compressor house. Further, IA ring header of Phase-III power house shall have interconnection with that of power house Phase-II.

vi) Service Air System

Service air line of Phase-III shall be interconnected with service air header of Phase-II near existing plant air compressor house. Further, SA ring header of Phase-III power house shall have interconnection with that of power house Phase-II.

vii) Cooling water supply & return lines

DMCCW supply and return header of Phase-II inside compressor house shall be extended to cater the cooling water requirement of IA & SA compressors and dryers of phase-III.

4.00.00 GENERAL DESIGN AND CONSTRUCTION

4.01.00 General Considerations

4.01.01 The piping systems included in this section shall be designed to operate continuously without replacement during the plant service life of 30 years.

4.01.02 The piping system shall be complete in every respect and in accordance with the highest standard of workmanship. Any item of the section on which the bidder is in doubt shall be referred to the Owner for clarification.

4.01.03 All design and fabrication shall be in accordance with codes/standards specified.

4.01.04 No pipe work shall be run in trenches carrying electrical cables.

4.01.05 Pipe size above 50 NB shall be shop fabricated and of size 50 NB and below shall be field run.

4.01.06 All piping shall be identified by means of colour strips and by adequate lettering, conveniently spaced and located. Identification colours and lettering shall be as approved.

4.01.07 Air release and drain branches shall be provided wherever necessary depending upon the layout and arrangement so that the drains and air release valves are located for easy operation.

4.01.08 Unless otherwise specified, all pipe work shall be suitable for a minimum pressure of 10.0 kg/sq. cm(g) at 80 deg. C or as required by the design of the different piping system, if higher.

4.01.09 **Drain Pipe Work**

a) Low pressure drains shall have an isolating valve at the point of take-off from the pipe or vessel to be drained, or as near as possible for conventional operation.

b) Unless otherwise stated, all drain piping shall be of 25 mm NB minimum and all vent pipings shall be of 15 mm NB size minimum. For pipes up to 50mm NB, pipe wall thickness shall be as per schedule 80 of ANSI B36.10.

c) Unless otherwise stated, wherever a main or branch of any pipeline is terminated with a valve, such terminal valve shall be provided with a blank flange/blanking cap at the free end.

4.01.10 Specification of pipes used in different services included in the L.P piping section has been detailed in Annexure-I.

4.02.00 **Material Specification**

4.02.01 Materials for pipes and fittings shall be as stipulated in Annexure-I. In case bidder wants to offer alternative piping material, same may be accepted by the Purchaser depending on the merits of alternative material.

4.02.02 Pipe attachments for supports, anchors and restraints, which are coming in direct contact with pipes, shall have similar materials as the piping concerned. All other materials of supports, anchors and restraints shall be of tested quality and as per manufacturer's standards.

4.03.00 **Fabrication**

All pipes above 50 NB shall have butt-welded connections as per ANSI B 16.25 with a minimum of flanged joints necessary for maintenance. Piping of sizes 50 NB and below shall have socket welded connections as per ANSI B 16.11. Where flanges are adjacent to welded fittings, weld neck flanges shall be used.

Branches shall, in general, be formed by welding. Standard fittings may be used in positions and for sizes where approval has been given in detail drawings. Pipe bends and tees shall be truly cylindrical and of uniform section. all welded branches shall be reinforced where needed as per the applicable codes/regulations.

4.03.01 Piping shall be fabricated in the shop in the largest transportable sections to minimize the number of field weld joints. The choice of field weld joints locations shall be based on the traverse of the pipe through walls, floors,

sleeves or other restrictive areas. Support attachments for major piping shall be done at shop.

4.03.02 All pipes bends shall be made true to angle with no negative tolerance and shall have a smooth surface free of flat spots, crease and corrugations. A cross section through any bent portion of the pipe shall be true in diameter, within plus or minus 3% of the pipe diameter. Pipe bends shall be made from straight pipe pieces of sufficiently higher thickness so that after thinning, the minimum thickness of bends shall not be less than the minimum thickness required for the straight pipe. Thinning allowance shall be considered as per the relevant code.

4.03.03 For bends in pipes straight piece of pipes shall be bent by the bidder to required bend radius. However, forged bends (Bend radius = 1.5 x pipe diameter) wherever required shall be provided.

4.03.04 The ends of Pipe and welded fittings shall be bevelled according to details shown in the relevant piping code. All welding shall be made in such a manner that complete fusion and penetration are obtained without an excessive amount of filler metal beyond root area. The reinforcement shall be applied in such a manner that it shall have a smooth contour merging gradually with the surface of adjacent pipe and welded fittings. Backing rings shall not be used on any pipe welds, unless otherwise approved by the Engineer.

4.03.05 **Cutting and Beveling**

a) Carbon steel piping - End preparation for butt welding shall be done by machining/flame cutting.

4.04.00 **Hangers, Supports, Anchors**

Normally pipe supports and anchors shall be selected at those points in the buildings where provision has been made for the loads imposed. The cutting of floor/roof beams or the reinforcement in slabs will not be permitted. Piping attached to a plant item shall be supported in such a way that the weight of the piping is not taken by the plant item.

4.04.01 Support spacing shall be as per good engineering practice. However in no case it shall be less than support spacing stipulated in ANSI B31.1.

4.04.02 Accurate weight balance calculations shall be made to determine the required supporting force at each hanger location and the pipe weight load at each equipment connection.

4.04.03 All large pipes and all long pipes shall have at least two supports each arranged so that any length of pipe or valve may be removed without any additional supports being required.

4.04.04 Support steel shall be of structural quality. Perforated strap, wire or chain shall not be used. Support components shall be connected to support steel by

welding, by bolting or by beam clamps. Bolt holes shall be drilled not burned. Support components may be bolted to concrete using approved concrete anchors.

4.05.00 **Valves and Accessories**

4.05.01 General Requirements

a) All valves shall be of approved make and type and shall have cast/forged bodies with covers and glands of approved construction and materials as specified in Annexure II & III. The valves shall be provided with electric motors/solenoids and actuators as required.

b) Valves and specialties to be supplied under this specification will be used for various air and water services and will be located indoor/outdoor and on horizontal/vertical runs of the pipelines. However, mounting of valves in vertical pipe runs should be avoided as far as possible.

c) All valves shall, unless otherwise stated, have the internal diameter same/as the internal diameter of the pipes to be joined.

d) All valves shall receive tests at manufacturer's or bidder's works in accordance with the specific requirements of the approved Codes of Practice. Valves shall be rising stem or otherwise as approved by the Purchaser.

e) Gate valve and Ball valve have been specified with the intention of achieving isolation and tight shut-off. In full open condition, these valves should offer minimum of resistance to fluid flow.

f) Globe valves have been specified with the intention of achieving good control of fluid passing. The plug and seat will have therefore suitable profiles for obtaining such controlling action.

g) Check valves have been specified in order to prevent reverse flow through them.

h) All valves shall function smoothly without sticking, rubbing or vibration on opening or closing and shall be suitable for most stringent service conditions i.e. flow, temperature and pressure under which they may be required to operate.

i) Material, design, manufacture, testing etc. for all valves and specialties along with the accessories shall conform to the latest editions of codes.

j) By pass valves shall be provided for larger size valves as per standards followed and as felt necessary for smooth and easy operation, even though not specifically mentioned in the specification.

k) All flanged valves and specialties to be supplied under this section shall be provided with two (2) counter flanges, bolts, nuts, washers, gaskets etc.

l) All valves shall be of approved design and manufacture. Where valves are of similar size and type they shall be interchangeable with one another. Valves shall have welded or flanged connections subject to the Purchaser's approval.

m) All valves shall have outside screwed spindles and screwed thread of spindle shall not pass through or into the stuffing box. Where valves are exposed to the weather, protective covers shall be provided for the spindles, which shall be subject to approval.

n) Gate, Globe and Ball valves shall be provided with the following accessories in addition to other standard items:

i) Hand wheel with embossed open and shut directions.
ii) Local position indicator.
iii) Motorised operation as specified by Engineer.

o) Gate valves, in addition shall be provided with following extra features

i) Bypass valve for valves of 300 mm size and above.

ii) Draining arrangement

iii) Enclosed Gear operators for valves 300 mm size and above for ease in operation.

iv) Motorised operation as specified by Engineer.

p) All gate and globe valves shall be rising stem type.

q) All valves shall be provided with hand-wheels, chain, operator, extended spindle and floor stand wherever required so that they can be operated manually by a single operator from the nearest operating floor either at a lower or higher elevation as the case may be. If such a valve is provided with integral bypass then similar arrangement shall be done for the bypass valve also.

r) All valves and specialties shall be provided with brass Tag Discs indicating Tag numbers and nomenclature of the valve including duty or service intended and the function of the valves specialties.

s) Stems shall preferably be arranged vertically with gland at the top, however, in no circumstances must the stem be inclined downward from horizontal or gland be at the bottom. Globe valves shall be installed with the pressure under the disc. Valves shall not be fitted in inverted position.

t) Where necessary, for accessibility, grease nipples shall be fitted at the end of extension piping and where possible these shall be grouped together and mounted on a common panel situated at a convenient position. A separate nipple shall be provided to lubricate each point. The Bidder shall supply the first fill of oil or grease for these parts. The Bidder shall supply a suitable manually operated grease gun for the standard type of nipple provided.

u) The spindles for all valves for use outside the building shall have weatherproof protection covers of approved construction.

v) All valves shall be fitted with indicators so that it may be readily seen whether the valves are open or shut. In the case of those valves fitted with extended spindles, indicators shall be fitted both to the extended spindles and to the valve spindles.

w) Plastic or bakelite valve hand wheels will not be accepted.

x) All valves shall be closed by rotating the hand wheel in a clockwise direction when looking at the faces of the hand wheel. The face of each hand wheel shall be clearly marked with the words 'Open' and 'Shut' with arrows adjacent to indicate the direction of rotation to which each refers.

y) Wherever practicable heavy valves of total weight including actuator, drive motor, integral by-pass etc., equal to or greater than 500 kg. shall be provided with suitable lugs to permit direct suspension by hanger rod or direct resting on bottom support, as applicable.

z) Special attention shall be given to the operating mechanism for large size valves in order that quick and easy operation is obtained and maintenance is kept to a minimum.

aa) Eyebolts shall be provided where necessary to facilitate handling heavy valves or parts of valves.

bb) The Bidder shall supply with his bid and in addition during the course of the Contract, comprehensive drawings showing the design of valves, test pressure and working pressure/temperatures. They should include a parts list referring to the various materials used in the valve construction.

cc) All sampling and root valves shall be of integral body bonnet type.

4.05.02 For Design Requirements for different valves refer Annexure-II & III.

4.06.00 **Safety/Relief Valves**

Safety/Relief valves shall be of direct spring loaded type and shall have a tight, positive and precision closing.

All safety valves shall be provided with manual lifting lever.

Valves used for air and any other compressive fluid shall be of pop type.

Safety/Relief valves shall be constructed and adjusted to permit the fluid to escape without increasing the pressure beyond 10% above the set blow off pressure. Valve shall reset at a pressure not less than 2.5% and more than 5% of the set pressure.

Releasing capacity of the safety/relief valves shall be as per the applicable codes and standards and shall be subject to the approval of the Engineer.

The seat and disk of safety valves shall be of suitable material to resist erosion. The seat of valve shall be fastened to the body of the valve in such a way that there is no possibility of the seat lifting.

4.07.00 **Hosepipe and Accessories**

4.07.01 Hose valves for service water system shall be Gate valves and service air system shall be Globe valves.

4.07.02 Hose pipes with fittings for Service Water System:

a) The water hose shall be as per IS-444 (Type-3).

b) Length of each hose shall be 15 metres.

c) For each hose, one end shall be fitted with M.S. female coupling with swiveling nuts and soft seating ring suitable for connection to male end of hose valve and other end shall be made threaded for joining with the swiveling nut of a second hose whereby two hose lengths may be joined.

4.07.03 Hose pipes with fittings for Compressed air System**:**

a) The compressed air hose shall be as per IS-911 (Type 2).

b) The length and type of each end shall be similar to as specified in above clause no. (4.07.02) above.

5.00.00 **BROAD GUIDELINES FOR ERECTION AND INSTALLATION OF LP PIPING**

5.01.00 All fittings like "T" pieces, flanges, reducers etc. shall be suitably matched with pipes for welding. The valves will have to be checked, cleaned or overhauled in full or in part before erection, after chemical cleaning and during commissioning.

5.02.00 Adjustments like removal of oval ties in pipes and opening or closing the fabricated bends of high pressure piping to suit the layout shall be considered part of work and is required to carry out such work as per instruction of Owner,

which shall include specified heat-treatment procedures, etc. also wherever required.

5.03.00 Certain adjustments in length may be necessary while erecting high pressure pipelines and the bidder should remove the extra lengths to suit the final layout after preparing edges afresh and adopting specified heat treatment procedures.

5.04.00 Suspension for piping, pressure parts, etc., will be supplied in running lengths, which shall be cut to suitable sizes and adjusted as required.

5.05.00 All the valves, lifting equipments, actuators, power cylinders, etc., shall be serviced and lubricated to the satisfaction of Engineer before erecting the same and also during pre-commissioning. Even after commissioning, the equipments, if there are problems in the operation, they have to be attended to by the Bidder during the tenure of the contract. Welding or jointing of extension spindle for valves to suit the site conditions and operational facility shall be part of erection work.

5.06.00 All tubes and pipes shall be cleaned and blown with compressed air and shown to the engineer before lifting. Bigger size pipes should be cleaned with flexible wire brush, wherever necessary. After cleaning is over the end caps shall be put back in tube openings till such time they are welded to other tubes.

5.07.00 Fine fittings, drain piping, oil systems & other small bore piping have to be routed according to site conditions and hence shall be done only in position. As such, layout of small-bore piping shall be done as per site requirement. There is a possibility of slight change in routing the above pipelines even after completion of erection, which shall be carried out by the Bidder without any extra cost to the Purchaser. Work shall also include fabrication of small bends at site from straight lengths to suit the site conditions.

5.08.00 Welding of temporary supports, cleats, etc., on the building columns shall also be avoided. In case of absolute necessity, Erection bidder shall take prior approval from Bidder/Owner. Further, any cutting or alteration of member of the structure or platform or other equipments shall not be done without specific prior approval of Owner.

5.09.00 Wherever piping erected by the Erection Bidder is connected to piping or equipment erected by some other agencies the joint at the connecting point shall be considered under this specification.

5.10.00 a) All piping shall be grouped wherever practicable and shall be routed to present a neat appearance.

b) The piping shall be arranged to provide clearance for the removal of equipment for maintenance and for easy access to valves, instruments and other piping accessories required for operational maintenance.

c) Piping shall be routed above ground unless otherwise specifically indicated/ approved by the Owner. In such special case, the piping may be arranged in trenches, or buried and properly protected as per AWWA Standards.

d) Overhead piping shall have a minimum overhead clearance of 4 meters above walkways and working areas and 6 meters above roadways unless otherwise approved by the Owner.

e) Drains shall be provided at all low points and vents at high points as per actual layout regardless of whether some have been shown in respective Tenders drawings or not. The pipelines shall be sloped towards the drain points.

5.11.00 All drips and drains for piping and equipment whether shown in the Tender drawings or not shall terminate on the ground floor up to station drain unless otherwise specified. Leading such drains up to station drainage is also the responsibility of the Bidder.

6.00.00 **DRAWINGS, DATA, INFORMATION & MANUALS**

6.01.00 Drawings, data, Information to be furnished by the Bidder besides those already mentioned in volume : IIA with the offer.

6.01.01 A complete list of all piping and fittings of various sizes with their quantities and details e.g. nominal size, O.D., I.D. (as applicable) thickness, design pressure, design temperature, material of construction/code/standards etc.

6.01.02 A complete list of all valves with their type, quantities & ratings.

6.01.03 Manufacturer's catalogue indicating complete range of available size and rating of pipes & fittings.

6.01.04 Descriptive literature on the manufacturing process and quality control procedures highlighting the manufacturing, fabricating and testing facilities available in the shop.

6.02.00 **After Award of Contract**

Detail drawings including fabrication drawings of all shop fabricated piping system indicating design parameters and complete bill of material (Relevant Standards and grades to be indicated) and information/data pertaining to the hydrostatic and non-destructive test requirements to be submitted progressively.

6.02.01 Detail dimensioned drawing of each valve, specialties, indicating tag no., pressure rating, manufacturing standard, the bill of materials and hydrostatic test pressures. The drawing shall include the end preparation details and shall indicate the position of the hand wheel/operator. Technical particulars of motor operators wherever applicable shall also be indicated.

6.02.02 General arrangement drawing for each hanger/support/anchor etc. indicating identification number, auxiliary supporting structural details, other details & information as required in the specification.

6.02.03 Wiring diagram for all limit switches of motor operated valves.

6.02.04 The loading data required for design of structures shall be furnished well in advance to suit Purchaser's time schedule.

ANNEXURE-I

SPECIFICATION OF PIPES FOR DIFFERENT SERVICES

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

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

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

ANNEXURE-II

SERVICES OF VARIOUS CATEGORIES OF VALVES

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

ANNEXURE-III

SPECIFICATION OF VALVES

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

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

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

VOLUME II-K

TECHNICAL SPECIFICATIONS
SUMP PUMPS, MISCELLANEOUS ~~CRANES &~~ HOISTS ~~AND ELEVATORS~~

CONTENTS

VOLUME: IIK : SPECIFICATIONS FOR SUMP PUMPS, MISCELLANEOUS CRANE & HOISTS AND ELEVATORS

SECTIONS		DESCRIPTION
SECTION-I	:	SUMP PUMPS, DRIVES AND ACCESSORIES
~~SECTION-II~~	~~:~~	~~MISCELLANEOUS CRANES~~
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VOLUME : II-K

SECTION-I

SUMP PUMPS, DRIVES AND ACCESSORIES

CONTENT

CLAUSE NO.	DESCRIPTION	PAGE NO.
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SECTION-I

SUMP PUMPS, DRIVES AND ACCESSORIES

1.00.00 GENERAL INFORMATION

1.01.00 Sump pumps specified hereinafter shall be used to dewater various sump pits within the plant area where gravity draining will not be envisaged and to ensure general housekeeping.

1.02.00 Pumps under this specification have been divided into following four (4) groups according to different duty envisaged and location of sumps/pits.

1.02.01 Group - A

The Group - A pumps shall be electric motor driven permanently installed vertical wet pit bottom suction volute type and will handle drainage water, containing solid particles with sludges, polluted liquid etc. from the area where they are installed. These pumps will run continuously by the use of high and low level switches in the sump. Particle size in the water will not exceed 15 mm.

Group-A pumps shall also be provided to all indoor sumps of the plant and outdoor sumps of capacity 5 cu.m and above and underground cable vaults (if any) under the Scope of Bidder.

1.02.02 Group - B

These pumps shall be horizontal centrifugal diesel engine driven portable type. Each pump set along with control panel etc. shall be mounted on a trolley for ease of transportation. These pumps shall be suitable for dewatering of pipelines of large diameter, if required and alike jobs and handling of liquids containing hard solid particles, sludge, polluted liquid, significant amount of fuel oil/LDO etc. and particle size will not exceed 20 mm. These types of pumps shall be used in different plant areas.

1.02.03 Group - C

The Group - C pumps shall be vertical submersible portable type pump motor sets with suitable arrangement for carrying to any place and for lowering to and raising from various water reservoirs and pits. The pump motor set shall be suitable for handling water containing muds/sludge, solid particles, cotton waste, silica, ash particles, coal particles, polluted liquid etc. The particle size in water will not exceed 20 mm. These pumps will be utilised to dewater various deep sumps/pits in case of any eventuality.

1.02.04 Group - D

These pumps shall be similar to Group - A pumps except that these pumps will be used to handle water containing solid particles, sludges, ash polluted liquids, etc. Particle size in the water will not exceed 25 mm. These pumps

should be installed in the sumps/pits at the following locations:

a) Ash Slurry Pump House

b) Fly Ash Storage Silo area

c) Other areas as envisaged by the successful bidder

NOTE : Total numbers and rating of all the groups of sump pumps are given in Annexure-II enclosed with this specification.

2.00.00 CODES AND STANDARDS

2.01.00 The design, manufacture and performance of the sump pumps and drives specified, hereinafter, shall comply with the requirements of all applicable codes, the latest applicable Indian/British/American/DIN Standards, in particular the following:

2.01.01 IS-1710 : Vertical Turbine Pumps for clear cold and fresh water.

2.01.02 IS-5120 : Technical Requirements – Roto-dynamic special purpose pumps.

2.01.03 IS-5600 : Sewage and drainage pumps.

2.01.04 Hydraulic Institute Standards of USA.

2.02.00 The materials of the various components shall conform to the applicable IS/BS/ASTM/DIN Standards.

3.00.00 GENERAL PERFORMANCE REQUIREMENT

3.01.00 The pumps shall be designed to have best efficiency at the specified duty point. The pump set shall be suitable for continuous operation at any point within the "Range of Operation" as stipulated by the manufacturer.

3.02.00 Pumps shall have a continuously rising head capacity characteristics from the specified duty point towards shut off point, the maximum head being at shut off.

3.03.00 Permanently installed vertical pumps shall be suitable for parallel operation. The head vs capacity, the bhp. vs capacity characteristics etc. shall match to ensure equal load sharing and trouble free operation throughout the range. Drive Motor shall not be overloaded when pump discharge is more than rated condition.

3.04.00 The static head requirement of portable submersible type sump pump may have a considerably wide range of variation depending upon the depth of pit being dewatered. While the pump shall have adequate capacity at the maximum head, the motor shall be sufficiently rated to cater for any

overloading during the pump operation at its minimum possible head, i.e., maximum discharge.

3.05.00 Pump motor set shall run smooth without undue noise and vibration. Acceptable peak-to-peak vibration limits shall generally be guided by Hydraulic Institute Standards (latest edition).

4.00.00 SCOPE OF WORK

4.01.00 Pumps under groups A, B, C and D as listed in the Annexure-II along with drive units, couplings and other accessories mentioned below, as also those needed to make the pump-motor sets complete in all respect, for proper operation and maintenance. All motors in outdoor duty will be provided with IP-55 enclosure. The accessories shall include among other things of the following:

4.02.00 For the vertical Group - A sump pump motor sets

a) Discharge piping of these sump pumps shall include a non-return valve and an isolating valve for each pump, necessary pipes, fittings, flange connections and counter flange with bolts, nuts and gaskets. Suction strainer will be provided of suitable size.

b) A common base frame for the purpose of supporting the pump motor sets in each sump, utilising embedded curb angle around the top of the sump. The base frame shall also be used to support each discharge piping.

c) Three (3) nos. electrode type capacitance level switches per sump; one for low level, the second for high level and the third for very high level, along with necessary junction box, local control panel, control cables etc. to achieve automatic starting/stopping of the sump pumps, and also ON/OFF indication for sump pump shall be monitored at DCS. The entire assembly being mounted on the same base frame as mentioned above (item "b"). The control panel shall also be equipped with start/stop push button for starting/stopping individual sump pumps manually. Local control panel and cable shall be as per Volume-II-F1 & F2 of the specification.

4.03.00 For each of the trolley mounted horizontal Group-B sump pump -Diesel Engine sets

a) One (1) no. 7.5 meters long hose for the pump suction and one (1) no. 30 meters long hose for the pump discharge, either ends of each hose being provided with female hose coupling.

b) One (1) no. 500 mm long straight pipe piece, with both ends flanged, one end matching with the pump suction nozzle.

c) Two (2) nos. male type hose couplings, one of which is suitable for coupling with the above mentioned 500 mm pipe piece on one side

and the 7.5 meters long suction hose on the other side, whereas the other is suitable for coupling with the pump discharge nozzle on one side and the 30 metres long hose on the other side. The pump suctions pipe-piece and discharge nozzle shall be of flanged type. As such each coupling end that is to match with the pipe/pump nozzle shall also be flanged and shall be equipped with necessary bolts, nuts & gaskets.

d) A foot valve (of Bidder's recommended size) with suction strainer, necessary coupling and matching piece/reducer (if necessary) to couple with the 7.5 meter long suction hose end.

e) The pump diesel engine set with a base frame along with the suction & discharge hoses etc., as mentioned above, shall be mounted on a suitable trolley with swivelling front wheel and having adequate fixing arrangement for all equipment, for operation without any undue vibration and with facility for being handled by a single operator.

4.04.00 For each of the portable submersible Group-C sump pump motor sets**.**

a) Two (2) nos. 30 metres long discharge hose, having female hose coupling at both ends.

b) One (1) no. 500 mm long pipe piece with both ends flanged, one end connected by necessary bolts, nuts & gaskets with the flanged discharge nozzle of the sump pump.

c) One (1) no. male type hose coupling, one end of which is suitable to couple with the discharge hose and the other end is flanged, matching with the above mentioned 500 mm long pipe end and connected therewith by necessary bolts, nuts & gaskets.

d) Suitable attachment for temporary seat of the pump motor set on the floor at sump bottom. Suction strainer of suitable size will be provided.

e) One (1) no. 25 metres long submersible type power cable having a power plug at one end and a hermetically sealed (waterproof) cable gland for connection with the pump drive- motor at the other end.

f) Suitable lugs and other attachments on the pump motor assembly frame, for hoisting and lowering of the pump motor set from and to the sump.

g) One starter panel, having a plug socket as receptacle of the above mentioned power plug (item "e"), a 25 metre long incoming power cable with switch/contactor and fuse, start- stop push buttons, red and green LED type indication lamps, over load relays, O/L reset push button, cable gland etc., and also a suitable arrangement for temporarily mounting the starter panel, near the sump, where the portable sump pump-motor set is to work. The incoming 25 metre long power cable shall also be provided with a suitable power plug at one end.

4.05.00 For the vertical Group - D sump pump motor sets, the scope of supply should be similar to Group - A sump pump motor sets.

4.06.00 Other accessories to be supplied with the pump-motor sets are as follows:

a) One discharge pressure gauge with 3 way SS isolating valve for each pump of Group-A and Group-D and all other instrumentation as required for safe and trouble free operation. Suction and discharge pressure gauge for Group-B pump.

b) All integral/internal piping, valves, fittings etc. for lubrication, cooling and sealing for each pump wherever required.

c) All equipment, accessories and consumable required for erection, testing and commissioning.

4.07.00 Lubrication of one (1) initial fill and one additional fill after commissioning.

4.08.00 Rust inhibiter paint at Manufacturer's works.

4.09.00 Any additional accessories not mentioned hereinabove but specified in enclosed technical specification for sump pumps, as applicable and those indicated in sump pump data specification sheets and electric motor specification should also be supplied.

5.00.00 DESIGN AND CONSTRUCTION

5.01.00 The design, construction testing and other details of the sump pumps and related accessories shall be in line with the stipulations and data in this section and the lead specification (Vol. II A)

5.02.00 Each sump pump shall be equipped and coupled with a drive motor, with rating so selected as to have at least 15% margin over the maximum power required by the pump, throughout its range of operation. All other requirements of the drive motors shall be as stipulated in the Vol.II F1 & F2.

The discharge rate of sump pump is uncontrolled. As such pump should be capable to operate even under a condition of as low as 25% of specified total head. Motors of group-B pumps should be designed to cater such eventuality.

5.03.00 All electrical items shall conform to the stipulations of Vol.II F1 & F2 as applicable.

5.04.00 All piping shall be as per IS-1239 of medium or heavy grade (as suited for the maximum operating pressure) and shall be either galvanised or painted with approved rust inhibiting paint.. Any matching piece/reducer required to match the pipe with pump nozzle, hose, etc. shall be provided.

5.05.00 All valves shall be steel body type as per applicable IS/BS/ANSI standard, with pressure class compatible with the maximum working pressure.

5.06.00 All hoses shall be of steel wire reinforced type. Pump suction hose shall be

suitable for working under vacuum. Pump discharge hose shall be suitable to withstand the maximum pressure that it may be subjected to in all working conditions, including hydrostatic testing of the sump pump discharge line.

5.07.00 Pump suctions strainer shall have openings large enough just to permit the entry of solids having maximum size as stipulated under clause no. 1.02.00.

5.08.00 Pressure gauges shall be of Bourdon type, with sealing diaphragm to prevent ingress of the working fluid. Selected range of pressure gauge shall be such that the entire range of working pressure covers about 1/3rd to 2/3rd to its range. Accuracy of measurement shall be within ± 1% of scale range. The suction pressure gauge shall be compound type. Pressure gauge dial size shall be 100 mm or more.

5.09.00 Pumps

5.09.01 Pumps under Group-A shall be wet pit type, vertical shaft, centrifugal, vertical submerged suction, non-clog volute type complete with enclosed shaft, discharge pipe, head assembly thrust bearing and drive assembly, cover plates etc.

5.09.02 Pumps under Group-B shall be of horizontal shaft, single stage, end suction, radially split casing, centrifugal, non-clog design complete with common base plate, drive assembly etc. These pumps shall be trolley mounted portable type.

5.09.03 Pumps under Group-C shall be submersible pump-motor type, single stage and non-clog design and shall be portable type.

5.09.04 Pumps under Group-D shall be similar to Group-A pumps.

5.09.05 Casing

a) Casing shall be so designed to allow free passage of specified maximum size of solid.

b) Casing shall be designed to withstand the maximum shut-off pressure developed by the pump.

c) The casings shall be cast, free from blowholes, sand holes, other detrimental defects. The casing shall be complete with suction and discharge connections.

d) For pumps under Group-A, and Group-D adequate seal arrangement shall be made to keep leakage of liquid from casing to column assembly to minimum and adequate drain shall be provided in column assembly to permit escape of the leakage flow. The casing shall also include the bearing housing of the bottom pump shaft bearing.

e) Casing of pumps under Group-B shall be provided with vent connections and drain connections with valves. These pumps shall be manually primed.

5.09.06 Impeller

a) The impeller shall be open/semi-open non-clog type, cast in one piece and specially designed to `pass large solids or unscreened liquids. The clearance between stationary and moving parts should be such as to allow sustained performance without exclusive maintenance.

b) Impellers of pumps under Group-A and Group-D shall have provision for adjustment from an accessible location and for pumps under Group-C shall be capable of passing fibrous material like cotton waste, jutes, etc.

5.09.07 Pump Shaft

a) Shaft size selected shall be such that critical speed is at least 20% away from the operating speed and the runway speed.

b) The shaft shall be ground and polished to final dimension and of ample size to withstand all stresses resulting from rotor weight, hydraulic loads and across the line starting. Shaft shall be provided with renewable sleeves particularly under stuffing boxes and other locations as recommended by pump manufacturers.

c) The coupling between shafts shall be so designed that they become tight during pump operation.

5.09.08 Column Pipe (for pumps under Group-A and Group D)

The discharge pipe shaft assembly shall be flanged or screwed as per manufacturer's standard and standard length of each piece of column pipe shall be in conformity to the shaft piece lengths from consideration of easy handling.

5.09.09 Bearings

a) Adequate nos. of properly designed bearings shall be furnished. Bearings for pumps shall be antifriction type and lubricated by grease. Line shaft bearings of vertical pumps shall also be grease lubricated. All necessary grease gun, grease cup and tubing shall be included.

b) Thurst bearing of adequate design shall be furnished for taking the entire pump thurst arising from all probable conditions of continuous operation through out its "range of operation" and also the shut-off condition. The life of thurst bearing shall be 20,000 working hour minimum for the load corresponding to the duty point. The bearings shall be lubricated by grease from a location conveniently accessible. Design shall be such that the lubricant cannot contaminate the handling liquid.

5.09.10 Wearing Ring/Liner Plate

Renewable wearing rings/liner plates shall be provided either on impeller or

on the casing or on both impeller and casing.

5.09.11 Stuffing Box

Stuffing Box of pumps under Group-A and Group-D shall be of mechanical packing type. For pumps under Group-B and Group-C mechanical seal of reliable design shall be provided.

5.09.12 Coupling

Pump and motor shall be connected with a suitable flexible coupling. Coupling shall be provided with coupling guard.

5.09.13 Mounting Plate for Group-A and Group-D Pumps and Base Plate for pumps under Group-B.

Each pump under Group-A and Group-D shall be provided with a suitable mounting plate. The mounting plate shall be adequately sized to accommodate the level switches, discharge pipe, grease cups etc. if any. Pumps and motor under Group-B shall be mounted in one base plate. Base plate shall be of rigid construction properly ribbed as needed. Suitable drain with valve and drain funnel shall be furnished by the Bidder.

The necessary supporting plate, mounting frame, base plate etc. as required shall be supplied under this specification, along with anchor bolts, foundation bolts, pipe, sleeves etc. Lifting lug, eyebolts, etc. as required for the proper handling of each pump set shall be furnished.

5.09.14 Suction Bell

The pumps under Group-A, C and D shall be complete with adequately dimensioned suction bell to guide and streamline intake fluid.

5.09.15 Material of Construction

For material of construction of various parts of data specification sheet Annexure-I shall be referred to.

6.00.00 INSPECTION AND TESTING

6.01.00 All pumps shall be tested at the shop for capacity, head, efficiency and brake horse power. These tests are to be done according to the requirements of "Hydraulic Institute Standard".

6.02.00 The pump integral accessories like thrust bearing, pump motor coupling etc. shall be subject to tests as per manufacturer's standard.

6.03.00 Test on motors, control panels, starter panels, cables shall be conducted as per the requirement of Vol.II F1 & F2 of this specification and as per Quality

Assurance Plan to be approved by Owner during detail Engineering.

6.04.00 After delivery/erection at site, pumps shall be operated to prove satisfactory and trouble free performance.

6.05.00 In addition to these tests also refer lead specification Vol. IIA.

7.00.00 DRAWINGS, DATA, INFORMATION REQUIRED

7.01.00 Location and dimension of all sumps which requires assisted evacuation, present in the areas covered under the scope of this specification.

7.02.00 List of location of Group-A and Group-D pumps.

7.03.00 Characteristic curves of pumps showing effective head, pump input power, efficiency, submergence and NPSH, against capacity ranging from shut-off condition to 125% of rated capacity for Group A, B & D pumps and to 150% of rated capacity for Group C pumps.

7.04.00 Speed vs. torque curve of the pump corresponding to recommended mode of pump starting, super-imposed on speed vs. torque of the motor, corresponding to 80% and 100% rated voltage.

7.05.00 Diagram showing the type of lubrication system etc.

ANNEXURE-I

DATA SPECIFICATION SHEET

		Group-A	Group-B	Group-C	Group-D
1.	Pumps				
1.1	Rated Capacity (Cu.M/hr.)	<---------- Refer ANNEXURE - II ---------->			
1.2	Total Head at rated Capacity (MLC)	<---------- DO ---------->			
1.3	Nos. Required	<---------- DO ---------->			
1.4	Duty	<---------- Intermittent ---------->			
1.5	Pump Design Standard	<---------- IS-5120/ IS:1710---------->			
1.6	Parallel operation required	Yes	No	No	Yes
1.7	Material of Construction				
	a) Base plate/Cover Plate	<---------- M.S. IS-2062 / Equivalent ---------->			
	b) Column Pipe	<---------- M.S. IS-2062 / Equivalent ---------->			
	c) Casing	<--------- 2% NiCI, IS-210, FG-260 (*)---------->			
	d) Impeller	<---------- 2% NiCI, IS-210, FG-260 (**)------->			
	e) Pump/Impeller Shaft	<---------- SS. AISI-316 ---------->			
	f) Shaft Sleeve	<---------- SS. AISI-316 (Hardened) ---------->			
	g) Shaft Coupling	<---------- SS. AISI-410 ---------->			
	h) Shaft Bearing	BUSH GM as per IS-306 Gr.1 / Equivalent			
	i) Gland	<----- C.I., IS-210, FG-260/Equivalent ---------->			
	j) Gland Packing	<------ Braided Graphite-free Teflon -->		***	
	k) Fasteners coming in contact with water	<---------- SS. AISI-304 ---------->			
	l) Fasteners not coming in contact with water	<---------- Carbon Steel ---------->			
	m) Discharge pipe	MS IS-1239/ Equivalent	--	--	MS IS-1239/ Equivalent
	n) Motor stool	<---------- Close Grained C.I.---------->			

		Group-A	Group-B	Group-C	Group-D
1.8	Range of Operation	<---------- Refer ANNEXURE-II ---------->			
1.9	Tests and Inspection	<-- As per Cl. No. 6.00.00 and lead specification -->			
1.10	Supply of Accessories & Services (Wherever Applicable) for each group and each rating of Pumps				
	a) Base plate/ Mounting plate	Yes			
	b) Sole Plate	Yes			
	c) Foundation bolts, nuts, sleeves etc.	Yes			
	d) Companion flanges with nuts, bolts & gaskets	Yes			
	e) Unions for external water for cooling/sealing/ lubrication	Yes, if required			
	f) Cooling/ sealing/lubrication system with all accessories, complete with pipes, valves and with instruments	Yes, if required			
	g) Discharge pressure gauge	Yes			
	h) Suction pressure gauge	Yes, for Group-B only			
	i) Pump-motor coupling and guard	Yes			
	j) Eye bolts, lifting tackle etc	Yes			
	k) Pre-lubrication tank and accessories	Yes, if required			
	l) Suction bell	Yes			

Note : * Alloy CI (min 30 mm thick) BHN 350 min
** Ni-hard (min 25 mm thick) BHN 550 min.
*** S.S. Wire reinforced/impregnated graphite teflon.

ANNEXURE-II

SCHEDULE OF SUMP PUMPS

GROUP-A PUMPS : PERMANENTLY INSTALLED VERTICAL SUMP PUMP

Sl. No.	Location	Numbers required (Total)	Capacity (cum/Hr.) Each	Total head (MLC)	Pit size in which pumps are to be installed (in mm)	Type of liquid to be handled	Remarks
1.	These pumps should be located in the following areas as minimum : i) Power house ground floor sump pits near condenser ii) ACW trench in Power House iii) Any other places felt necessary. These pumps will also be provided in all indoor sumps and outdoor sumps of capacity 5 cu.m.& above and underground cable vaults (if any).	Two pumps (100% capacity) are to be located in each sump pit	Capacity of each pump should be so selected to empty the sump pit in 10 minutes	To be calculated with 10% margin over total dynamic head (TDH = static head + friction losses)	To be decided by the bidder	As described in cl. no. 1.02.01	Discharge pipe sizing should be done taking minimum water velocity to be 2m/sec but should not be less than 50 NB. One gate valve and one non return valve should be provided at pump discharge.

Note: For sump pump of FGD Area, please refer Vol-IIB, Section - V

GROUP-B PUMPS : HORIZONTAL CENTRIFUGAL TROLLEY MOUNTED PORTABLE SUMP PUMP

Sl. No.	Location	Numbers required (Total)	Capacity (cum/Hr.) Each	Total head (MLC)	Pit size in which pumps are to be installed (in mm)	Type of liquid to be handled	Remarks
1.	Pumps will be used for dewatering of pipelines if required and in sumps which are not very deep within the Plant area	Two (2) Nos. Diesel Engine driven Pumps.	Twenty (20) (Working Range: 0 to 150%)	6	To be finalised by the Bidder	As mentioned in clause no. 1.02.02	To be supplied with suction & discharge pressure gauge and other accessories as specified and shall be trolley mounted. Suction hose should be of 80 NB size. Discharge hose should be of 65 NB size.

GROUP-C PUMPS : VERTICAL SUBMERSIBLE PORTABLE SUMP PUMP

Sl. No.	Location	Numbers required (Total)	Capacity (cum/Hr.) Each	Total head (MLC)	Pit size in which pumps are to be installed (in mm)	Type of liquid to be handled	Remarks
1.	Pumps will be used for dewatering various deep sumps/ pits (e.g. CW pump sump) in case of eventuality.	Two (2) nos. as a minimum requirement.	100 (Working range as per pump characteristic curve for full range of head variation).	Twenty (20) (Range 5 to 25)	To be finalised by the Bidder.	As mentioned in clause no. 1.02.03	To be supplied with discharge pressure gauge and 500 mm M.S. pipe spool at discharge as specified. Discharge hose should be of 100 NB size.

GROUP-D PUMPS: PERMANENTLY INSTALLED VERTICAL SUMP PUMP

Sl. No.	Location	Numbers required (Total)	Capacity (cum/Hr.) Each	Total head (MLC)	Pit size in which pumps are to be installed (in mm)	Type of liquid to be handled	Remarks
1.	These pumps should be located in the following areas as minimum : i) AHP Vacuum Pump House ii) Trench in Pyrite hopper area (MRS system) iii) Any other places felt necessary by the Bidder.	Two pumps (100% capacity) are to be located in each sump pit	Capacity of each pump should be so selected to empty the sump pit in 10 minutes	To be calculated with 10% margin over total dynamic head (TDH = static head + friction losses)	To be decided by the Bidder	As described in Cl. no. 1.02.04	Discharge pipe sizing should be done taking minimum water velocity to be 2m/sec but should not be less than 80 NB. One gate valve and one non return valve should be provided at pump discharge.

Note: Sump pumps to be installed in CHP area, FGD area are covered in respective sections.

VOLUME : II-K

SECTION-III

MISCELLANEOUS HOISTS

CONTENT

CLAUSE NO.	DESCRIPTION	PAGE NO.
1.00.00	GENERAL INFORMATION	1
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4.00.00	SPECIFIC DESIGN REQUIREMENTS	2
5.00.00	DESIGN AND CONSTRUCTION	3
6.00.00	INSPECTION AND TESTING	6
7.00.00	DRAWINGS, DATA AND INFORMATION	7
ATTACHMENT		
ANNEXURE-I	LIST OF LOCATION FOR MONORAIL HOISTS	8

SECTION-III

MISCELLANEOUS HOISTS

1.00.00 GENERAL INFORMATION

1.01.00 The hoists will be used for erection and maintenance of various equipment in different buildings under the scope of Entire Package, except FGD and Coal Handling Plant, of 1 x 660 MW Sagardighi Thermal Power Project Unit 5, Phase-III. Hoists for FGD and CHP area are mentioned in Section-V of Volume-IIB and Volume II H1 respectively.

1.02.00 Hoists are divided into two separate groups - (a) Hand operated and (b) Electric operated.

2.00.00 CODES AND STANDARDS

The design, manufacture and testing of the equipment covered under this specification shall conform to the latest editions of the following Indian Standards:

2.01.00	IS : 3832	:	Specification for Hand Operated Chain Pulley-blocks.
2.02.00	IS : 807	:	Code of Practice for Design, Manufacture, Erection and Testing (Structural Portion) of Cranes and Hoists.
2.03.00	IS : 6216	:	Short link Chain, Grade T(8) for Pulley-blocks & other Lifting Appliances.
2.04.00	IS : 2429 (part -I)	:	Non-calibrated Load Chain for Lifting Purposes.
2.05.00	IS : 15560	:	Point Hook with Shank up to 160 tones - Specification
2.06.00	IS : 3938	:	Specification for Electric Wire Rope Hoists.

and other Indian Standards referred to in the above standards.

3.00.00 SCOPE OF WORK

3.01.00 Hoists shall be provided in all areas under the scope of this specification (except the areas covered by E.O.T. cranes) where any equipment/component weighing above 100 kg is installed and needs to be handled for maintenance purposes. Number of monorail beams shall be such that the centre line of the hoist and the centre line of equipment to be handled shall be not more than 500 mm.

3.01.01 The location and no. of hoists is to be finalised during detailed engineering. Final arrangement is subject to approval of Owner/Consultant.

3.01.02 Monorail hoists shall at least be provided in the areas mentioned in Annexure-I. The list is indicative only and not an exhaustive one.

3.01.03 Besides monorail hoists, fixed Chain Pulley blocks of following capacities shall be provided:

Capacity (T)	**Nos.**
1	10
3	10
5	8
10	3

3.02.00 All drive motors and driving gears as necessary.

3.03.00 Limit switches for electrical hoist as necessary.

3.04.00 Trailing cable with all supporting fixtures as necessary for electric hoists.

3.05.00 Pendent control station with all accessories for electric hoists.

3.06.00 Lifting lug, eye bolts etc., for handling hoist parts.

3.07.00 Protection guard as specified.

3.08.00 Lifting hook block assembly for hoists.

4.00.00 SPECIFIC DESIGN REQUIREMENTS

4.01.00 Lifting capacity

4.01.01 Capacity of each hoist shall be 1.2 times the maximum working load.

4.01.02 Hoists of capacity below 3 tones shall be manual hoists.

4.01.03 Hoists of capacity equal and above 3 tones shall be electric hoists.

4.02.00 Effort for Mechanical Hoists

4.02.01 Hoisting

Hoisting effort for hoists up to 3 tones capacity shall not be more than 20 kg.

4.02.02 Trolley Motion

Effort for trolley motion for hoists upto 3 tones capacity shall not be more than 43 Kg.

4.02.03 For Electric operated hoist both hoisting and trolley motion shall be motor operated.

4.03.00 Lift

4.03.01 Lift above operating floor

Highest position of the hook shall be such that during operation of hoists, the vertical distance between bottom of any equipment handled and top of any permanent structure or equipment in the operating area shall be at least one metre.

4.03.02 Approach below operating floor

To be decided by the Bidder for safe and reliable handling of any equipment above half ton below the operating floor.

4.04.00 Length of monorail hoist

To be decided by the Bidder depending on the floor and machine layout. The horizontal distance between the centre line of the hoist and centre line of any installed equipment in its operating shall not be more than half metre.

5.00.00 DESIGN AND CONSTRUCTION

5.01.00 All parts requiring replacement or lubrication shall be easily accessible without the need for dismantling of other equipment and structures.

Robust construction and ample rating merging which experience has shown to be necessary shall be ensured throughout manufacture.

5.02.00 All components of hoists of identical capacity and duty shall be interchangeable. The hoists of identical capacity and duty shall be identical in all respects unless otherwise required. The hoist design shall be such that these can be quickly removed from one monorail beam and fixed on another beam without disassembling major components.

5.03.00 All machinery and equipment included under this specification must be equipped with safety devices and clearances to comply with recognized standards and specification requirements.

5.04.00 Cast iron parts wherever used, shall conform to IS:210 - FG 260. Also no wood or other combustible materials shall be used.

5.05.00 Defects in material like fractures, cracks, blowholes, laminations, pitting etc. are not allowed. Rectifications of any such flaw is permissible only with the approval of the Owner.

5.06.00 Each hoist shall be permanently and legibly stamped with the tag number, manufacturer's name, safe working load, grade of load chain (where applicable), range of lift etc.

5.07.00 Load chain (where applicable) shall be of grade T(8) as per IS:6216 and Hand chain shall be as per IS:2429 (Part-I) grade 30.

5.08.00 Wheels in trolley unit travel shall be single flanged with straight/tapper/barrel shaped tread to suit the monorail. Wheels should be preferably of forged steel construction. Material of construction for wheels of traversing block and hoist gear for hoist used in hazardous areas shall be of non-ferrous material to avoid spark during operation.

5.09.00 All gears shall be hardened and tempered steel with machine out teeth.

5.10.00 Hoist (Manually Operated)

5.10.01 Manually operated hoists shall be of spur gear chain pulley block type. It shall be suspended from the trolley by a hook. The design of the hoist shall conform to IS:3832 (Specification for hand operated chain pulley blocks).

The hooks and brakes of hoist shall conform to the requirements stipulated in (a) and (b) below

a) Hooks shall conform to IS:3832. The load hook shall be swiveling type fitted with a locking device.

b) The pulley blocks shall be fitted with an automatic mechanical load brake to prevent self-lowering of load in all working positions. The load brake shall also allow smooth lowering of load without serious overheating.

c) All manually operated hoists, unless stated otherwise, shall be trolley suspended type.

5.10.02 The trolley of hoists shall be manually operated.

5.10.03 The hoists shall be of Mechanism class 2 as per IS:3832.

5.11.00 Electric Hoist

5.11.01 Electric hoist shall be electric wire rope trolley suspended type. The design, operation, testing of electric hoist shall conform to IS:3938 (Specification for electric wire rope hoist).

Minimum speed for hoisting shall be 3 m/min. and that of for trolley motion shall be 15 m/min.

5.11.02 Lifting hook shall conform to IS 15560 as applicable.

5.11.03 Wire rope for hoists shall conform to IS-2266.

Annexure II- Quality Assurance and Inspection requirement

(Refer “QUALITY ASSURANCE REQUIREMENTS, Volume II-A” of Customer’s specification)

Annexure III- Site Information

(Refer “Technical Specification, Volume II-A” of Customer’s specification)

ANNEXURE IV- MANDATORY SPARES

(Refer "REQUIREMENT OF SPARES, TOOLS & TACKLE, Section X, Volume II-A" of Customer's specification)

Note :-

1. If percentage comes as fraction next higher integer should be considered for the purpose of quantity required.
2. The List is tentative & the bidder shall include in the offer any additional items that shall be required for the system in offer as well any item description that may undergo specific technical changes.
3. "Sets of each type", "Sets" means 100% requirement for one stack up assembly.
4. Any item which is quoted as "not applicable" and is found to be "applicable" at a later date shall be supplied by the Bidder without any commercial implications. The Bidder shall note that if there in any change/ variation in equipment/ system during detail engineering which causes any change/ variation in the essential spares quantity, the same shall be supplied without any commercial implications. The price indicated for the mandatory spares shall be considered for the purpose of evaluation.
5. The bidder shall include in their offer, on basis of technical specification, the mandatory spares as applicable for their design.

ANNEXURE V- MAINTENANCE TOOLS & TACKLES

Refer "REQUIREMENT OF SPARES, TOOLS & TACKLE, Section X, Volume II-A" of Customer's specification.

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Sl.No.	Description	Qty.	Unit
1	Spur geared chain pulley block of 2.0 tonnes capacity , 3 mtr lift	1	Nos.
2	2 lbs ball pen hammers	2	Nos.
3	Cold Chisel 8"	2	Nos.
4	6" outside and inside caliper	2	Nos.
5	Double end spanners and ring spanners upto one inch size	2	Sets
6	6 feet long measuring tape	1	Nos.
7	a Hacksaw frames 1/2" x 12	4	Nos.
	b HSS blade 12 x 1/2"	6	Nos.
	c Hacksaw blades	6	Nos.
8	Allen keys set	2	Sets
9	Pipe wrenches 18"	2	Nos.
10	10" right angle	1	Nos.
11	12" aluminium spirit levels	2	Nos.
12	Filler Gauges - 8" & 12"	2	Sets
13	10" slide wrenches	2	Nos.
14	6",8",10",12" screw drivers	1	Set
15	Insulated Pliers 8"	1	No.
16	Tommy Bars 6"	2	Nos.
17	a) Cotton Hand Gloves	2	Pairs
	b) Lather Hand Gloves	2	Pairs
18	Lifting wire rope slings 8 ft with eye at each end 1/2 " size and 5/8" size	2	Pair each
19	Ratchet and sockets set for hexagonal head screws & bolts size M-6 to M-24	1	Set
20	Flaring tools with disc	1	Set
21	Grease Gun	1	No
22	Oil Gun	1	No
23	Screw Pitch Gauge	1	No
24	a) JK Flat file 12" smooth	2	Nos.
	b) JK Half round file 12" rough	2	Nos.
	c) JK Half round file 12 " fine	2	Nos.
	d) Square file 12"	2	Nos.
	e) Round File 12"	2	Nos.
25	Line Tester no: 814	2	Nos.
26	a) Cutting Pliers 8"	2	Nos.
	b) Nose Pliers 6"	2	Nos.
27	Soldering iron with flux	1	No.
28	Vice 4" & 12"	1	No. each
29	Taps and Dies	1	No.
30	Steel Scale 12" & 24"	2	each
31	Hand Lamps	2	Nos.
32	Torch with Battery (2 sizes)	2	Nos.

ANNEXURE VI- DRAWINGS/DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT: The successful bidder shall submit the following drawings / documents during detail engineering for customer's approval /information:

S.No.	BHEL DRG NO	DRG TITLE	CATEGORY	SCHEDULED SUBMISSION (NO. OF DAYS FROM LOA DATE)	REMARKS
MILL REJECT HANDLING SYSTEM					
1	PE-V0-445-160-A021	QP FOR CONVEYING COMPRESSOR FOR MILL REJECT SYSTEM	A	84	
2	PE-V0-445-160-A010	P & I DIAGRAM OF MRS COMPRESSOR		70	
3	PE-V0-445-160-A017	QAP OF SELF MANUFACTURED-CONVEYING VESSEL , PYRITE HOPPER, BUNKER DISCHARGE GATE, PRESSURE RELIEF VALVE, DENSEVYOR, TERMINAL BOX , ACI BEND, AIR RECEIVER , PNEUMATIC PANEL FOR MILL REJECT SYSTEM	A	42	BASIC DRG.
4	PE-V0-445-160-A033	QP FOR COMPRESSOR MOTOR OF MILL REJECT SYSTEM	A	84	
5	PE-V0-445-160-A030	QP FOR RUPTURE DISC OF MILL REJECT SYSTEM	A	84	
6	PE-V0-445-160-A028	QP FOR METALLIC EXPANSION BELLOW OF MILL REJECT SYSTEM	A	84	
7	PE-V0-445-160-A026	QP FOR BAG FILTER OF MILL REJECT SYSTEM	A	84	
8	PE-V0-445-160-A020	QAP OF MS ERW PIPE OF MILL REJECT SYSTEM	A	84	
9	PE-V0-445-160-A022	TRENCH AND INSERT DETAIL OF MILL REJECT SYSTEM	I	56	BASIC DRG.
10	PE-V0-445-160-A055	OPERATION AND MAINTENANCE MANUAL FOR MRS	I	168	
11	PE-V0-445-160-A052	PAINTING SCHEDULE FOR MRS	I	56	
13	PE-V0-445-160-A049	TECHNICAL DATA SHEET OF CABLE TRAY FOR MRS	I	70	
14	PE-V0-445-160-A048	CONTROL WRITE-UP & INTERLOCK & PNEUMATIC CIRCUIT OF CONVEYING VESSEL, BLOCK LOGIC DIAGRAM/CONTROL SCHEME WITH HMI SCREEN & I/O LIst	A	70	
15	PE-V0-445-160-A059	JUNCTION BOX DATASHEET & SCHEDULE OF MILL REJECT SYSTEM	A	70	
16	PE-V0-445-160-A051	CABLE INTERCONNECTION DIAGRAM FOR MRS	I	98	
17	PE-V0-445-160-A054	CABLE SCHEDULE -SIGNAL AND CONTROL OF MILL REJECT SYSTEM	I	84	
18	PE-V0-445-160-A056	SCHEDULE OF INSTRUMENTS FOR MILL REJECT SYSTEM	I	70	
19	PE-V0-445-160-A047	TECHNICAL DATA SHEET OF INSTRUMENTS (LIKE TEMPERATURE SWITCH, TEMPERATURE GAUGE,	A	70	

		PRESSURE SWITCH, PRESSURE GAUGE, SOLENOID VALVE , LEVEL SWITCH , AIR FILTER REGULATOR ETC.) OF MILL REJECT SYSTEM			
20	PE-V0-445-160-A045	GA, TECHNICAL DATA SHEET AND WIRING DIAGRAM OF SUMP PUMP OF MILL REJECT SYSTEM	I	98	
21	PE-V0-445-160-A043	G.A., TECHNICAL DATA SHEET AND FOUNDATION DETAILS OF AIRCOMPRESSOR, GA AND WIRING DIAGRAM FOR LOCAL PANEL OF CONVEYING AIR COMPRESSOR OF MILL REJECT SYSTEM	A	70	BASIC DRG.
22	PE-V0-445-160-A037	GA OF CHAIN PULLEY BLOCK OF MILL REJECT SYSTEM	I	56	
23	PE-V0-445-160-A035	G.A. OF RUPTURE DISC. OF MILL REJECT SYSTEM	I	56	
24	PE-V0-445-160-A034	G.A OF METALLIC EXPANSION BELLOW OF MILL REJECT SYSTEM	I	56	
25	PE-V0-445-160-A027	G.A OF BAG FILTER OF MILL REJECT SYSTEM	I	56	
26	PE-V0-445-160-A025	GA OF KNIFE GATE/PLATE VALVE OF MILL REJECT SYSTEM	I	56	
27	PE-V0-445-160-A024	DESIGN CALCULATION AND STRUCTURAL ARRANGEMENT OF BUNKER AND LOAD DATA OF BUNKER OF MILL REJECT SYSTEM	A	70	BASIC DRG.
28	PE-V0-445-160-A019	G.A OF MRS BUNKER	A	42	BASIC DRG.
29	PE-V0-445-160-A018	CONTROL ROOM LAYOUT-MILL REJECT SYSTEM	A	70	
30	PE-V0-445-160-A014	LAYOUT OF MRS COMPRESSOR HOUSE	A	70	BASIC DRG.
31	PE-V0-445-160-A013	EQUIPMENT AND PIPING LAYOUT OF MILL REJECT SYSTEM AND PIPING LAYOUT FROM MRS COMPRESSOR HOUSE	A	56	BASIC DRG.
32	PE-V0-445-160-A011	SUB VENDOR LIST WITH INSPECTION CATEGORY OF MILL REJECT SYSTEM	A	28	BASIC DRG.
33	PE-V0-445-160-A009	P G TEST PROCEDURE OF MILL REJECT SYSTEM	A	140	
34	PE-V0-445-160-A008	GA & DS OF SELF MFG. ITEMS (DENSVEYOR, HOPPER, BNKR DIS. GATE, PRV, ACI BEND, PNEU. PANEL, AIR RECVR, TER. BOX, ETC.) OF MILL REJECT SYSTEM	I	42	BASIC DRG.
35	PE-V0-445-160-A006	P & I DIAGRAM OF MILL REJECT HANDLING SYSTEM	A	28	BASIC DRG.
36	PE-V0-445-160-A004	DESIGN PHILOSPHY AND SYSTEM SIZING CALCULATIONOF MILL REJECT SYSTEM	A	28	BASIC DRG.

37	PE-V0-445-160-A003	G.A., TECHNICAL DATA SHEET OF AIRCOMPRESSOR MOTOR OF MILL REJECT SYSTEM	A	70	
38	PE-V0-445-160-A002	GA OF WATER AND AIR LINE VALVES OF MILL REJECT SYSTEM	I	84	

Notes:

1. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order. While some of the drawings indicated above may not be applicable, some additional drawings may also be required based on scope of work. Drawings /documents indicated at Electrical and C&I specification are also to be submitted as per applicability.
2. Drawings shall be prepared in Auto-Cad latest edition and to the scale. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.
3. Only manual calculation with authentic supporting literature (e.g. extracts of hand Book/ standard/codes) shall be acceptable. All design calculations and drawings shall be in SI system only.
4. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.:-

a) All drawings and documents shall indicate the list of all reference drawings including general arrangement.

b) All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.

c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.

d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.

e) Drawings/ documents to be submitted for purchasers review/ approval shall be under Revision A, B, C… etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3 ….etc.

f) Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication.

g) All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS No., Technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity.

h) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing No.

i) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.

j) Bidder to follow the following the drawing submission schedule:

k) 1st submission of drawings from date of LOI as per the submission schedule.

l) Every revised submission incorporating comments – within 10 days.

m) Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

n) BHEL drawing numbers shall be informed after award of contract and essentially to be incorporated in drawings. The pdf files of all drawings and documents shall be named and submitted with BHEL drawing numbers.

o) Drawings documents above have been identified as basic drawings in remarks column. During contract engineering stage, approval of these drawings from BHEL/Customer shall be treated as clearance to milestone payment of Engineering Services.

Upon review of each drawing, depending on the correctness and completeness of the drawing, the same will be categorized and approval accorded in one of the following categories:

CATEGORY- 1 : Approved
CATEGORY- 1* : Approved with comments.
Resubmit revised drawing incorporating the comments.
CATEGORY –2 : Approved except as noted, forward final drawing.
CATEGORY - 3 : Approved except as noted, resubmission required.
CATEGORY – 4 : Disapproved.
CATEGORY – 5* : For information and record with comments.
CATEGORY – 5 : For information and record.

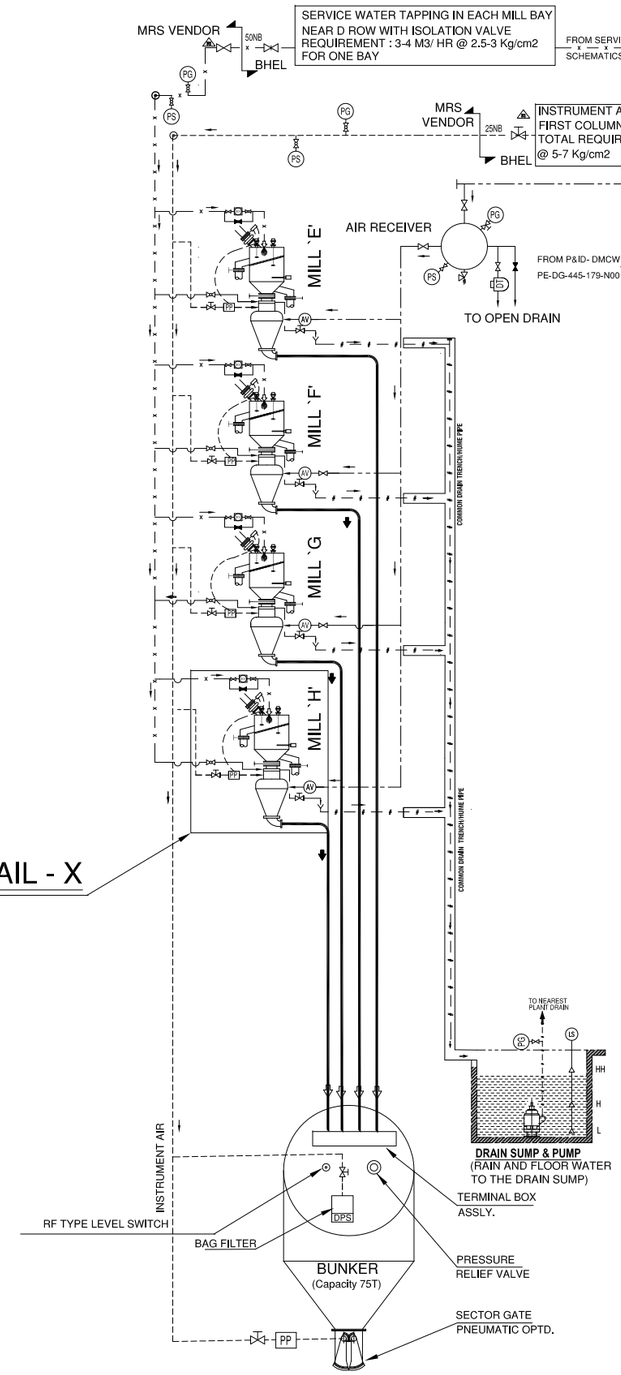
Drawings resubmitted shall show clearly the portions where the same are revised marking the relevant revision numbers and Employer shall review only such revised portion of documents.

B.0 NO.OF DRAWINGS/DOCUMENTS FOR SUBMISSION

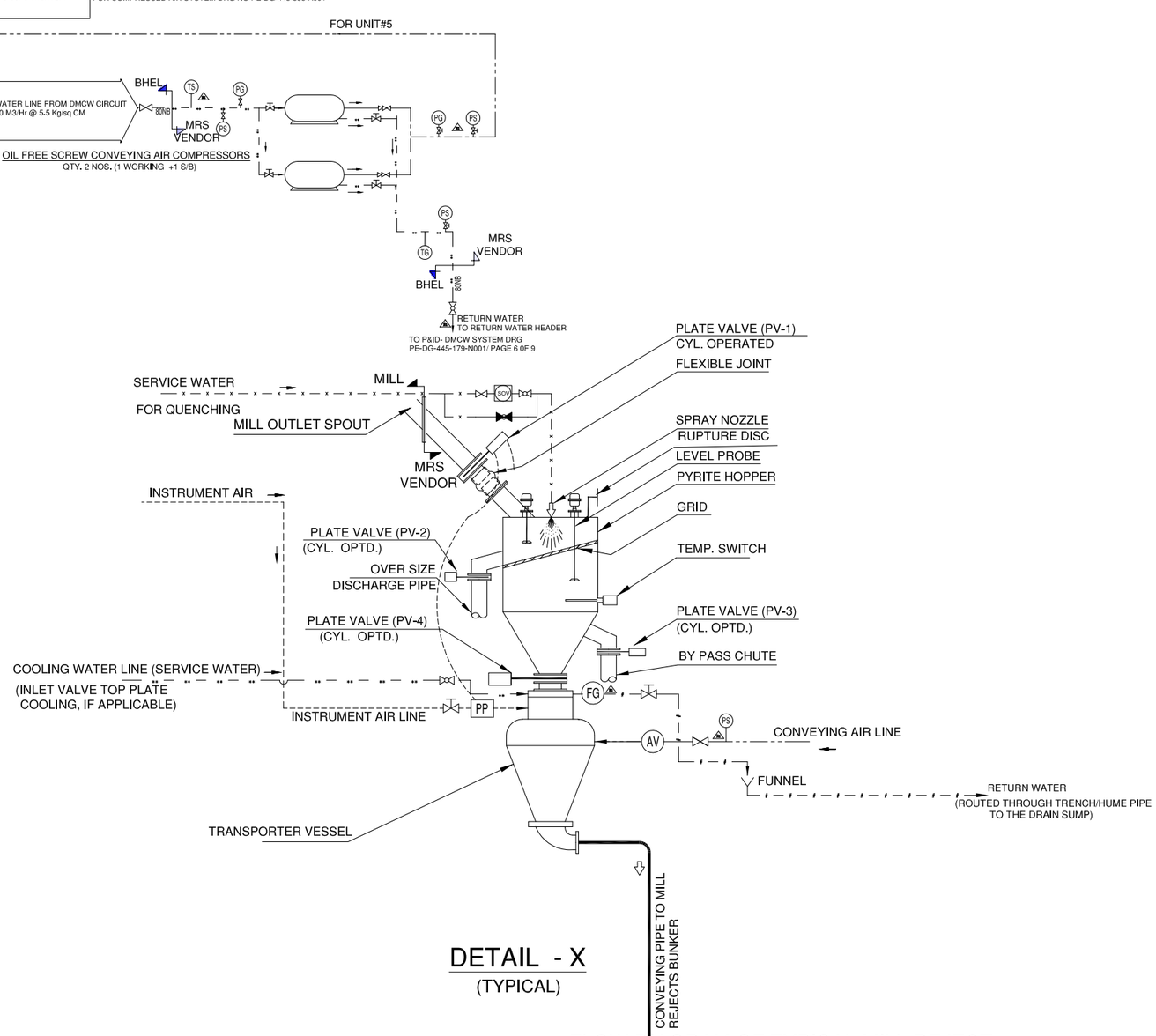
A.	Drawing for Approval	No. of prints/copies (hard prints)
i.	For approval	8
ii.	For final distribution (after the vendor obtains final approval from the customer).	12
B.	Certificate, reports etc. (Material test, inspection report and all other type of tests etc.)	6
C.	O&M Manual	
I.	Draft for approval	2
ii.	For final distribution	12

Annexure VII- Input Drawings & Documents

1) Single Line Flow Diagram of Mill Reject handling system – Drg no PE-DG-445-160-A001
2) General Arrangement drawing of HP-1103 Mill (with Planetary gear box) - Drg no HY-DG-445-HFC-A001.
3) Bowl Mill Foundation- General Arrangement of Bowl Mill Foundation – Drg no PE-DG-445-615-C001.
4) Plot Plan - Drg no PE- DG-445-100-M001.
5) Floor plan arrangement View at EL 12000 (MBL 1), EL 13000 & EL 14100 drg no 0-00-021-77627.
6) Sectional Front Elevation View drg no 0-00-022-77605.
7) Flow scheme for 0.75m3 air receivers at feeder floor.



FLOW DIAGRAM OF TYPICAL MILL BAY



DETAIL - X
(TYPICAL)

FLOW DIAGRAM OF TYPICAL MILL REJECT

NOTE:

1. THE DRG INDICATES BROAD SCOPE & WORKING PRINCIPAL OF THE SYSTEM. FLOW DIAGRAM SHALL BE READ IN CONJUNCTION WITH DESIGN MEMORANDUM.
2. RETURN SERVICE WATER FROM TRANSPORTER VESSEL SHALL BE AS PER APPLICABILTY OF MRS VENDOR'S DESIGN.

LEGEND:-

- MILL REJECTS CONVEYING PIPE
- CONVEYING AIR
- INSTRUMENT AIR
- COOLING WATER
- SERVICE WATER
- RETURN WATER
- GATE VALVE
- BALL VALVE
- NORMALLY CLOSED BALL VALVE
- NON RETURN VALVE
- DRAIN TRAP (DT)
- AIR VALVE (AV)
- PNEUMATIC PANEL (PP)
- SAFETY VALVE
- PRESSURE GAUGE (PG)
- PRESSURE SWITCH (PS)
- SOLENOID OPTD. VALVE (SOV)
- TEMPERATURE GAUGE (TG)
- TEMPERATURE SWITCH (TS)
- DPS DIFFERENTIAL PRESSURE SWITCH
- SS MANIFOLD WITH ISOLATION VALVE
- GLOBE VALVE

JOB NO. 445				
STATUS CONTRACT				
DISTRIBUTION				
TO				
NO.				
REV	DATE	ALTD	CHKD	APPD
01	06-07-21	VVH	VVH	SKB

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

CONSULTANT
DEVELOPMENT CONSULTANTS PRIVATE LIMITED
KOLKATA

BHARAT HEAVY ELECTRICALS LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
PROJECTS ENGINEERING MANAGEMENT, NOIDA

TITLE: SINGLE LINE FLOW DIAGRAM OF MILL REJECT HANDLING SYSTEM

	NAME	SIGN	DATE
DRAWN	VVH	-sd-	15.12.20
CHECKED	PKK	-sd-	15.12.20
APPRD	GB	-sd-	15.12.20

CARD CODE | DRG.NO. PE-DG-445-160-A001 | REV 01
SHEET NO 1 OF 1 | NO OF SHEETS 1

DRAWING NO. 0-00-620-87092

FIRST ANGLE PROJECTION — ALL DIMENSIONS ARE IN MM

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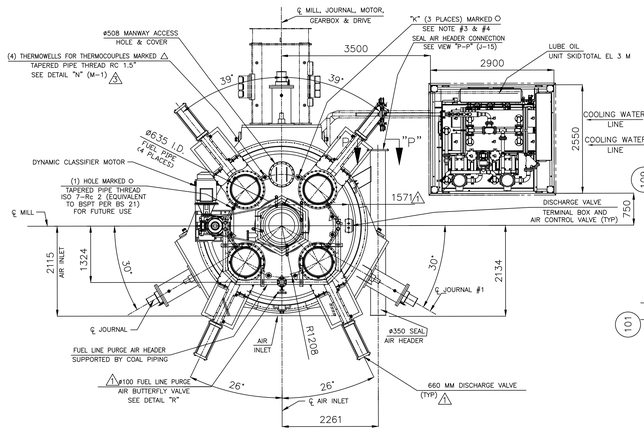
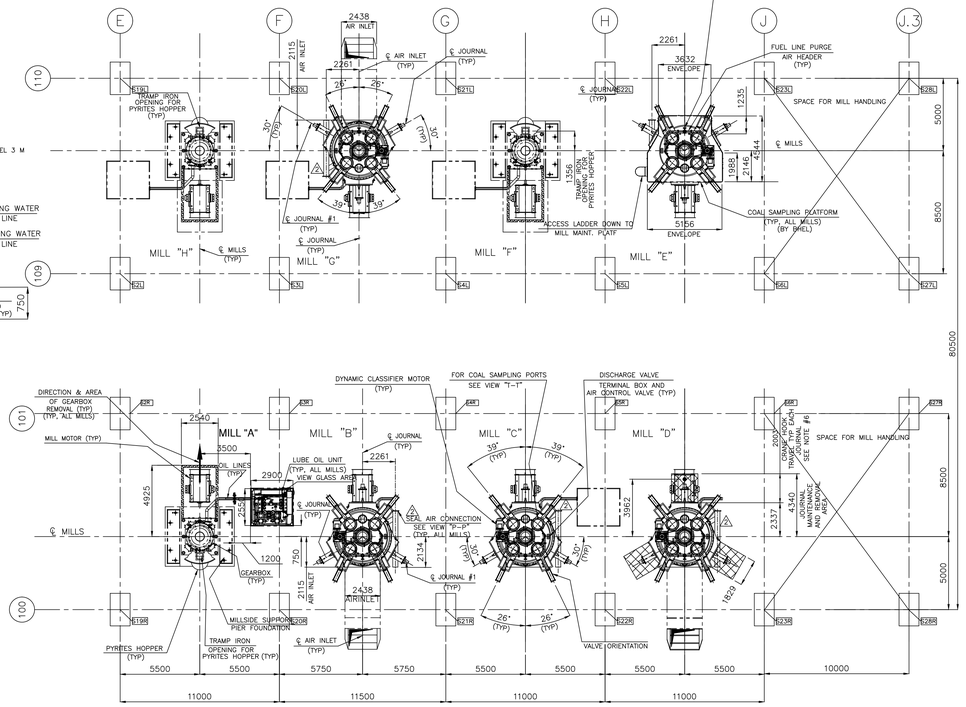
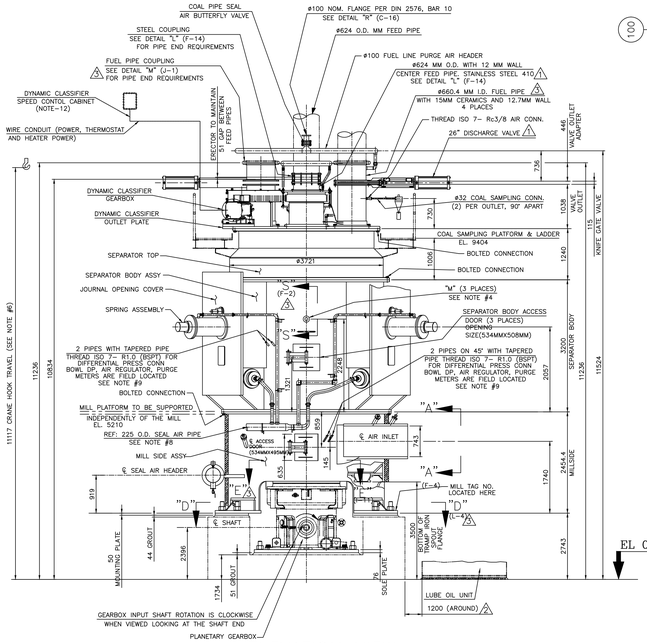
ELECTRONIC FILE NAME:



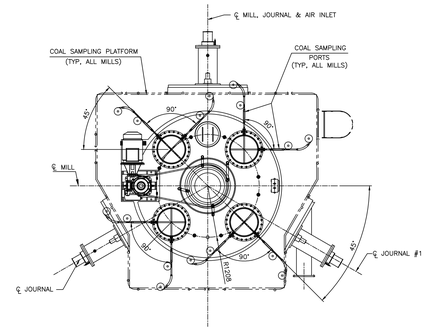
PLAN VIEW △ (SEE NOTE #3)



KEY PLAN – MILL ARRANGEMENT △

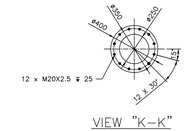


ELEVATION VIEW

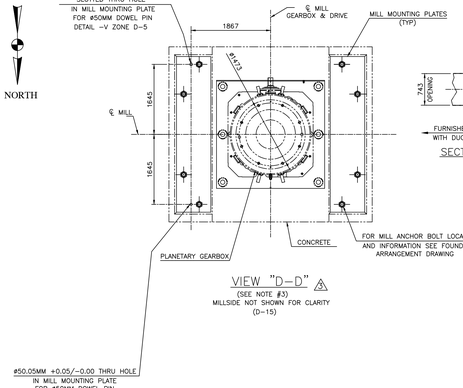


VIEW "T-T" (SEE NOTE #3)

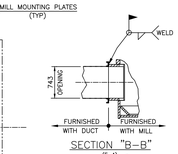
FOR INFORMATION NOT SHOWN ON THE PLATFORM (SEE KEY PLAN –MILL ARRANGEMENT)



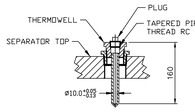
VIEW "K-K" TRAMP IRON SPOUT FLANGE (MATING FLANGE ø250 NOM. PER DIN 2576) (FLANGE THK. 26) SCALE 1 : 12 (I-11)



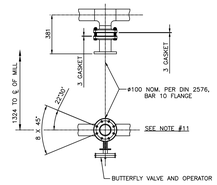
VIEW "D–D" △ (SEE NOTE #3) MILLSIDE NOT SHOWN FOR CLARITY (D-15)



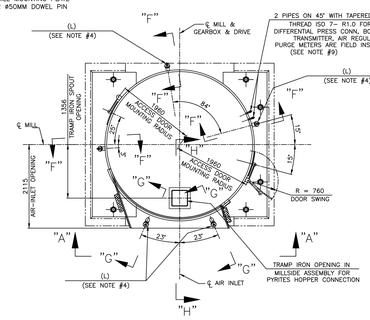
SECTION "B-B" (F-4) △



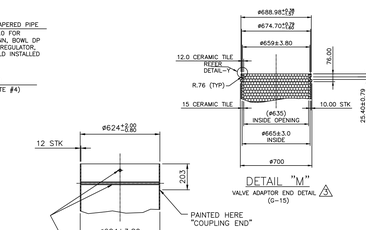
DETAIL "N" THERMOWELL DETAIL (L–15) △ SCALE: 1 : 4



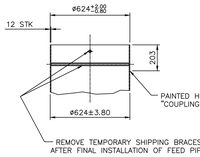
DETAIL "R"



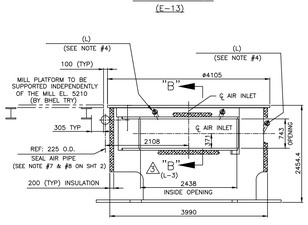
VIEW "C"–"C" (E-13)



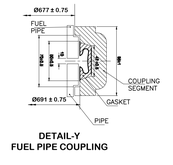
DETAIL "M" VALVE ADAPTOR END DETAIL △ (0–15)



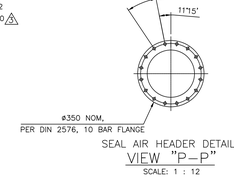
DETAIL "L" CENTER FEED PIPE END DETAIL (C–3) SCALE: 1 : 12 MATERIAL : SS410 △



VIEW "A–A" (SEE NOTE #3 ON SHT 2) (E–14) △



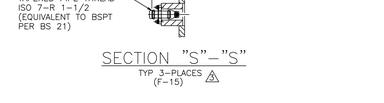
DETAIL-Y FUEL PIPE COUPLING



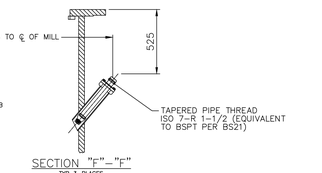
SEAL AIR HEADER DETAILS △

VIEW "A–A" (SEE NOTE #3 ON SHT 2) (E–14) △

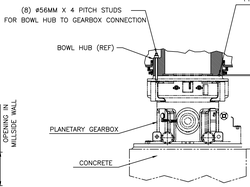
DETAIL-Y FUEL PIPE COUPLING



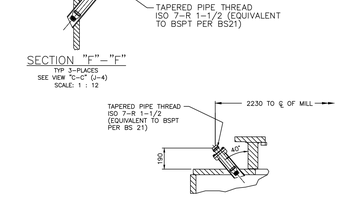
SECTION "S"–"S" TYP 3–PLACES △ (F–15)



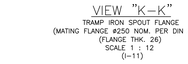
SECTION "F"–"F" TYP 3–PLACES SEE VIEW "C–C" (J–4) SCALE: 1 : 12



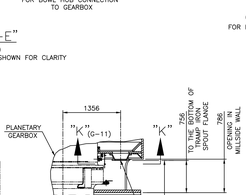
SECTION "J–J" (H–11 ON VIEW E–E)



SECTION "G"–"G" TYP 2–PLACES (SEE VIEW "C–C" (J–4) SCALE: 1 : 12



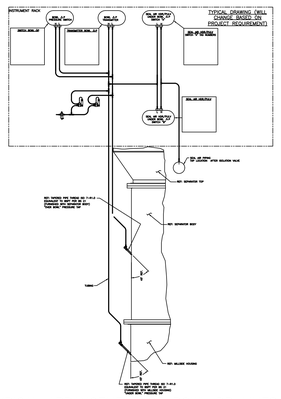
VIEW "E–E" (SEE NOTE #3) BOWL HUB AND MILLSIDE NOT SHOWN FOR CLARITY △(E–15)



SECTION "H–H" (0–13 ON VIEW C–C)

VIEW–X

MAJOR COMPONENTS	WEIGHT (ESTIMATED) (MT)	QUANTITY PER MILL
PLANETARY GEAR BOX (W/O OIL)	16.00	1
MILLSIDE ASSEMBLY	19.83	1
BOWL AND BOWL HUB ASSEMBLY	18.35	1
SEPARATOR BODY ASSY. WITH TRUNNION SHAFTS	21.98	1
SEPARATOR TOP	4.74	1
DYNAMIC CLASSIFIER COMPLETE	11.80	1
DYNAMIC CLASSIFIER OUTLET PLATE AND DRIVE ASSEMBLY	9.00	1
JOURNAL SHAFT ASSEMBLY WITH GRINDING ROLL (1)	5.76	3
JOURNAL HEAD ASSEMBLY (1)	3.44	3
JOURNAL OPENING COVER ASSEMBLY WITH SPRING ASSEMBLY (1)	3.91	3
JOURNAL MAINTENANCE: – JOURNAL TILT OUT – JOURNAL BEARING & END PLAY CHECKING	6.03 6.45	1


INSTRUMENT RACK
TYPICAL DRAWING ONLY CHANGE BASED ON PROJECT REQUIREMENT
SEAL AIR HEADER
SEAL AIR PIPE
SEPARATOR BODY

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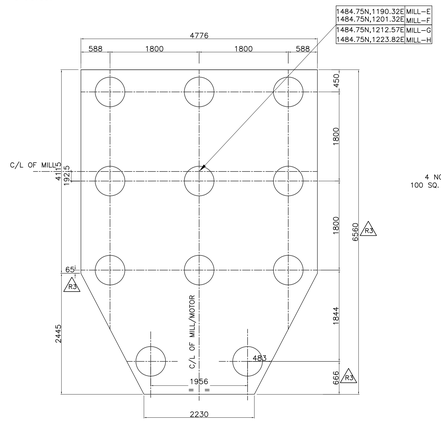
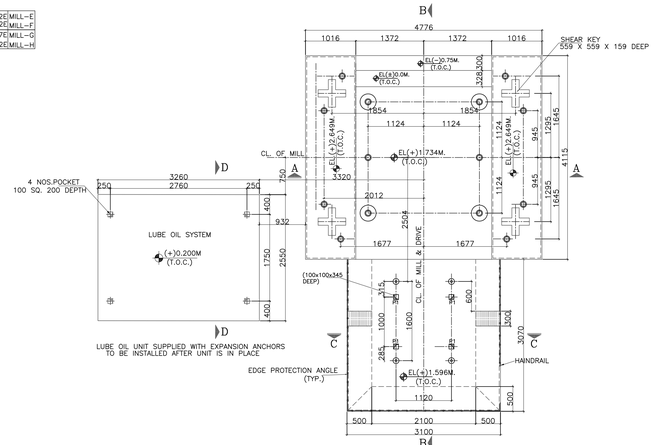
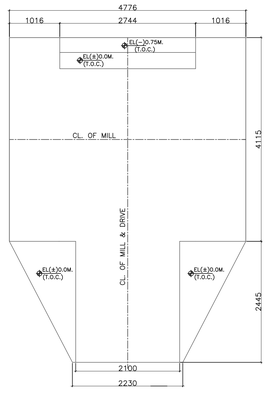
NORTH



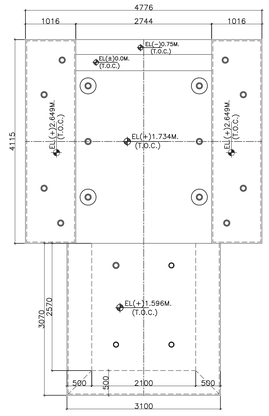
LAYOUT OF PILE & PILE CAP
FOR MILL E, F,G & H
PC–1



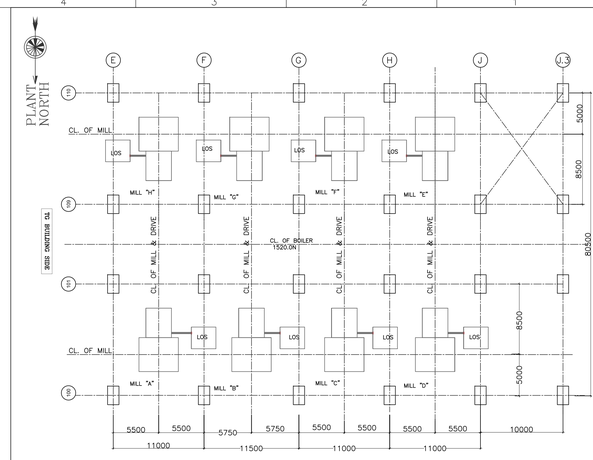
FOUNDATION PLAN AT EL.(+)2.649M
FOR MILL E, F,G & H



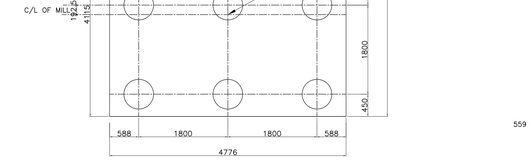
PLAN AT EL.(±)0.00
FOR MILL E, F,G & H



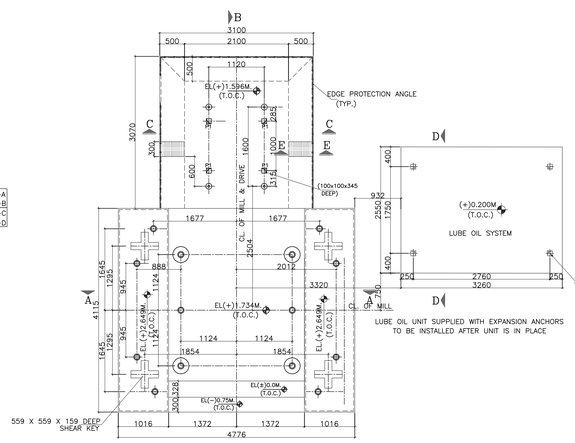
PLAN AT EL.(±)2.649
FOR MILL E, F,G & H
(SHOWING ANCHOR BOLT ONLY)



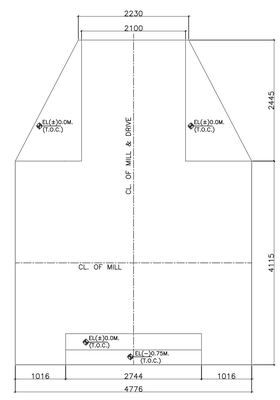
KEY PLAN



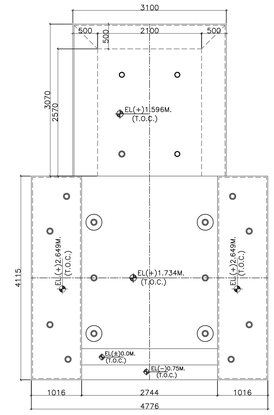
LAYOUT OF PILE & PILE CAP
FOR MILL A,B,C & D
PC–2



FOUNDATION PLAN AT EL.(+)2.649M
FOR MILL A,B,C & D



PLAN AT EL.(±)0.00
FOR MILL A,B,C & D



PLAN AT EL.(±)2.649
FOR MILL A,B,C & D
(SHOWING ANCHOR BOLT ONLY)

NOTES :–

1. ALL DIMENSIONS ARE IN MILLIMETER AND ALL ELEVATIONS ARE IN METER UNLESS OTHERWISE SPECIFIED.
2. ALL ELEVATIONS ARE W.R.T EL(+) 0.00 M WHICH CORRESPONDS TO FFL RL(+)34.5 OF POWER HOUSE GROUND FLOOR ELEVATION. (–)0.200M RL(+)34.3 CORRESPONDS TO FFL OF BOILER AREA.
3. ANCHOR BOLT ASSEMBLY AND DRAIN PIPES ARE TO BE SUPPLIED AT SITE BY BHEL–HYD AND EMBEDDED BY BHEL CIVIL CONTRACTOR AFTER PROPER CLEANING. BHEL CIVIL CONTRACTOR SHALL USE TEMPLATES FOR MAINTAINING EXACT LOCATION AND VERTICAL ALIGNMENT OF BOLTS. ADEQUATE CARE TO BE TAKEN FOR PREVENTING CONCRETE FLOW INTO POCKETS.
4. GRADE OF REINFORCEMENT SHALL BE FE 500 D TMT BARS CONFORMING TO IS:1786
5. ALL STRUCTURAL CONCRETE SHALL BE DESIGN MIX CONC. OF GRADE M–30 UNLESS OTHERWISE NOTED.
6. REF. DRG. PE–DG–445–600–C001 – GENERAL NOTES AND STANDARD DETAILS FOR R.C.C. WORKS.
7. GROUTING SHOULD BE DONE ONLY AFTER FINAL ALIGNMENT OF MILL.
8. NON SHRINK GROUTING SHALL BE DONE WITH READYMIX GROUT OF CONBEXTRA–GP2 OR EQUIVALENT.
9. BACK FILLING SHALL BE DONE WITH APPROVED EXCAVATED EARTH IN LAYERS NOT EXCEEDING 250MM LOOSE THICKNESS & COMPACTED SO AS TO ACHIEVE AT LEAST 90% OF STANDARD PROCTOR DENSITY AS PER IS: 2720 PART VII.
10. THE ROUGH EXCAVATION MAY BE CARRIED OUT UP–TO A MAXIMUM DEPTH OF 500 MM ABOVE THE FINAL FOUNDATION LEVEL. THE BALANCE SHALL BE EXCAVATED WITH SPECIAL CARE AND PCC SHALL BE PLACED IMMEDIATELY AFTER THE FINAL EXCAVATION IS REACHED.
11. BHEL/ERECTOR SHALL REFER FOR ORIENTATION, ALIGNMENT AND SIZES OF ANCHOR BOLT ASSEMBLY AND SHEAR KEY WITH BHEL HYD. DRG. NO. –HY–DG–445–HFC–A002 BEFORE CONCRETING OF PEDESTAL.
12. FOUNDATION POCKETS SHOULD BE PERPENDICULAR TO THE FLAT SURFACE OF FOUNDATION.
13. GRADE OF CONCRETE MIX USED FOR GROUTING SHALL BE ONE GRADE HIGHER THAN THE CONCRETE USED FOR FOUNDATION. NON SHRINK FREE FLOW CEMENT OR ADMIXTURE SHALL BE USED FOR GROUTING. AS PER SPECIFICATION. PROPER COMPACTION AND CURING OF GROUT SHOULD BE ENSURED.
14. CLEAR COVER TO MAIN REINF.SHALL BE AS FOLLOWS:–

ITEM	TOP	BOTTOM	SIDE	ENDS
a) MILL FOUNDATION & PEDESTALS	50	75	50	–
b) PILE CAP	75	75	75	–

NOT APPLICABLE HENCE, DELETED

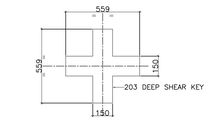
15. DURING PLACEMENT OF CONCRETE, TEMPERATURE OF FRESH CONCRETE SHALL BE MAINTAINED LESS THAN 23°C BY USING CRUSHED ICE AS PER DIRECTION OF ENGINEER– IN– CHARGE AT SITE.
16. UPV TEST SHALL BE DONE AS PER DIRECTION OF ENGINEER– IN –CHARGE AT SITE.

REFERENCE DRGS.

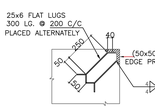
1. HY–DG–445–HFC–A001– GENERAL ARRANGEMENT DRAWING OF HP–1103 MILL (WITH PLANETARY GEAR BOX)
2. HY–DG–445–HFC–A002– FOUNDATION PLAN OF HP–1103 MILL (WITH PLANETARY GEAR BOX) (BHEL HYD. DRG.).
3. PE–DG–445–615–C002 – BOWL MILL FOUNDATION OF RC DETAILS.
4. PE–DG–445–100–M002–MAIN EQUIPMENT PLAN
5. PE–DG–445–607–C005–––––DETAILS OF 600 DIA JOB PILES.
6. PE–DG–445–617–C001–––––BOILER FOUNDATIONGA OF PILE LAYOUT, PILE CAPS & PEDESTALS

LEGEND

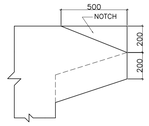
T.O.C – TOP OF CONCRETE.
T.O.G – TOP OF GROUT.
REF – REFER.



PLAN OF SHEAR KEY POCKET



TYPICAL LUG DETAILS
OF ANGLE FOR EDGE PROTECTION



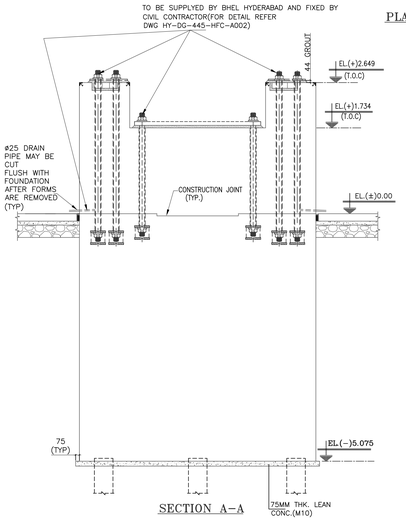
SECTION E–E
(DETAIL FOR CABLE ENTRY)

PILE SCHEDULE TABLE

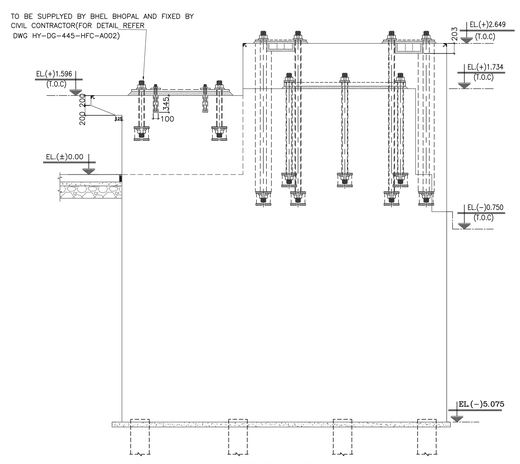
PILE CAP MKD	PILE DIA (MM)	NO. OF PILE CAP	NO OF PILES PER PILE CAP	TOTAL PILES
PC–1	600	4	11	44
PC–2	600	4	11	44
TOTAL PILES				88

DETAILS OF PILE

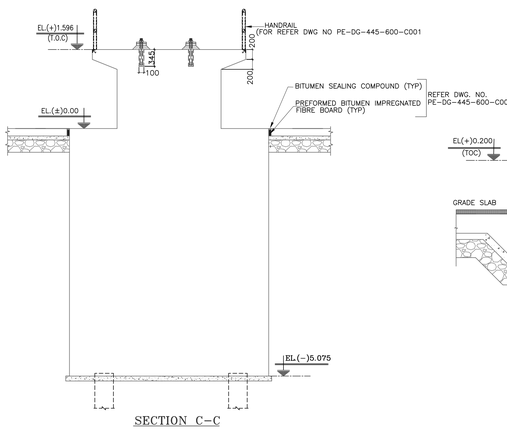
CAPACITY IN VERTICAL COMPRESION	UPLIFT CAPACITY (T)	LATERAL LOAD CAPACITY (T)	SYMBOL	PILE DIA NOMINAL	LENGTH BELOW CUT OFF LVL	TYPE OF PILE	PILE CUT–OFF LEVEL	NO OF PILES
150	35	10	⊕	600	24.00m	BORED CAST IN SITU	(–)5.0M	88



SECTION A–A



SECTION B–B



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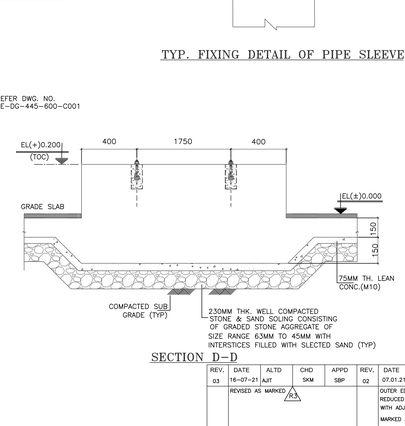
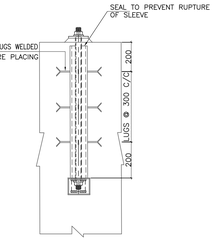
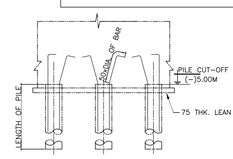


SECTION D–D



TYP. FIXING DETAIL OF PIPE SLEEVE



TYP. DET. OF PILE
CAP AND PILE CUT–OFF

BHEL–PROJECT ENGINEERING MANAGEMENT(CIVIL)
THIS DRAWING MARKED(√) IS RELEASED FOR
☑ COMMENTS/APPROVAL
☐ PLANNING/INFORMATION
☐ CONSTRUCTION
STAMP ALL PREVIOUS REVISION AS SUPERSEDED

ISSUED BY	
NAME	SKM
SIGNATURE	Sd/–
DATE	16-07-2021

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

CONSULTANT:
DEVELOPMENT CONSULTANTS PRIVATE LTD.
KOLKATA

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

JOB NO. 445
STATUS CONTRACT
DISTRIBUTION

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DEPT CODE		NAME	SIGN	DATE
C	DRN	VEENA	–Sd–	10.11.2020
	DESN	AJIT	–Sd–	10.11.2020
	CHD	SKM	–Sd–	10.11.2020
	APPD	SBP	–Sd–	10.11.2020

REV.	DATE	ALTD	CHD	APPD
03	16–07–21	AJIT	SKM	SBP

REVISED AS MARKED 3

REV.	DATE	ALTD	CHD	APPD
02	07.01.21	AJIT/VEENA	SKM	SBP

OUTER EDGE(MOTOR SIDE) OF PILE CAP REDUCED BY 125 MM TO AVOID FOULING WITH ADJACENT BOILER FOUNDATION AND MARKED AS 2

REV.	DATE	ALTD	CHD	APPD
01	02.12.20	AJIT/VEENA	SKM	SBP

REVISED AS PER CUSTOMER COMMENTS AND MARKED AS 1

TITLE
BOWL MILL FOUNDATION
GENERAL ARRANGEMENT OF BOWL MILL FOUNDATION

DEPT. SIGN SCALE
DRAWING NO. PE–DG–445–615–C001
SHEET 1 OF 1 REV. 03
SIZE–A0

ELECTRONIC FILE NAME:

PE-DG-445-100-M001

EXISTING ROAD

12.0M WIDE ROAD, E 938

ASH DISPOSAL/RECOVERY PIPE RACK(CUSTOMER SCOPE)

4.0M WIDE ROAD CL OF ROAD 958.0 E

8.0M WIDE ROAD CL OF ROAD 1635.635 N

8.0M WIDE ROAD CL OF ROAD 1650.750 N

8.0M WIDE ROAD CL OF ROAD 1601 N

1839.00 N
1045.574 E

E=1000.0M.

E=1100.0M.

E=1200.0M.

E=1300.0M

N=1800.0M.

GRADED LEVEL
RL.34.20

GRADED LEVEL
RL.54.20

1757.00 N
1029.00 E

1686.900 N
1188.608 E

1753.151 N
1314.072 E

1828.320 N
1324.663 E

1698.217 N
1260.235 E

1619.980 N
1338.477

1610.99 N
1240.50 E

1616.466 N
1316.037 E

1567.500 N

1560.000 N

1659.800 N
1064.700 E

1659.800 N
1079.662 E

1659.800 N
1066.975 E

1659.800 N
1064.700 E

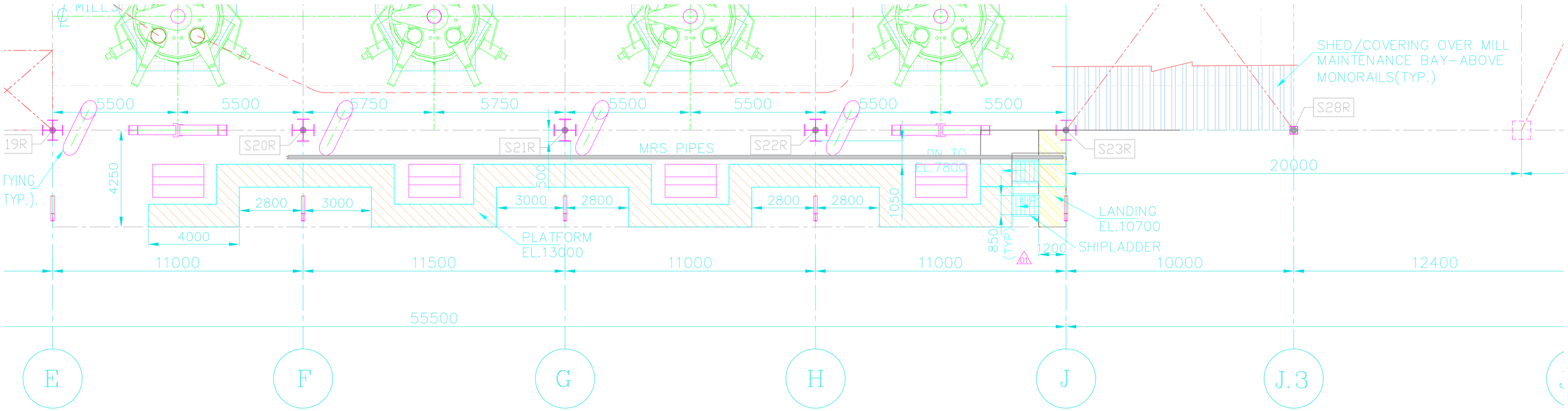
1658.500 N
1050.000 E

1658.500 N
1050.000 E

1658.500 N
1066.975 E

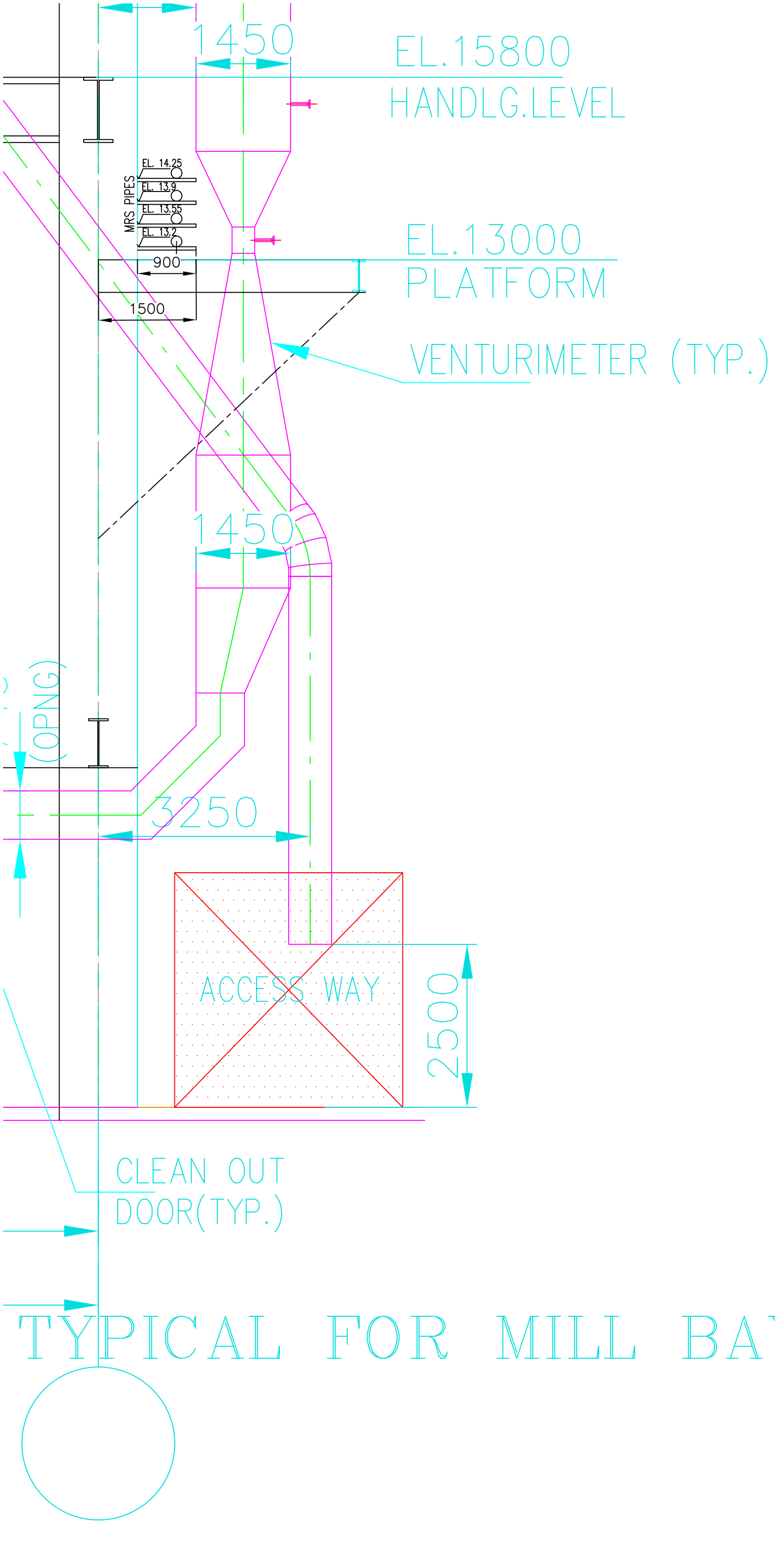
1658.500 N
1079.662 E

1658.500 N
1064.700



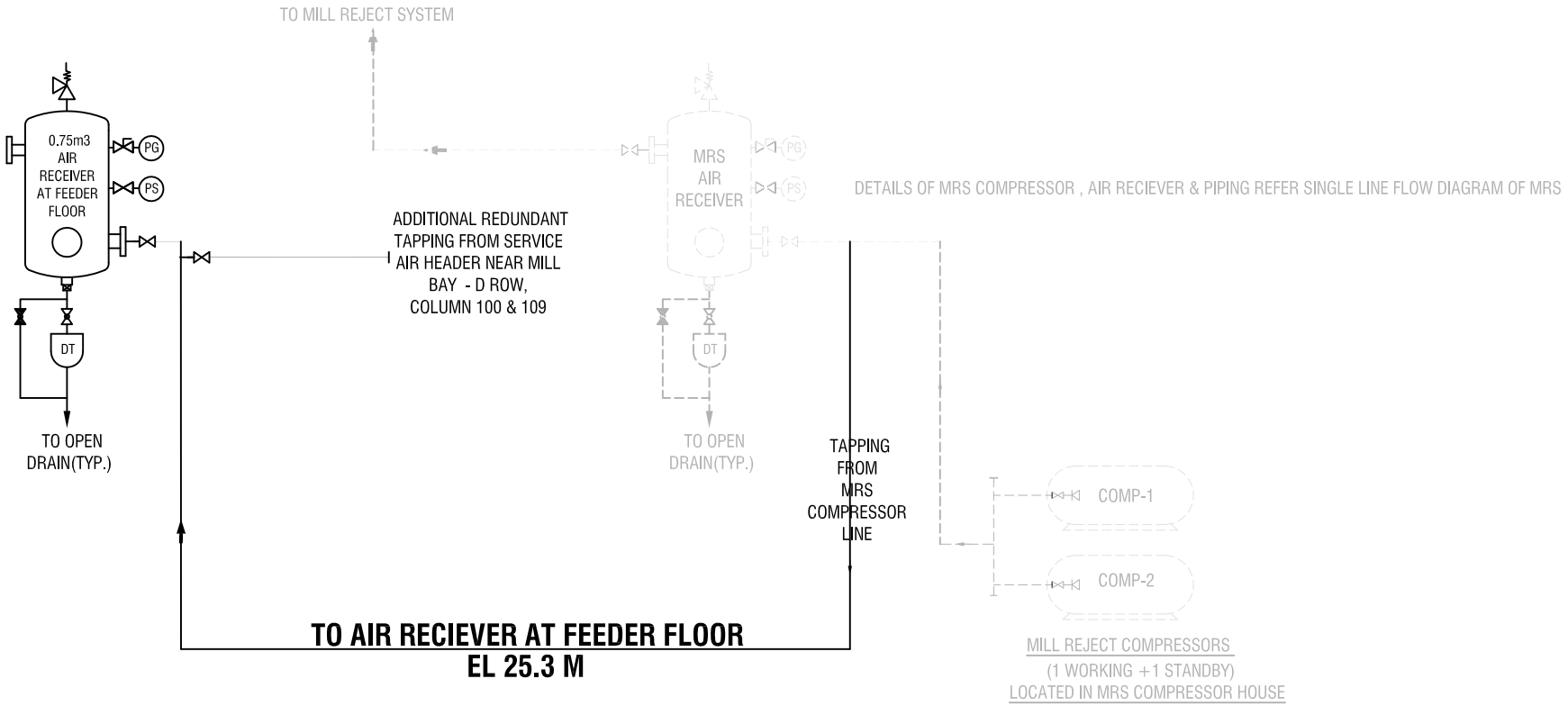
FLOOR PLAN AT EL.12000(MBL-1), EL.13000,& EL.14100

(TYPICAL FOR EACH MILL BAY)



TYPICAL FOR MILL BAY

ARRANGMENT FOR COMPRESSED SERVICE AIR SUPPLY TO 0.75M3 AIR RECIEVER AT FEEDER FLOOR
TYPICAL ARRANGMENT FOR A MILL BAY



SUPPLY OF PIPING, 0.75M3 AIR RECIEVER , INSTRUMENTS ETC AND ERECTION AND COMISSIONING BY MRS VENDOR

LEGEND:-

- GATE VALVE
- BALL VALVE
- GLOBE VALVE
- DRAIN TRAP (DT)
- INSTRUMENT ISOLATION COCK
- AIR OPERATED VALVE (AOV)
- NON RETURN VALVE
- SAFETY VALVE
- PRESSURE GAUGE (PG)
- PRESSURE SWITCH (PS)
- SIGHT FLOW INDICATOR (SFI)
- SOLENOID VALVE (S)
- TEMPERATURE SWITCH (TS)
- FILTER REGULATOR LUBRICATOR & MOISTURE SEPARATOR (FRL)

NOTE:

1. EQUIPMENT & INSTRUMENTS SHOWN IN THIS SCHEME ARE MINIMUM REQUIREMENT FOR THE SYSTEM. ANY ADDITIONAL DEVICE/ EQUIPMENT/ INSTRUMENTS REQUIRED FOR SYSTEM COMPLETION SHALL BE PROVIDED.

	DATE	NAME
DRAWN BY	06.06.22	VVH
DESIGN BY	06.06.22	VVH
CHECKED BY	06.06.22	PKK
APPROVED BY	06.06.22	SKP
SUPERSEDES		
SUPERSEDED BY:		
SYSTEM:		

CUSTOMER: THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.(WBPDCL)
KHODARAMCHAK TEESTA POWER EXTENSION EXTENSION PROJECT (UNIT #5)

CONSULTANT: DEVELOPMENT CONSULTANTS PRIVATE LIMITED KOLKATA

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECTS ENGINEERING MANAGEMENT
NOIDA

SCALE:
SHEET: 1 OF 1

TITLE: FLOW SCHEME FOR 0.75M3 AIR RECEIVERS AT FEEDER FLOOR EL 25.3 M

SIZE: A3 | PROJECT NO.: 446 | FILE:
ANNEX: | DRAWING NO.: PE-DCS-446-015A100 | REV: 0

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THE WEST BENGAL POWER DEVELOPMENT CORPORATION LIMITED

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

MILL REJECT SYSTEM
(ELECTRICAL PORTION)

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

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I	ELECTRICAL LOAD DATA FORMAT (ANNEXURE-II)	1
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I	EXPLANATORY NOTES FOR CABLE ROUTING	2
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I	MOTOR DATASHEET-A	1
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II	MOTOR DATASHEET-C	2
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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.

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 **MILL REJECT SYSTEM**
e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer /BHEL approval without any commercial and delivery implications to BHEL
g) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.
h) Motor shall meet minimum requirement of motor specification.
i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
j) Cable BOQ worked out based on routing of cable listing provided by the vendor for "both end equipment in vendor's scope" shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:

Refer "Electrical Scope between BHEL and Vendor".

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of 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 –II)
c) Cable schedule(Annexure –III)
d) BHEL cable listing format
e) Technical specification for motors
f) Datasheets & quality plan for motors.
g) Technical specification for cabling, grounding and lightning protection

REV-0, DATE: 09.03.2015

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR(FOR EPC PROJECTS)

PACKAGES : MRS
SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT
PROJECT: 1X660 MW SAGARDIGHI TPP

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor. **Starter for single phase motor (if applicable) shall be in vendor's scope. BHEL shall provide only single phase supply feeder.**
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	 BHEL BHEL BHEL	 BHEL Vendor BHEL	1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.
4	Junction box for control & instrumentation cable	Vendor	Vendor	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 mtrs) and trunk cable.
5	Any special type of cable like compensating, co-axial, prefab, MICC, optical fibre etc.	Vendor	Vendor	Refer C&I portion of specification for scope of fibre Optical cables if used between PLC/ microprocessor & DCS.
6	Cable trays, accessories & cable trays supporting system 100/ 50 mm cable trays/ Conduits/ Galvanised steel cable troughs for local cabling	BHEL Vendor	BHEL Vendor	Local cabling from nearby main route cable tray (BHEL scope) to equipment terminal (vendor's scope) shall be through 100/ 50 mm. cable trays/ conduits/ Galvanised steel cable troughs, as per approved layout drawing during contract stage.
7	Cable glands ,lugs and bimetallic strip for equipment supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power and control cables.
8	Conduit and conduit accessories for cabling between equipment supplied by vendor	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537.

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR(FOR EPC PROJECTS)

PACKAGES : MRS

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

PROJECT: 1X660 MW SAGARDIGHI TPP

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
9	Lighting	BHEL	BHEL	
10	Equipment grounding (including electronic earthing) & lightning protection	BHEL	BHEL	Refer note no. 4 for electronic earthing
11	Below grade grounding	BHEL	BHEL	
12	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
13	Mandatory spares	Vendor	-	Vendor to quote as per specification.
14	Recommended O & M spares	Vendor	-	As specified elsewhere in specification
15	Any other equipment/ material/ service required for completeness of system based on system offered by the vendor (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
16	a) Input cable schedules (Control & Screened Control Cables) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable and electronic earthing cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
17	Electrical Equipment & cable tray layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish Electrical equipment layout & cable tray layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipment requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Cabling arrangement of the same (wherever overhead cable trays, trenches, cable ducts, conduits etc.) shall be decided during contract stage. Electrical equipment layout & cable tray layout drawing shall be subjected to BHEL/ customer approval without any commercial implications to BHEL.
18	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR(FOR EPC PROJECTS)

PACKAGES : MRS

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

PROJECT: 1X660 MW SAGARDIGHI TPP

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

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.	VERIFICATION FROM MOTOR DATASHEET (Y/N)	KKS NO
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOs						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
ANNEXURE-II																			SECTION-I	

NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)/ CUSTOMER

2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V

: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)

LOAD DATA (ELECTRICAL)	JOB NO.	475	ORIGINATING AGENCY		PEM (ELECTRICAL)
	PROJECT TITLE	SAGARDIGHI THERMAL POWER PROJECT, 1x 660 MW UNIT NO. 5, PHASE – III	NAME		DATA FILLED UP ON
	SYSTEM	MILL REJECT SYSTEM	SIGN		DATA ENTERED ON
	DEPTT. / SECTION	MAUX	SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE

ANNEXURE-III

SECTION-I

CABLE SCHEDULE FORMAT

ANNEXURE III

UNITCABLENO	FROM	TO	PURPOSE	CABLE SCOPE (BHEL PEM/ VENDOR)	REMARKS	CABLESIZE	PATHCABLENO	TENTATIVE CABLE LENGTH

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

(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

A.C. & D.C. MOTORS

1.00.00 SCOPE

1.01.00 This specification covers the general requirements of the electric motors for plant auxiliary equipment except for special application like crane, lift, submersible pump etc., motors for which are covered in individual equipment specifications.

1.02.00 Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification.

1.03.00 In case of any discrepancy, the driven equipment specification shall govern.

2.00.00 STANDARDS

2.01.00 All motors shall conform to the latest applicable IS, IEC and CBIP Standards/Publications except when otherwise stated herein or in the driven equipment specification.

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

3.00.00 SERVICE CONDITIONS

3.01.00 The motors will be installed in hot, humid and tropical atmosphere, highly polluted area.

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

3.03.00 For motor installed outdoor and exposed to direct sun rays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

4.00.00 TYPE AND RATING

4.01.00 A.C. Motors

4.01.01 Motors shall be general purpose, constant speed, squirrel cage, three/single phase, induction type.

4.01.02 All motors shall be either totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or closed air circuit air cooled (CACA) or closed air water cooled (CACW) type. Temperature rise shall be limited to 70 deg C by resistance method.

4.01.03 All motors shall be rated for continuous duty. They shall also be suitable for long period of inactivity.

4.01.04 All LT motor shall conform to minimum efficiency performance standards (MEPS) of IE2 mentioned in IS: 12615. All HT motors shall have efficiency and power factor higher than 90% and 0.83 respectively.

4.01.05 The motor name-plate rating at 50°C shall have at least 15% margin for LT system and 10% margin for HT system, over the input power requirement of the driven equipment at rated duty point and also covering the maximum load demand of the driven equipment under entire operating range, including voltage and frequency variations, unless stated otherwise in driven equipment specification or in general electrical specification.

4.01.06 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service. The direction of rotation of motor and its cooling fan should be properly matched with the driven equipment.

4.02.00 AC motor for VFD application (If applicable)

4.02.01 Inverter duty motors are designed according to the requirements of IEC/TS-60034 part17 & part 25 or NEMA MG-1, Part-30, Part 31 and have performance characteristics match with the driven equipment and variable speed requirement.

4.02.02 Induction motors to be operated in adjustable-speed drive applications should be de-rated as per NEMA/IEC standard due to the reduction in cooling resulting from any reduction in operating speed and the effect of additional losses introduced by harmonics generated by the control.

4.02.03 Inverter duty motors shall have VPI/improved insulation systems that do not degrade readily due to transient voltage spikes and have an adequate thermal margin.

4.02.04 Inverter duty motors shall be self ventilated without any auxiliary blower. Force ventilation shall be subject to purchaser approval.

4.02.05 Inverter motor shall be suitable for scalar (open loop) control, without any speed feedback signal, where fast response is not required. Vector (closed loop) control will be used with encoder if specified.

4.02.06 The breakdown torque at any frequency within the defined frequency range shall be not less than 150% of the rated torque at that frequency when rated voltage for that frequency is applied.

4.02.07 The motor should be capable of producing a breakaway torque of at least 140% of rated torque requiring not more than 150% rated current when the voltage boost is adjusted to develop rated flux in the motor and when the inverter is able to produce the required minimum fundamental frequencies

4.02.08 The motor shall be provided with insulated bearing on one side.

4.02.09 Normally the maximum safe speed shall be as per IEC/NEMA, however it should be coordinated with VSD requirement.

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

4.03.00 **D. C. Motors**

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

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

5.00.00 PERFORMANCE

5.01.00 **Running Requirements**

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

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

5.02.00 **Starting Requirements**

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

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

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

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

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

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

5.03.00 Stress During Bus Transfer

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

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

5.04.00 Locked Rotor Withstand Time

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

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

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

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

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

5.05.00 Torque Requirements

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

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

6.00.00 SPECIFIC REQUIREMENTS

6.01.00 Enclosure

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

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

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

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

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

6.02.00 **Cooling**

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

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

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 120ºC. 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 120ºC.

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^{o} in steps of 90^{o}, unless otherwise approved.

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

6.07.04 The terminal box shall have sufficient space inside for termination /connection of suitable sized HT cables. Where the specified main cable size demands, adopter/extension box of suitable size shall be provided as a part integral to the motor, for easy termination of the cable.

6.07.05 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.

6.07.06 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.

6.07.07 The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.

6.07.08 For HT motor, the terminal box shall be phase segregated type. The neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type) with shorting links for star connection.

6.07.09 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match Owner's cable. All threads shall be ISO metric thread only.

6.07.10 The gland plate for single core cable shall be non-magnetic type.

6.08.00 **Grounding**

6.08.01 The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.

6.08.02 The grounding connection shall be suitable for accommodation of ground conductors as follows:

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

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

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

6.09.00 **Rating Plate**

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

a. Temperature rise in ^{o}C under rated condition and method of measurement.
b. Degree of protection.
c. Bearing identification no. and recommended lubricant.
d. Location of insulated bearings.

7.00.00 ACCESSORIES

7.01.00 General

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

7.02.00 Space Heater

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

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

7.03.00 Temperature Detectors

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

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

7.03.03 The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at $0^{o}C$.

7.04.00 Indicator/Switch

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

a) HT motor bearing temperature.

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

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

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

7.05.00 Current Transformer for Differential Protection

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

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

7.06.00 **Accessory Terminal Box**

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

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

7.07.00 **Drain Plug**

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

7.08.00 **Lifting Provisions**

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

7.09.00 **Dowel Pins**

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

7.10.00 **Painting**

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

8.00.00 TESTS

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

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

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

a) Degree of protection test for the enclosure followed by IR, HV and no load run test.

b) Fault level withstand test for each type of terminal box.

c) Lightning impulse withstand test on the sample coil as per IEC 60034, part-15.

d) Surge withstand test on inter-turn insulation as per clause no. 5.1.2 of IEC 60034, part-15.

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

a. Measurement of stator resistance (and rotor resistance on slip ring motors).

b. No load test at rated voltage to determine voltage, current, power input and speeds.

c. Locked rotor reading of voltage, current, power input and values of torque of motor.

d. Full load test to determine efficiency, power factor and slip.

e. Temperature rise test. During heat run test, bearing temperature, Winding temperature, core temperature, coolant flow and its temperature shall be recorded. In case temperature rise test is carried at any load other than rated load, specific approval for test procedure and method has to be obtained.

f. Momentary overload test.

g. Test for noise level of motor.

9.00.00 SPARE

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

10.00.00 DRAWINGS, DATA & MANUALS

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

10.01.00 Along with the bid

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

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

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

ANNEXURE-A

SECTION-I

DESIGN DATA

1.0 AUXILIARY POWER SUPPLY

Supply	Description	Consumer
H.T. Supply	11 kV, 3 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

	TITLE	SPECIFICATION NO. SECTION-I
BHEL	**LV MOTORS** **DATA SHEET-A** **SAGARDIGHI THERMAL POWER PROJECT** **1 x 660 MW UNIT NO. 5, PHASE – III**	VOLUME II B SECTION D REV NO. 00 DATE 08.04.21 SHEET 1 OF 1

1.0	Design ambient temperature	:	50 °C
2.0	Maximum acceptable kW rating of LV motor	:	Upto & Including 160KW
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Details of supply system		
	a) Rated voltage (with variation)	:	415V ± 10%
	b) Rated frequency (with variation)	:	50 Hz (Variation: +5% TO –5%)
	c) Combined voltage & freq. variation	:	10% (sum of absolute values)
	d) System fault level at rated voltage	:	50 kA for 1 sec
	e) Short time rating for terminal boxes		
	* Above 90 kW upto & including 160kW(Breaker Controlled)	:	50 KA for 0.25 sec.
	* Rated upto & including 90 kW (Contactor Controlled)	:	50 KA protected by MCCB
	f) LV System grounding	:	Solidly
5.0	Class of insulation	:	Class 'F', with temp rise limited 120 Deg.C
6.0	Minimum voltage for starting	:	80% of rated voltage
7.0	Power cables data	:	Shall be given during Detailed engg.
8.0	Earth Conductor Size & Material	:	Shall be given during Detailed engg.
9.0	Space heater supply **(30KW & ABOVE)**	:	240 V, 1Φ , 50 Hz
10.0	Rating up to which Single phase motor	:	Acceptable below 0.20 Kw
11.0	Locked rotor current a) Limit as percentage of FLC	:	As per IS 12615
12.0	Makes	:	BHEL/ Customer approval (Package owner to take care)
13.0	Paint shade	:	RAL 7032
15.0	Additional tests	:	As per QP
14.0	Degree Of protection for motor/ terminal box	:	IP 55

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

15.0 TESTING REQUIREMENTS: IN LINE WITH SPECIFICATION

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

SUB-VENDOR LIST FOR LT MOTORS

SL NO.	VENDOR NAME	
1	ABB	14, MATHURA ROAD, FARIDABAD, HARYANA-121003
2	BHARAT BIJLEE LTD.	BHARAT BIJLEE LIMITED, 1ST FLOOR, 7-B, RAJINDRA PARK, PUSA ROAD, NEW DELHI - 110 060.
3	CROMPTON GREAVES	3RD FLOOR, EXPRESS BUILDING,9-10, BAHADUR SHAH ZAFAR MARG, NEAR ITO CROSSING,NEW DELHI-110002, INDIA
4	GE-POWER	KAMAK TOWER, 3RD FLOOR, PLOT NO. 12-A, TVK INDUSTRIAL ESTATE, EKKADUTHANGAL, GUINDY, CHENNAI-600032
5	KIRLOSKAR ELECTRIC CO LTD.	P.O. BOX 5555 , MALLESWARAM WEST ,BANGALORE 560055
6	LAXMI HYDRAULICS PVT. LTD	129/130, INDUSTRIAL ESTATE PATIL NAGAR, HOTGI ROAD SOLAPUR-413003, MAHARASHTRA
7	MARATHON	MARATHON ELECTRIC INDIA PRIVATE LTD.SECTOR - 11, MODEL TOWN, FARIDABAD - 121006
8	NGEF	POCKET NO.10, FLAT NO. 37 & 38, EXPANDABLE DDA FLATS, NASIRPUR DWARKA, PHASE-I NEW DELHI-110 045
9	RAJINDRA ELECT INDUSTRIES	14 SHAH IND.ESTATE VEERA DESAI RD,ANDHERI(W) MUMBAI-400053
10	SIEMENS	RC-IN I S NR DEL AREA, JIL BUILDING, TOWER-B, PLOT NO. 78, SECTOR 18, GURGAON-122015, INDIA

SUB-VENDOR LIST FOR GLANDS

1	ALLIED TRADERS & EXPORTERS	C-124 A, SECTOR-2, NOIDA -201 301, UTTAR PRADESH, INDIA
2	ARUP ENGG & FOUNDARY WORKS	391/119,PRINCE ANWAR SHAH ROAD, CALCUTTA-700068
3	BALIGA LIGHTING EQPT.PVT.LTD.	63A,CP RAMASWAMY ROAD, ALWARPET,P.B.No 6910, CHENNAI-600018
4	COMMET BRASS PRODUCTS	NUTAN CHEMICAL COMPOUND, WALBHAT ROAD, GOREGAON, MUMBAI-400063
5	DOWELLS	M/S. DOWELLS ELECTRICALS 47/47A, SATGURU INDUSTRIAL ESTATE. OFF AAREY ROAD, GOREGOAN (EAST). MUMBAI 400 063.
6	ELECTROMAC INDUSTRIES	27/28AF NEW EMPIRE IND.ESTT., R.KRISHNA MANDIR RD.JB NGR ,ANDHERI(E),MUMBAI-400059
7	INCAB	HARE STREET,KOLKATA,WEST BENGAL-700001

SUB-VENDOR LIST FOR LUGS

1	DOWELLS	M/S. DOWELLS ELECTRICALS 47/47A, SATGURU INDUSTRIAL ESTATE. OFF AAREY ROAD, GOREGOAN (EAST). MUMBAI 400 063.
2	UNIVERSAL MACHINES LTD.	4,B.B.D.BAG (EAST) 90,STEPHEN HOUSE,5TH FLR CALCUTTA-700001

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

	TITLE	SPECIFICATION NO.
	LV MOTOR DATA SHEET – C SAGARDIGHI THERMAL POWER PROJECT 1 x 660 MW UNIT NO. 5, PHASE – III	VOLUME II B SECTION D REV NO. 00 DATE SHEET 1 OF 2

S. No.	Description	Data to be filled by successful bidder
A.	**General**	
1	Manufacturer & country of origin	
2	Motor type	
3	Type of starting	
4	Name of the equipment driven by motor & Quantity	
5	Maximum Power requirement of driven equipment	
6	Rated speed of Driven Equipment	
7	Design ambient temperature	
B.	**Design and Performance Data**	
1	Frame size & type designation	
2	Type of duty	
3	Rated Voltage	
4	Permissible variation for	
5	a Voltage	
6	b Frequency	
7	c) Combined voltage & frequency	
8	Rated output at design ambient temp (by resistance method)	
9	Synchronous speed & Rated slip	
10	Minimum permissible starting voltage	
11	Starting time in sec with mechanism coupled	
12	a) At rated voltage	
13	b) At min starting voltage	
14	Locked rotor current as percentage of FLC (including IS tolerance)	
15	Torque	
	a) Starting	
	b) Maximum	
16	Permissible temp rise at rated output over ambient temp & method	
17	Noise level at 1.0 m (dB	
18	Amplitude of vibration	
19	Efficiency & P.F. at rated voltage & frequency	
	a) At 100% load	
	c) At 75% load	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

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

NAME OF VENDOR				REV.	
NAME	SIGNATURE	DATE	SEAL		

SCHEDULE-IIID/1

A.C. AND D.C. MOTORS

A.	A.C. MOTOR		
1.0	**GENERAL**		
1.1	Application		:
1.2	Quantity		:
1.3	Make		:
1.4	Frame Size		:
1.5	Applicable Standard		:
2.0	**TYPE AND RATING**		
2.1	Type of Motor		:
2.2	Service		:
2.3	Duty Cycle/Designation		:
2.4	Rated Continuous Output		
	At 40 Deg.C ambient	KW	:
	At 50 Deg.C ambient	KW	:
2.5	Rated Speed	r.p.m.	:
2.6	Rated Voltage & % variation		:
2.7	Rated Frequency & % variation		:
2.8	Combined voltage and frequency variation % (absolute sum)		:
2.9	Full load current	Amps	:
2.10	No load current	Amps	:
2.11	Rated Power Factor		:

2.12	Efficiency at rated voltage and frequency:					
	a) Full load	%	:			
	b) 3/4 load	%	:			
	c) 1/2 load	%	:			
3.0	**PERFORMANCE**					
3.1	Method of Starting		:			
3.2	Starting current at 110% voltage % f.l.c		:			
3.3	Starting Current at rated voltage	% f.l.c.	:			
3.4	Starting Torque at rated voltage	kg.m	:			
	a) Pull out torque	kg.m	:			
	b) Full load torque	kg.m	:			
3.5	Starting time at			80% Voltage	100% Voltage	110% Voltage
	a) With load	sec.	:			
	b) Without load (driven equipment Coupled)	sec	:			
3.6	Safe stall time at			80% Voltage	100% Voltage	110% Voltage
	a) Hot condition	sec.	:			
	b) Cold condition	sec.	:			
3.7	a) Heating time constant	min	:			
	b) Cooling time constant	min	:			
4.0	**CONSTRUCTION**					
4.1	Degree of Protection of Enclosure		:			
4.2	Method of Cooling		:			
4.3	Insulation Class		:			
4.4	Temperature Rise Over 50 Deg.C ambient (by resistance)		:			

4.5	Tropicalised	Yes/No:		
4.6	Winding Connection	:		
4.7	Bearings		D.E.	N.D.E.
	a) Make	:		
	b) Type	:		
	c) Recommended lubricant	:		
4.8	Motor Terminal Box			
	a) Type	:		
	b) Fault withstand Current KA	:		
	c) Fault Current Withstand Time Sec.	:		
	d) Cable lugs & glands furnished Yes/No	:		
	e) Position	:		
5.0	**ACCESSORIES**			
5.1	Space Heaters			
	a) No. x Watt	:		
	b) Volt, phase, frequency	:		
5.2	Winding temperature detector			
	a) Type	:		
	b) Nos. furnished	:		
5.3	Bearing temperature detector			
	a) Type	:		
	b) Nos. furnished	:		
5.4	Temperature Indicators			
	a) Type	:		
	b) Nos. provided	:		
	c) Locations	:		

5.5	Temperature Alarm Contact		
	a)	Nos. provided	:
	b)	Locations	:
	c)	Contact rating	:
5.6	Flow Switch		
	a)	Type	:
	b)	Nos. provided	:
	c)	Locations	:
	d)	Contact Rating	:
5.7	Current Transformer for differential protection		
	a)	Nos. provided	:
	b)	Current Ratio	:
	c)	Class	:
	d)	Knee point voltage	:
	e)	Excitation current at VK/2	:
5.8	Accessory Terminal Box		
	a)	No. provided	:
	b)	Cable glands furnished	Yes/No:
5.9	Speed Switch		
	a)	Type	:
	b)	Nos. provided	:
	c)	Locations	:
	d)	Contact Rating	:

6.0	GROUNDING		
6.1	No. of grounding pads provided		
	a) On motor body		:
	b) On terminal box		:
7.0	MISCELLANEOUS		
7.1	Type of mounting		:
7.2	Overall dimension (LxBxH) mm x mm x mm		:
7.3	Approximate Weight Kg		:
7.4	Moment of Inertia (Sq.GD)		
	a) Stator	Kg.Sq.m	:
	b) Rotor	Kg.Sq.m	:
	c) Total	Kg.Sq.m	:
7.5	Weight		
	a) Stator	Kg	:
	b) Rotor	Kg	:
	c) Total	Kg	:
B.	D.C MOTOR		
1.0	GENERAL		
1.1	Application		:
1.2	Make		:
1.3	Frame Size		:
1.4	Reference Standard		:
2.0	TYPE & RATING		
2.1	Type		:

2.2	Service		:
2.3	Duty cycle		:
2.4	Rated Continuous Output		
	a) at 40 Deg.C ambient KW		:
	b) at 50 Deg.C ambient KW		:
2.5	Rated voltage	Volt	:
2.6	Voltage range over which satisfactory Operation is guaranteed		:
2.7	Rated Current		
	a) Starting	Amp.	:
	b) Running	Amp.	:
2.8	Rated Speed	r.p.m.	:
3.0	CONSTRUCTION		
3.1	Enclosure		
	a) Type		:
	b) Degree of Protection		:
3.2	Method of Cooling		:
3.3	Insulation Class		:
3.4	Tropicalized?		:
3.5	Commutator Material		:
4.0	ACCESSORIES		
4.1	Motor Starter		
	a) Type		:
	b) Make		:
	c) Resistance	ohm	:

4.2	Space Heater		
	a) No. x KW		:
	b) Volts/Phase/Frequency		:
4.3	Motor Terminal Box		
	a) Type		:
	b) Cable lug/gland furnished		:
5.0	MISCELLANEOUS		
5.1	Overall Dimension (LxBxH) mm		:
5.2	Approx. Weight	Kg	:

BHEL	TITLE : **GENERAL TECHNICAL REQUIREMENTs** **FOR** **LV MOTORS**	SPECIFICATION NO. PE-SS-999-506-E101 VOLUME NO. : **II-B** SECTION : **D** REV NO. : **00** DATE : 29/08/2005 SHEET : 1 OF 1

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.: PE-SS-999-506-E101 Rev 00

BHEL	TITLE : **GENERAL TECHNICAL REQUIREMENTs** **FOR** **LV MOTORS**	SPECIFICATION NO. PE-SS-999-506-E101 VOLUME NO. : **II-B** SECTION : **D** REV NO. : **00** DATE : 29/08/2005 SHEET : 1 OF 4

1.0 INTENT OF SPECIFIATION

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 machnines
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.

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 mimimum 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: 4691and 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.

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**

4.9.1 Motors provided for similar drives shall be interchangeable.

4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.

4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.

4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.

4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.

4.9.6 Name plate with all particulars as per IS: 325 shall be provided

4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.

5.0 INSPECTION AND TESTING

5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.

5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.

5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.

5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.

6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT

a) OGA drawing showing the position of terminal boxes, earthing connections etc.
b) Arrangement drawing of terminal boxes.
c) Characteristic curves:
(*To be given for motor above 55 kW unless otherwise specified in Data Sheet*).

i) Current vs. time at rated voltage and minimum starting voltage.
ii) Speed vs. time at rated voltage and minimum starting voltage.
iii) Torque vs. speed at rated voltage and minimum voltage.
For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.
iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-Q-006, REV-02	DATE: 17.04.2020
	PROJECT:		PO NO.:	DATE:
	ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 1 of 2

S. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/ N					M	C	N	
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	-	MFG. SPEC.	MFG. SPEC.	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	VISUAL	100%	-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	LOG BOOK		P	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	-	MFG.SPEC./	MFG.SPEC.	LOG BOOK		P	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	-	MFG. SPEC/ APPROVED DATASHEET	MFG. SPEC/ APPROVED DATASHEET	LOG BOOK	✓	P	V	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST	MA	VISUAL	100%	-	IS-325 / IS-12615/ APPROVED DATA SHEET	IS-325 / IS-12615/ APPROVED DATA SHEET	TEST/ INSPN. REPORT	✓	P	V *	-	* NOTE -1
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	-	APPROVED DRG/ DATA SHEET	APPROVED DRG/ DATA SHEET	TEST/ INSPN. REPORT	✓	P	V *	-	* NOTE -1 & NOTE-2

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ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
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Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

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Sign & Date	
Seal	

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		3.NAMEPLATE DETAILS	MA	VISUAL	100%	-	IS-325 / IS-12615 / APPROVED DATA SHEET	SAME AS COL. 7	TEST/ INSPN. REPORT	✓	P	V	-	
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MFG. STANDARD / (#)	AS PER MFG. STANDARD / (#).	INSPC. REPORT	✓	P	W	-	(#) REFER NOTE-8

NOTES:
1. Routine tests on 100% motors shall be done by the vendor. However, BHEL/ Customer shall witness routine tests on random samples. The sampling plan shall be mutually agreed upon.
2. For exhaust/ventilation fan motors of rating up to 1.5 KW, only routine test certificates shall be furnished for scrutiny.
3. In case test certificates for these tests on similar type, size and design of motor from independent laboratory are available, the same is valid for 5 years.
4. BHEL reserves the right to perform repeat test, if required.
5. After packing and prior to issue MDCC, photographs of items to be despatched shall be sent to BHEL for review.
6. In case of any changes in QP commented by customer at contract stage, same shall be carried out by bidder without any implication to BHEL/ Customer.
7. Project specific QP to be developed based on customer requirement.
8. For export job, BHEL technical specification for seaworthy packing to be followed.
9. Packing shall be suitable for storage at site in tropical climate conditions.
10. Latest revision/ year of issue of all the standards (IS/ ASME/ IEC etc.) indicated in QP shall be referred.

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,
** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, B: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **C**: CUSTOMER,
P: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE
MA: MAJOR, **MI**: MINOR**, CR:** CRITICAL
D: DOCUMENTATION

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BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 1 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.0	RAW MATERIAL & BOUGHT OUT CONTROL													
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	LOG BOOK		P	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	SAMPLE	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	TEST REPORT		P/V	-		
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%	-		FREE FROM CRACKS, UN-EVENNESS ETC.	TEST REPORT		P	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	TC		P/V	-	-	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%	-	MANUFACTURER'S DRG./SPEC	FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK		P/V	-		
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	TC		P/V	-		HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG.	MANUFACTURER'S DRG.	LOG BOOK		P/V	-		
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	LOG BOOK		P/V	-		

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Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

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Seal	

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
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	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 2 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S DRG./ STD.	TC		P/V	-		
		3. DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S DRG.	LOG BOOK		P/V	-		
		4.INTERNAL FLAWS	CR	ULTRASONIC TEST	100%	-	ASTM-A388	MANUFACTURER'S STD.	INSPECTION REPORT	✔	P/W	V	-	FOR DIA OF 55 MM & ABOVE
1.6	SPACE HEATERS, CONNEC-TORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	100%	-	MANUFACTURER'S DRG./STD.	MANUFACTURER'S DRG./STD.	INSPECTION REPORT		P/V	-	-	
		2. PHYSICAL COND.	MA	VISUAL	100%	-	MANUFACTURER'S DRG./STD.	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	INSPECTION REPORT		P/V	-	-	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG./ STD	MANUFACTURER'S DRG. / STD.	INSPECTION REPORT		P/V	-	-	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-	MANUFACTURER'S DRG./ STD	MANUFACTURER'S DRG. / STD.	TEST REPORT		P/V	-	-	

BHEL					
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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 3 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS	TEST REPORT		P/V	-	-	
		2.DIMENSION(BORE DIA, WALL THICKNESS, BDV AS RECEIVED, BDV AFTER FOLDING AT 180°	MA	TEST	SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK AND OR SUPPLIER'S TC		P/V	-	-	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK		P	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG. .	MANUFACTURER'S DRG.	LOG BOOK		P/V	-	-	
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	SAMPLE	-	MANUFACTURER'S DRG./ STD.	MANUFACTURER'S DRG./ STD.	TC		P/V	-	-	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		*P/V	-	-	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY
		2.ELECT. PROP, & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S / SPEC.	TC & VENDOR'S TEST REPORTS		P/V	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
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Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 4 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLES	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S / SPEC.	LOG BOOK		P/V	-	-	
1.10	BEARINGS	1.MAKE & TYPE	MA	VISUAL	100%	-	MANUFACTURER'S DRG./ APPROVED DATASHEET	MANUFACTURER'S DRG./ APPROVED DATASHEET	LOG BOOK		P/V	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	APPROVED DATASHEET	APPROVED DATASHEET/ BEARING MANUF'S CATALOGUES	LOG BOOK		P/V	-	-	
		3.SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P/V	-	-	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	SAMPLE	-	MANUFACTURER'S STD./ APPROVED DATASHEET	MANUFACTURER'S STD./ APPROVED DATASHEET	LOG BOOK		P/V	-	-	
		4.HV/IR	MA	-DO-	100%	-	MANUFACTURER'S STD./ APPROVED DATASHEET	MANUFACTURER'S STD./ APPROVED DATASHEET	LOG BOOK		P/V	-	-	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	-	MANUFACTURER'S DRG/SPECS	MANUFACTURER'S DRG./ SPECS.	LOG BOOK		P	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	

BHEL					
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Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
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Seal	

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					M	C/N				D	M	C	N	
2.0	IN PROCESS													
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-	MANUFACTURER'S DRG	GOOD FINISH	LOG BOOK		P/W	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-	-DO-	GOOD FINISH	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	100%	-	MANUFACTURER'S STD./ ASTM-E165	MANUFACTURER'S STD./ APPROVED DATASHEET.	LOG BOOK	✔	P	V	-	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		3.SHADE	MA	VISUAL	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	

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					M	C/N				D	M	C	N	
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK		P	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK		P	-	-	
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		2.CLEANLINESS	CR	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	100%	-	IS-325//IS-12615/IEC-60034 PART-1	IS-325//IS-12615/IEC-60034 PART-1	TEST/INSPC. REPORT	✔	P	V	-	
		4.RESISTANCE	CR	ELECT. TEST	100%	-	IS-325//IS-12615/IEC-60034 PART-1	IS-325//IS-12615/IEC-60034 PART-1	TEST/INSPC. REPORT	✔	P	V	-	
		5.INTERTURN INSULATION	CR	ELECT. TEST	100%	-	IS-325//IS-12615/IEC-60034 PART-1	IS-325//IS-12615/IEC-60034 PART-1	TEST/INSPC. REPORT		P	-	-	
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		3.NO. OF DIPS	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK	✔	P	V	-	THREE DIPS TO BE GIVEN

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					M	C/N				D	M	C	N	
		4.DURATION	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK	✔	P	V	-	
2.7	COMPLETE STATOR ASSEMBLY	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	VISUAL	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	TEST/INSPC. REPORT	✔	P	V	-	
		3.HV	MA	ELECT. TEST	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	TEST/INSPC. REPORT	✔	P	V	-	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	100%	-	MANUFACTURER'S SPEC./ ISO 1940	MANUFACTURER'S DWG.	LOG BOOK		P	-	-	
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	TEST/INSPC. REPORT	✔	P	V	-	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		2.WORKMANSHIP	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		3.AXIAL PLAY	MA	MEAS.	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK	✔	P	V	-	
		4.DIMENSIONS	MA	MEAS.	100%	-	MANUFACTURER'S DRG./ MANUFACTURER'S SPEC.	MANUFACTURER'S DRG./ MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK	✔	P	V	-	

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					M	C/N				D	M	C	N	
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS	MA	ELECT.TEST	1/TYPE/SIZE	1/TYPE/SIZE	IS-325//IS-12615/APPROVED DATASHEET	IS-325/IS-12615/APPROVED DATASHEET	TEST REPORT	✔	P	W*	-	* NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST	MA	ELECT.TEST	100%	-	IS-325//IS-12615/APPROVED DATASHEET	IS-325/IS-12615/APPROVED DATASHEET	TEST REPORT	✔	P	V$	-	$ NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	ELECT.TEST	100%	-	IS: 12075 / IEC 60034-14 & IS-12065	IS: 12075 / IEC 60034-14 & IS-12065	TEST REPORT	✔	P	V$	-	$ NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET &	TEST/INSPC. REPORT	✔	P	W	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	-	IEC 60034-5/IS-12615	APPROVED DATASHEET	TC	✔	P	V	-	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	ELECT. & MECH. TEST	100%	-	IS-325//IS-12615/IEC-60034 PART-1/IS: 12802	IS-325/IS-12615/IEC-60034 PART-1/IS: 12802	TC	✔	P	V$	-	$ NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	ELECT. & MECH. TEST	100%	-	IS-325//IS-12615/IEC-60034 PART-1	IS-325/IS-12615/IEC-60034 PART-1	TC	✔	P	V$	-	$ NOTE - 2
		8. NAME PLATE DETAILS	MA	VISUAL	100%	-	IS-325//IS-12615& DATA SHEET	IS-325//IS-12615 & DATA SHEET	TEST/INSPC. REPORT	✔	P	V$	-	$ NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	-	IS 2148 / IEC 60079-1	IS 2148 / IEC 60079-1	TC	✔	P	V	-	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	SAMPLE	APPROVED DATASHEET	APPROVED DATASHEET	TC	✔	P	W$	-	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY $ NOTE - 2

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4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MANUFACT. STANDARD / (#)	AS PER MANUFACT. STANDARD / (#)	INSPC. REPORT	✔	P	W	-	(#): REFER NOTE-8

NOTES:

1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.

2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL/CUSTOMER SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON.

3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THE SAME IS VALID FOR 5 YEARS.

4 BHEL RESERVES THE RIGHT TO PERFORM REPEAT TEST, IF REQUIRED.

5 AFTER PACKING AND PRIOR TO ISSUE MDCC, PHOTOGRAPHS OF ITEMS TO BE DESPATCHED SHALL BE SENT TO BHEL PURCHASE GROUP FOR REVIEW.

6 IN CASE , ANY CHANGES IN QP COMMENTED BY CUSTOMER AT CONTRACT STAGE SHALL BE CARRIED OUT BY BIDDER WITHOUT ANY IMPLICATION TO BHEL/ CUSTOMER.

7 PROJECT SPECIFIC QP TO BE DEVELOPED BASED ON CUSTOMER REQUIREMENT.

8 FOR EXPORT JOB, BHEL TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING TO BE FOLLOWED.

9 PACKING SHALL BE SUITABLE FOR STORAGE AT SITE IN TROPICAL CLIMATE CONDITIONS.

10 LATEST REVISION/ YEAR OF ISSUE OF ALL THE STANDARDS (IS/ ASME/ IEC ETC.) INDICATED IN QP SHALL BE REFERRED.

LEGENDS:

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

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

P: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE

MA: MAJOR, **MI**: MINOR, **CR:** CRITICAL

D: DOCUMENT

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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.

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 i n 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-IIE, 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, adopters, 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 960º C.

c) Boxes shall be suitable for continuous operation at an ambient temperature range of -10º C to +80º 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 JBs 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 approv ed 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 alumunium 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:

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 necessa ry, 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 carryout 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 are wilding 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

of the above rods shall be left free above the grade level/concrete floor level for connection with columns.

7.10.14 Electronic Equipment Grounding

Internal ground connection of electronic panels shall be insulated from the enclosure, frame, chasis 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 fo rm 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 & li ghtning 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 side 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 ASTMD - 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:

Heating time (minute)	30	90	120 150 180 210 240
Furnace temp (°C)	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, t he system shall 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 moped 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:

Phy sical 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 inspect / vermin such as rate 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.
6> Current rating of motor feeder/cables should be at least 125% of full load current.

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.

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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.

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H.V. POWER CABLE

1.0 3300/3300V & 11000/11000V (i.e. un-earthed grade) 90ºC 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, 90º 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 mm2and 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 (X LPE) 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 70ºC 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)

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)

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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.

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 restriking 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 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 gasketted.

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 wireway extending the entire length of the assembly shall be provided of 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 55ºC with silver plated joints and 40ºC with all other types of joints over an ambient of 50ºC.

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 disconnecting links shall be provided for all incoming and outgoing feeders for isolation of neutral, if necessary.

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, lens' 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 incomes and bus sections shall be provided with one (1) LOCAL-REMOTE selector switch.

Contactor operated motor feeder modules shall be provide with one (1) MCC-NORMAL-TRIALselector 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.

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 incomer 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. One 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.

Alternatively, electrically reset-latching relay may be used for the purpose. The exact requirement contacts of the position/cells switch, limit switch, auxiliary switch and latching relays shall be decided by the Tenderers taking into account the scheme requirements spares. 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 Con tactors

a) The cont actors shall be three po le, air break t ype wit h no n-bouncing silver/silver alloy co ntacts. The con tactor sh all b e design ed for duty as per Annexure-A attached.

b) Each contactor shall be pro vided wit h mini mum (2) normall y open and two (2) normally cl osed auxiliary c ontacts rated 10A at 240V A.C. The exact req uirement of co ntacts shall be decide d by t he ten derer t aking into account the scheme requirements and spares.

c) Contactors f or forwa rd a nd re verse direction of reversible d rives s hall preferably be both electrically and mechanically interlocked.

d) Delayed dropout contactors, if required and provided for some essential auxiliaries, s hall n ot dropout on po wer failure i f the voltage is restore d within three seconds

e) Contactor starters shall comply with the requirements of IEC 60947-4-1 or IS 13947(Part4/Sec.1) in re spect 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 o verload rel ays shall be three elements, p ositive actin g, ambient temperature compensated with adjustable settings.

b) Single phasi ng pre ventor shall b e provi ded as an inbuil t fea ture of the thermal overload relay.

c) Relays shall be manual reset type with 1 NO and 1NC contacts;

Resetting of relays s hall be possi ble with co mpartment do or closed. Colour of the resetting button shall be BLACK.

d) Relays ma y be direc t acting or C. T. operated, depen ding on current rating. C.T.s shall be included in the scope of supply.

e) Relays for fan motors h aving long s tarting time shall be sat urable 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 Incomer, 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 Incomer/ Bus-coupler/ Motor feeder / Transfo. 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.

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 lock able 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 InP Technology (Aluminium Indium Gallium Phosphide Technology). The body shall be made of Poly Carbonate Unbreakable Lens. LED shall be protected by inbuilt fuse with surge suppressor or leakage voltage glow protection. LED circuit shall be PCB mounted. Intensity shall be greater than 200 mcd. All Push Button lamp shall be as per LED indicating lamp.

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.

5.10.00 **Meters and Meter Selector Switches**

5.10.01 All indicating instruments (96 x 96 mm) shall be switchboard types, with 240 Deg. scale, anti-glare glass and accuracy class of ± 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.

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 / IEC: 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

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.

d) Software Security

Relay shall be provid ed with pa ssword protection against unauthorized write access. However, viewing of metering data, settings, an d status an d event data as read o nly paramet ers should be without password protection. All so ftware shall be user friendly and latest up to date version.

e) Disturbance, Event Recording & Data Storage

Status, dist urbance data and even ts 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 t o see the latest state of display when power is restored. Also, in case o f power supply failure lock out status of the relay sh ould be stored and kept in memory to allow the working of in terlock lo gic properly on restoration of the supply.

f) Trip Circuit Supervision & Lock out function

i) Relay shall have built in lo ckout function. L ock 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 cont acts each shall separat ely 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 e ffect 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 o n three ports; local front port communication to lapto p and a dual port on IEC 61850 to commun icate 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 ea sy interface with world wide used open protocol like Modbus or IEC 103 protocols.

iv) It shall be also possib le for Relay Parameterization as well Downloading of Disturbance Records f rom PC /Laptop pro vided in Unit & Engine ering Workstations located in Central Control Room of each unit. Necessary user friendly and latest software to be provided fo r this purpose. Communication p rotocol shall be selected fro m relay to PC to provide all information.

v) One (1) set of L aptop by each Switchgear manufacturer, loaded with common support so ftware and which will allow easy settings of relays in addition to uploadin g of event, fault, d isturbance r ecords, measurements from re lay front communication port. The Switchgear supplier shall fur nish CD's for the above relay parameterization as well as download o f disturbance recorder f or all relays of his supplied switchgear. Accessories like ta ble/chair/desk/power socket et c. as require d 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 b oards s hall b e full y wired at the fact ory to ensure p roper f unctioning of control, protection, transfer and interlocking schemes.

5.14.02 Fuse and lin ks shall be provided to permit indi vidual ci rcuit i solation f rom 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 s hall be don e wi th fle xible, 1 100 V grade, PVC insulated s witchboard wires with s tranded co pper con ductors of 2 .5 mm^2 f or co ntrol, curren t and voltage circuits.

5.14.04 Each wire shall be ferru led by plastic tube with indelible ink print at both end having terminal block n o., terminal nos., destination no. as per approve d Drawing.

5.14.05 Wire t erminations sh all be made with cri mping t ype conn ectors wi th sol der a s insulating sleeves. Wires shall not be spliced between terminals.

5.15.00 Termin al Blocks

5.15.01 Terminal blocks shall be 1100V grade box-clam p type 10-mm^2 m inimum with marking s trips. Te rminals for C.T. secondary l eads sha ll have p rovision fo r shorting.

5.15.02 Terminal blocks used f or interface with DCS via termination cabinet sh all be suitably sized to facilitate proper termination of interconnecting cables.

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) over 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 cir cuit breakers a nd drawout V.T. units shall be grou nded through heavy multiple contracts at all tim es 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 e ach circuit th us grounde d shall be run i ndependently to the ground bus and connected thereto.

5.18.05 C.T. & V.T . secondary neutrals sha ll be earth ed throu gh remo vable 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 Na meplates

5.19.01 Nameplates of approved design sh all be provid ed on each cubicle, at the top of the asse mbly and o n each instr ument & de vice mounte d on or inside the cubicle.

5.19.02 The material shall be lamicoi d or ap proved equal. 3 mm thic k with wh ite letters on black background.

5.19.03 The name plates sha ll b e 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 s uitable metal pl ate sh all b e affi xed b oth at the fro nt an d back of each vertical panel.

5.20.00 Space Heaters and Plug Sockets

5.20.01 Panel and motor space heaters, Plug socket, p anel Illumin ations shall be fed from separate AC auxiliary busbars running t hroughout the switchboar d. All the panel and motor sp ace heaters shall be fed from thes e busbars through single pole MCB and neutral link.

The AC auxiliary bus sh all be charged thru' 2X100%, 415/240V Space heater supply transformers with a “TRANSFO RMER-A /TRANSF ORMER-B sel ector switch. The 415V incoming supply to these aux. transformers shall be tap ped before the respective In comer breakers, so that in the event of 415V panel is not energized, the 240V aux. bus remains ready for supplying power to motor / panel spa ce heaters, panel illu mination. Necessary protection, al arm & 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 s pace heater through sui tably rated breaker auxiliary NC contact and/or contactor.

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 inbuilt front adjustable releases (short ckt and overload). MCCB of rating above 100A shall

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.

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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 ± 10%	220V ± 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 .

1.5 **A.C./D.C. Power Supply**

Control Voltage for Circuit breaker	:	220 V DC ± 10%
DC power supply For C & I	:	24 V DC ± 10%
Control voltage for MCC modules	:	240 V AC ± 10%, 1 Ph, 50 Hz ± 5%
Service voltage	:	240 V AC ± 10%, 1 Ph, 50 Hz ± 5%

2.0 **CIRCUIT BREAKER**

2.1	Duty Cycle	:	0-3'-CO-3'-CO
2.2	B reaking 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%)

			AC	DC
3.0	**CONTACTOR DUTY**	:	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

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 (51SN) for stand by 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)
- Temperate monitoring (stator, bearing etc.).
- Phase reversal.

Apart from above suitable provision for metering and monitoring such as voltage, current, power factor, watt-hr, event record etc. shall be provided.

The relays 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-F

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, Contractor are t o be coordinated (Type-2) with motor rating by the Contractor.

2. "U" stands for Undirectional 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 :

1. Following Indication Lamps shall be provided on MCCB module-
   ON : Red, OFF : Green, Trip :Amber.

2. ON indication Lamp shall be provided on DC module.

SUB SECTION-IC

(CONTROL AND INSTRUMENTATION)

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

C&I TECHNICAL SPECIFICATION

FOR

MILL REJECT SYSTEM

CONTROL AND INSTRUMENTATION DEPARTMENT
PROJECT ENGINEERING MANAGEMENT
BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
NOIDA

PREPARED BY	CHECKED BY	APPROVED BY
ANJALI RAMAN	SC SHARMA	SC SHARMA
MNGR. (C&I)	DGM (SH-I02,C&I)	DGM (SH-I02,C&I)

INDEX

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5	LIST OF DOCUMENTS/DELIVERABLES
6	MOTORISED VALVE ACTUATORS
7	FIELD & MEASURING INSTRUMENTS
8	SIGNAL EXCHANGE BETWEEN DRIVES & DCS
9	INSTRUMENT CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY
10	ERECTION HARDWARE
11	QUALITY ASSURANCE
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GENERAL TECHNICAL SPECIFICATION
CONTROL & INSTRUMENTATION

GENERAL REQUIREMENT

1.0 Bidder shall provide complete and independent control & instrumentation system with all accessories, auxiliaries and associated equipments for the safe, efficient and reliable operation of auxiliary systems.

2.0. The quantity of instruments for auxiliary system shall be as per tender P &ID, wherever provided, for the respective system as a minimum for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe &reliable operation of plant, bidder shall supply the same without any price and delivery implication to BHEL.

3.0 Measuring instruments/equipment and subsystems offered by the bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further all the instruments shall be of proven reliability, accuracy, and acceptable international standards and shall be subject to employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specification, ranges, makes/ numbers as approved by the employer' during detail engineering.

4.0 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/ erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg / Cm2. The contacts of equipment mounted instruments; sensors, switches etc. for external connection including spare contacts shall be wired out to suitably located junction boxes.

5.0 In case of any contradiction most stringent clause/condition shall prevail.

C&I SPECIFIC TECHNICAL REQUIREMENT

Specific Technical Requirements (C&I):

1) The control of Mill Reject system (MRS) shall be through DDCMIS based control system (in BHEL scope) of CPU system of Unit#5. The operation and control philosophy of MRS shall be as per design memorandum given elsewhere in the specification. The DDCMIS panel along with a dedicated OWS (in BHEL scope) shall be located in CPU regeneration control room.

2) Conveying air compressor's control & operation shall be from MRHS control system. Each compressor shall have its own microprocessor based control system also, which shall be further interfaced (Hardwired & redundant soft wired) with MRHS control system for overall control, operation & monitoring of compressors. Bidder shall include required hardware at MP end.

3) The Contractor shall provide complete Instrumentation for control, monitoring and operation of entire Mill Reject system. The requirements given are to be read in conjunction with detailed Technical specification enclosed in the specification. Further in case of any discrepancy in the requirement within the same section noted by the bidder in the specification, the same will be brought to the notice of BHEL in the form of pre- bid clarification. In absence of any pre-bid clarification, the more stringent requirement as per interpretation of Customer shall prevail without any commercial implication.

4) The instrumentation to be provided for MRS shall be as per the technical specification document / drawings wherever provided for the respective systems as a minimum requirement for bidding purpose. However, for completeness of the system and its associated equipment, Bidder shall also provide all the necessary instruments to the process requirement even if not indicated in the given technical Specification document /drawings. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any technical, commercial and delivery implication to BHEL.

5) The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial and delivery implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.

6) Bidder to provide local pneumatic cum control panel for each conveying vessel/pyrite hopper. This local panel will act as interface between the DCS and the field devices for commands & feedbacks. This panel shall also consist of vessel high and low pressure switch.

7) Bidder to provide local control panel for Control of deblocking devices. Further compressor of deblocking devices shall have its own microprocessor based

control system also, which shall be further interfaced (Hardwired & redundant soft wired) with DCS for overall control, operation & monitoring of compressors.

8) Electrical Actuators with integral starter shall be provided for all on/off and inching type valves along with necessary interface units for linking to corresponding Control System as applicable, typical Hook-up diagram of drives is included for reference. Non-contact type electronic 2-wire position transmitters shall be provided for all inching type motorised valves. The detailed specification is attached elsewhere in the specification.

9) The solenoid operated valves/Dampers/Gate shall have a limit switch for open/close feedback. Control voltage of Solenoid Valve shall be 24V DC only.

10) 2 nos. RF type level switch and One no. temperature switch shall be provided for interlock & monitoring purpose per hopper.

11) RF Type level switches shall be provided for each storage bunker and DPS shall be provided across each bag filter for interlock & monitoring purpose.

12) Local control panel/station if any required for operation shall be in bidder scope.

13) 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.

14) All the instruments/drives shall be terminated on JBs/Panels in field. JBs/Panels shall be in Bidder's scope. Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 12-15 mtrs) and trunk cable.

15) RTD’s shall be of duplex type. Both the elements of duplex temperature sensors shall be terminated to junction boxes. Temperature measurement shall have up scale / down scale drive to protect from process upset in case of sensor failure. For RTDs ring - tong type lugs shall be used at Junction Boxes.

16) All local gauges, transmitters and switches shall be mounted on suitable enclosures, racks subject to owner’s approval. All transmitters shall be HART compatible.

17) 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.

18) 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.

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

20) 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.

21) Primary sensor redundancy for Control/measurement shall be decided as per following general criteria:
    a. Critical controls & respective measurements, measurements required for protection of auxiliaries & for major CLCS- Triple redundant.
    b. Non-critical but important control & measurements and measurements required for other CLCS- Dual redundant.

22) 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.

23) Bidder to comply with codes and standards as mentioned in the specification.

24) 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.

25) Bidder shall provide erection hardware as per installation drawings.

26) Bidder to provide mandatory spares as per mandatory spares list attached elsewhere in the specification.

27) 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.

28) Bidder must offer general tools and tackles and special calibration instruments required during start-up, trial run, operation and maintenance of the system.

29) 230V UPS supply shall be made available for MRS package at below mentioned locations:

i. One no. supply at compressor house which shall be used for controllers of MRS compressor skids.
ii. One no. supply at each mill bay which shall be used for power supply required for level probes installed at pyrite hopper & on silo, level instrument installed on silo and power supply to timer card panel of bag filters installed at silo etc.
iii. Distribution of 230V supply from a single source to various locations in compressor house & mill bay area shall be in bidder's scope.

Further distribution to various instruments shall be in Bidder's scope. Bidder to include necessary power distribution board (ACDB) (as per details attached elsewhere in this specification) in his scope. Any power supply other than the above, if required by any instrument/device, has to be derived by the Bidder from the above supply and all necessary hardware for the same shall be in bidder's scope. Bidder to furnish UPS power requirement UPS / Electrical load data along with the bid.

30) Bidder to furnish electrical load/UPS load data during detailed engineering.

31) 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.

32) 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

33) Number of cores to be selected for Control cable (Size: 2.5 mm2):
    a) 3 Core
    b) 5 Core
    c) 12 Core

34) 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.

35) 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.

36) 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.

37) Contractor shall furnish Instrument Schedule, I/O list, Drive list, Cable Schedule, Cable interconnection (DCS end terminal details shall be provided to vendor during detail engineering to incorporate in cable interconnection), JB grouping, Annunciation list, SOE list, List of Instruments/devices for HART in BHEL approved format. Also reusable database format like MS Excel, MS Access etc. of these documents shall also be provided by Contractor in BHEL approved format. Soft copy of the formats shall be provided to the successful bidder.

38) 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.

39) In case of any conflict and repetition of clauses in the specification, BHEL discretion will prevail.

40) 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

41) Control & Instrumentation equipment shall be guaranteed against manufacturing defect for at least two (2) years from the date of handing over to Owner.

42) 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.

43) Bidder to delegate /depute their persons/experts (21 man days for minimum 3 tours) as per owner/consultants' requirement without any additional cost at site during commissioning.

44) Bidder's presence is required for 3 Man days (Excluding travel time) at EDN Bangalore during FAT of DDCMIS for certifying correctness & completeness of implementation of Control logic. Intimation to attained FAT shall be informed in 2 days advance. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope.

45) Bidder to ensure participation of their senior personnel and experts in discussions with Owners and other equipment bidders during various stages of contract implementation as required by the Owner.

2.06.02

2.06.04 The conveying air compressor for Unit#5 shall have common stand by with Stage II conveying compressors and shall be controlled from the existing Stage II control system. Compressor control shall be envisaged through skid mounted proprietary local control panel with serial interface with existing MRHS PLC system.

2.06.06 Necessary and suitable instrumentation as required to achieve the operation philosophy as indicated in V.II/H2 of this specification and as illustrated in the relevant tender flow diagram shall be provided as minimum requirement of the system.

2.06.07 Bidder shall provide all control equipment, accessories, all instrumentation cables including laying and termination of cables, erection hardware for safe, efficient and reliable operation of the plant instruments (As per Technical Specification Volume IIE/Section -VI).

C&I DELIVERABLES LIST

LIST OF VENDOR DELIVERABLES FOR C&I FOR MILL REJECT SYSTEM
(1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5))

DOCUMENT NUMBER PE-GL-445-160-I001 **SHEET 1 of 1**

Sl.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY
1	PE-V0-445-145-I901	CONTROL & OPERATIONAL WRITE-UP FOR THE SYSTEM	A
2	PE-V0-445-145-I902	CONTROL SCHEME/LOGIC DIAGRAM (TO BE IMPLEMENTED IN DDCMIS)	A
3	PE-V0-445-145-I903	HMI PICTURES/PLANT SCHEMATICS	A
4	PE-V0-445-145-I904	INSTRUMENT SCHEDULE WITH SET POINTS	A
5	PE-V0-445-145-I905	I/O LIST (ANALOG & BINARY)	A
6	PE-V0-445-145-I906	DRIVE LIST/SOLENOID/ACTUATOR VALVE LIST WITH LOCATION DATA	A
7	PE-V0-445-145-I907	FIELD JB/LIE/LIR,DRIVES TERMINATIONS / GROUPING DOCUMENT	A
8	PE-V0-445-145-I908	DATASHEETS FOR INSTRUMENTS, JBs, etc.	A
9	PE-V0-445-145-I909	QUALITY PLANS (INSTRUMENTS, VMS, LCP etc.)	A
10	PE-V0-445-145-I910	INSTRUMENT INSTALLATION/ HOOK UP DRAWINGS	A
11	PE-V0-445-145-I911	THERMOWELL SIZING CALCULATION	A
12	PE-V0-445-145-I913	CABLE SCHEDULE & INTERCONNECTION	A
13	PE-V0-445-145-I914	ANNUNCIATION & SOE LIST	A
15	PE-V0-445-145-I916	LCP GA DRAWING	A

NOTES:

1. ANY OTHER DOCUMENT DECIDED DURING DETAILED ENGINEERING SHALL BE PROVIDED BY BIDDER WITHOUT ANY COMMERCIAL/TECHNICAL IMPLICATION.

2. CONTRACTOR TO SUBMIT REUSABLE DATABASE FORMATS IN BHEL/CUSTOMER APPROVED FORMATS LIKE MS EXCEL,MS ACCESS OF DOCUMENTS LIKE INSTRUMENT SCHEDULE, I/O LIST, DRIVE LIST,FIELD JB TERMINATIONS, CABLE SCHEDULE & INTERCONNECTION, etc. SOFT COPY OF FORMATS SHALL BE PROVIDED TO SUCCESSFUL BIDDERS.

SPECIFICATION FOR
MOTORISED VALVE ACTUATOR

	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 to70 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	

Data Sheet A & B

		DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY	
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY	
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC	
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ☐ 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	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 THERMOSTSTTRIP 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	

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	± 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.

Data Sheet A & B

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

NOTES:

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

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

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

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

Data Sheet A & B

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

ADDITONAL 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.

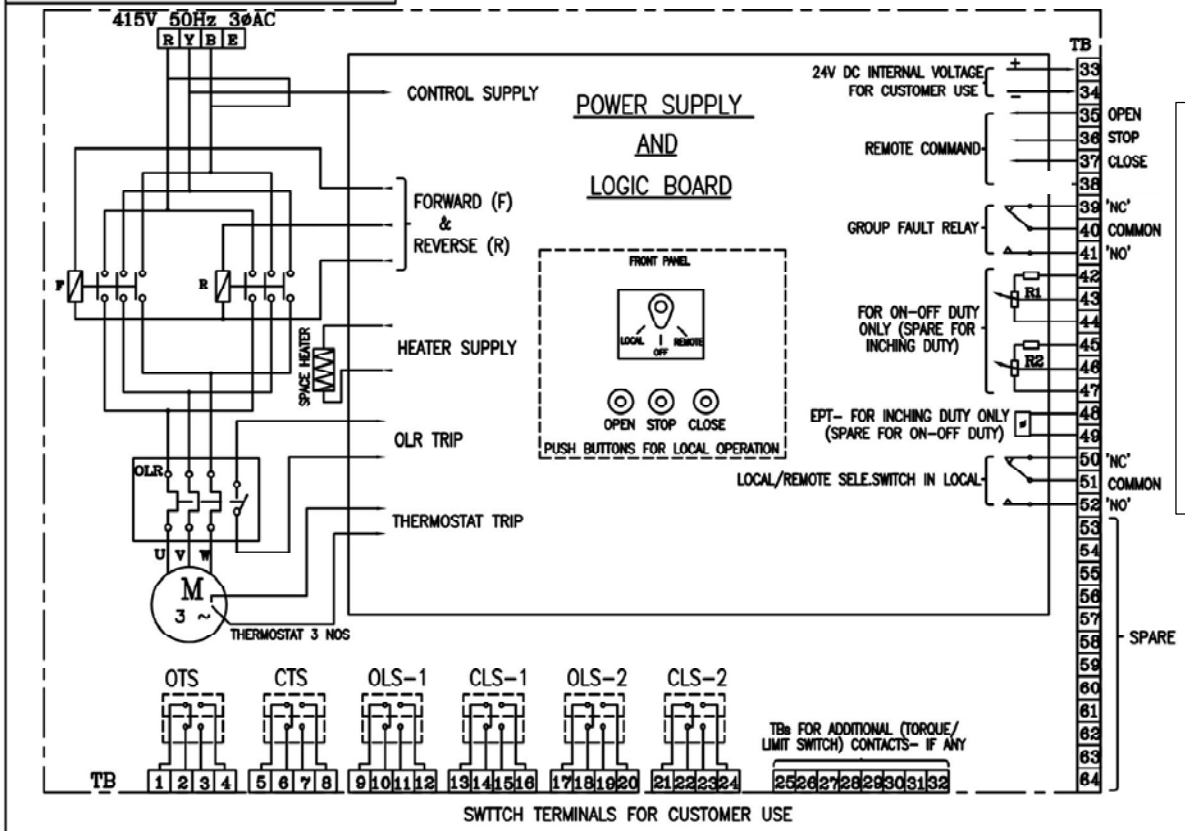
- ADVANCE NOTICE SHALL BE GIVEN TO THE OWNER AS AGREED IN THE CONTRACT, PRIOR TO THE STAGE OF MANUFACTURE BEING REACHED, AND THE PIECE OF PLANT MUST BE HELD AT THIS STAGE UNTIL THE OWNER HAS INSPECTED THE PIECE, OR HAS ADVISED IN WRITING THAT INSPECTION IS WAIVED, IF HAVING CONSULTED THE OWNER AND GIVEN 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.

DRAWING NO. 3-V-MISC-24227



SWTTCH TERMINALS FOR CUSTOMER USE

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.

CONTACT DEVELOPMENT DIAGRAM

OTS	1-2	OPEN AT OVER TORQUE DURING OPENING TRAVEL
	3-4	CLOSE AT OVER TORQUE DURING OPENING TRAVEL
CTS	5-6	OPEN AT OVER TORQUE DURING CLOSING TRAVEL
	7-8	CLOSE AT OVER TORQUE DURING CLOSING TRAVEL
OLS-1	9-10	
	11-12	
CLS-1	13-14	
	15-16	
OLS-2	17-18	
	19-20	
CLS-2	21-22	
	23-24	

SWITCH TERMINAL NO. — FULL OPEN — a — INTERMEDIATE — b — FULL CLOSE

VALVE POSITION

——— INDICATES CONTACT CLOSED

- - - - - - INDICATES CONTACT OPEN

CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

VALVES	OPEN		CLOSE	
	MAIN	BACK UP	MAIN	BACK UP
GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS *	CLS	CTS
ALL OTHER GATE & GLOBE VALVES	OLS	OTS *	CTS	#

– CLS NOT TO BE CONNECTED IN TRIP CIRCUIT

* – BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)

NOTE:–

1. 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
2. CTS – TORQUE SWITCHES FOR CW ROTATION (CLOSE)
3. OTS – TORQUE SWITCHES FOR CCW ROTATION (OPEN)
4. OLS-1, OLS-2 – LIMITSWITCHES FOR POSITION OPEN
5. CLS-1, CLS-2 – LIMITSWITCHES FOR POSITION CLOSE
6. EPT – ELECTRONIC POSITION TRAMSMITTER (POTENTIOMETRIC TYPE, FOR INCHING DUTY)
7. R1–R2–POTENTIOMETER 2 x 100 OHMS (FOR ON–OFF DUTY)
8. FOR COMMANDS & EPT EITHER INTERNALLY GENERATED 24 VDC OR EXTERNAL SUPPLY OF 24VDC CAN BE USED
9. M – MOTOR 3ø 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)

BHARAT HEAVY ELECTRICALS LTD.,
UNIT: HIGH PRESSURE BOILER PLANT.
TIRUCHIRAPALLI-620014.
365-121

	NAME	SIGN	DATE	NO. OF VAR.
DRN	N.P.ESWAR	N.P	07.10.04	
CHD	D.DINAKARAN	D.D	07.10.04	
APPD	K.ARUNACHALAM	K.A	07.10.04	

DEPT VL | CODE | SCALE | WEIGHT (KG). | REFERENCE INFORMATIONS | NO. OF ITEMS

TITLE: WIRING DIAGRAM (TERMINAL PLAN) FOR ACTUATOR WITH INTEGRAL STARTER

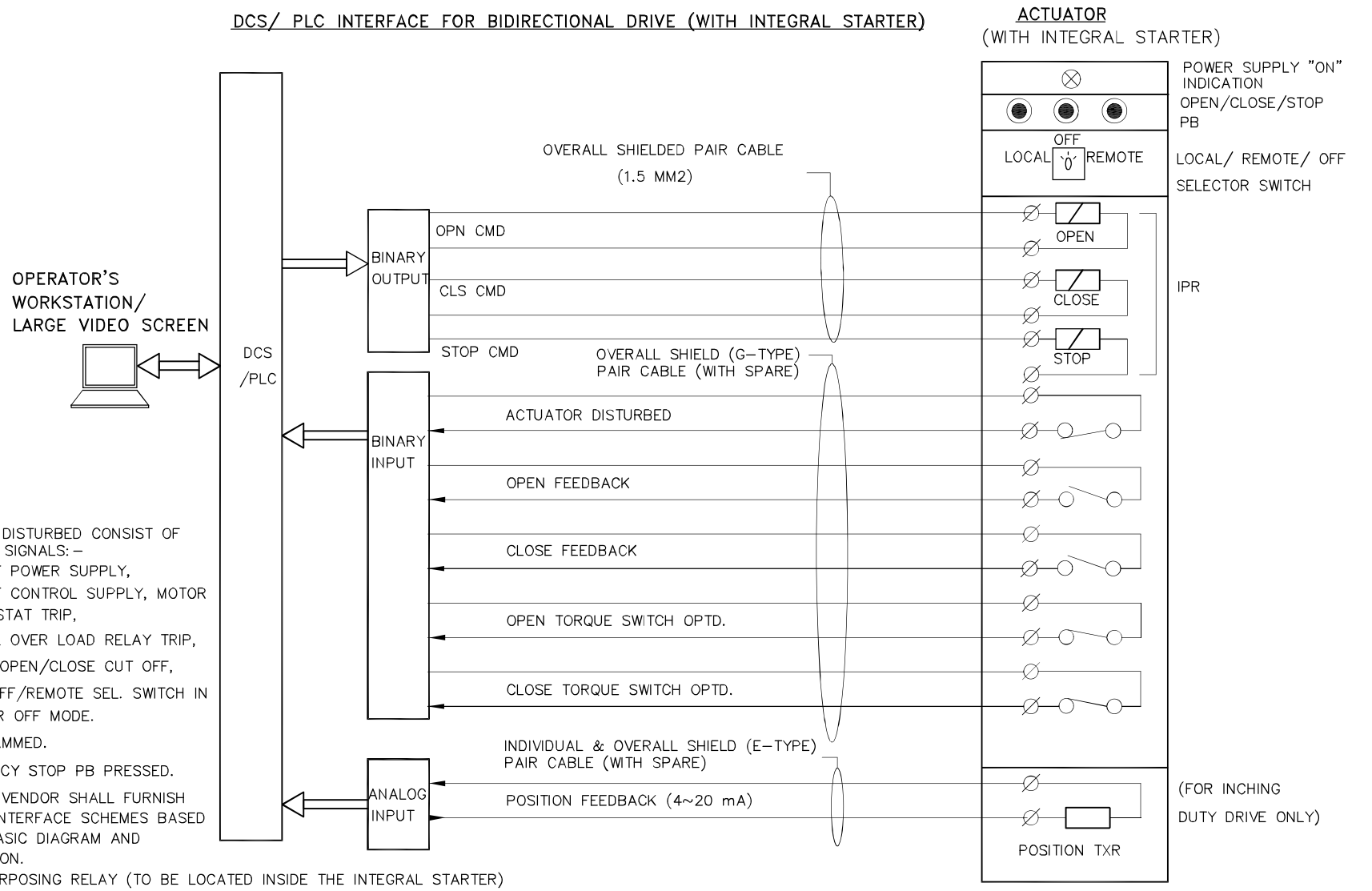
CARD CODE: U 01

DRAWING NO.: 3-V-MISC-24227

REV: 0

Size A3

DCS/ PLC INTERFACE FOR BIDIRECTIONAL DRIVE (WITH INTEGRAL STARTER)



NOTE:

1. ACTUATOR DISTURBED CONSIST OF FOLLOWING SIGNALS: –
   a) LOSS OF POWER SUPPLY,
   b) LOSS OF CONTROL SUPPLY, MOTOR THERMOSTAT TRIP,
   c) THERMAL OVER LOAD RELAY TRIP,
   d) TORQUE OPEN/CLOSE CUT OFF,
   e) LOCAL/OFF/REMOTE SEL. SWITCH IN LOCAL OR OFF MODE.
   f) VALVE JAMMED.
   g) EMERGENCY STOP PB PRESSED.
2. DCS /PLC VENDOR SHALL FURNISH DETAILED INTERFACE SCHEMES BASED ON THIS BASIC DIAGRAM AND SPECIFICATION.
3. IPR – INTERPOSING RELAY (TO BE LOCATED INSIDE THE INTEGRAL STARTER)
4. RELEVANT PARTS OF THE SPECIFICATION SHALL BE REFERRED FOR OTHER SPECIFIC REQUIREMENTS (FOR EXAMPLE REDUNDANCY)

FOR TENDER PURPOSE ONLY

REVIEWED										
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	–	0	11.08.16
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TYPICAL DRIVE INTERFACE FOR BIDIRECTIONAL DRIVE (WITH INTEGRAL STARTER)
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-0021 (SHEET 1 OF 6) | REV. 0

12A05-DWG-I-0021-R-0-SH7-1-5 11-08-16

A3 (9-96) [420x297]

SPECIFICATION FOR
FIELD & MEASURING INSTRUMENTS

SECTION-VI

TECHNICAL SPECIFICATION

CONTROL AND INSTRUMENTATION SYSTEMS

1.00.00 FIELD INSTRUMENTS

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

i) HART management system shall be integral feature of the DDCMIS and shall be provided for centralised configuration, maintenance, diagnostics & record-keeping for all electronic transmitters.

ii) Bidder shall provide following facilities as a minimum through software:

a) Constant scanning to monitor faults of changes to instrument configuration.

b) Owner-defined and standard calibration and configuration procedures for all transmitters.

c) Constant signal data collection facilities to maintain continuously updated records.

d) Automatic tracking of configuration changes made in the field, such as may be introduced by hand-held communicator. All configuration function associated with hand-held communicators shall be available in the system.

e) Event and log reports on screen as well as on printer.

f) Any addition/deletion of transmitter will be reported on printer and logged in hard disk.

1.01.00 PRESSURE TRANSMITTER

01.	Type	:	Microprocessor based Smart, HART protocol compatible
02.	Transmission	:	2 - Wire

03.	Output Signal	:	Simultaneous transmission of digital and 4-20 mA DC signal.
04.	Signal Processing	:	Silicon solid state electronic circuitry
05.	Sensor type	:	Capsule / Diaphragm
06.	Element material	:	AISI-316 or better
07.	Static Pressure	:	150 % of maximum span continuously, without affecting the calibration.
08.	Turn-down ratio	:	10 : 1 for vacuum/very low pressure application ; 30 : 1 minimum for other applications.
09.	Span and Zero	:	Locally adjustable non-interacting. Facility for elevation and suppression by 100% of span
10.	Enclosure Class	:	Weather proof as per IP-65 with durable corrosion resistant epoxy coating (Explosion proof for NEC Class-1, Division 1 area wherever required)
11.	Output Indicator	:	Backlit LCD type
12.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
13.	Body	:	Forged Carbon Steel (SS for DM Water & corrisve service).
14.	Power supply	:	16 - 48 Volts D.C.
15.	Load	:	500 Ohms (min.) at 24 Volts D.C.
16.	Ambient Temperature	:	0 - 50^{O}C
17.	Performance :		
i)	Accuracy	:	$\pm$ 0.075% of Span or better
ii)	Repeatability	:	$\pm$ 0.05% of Span or better
iii)	Response time	:	100 msec or better
iv)	Stability	:	$\pm$ 0.1% of Calibrated Span for 6 months up to 70 Kg/cm2 and $\pm$ 0.25% of Calibrated Span for more than 70 Kg/cm2
v)	Zero and span drift	:	$\pm$ 0.015% per deg. C at max span and 0.11% per deg. C at min span
18.	Sealing/Isolation	:	Extended diaphragm with 5 meters SS armored capillary for corrosive, viscous and dirty fluid applications. Material for separator

diaphragm shall be as per application. Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application

19. Diagnostics : Self indicating feature

20. Accessories :
a) Universal mounting bracket suitable for 2" pipe mounting.
b) High tensile carbon steel U- bolts.
c) Installation accessories as per relevant installation drawing.
d) Syphons for steam and hot water services.
e) ½" NPT 2-valve stainless steel manifold for pressure transmitters constructed from SS316 bar stock. In case it becomes necessary to use a DP transmitter for gauge pressure measurement then a 2-valve manifold should be used in place of 5-valve manifold.
f) Companion flange with nuts, bolts and gaskets.
g) Hand held configurator kit for calibration of Smart Transmitter.

1.02.00 Differential Pressure Transmitter

01. Type : Microprocessor based Smart, HART protocol compatible

02. Transmission : 2-Wire

03. Output signal : Simultaneous transmission of digital and 4-20 mA DC signal.

04. Signal Processing Unit : Silicon solid-state electronic circuitry

05. Sensor type : Capsule/Diaphragm

06. Element material : AISI-316 (Stainless Steel) or better

07. Static Pressure/

Overload Pressure		:	Maximum line (or static) pressure on either side without permanent deformation or loss of accuracy
08.	Turn-down ratio	:	10 :1for vacuum/very low pressure application; 30 : 1 minimum for other applications.
09.	Span and Zero	:	Locally adjustable, non-interacting
10.	Enclosure class	:	Weather proof as per IP-65 with durable corrosion resistant epoxy coating (Explosion proof for NEC Class-1, Division 1 area wherever required))
11.	Zero suppression / elevation	:	At least 100% of Span
12.	Output Indicator	:	Backlit LCD type
13.	Nameplate	:	Tag number and Service engraved in stainless steel tag plate
14.	Body	:	Forged Carbon Steel (SS for DM Water)
15.	Ambient temperature	:	0 - 50^{O} C
16.	Power supply	:	16 - 48 Volts DC
17.	Load	:	500 Ohms (min.) at 24 Volts DC
18.	Performance :-		
i)	Accuracy	:	±0.2 % of span or better
ii)	Repeatability	:	± 0.05 % of span or better
iii)	Response time	:	100 msec or better
iv)	Stability	:	± 0.1% of Calibrated Span for 6 months up to 70 Kg/cm2
v)	Zero and span drift	:	± 0.015% per deg. C at max span and 0.11% per deg. C at min span
19.	Sealing/Isolation	:	Extended diaphragm with 5 meters. SS armored capillary for corrosive, viscous and dirty fluid applications. Material for separator diaphragm, depending on application.
20.	Diagnostics	:	Self indicating feature
21.	Accessories	:	a) Universal mounting bracket suitable for2" pipe mounting.

b) High tensile carbon steel U-bolts.

c) Installation accessories as per relevant installation drawing.

d) Syphons for steam and hot water services.

e) ½" NPT 5-valve stainless steel manifold, constructed from SS316 bar stock.

f) Companion flange with nuts, bolts and gaskets.

g) Hand held configurator kit for calibration of Smart Transmitter.

1.02.00 DISPLACER TYPE LEVEL TRANSMITTERS

01.	Type		:	SMART
02.	Stages of operation		:	Continuous
03.	Material -			
	i)	Displacer	:	AISI 316 SS
	ii)	Suspension wire	:	AISI 316 SS
	iii)	Torque tube housing	:	Carbon steel or SS as per application
	iv)	Torque tube	:	Inconel
	v)	Displacer chamber	:	Carbon steel or SS as per process application
	vi)	Transmitter Housing	:	Die cast aluminium or better
04.	Power supply		:	16-48 Volts D.C.
05.	Transmission		:	2-wire
06.	Output Signal		:	Simultaneous transmission of digital and 4-20 mA DC signal. Standard HART protocol.
07.	Signal processing		:	Solid-state electronic circuitry
08.	Static / overload pressure		:	Maximum static pressure without permanent deformation or loss of accuracy.
09.	Turn-down ratio		:	10 : 1 or better

10.	Zero & Span	:	Easily accessible (local zero & span adjustment and non-interactive type)
11.	Enclosure Class	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
12.	Output Indicator	:	Yes, Backlit LCD type
13.	Nameplate	:	Tag number and Service engraved in stainless steel tag plate
14.	Ambient Temperature	:	0 - 50^{O}C
15.	Load Impedance	:	500 Ohms at 24 Volts (minimum)
16.	Process Connection	:	2" Companion flange with nuts, bolts and gaskets
17.	Performance -		
	Accuracy	:	$\pm$ 0.2% of span or better
18.	Accessories	:	a) Counter Flange, nuts, bolts, gaskets etc. b) Weights for 5 point calibration of instruments. c) Vent and drain plugs d) Special calibration tool/configurator,if any.
19.	Preferred Features	:	a) Test plug connection and cutout terminals physically separated from other electronics. b) Electronic Damping facility (adjustable).

1.03.00 MASS FLOW METER

A.	Sensor		
01.	Measuring Principle	:	Coriolis Mass flow.
02.	Primary Element	:	Flow Tube of 316SS or better
03.	Temperature Control For Heating	:	To be provided for heavy fuel oil application. Heating arrangement shall be integral.
04.	Process Connection	:	Flanged and rating as per process requirement.
05.	Drain	:	Self-draining facility

1.06.00 Rotameter

01.	Type	:	Online upto 2" and Bypass above 2" line size"
02.	Metering tube	:	Borosilicate glass
03.	Float	:	AISI 316-SS unless the process fluid demands some other material.
04.	Body MOC	:	SS as per fluid condition.
05.	Scale	:	Aluminium Graduated - Engraved black on white background.
06.	Process connection	:	Flanged to line size or threaded for connection size ½" or less.
07.	Accuracy	:	± 2% of full scale detection or better for on-line type and ±4% of full-scale detection or better for by-pass type.
08.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
09.	Accessories	:	Slip-on orifice plate of 316-SS and taps of / SS as per application. Applicable SS Isolation valves and SS Range Orifice - for bypass type rotameters.
10.	Housing protection class	:	IP- 65.

1.07.00 Pressure Gauge and Differential Pressure Gauge

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

09.	Scale	:	Black lettering on white background in 270 Deg. arc.
10.	Window	:	Shatterproof glass
11.	Range Selection	:	Normal process pressure – 50 ~ 70 % of range (approximately).
12.	Over-range Protection	:	125% of maximum range by internal stop. External stop at zero
13.	Adjustment	:	Micrometer screw for zero adjustment. Internal micrometer screw for range adjustment. External zero adjustment for glycerine filled gauges.
14.	Element Connection	:	Argon welding
15.	Process Connection	:	1/2" NPT(M) Bottom connection for local mounting, back connection for panel mounting.
16.	Performance	:	Accuracy of $\pm$ 1.0 % of span or better.
17.	Operating ambient temperature	:	0 - 50^{O}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	:	± 1 % or better
19.	Enclosure Class	:	IP-65
20.	Capillary	:	5 meters (local)/15.0 meters (local panel) - armoured stainless steel
21.	Compensation	:	Capillary and Case Compensation
22.	Accessories	:	a) Forged/barstock SS316 thermowell screwed as per ASME PTC code. Process connection M 33X2 (M). Material of construction of thermowell: 1) SS 316: in general 2) Inconel: For flue gas application 3) Tungsten carbide: For coal mill application b) Installation accessories as required.
23.	Nameplate	:	Tag number, service engraved in stainless steel tag plate

1.09.00 Thermocouples

01.	Type	:	a) Type-K (Chromel Alumel) / Type-R (Pt.-Rhodium Pt.) / Type-E (Chromel Constantan) [As per application] b) Duplex (Triplex incase of turbine/Generator/excitor bearing temperature may be used) c) Ungrounded
02.	Wire gauge	:	16 AWG for Type-K, 24 AWG for Type-R
03.	Standard	:	ANSI-MC 96.1.
04.	Protecting Tube :-		
i)	O.D.	:	8 mm
ii)	Material	:	316-SS Seamless
iii)	Filling	:	Magnesium Oxide (Purity above 99.4%)

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

1.10.00 Passing condition of various drain valves shall be monitored by measuring drain pipe metal temperature at the downstream of the drain valves. Also Drum, SH, RH metal temperature measurement shall be provided. Necessary thermocouples shall be provided as per the following specification.

01.	Measuring medium	:	Metal temperature
02.	Metal of thermocouple element	:	Chromel-Alumel Type-K
03.	Type of thermocouple ungrounded type.	:	Duplex with separate hot junctions,
04.	Insulation	:	Mineral insulation Magnesium Oxide
05.	Thermocouple wirer gauge	:	16 AWG
06.	Protective Sheath	:	SS 321
07.	Protective Sheath Dia	:	8 mm O.D.
08.	Characteristics of thermocouple	:	Special limits of error as in ANSI MC 96.01.1975
09.	Mounting Accessories	:	1/2" BSP SS sliding end connector, weld pad, weld on clamps of heat resistant steel SS 310.
10.	Cold end sealing	:	SS pot seal with colour coded PTFE headed sleeve insulated flexible tails. Sealing compound - Epoxy resin
11.	Minimum Bending Radius	:	30 mm
12.	Length of T/C	:	30 mtrs. (minimum)

1.11.00 Resistance Temperature Detector

01.	Type	:	Platinum (Duplex), Ungrounded
02.	Resistance	:	100 ohm at $0^{O}C$
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		:	± 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		:	½" NPT gland and grommet.
	v) Others		:	Terminal head cover with SS chain and suitable gasket. All thermowells in the high velocity steam service shal be checked for Strouhal's frequency limit to arrive at a safe size and design of thermowells"
10.	Accessories		:	a) Adjustable nipple-union-nipple [1/2" Sch 80 X ½" 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 11/2"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
1.12.00	Pressure Switch			
	01.	Type	:	i) Piston for high pressure application (above 40 bar) ii) Bellow /Diaphragm for low pressure application (below 40 bar)
	02.	Sensing element material	:	AISI SS-316. All other wetted part SS316.
	03.	Case Material	:	Die-cast aluminum alloy with neoprene gasket.
	04.	Setter Scale	:	Black graduation on white linear scale. Graduation 0-100% with red pointer for set points.
	05.	Over range	:	150 % of maximum pressure
	06.	Adjustments	:	a) Internal Set Point b) Differential adjustment
	07.	End Connection	:	1/2" NPT (M) bottom connected
	08.	Switch configuration	:	Two SPDT
	09.	Switch Rating	:	240V, 5A AC/220V, 0.5A DC
	10.	Switch Type	:	Snap acting, shock & vibration proof
	11.	Terminal Block	:	Suitable for full ring lugs for cable connection.
	12.	Elect connection	:	Plug in socket
	13.	Enclosure Class	:	IP-65 weather and dust proof (Explosion proof for NEC Class-1, Division 1 area).
	14.	Performance	:	a) Repeatbility $\pm$ 0.5% of full range b) Accuracy of Setting Indication of $\pm$ 1.5%
	15.	Ambient temperature	:	0 – 50^{O}C

	16.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
	17.	Accessories	:	a) Remote diaphragm seal with SS-316 capillary for viscous & corrosive application. MOC of seal material shall be as per process fluid requirement. b) Snubbers for pulsating fluid application. c) Syphons for steam and hot water services. d) Retention ring and screws for surface mounting. e) 1/2" NPT 2 Valve SS-316 manifold constructed from barstock f) Brass cable gland
1.13.00	Differential Pressure Switch			
	01.	Type	:	Bellows / Diaphragm / Piston actuated
	02.	Sensing element material	:	AISI SS-316. For all other wetted part SS 316
	03.	Case Material	:	Die-cast aluminum alloy with neoprene gasket.
	04.	Setter Scale	:	Black graduation on white scale with 0-100% graduation and provided with red pointer for set point adjustment
	05.	Over range	:	Static pressure on any one side, the other side being open to atmosphere.
	06.	Adjustments	:	a) Internal set point adjustment b) Differential adjustment
	07.	Process Connection	:	1/2" NPT (M) bottom connected / back connected.
	08.	Switch configuration	:	Two SPDT
	09.	Switch rating	:	240V, 5A AC/220V, 0.5A DC.
	10.	Switch type	:	Snap acting type contacts, shock and vibration proof.

	11.	Terminal Blocks	:	Suitable for full ring lugs for cable connection.
	12.	Elect connection	:	Plug in socket
	13.	Performance	:	a) Repeatbility ± 0.5% of full range b) Accuracy of set point Indication: ± 1.5%
	14.	Operating Ambient Temperature	:	0 - 50^{O}C
	15.	Enclosure	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area).
	16.	Accessories	:	a) Snubbers for pulsating fluid application. b) Syphons for steam and hot water services. c) Retention ring and screws for surface mounting. d) 1/2" NPT 3-Valve SS-316 manifold constructed from barstock
	17.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
	18.	Remote Seal type for special application	:	a) Silicone oil / fluorolube filled remote diaphragm seal for dirty / viscous / corrosive fluid. b) SS armoured capillary at least 3 meters each. c) Adapter flanges with nuts, bolts and gaskets for instrument and process side.

1.14.00 Temperature Switch

	01.	Type	:	Inert gas filled-in
	02.	Sensing Element Material	:	Bellow / Bourdon AISI SS-316
	03.	Bulb Material	:	AISI SS-316
	04.	Capillary	:	Stainless steel armoured
	05.	Movement Material	:	AISI SS-304
	06.	Case material	:	Epoxy coated steel plate or die-cast aluminum alloy with neoprene gasket and

clear glass where applicable cover conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).

07.	Scale	:	Black lettering on white background
08.	Over range Protection	:	120 %
09.	Instrument connection	:	Bottom
10.	Switch configuration	:	Two SPDT
11.	Switch rating	:	240V, 5A AC/220V, 0.5A DC
12.	Switch type	:	Snap acting, shock and vibration-proof.
13.	Adjustability	:	Internal Set point adjustable over span range
14.	Elect connection	:	Plug in socket
15.	Compensation	:	a) Capillary compensation with invar wire throughout the capillary length. b) Case compensation
16.	Performance	:	
	i) Scale Accuracy	:	± 1.0 % of full scale
	ii) Repeatability	:	< 0.5 % of full range
	iii) Response time	:	Less than 40 seconds with thermowell
17.	Capillary length	:	5 meters (minimum) for local mounting/15 meters for local panel mounting.
18.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
19.	Accessories	:	Thermowell from SS barstock, Mounting accessories, ½" NPT cable gland.

1.15.00 Level Switch

01.	Type	:	External cage float operated. Magnetically coupled.
02.	Float Material	:	AISI-316 stainless steel or better
03.	Other wetted parts	:	AISI-316 stainless steel or better
04.	External Cage	:	Carbon steel / Stainless steel or better as per process requirements, welded type / flanged

construction. Cage pressure rating shall equal or exceed the rating of the main vessel.

	05.	External cage mounting	:	Side-Side.
	06.	External cage connection	:	25 NB socket welded.
	07.	Switch housing	:	Epoxy coated die-cast aluminum alloy with neoprene gasket conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
	08.	Type of switch configuration	:	2 SPDT (two nos.)
	09.	Contact rating	:	5A, 240V/AC, 0.25A, 220V DC
	10.	Accessories	:	a) Counter flange, nuts & bolts, suitable gasket etc. b) Steel globe type drain valve. c) ½"NPT cable gland d) Stainless steel alpha-numeric engraved for service and tag. e) Globe drain valve
	11.	Preferred feature	:	Switch operating point marked on cage
	12.	Mounting	:	On standpipe

1.16.00 Conductivity Type Level Switch

	01.	Type	:	Conductivity discrimination.
	02.	Application	:	Drain pots viz. on CRH line
	03.	Mounting	:	Flanged – on external cage.
	04.	Probe MOC	:	Stainless steel with high purity ceramic.
	05.	Probe rating	:	> Maximum design pressure of vessel.
	06.	Input	:	Four independent channel with selectable switching threshold for water conductivity.
	07.	Relay Output	:	Four isolated output relays for Hi, Lo, Hi-Hi, Lo-Lo.

	08.	Contact type & rating	:	2SPDT or 1 DPDT @ 5A 30V DC.
	09.	Local Display	:	Coloured LEDs for Hi, Lo, Hi-Hi, Lo-Lo, Power & fault.
	10.	Power supply	:	Dual 240V AC, 50 Hz, 1Ph UPS supply.
	11.	Enclosure	:	IP–65, corrosion resistant & wall mounting type (Explosion proof for NEC Class-1, Division-1 area).
	12.	Accessories	:	a) PTFE cable from probe to electronics b) Mounting accessories c) External cage d) Washer & gasket
	13	Test pressure	:	Two times rated pressure
	14.	Elect connection	:	Plug in socket

1.17.00 Capacitance Type Level Switch

	01	Type	:	Capacitance type
	02	Probe	:	a) Rod or suspended electrode b) Rope type probes may be used only where required probe length is greater than 1.5 meters. c) Reference rod for non grounded tank.
	03.	Probe Mounting :	:	1-1/2" Flanged
	04.	Material of construction	:	316 SS and to suit fluid type
	05.	Insulation	:	PTFE/PP/Kynar Part/Full as required
	06.	Enclosure	:	Powder coated Die cast aluminium. with neoprene gasket conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
	07.	Ambient temperature	:	0-60ºC.
	08.	Mounting	:	Top Mounting
	09.	Supply voltage	:	240V AC, 50 Hz, 1Ph UPS supply/ 24V DC

	10.	Relay output	:	2 SPDT
	11.	Contact rating	:	5A min. at 240V AC on resistive load
	12.	Response time	:	100 msec or better
	13.	Elect connection	:	Plug in socket
	14.	Accessories	:	Counter flange, cable gland, prefab cable and stainless steel name plate engraved with alpha-numeric.
1.18.00	RF Type Level Switch			
	Sensing Probe		:	
	01.	Type	:	Rigid
	02.	Material	:	SS-316
	03.	Mounting	:	Threaded
	04.	Probe Head Housing	:	Cast Aluminium
	05.	Protection	:	IP-66
		Electronic Controller	:	
	01.	Supply Voltage	:	240V AC (UPS)
	02.	Relay Output	:	2 nos. SPDT
	03.	Contact Rating	:	240V AC,5A/ 220V DC, 0.25A
	04.	Housing Material	:	Cast Aluminium
	05.	Protection	:	IP-65
	06.	Local LED Indication	:	Power On, Alarm Level, Probe Healthy
	07.	Switching Repeatability	:	±0.5%
	08.	Accessories	:	Coaxial cable probe connection to controller ½"NPT Cable Gland
1.19.00	Ultrasonic Level Switch			
	01.	Principle of operation	:	Ultrasonic contact level technology
	02.	Input Power	:	24V DC/ 240V AC

	03.	Output Contact	:	2 SPDT (240V AC, 5A/ 220V DC, 0.25A)
	04.	Switch Mounting	:	Integral
	05.	Sensor Material	:	SS-316
	06.	Enclosure	:	Cast Aluminium (IP-65)
	07.	Process Connection	:	2" Flanged
	08.	Repeatability	:	2 mm
	09.	Power supply	:	240V AC, 50 Hz, 1Ph UPS supply/ 24V DC
	10.	Cable connection	:	½" NPT with cable gland
	11.	Accessories	:	Cable gland, cable, companion flange, bolts & nuts, gaskets etc. along with all mounting hardware

1.20.00 Ultrasonic Level Transmitter

	01.	Principle of operation	:	Detection of reflected ultrasonic pulse
	02.	Signal processing	:	Microprocessor Controlled Signal Processing
	03.	Type	:	Smart
	04.	Display	:	Large alpha-numeric back lit LCD/LED
	05.	Calibration & configuration	:	Accessible from front of panel
	06.	Diagnostic	:	On-line
	07.	Status	:	For power, Hi / Lo / V. Hi / V. Lo-level indication, fault etc.
	08.	Construction	:	Plug-on board
	09.	Power supply	:	240V AC, 50 Hz, 1Ph UPS supply/ 24V DC
	10.	Signal Output	:	4-20 mA DC (isolated) - 500 Ohm load with HART protocol.
	11.	Hysteresis	:	Fully adjustable preferred
	12.	Output contacts	:	2SPDT Potential free changeover contacts @ 5A 230V AC.

	13.	Power supply	:	Dual 240V AC, 50 Hz, 1Ph UPS supply.
	14.	Enclosure	:	a) IP–65, corrosion resistant & wall mounting type for local electronics. b) IP-42 for remote indicator
	15.	Accessories	:	a) PTFE cable from probe to electronics b) Mounting accessories. c) Standpipe d) Washer & gaskets e) Double isolation valves on each connection, double drain valves & double vent valves with mechanical lock. f) ½" NPT cable gland
	16.	Test pressure	:	Two times design pressure

1.22.00 Air Filter Regulator

	01.	Filter Element	:	Sintered Bronze
	02.	Filter Size	:	5 microns
	03.	Input Air	:	10.0 Kg/Sq. cm (maximum)
	04.	Output	:	Adjustable from 0-2.0 Kg / Sq. cm or 0-7.0 Kg / Sq. cm (continuous) as applicable.
	05.	Effect of Supply	:	Maximum 0.02 Kg/Sq. cm for a change pressure variation in supply pressure of 4 Kg/Sq. cm
	06.	Bowl Material	:	Metallic.
	07.	Accessories	:	2" dial size output pressure gauge
	08.	Feature	:	No perceptible drop of pressure on opening the drain port.

1.23.00 SOLENOID VALVE

non UPS 240 V AC supply is not acceptable for solenoid

	01.	Operating Principle	:	Electromagnetic (noiseless)
		Coil voltage rating	:	24V DC (in general) other 220V DC /240V AC /110V AC as required

	03.	Ways	:	3 ways in general other depending on requirement
	04.	Port size	:	1/4" NPT all ports
	05.	Body	:	SS Bar Stock
	06.	Trim	:	AISI SS-316
	07.	Manual Operator	:	In built
	08.	Duty	:	Suitable for continuous energization
	09.	Sealing	:	Airtight and leak proofing with nitrile (NBR) and polyurethane (PUR) material
	10.	Ambient Temperature	:	0 - 50^{O} C
	11.	Fluid Temperature	:	0-150^{O} C (approx.)
	12.	Coil Enclosure	:	Stainless Steel
	13.	Insulation	:	Class-H
	14.	Coil Casing	:	IP-65 (Explosion proof for NEC Class-1, Division-1 area)
	15.	Response time	:	4-7msec
	16.	Mounting	:	On pipe or on panel
	17.	Cable Connection	:	½" NPT cable gland
	18.	Accessories	:	Mounting brackets, nuts and bolts
	19.	Special feature	:	(i) LED indication for power (ii) Double coil type for open & close operation of valve / damper. (iii) Solenoid valve directly integral to actuator body shall have NAMOOR interface for uniformity

1.24.00 ORIFICE PLATE

	01.	Application	:	Low fluid velocity flow measurement
	02.	Design Standard	:	Concentric as per ASME PTC-19.5 (Part –II), ISA RP-3.2 or BS-1042, Part-I
	03.	Number of Tapings	:	As required plus one additional pair of taps
	04.	Diameter Ratio	:	Between 0.34 to 0.7

05.	Thickness	:	3mm for main pipe of diameter upto 250mm, 6mm for main pipe of diameter above 250mm and 10mm for diameter above 500 mm
06.	Document	:	Beta ratio calculation, assembly drawing and Flow vs. DP curve.
07.	Meter run pipe	:	Same as pipe material
08.	Accessories	:	Flanges, gaskets, nuts & bolts, root valves (1" 316 SS globe) jack screw, meter run pipe, Drain & vent hole as per application etc.

1/2" SS316 globe

NOTE: One flow element of each type shall be calibrated in the test laboratory for validation of computed flow calculations.

1.25.00 FLOW NOZZLE

01.	Application	:	High fluid velocity flow measurement
02.	Design Standard	:	ASME PTC 19.5
03.	Tapings	:	D and D/2 (Numbers as required plus one additional pair of taps)
04.	Diameter Ratio	:	Between 0.4 and 0.7
05.	Material	:	316 SS
05.	Document	:	Beta ratio calculation, assembly drawing and Flow vs. DP curve.
06.	Meter run pipe	:	Same as pipe material
07.	Accessories	:	Meter run pipe, nipples and root valves (1" 316 SS globe).(Inspection port assembly for nozzles used in plant performance purpose)

NOTE: One flow element of each type shall be calibrated in the test laboratory for validation of computed flow calculations.

1.26.00 GAUGE GLASS

01.	Type	:	Reflex
02.	Glass	:	Toughened borosilicate. Resistant to mechanical and thermal shocks.
03.	Body material	:	Carbon steel / stainless steel- As per process requirements (Flanged Connection)
04.	Pressure rating	:	Twice the maximum working pressure

	05.	Temperature rating	:	300^{O} C
	06.	Bolts and nuts	:	Rust proof alloy steel
	07.	Accessories	:	Suitable ball check valves of SS-304/316 body, gaskets, companion flange etc.

1.27.00 LEVEL GAUGE (FLOAT & BOARD)

	01.	Type	:	Float and Board
	02.	Float & Tape MOC	:	AISI 316
	03.	Pulley and Pulley Housing material	:	SS 304
	04.	Guide wire	:	SS 316 Stainless steel
	05.	Accuracy	:	+/- 2 mm
	06.	Indication	:	Vertical dial
	07.	Rating	:	Twice the design pressure
	08.	Spring tension assembly	:	SS 304
	09.	Anchor plate	:	SS304
	10.	Calibrated scale board:		Aluminium with black graduation

Note: The measuring rope/tape shall be passed through conduits

1.28.00 POWER CYLINDERS (PNEUMATIC)

	01.	Mounting Type	:	a) Fixed position mounting (End mounting).
			:	b) Trunnion mounting
	02.	Control Signal	:	4-20 mA DC to smart positioner with HART protocol for modulating purposes. 24V/48VDC operated solenoid valve operating on pneumatic line for open & closing purpose of on & off drive.
	03.	Supply Air	:	0-7 Kg / Cm^2.
	04.	Selection	:	Based upon thrust / torque, stroke length, angular movement, full-scale travel time, repeatability, space factor etc. Provision for air-to-open and air-to-close operation.
	05.	Casing	:	IP-65.

	06.	Accessories (as required)	:	a) Air lock relay b) Hand wheel. c) Air filter regulator with gauge. d) Volume Booster. e) Limit Switches. f) Smart Positioner with integral I-P convertor, feedback position Transmitter (4-20 mA DC output),Input & Output pressure gauges, local keypad & display. g) Solenoid Valve h) Junction box with cable gland
	07.	Fail-safe operation	:	Stay put for regulating duty.
	08.	Repeatability	:	Better than 0.5% of full travel.
	09.	Hysterisis	:	Less than ±1% of full travel
	10.	Operating Temp. limit	:	80^{O} C (min.)
1.29.00	SIGHT GLASS			
	01.	Type	:	Flap-type
	02.	End connection	:	Screwed / Flanged
	03.	Material	:	
	a)	Body	:	SS-304
	b)	Cover Plate	:	SS-304
	c)	Indicator	:	SS-316
	04.	Sight Glass	:	Toughened Borosilicate
	05.	Gasket	:	Neoprene
	06.	Bolts & Nuts	:	High tensile steel
	07.	Hydraulic Test		
		Pressure	:	1.5 times maximum working pressure
	08.	Accessories	:	As required
1.30.00	SMOKE DENSITY ANALYZER			
	01.	Type	:	Insitu dry visible light (through LED)
	02.	Principle of		

	13.	Enclosure Class	:	IP-65
	14.	Interchangeability	:	Fully Interchangeable Transmitters
	15	Accessories	:	Sampling System, cables, sensor holder, dessicant chambers, souble compression fittings, ¾" cable gland, mounting fixture etc.

1.37.00 DENSITY METER

	01.	Operating Principle	:	Vibration Density measurement
	02.	Wetted Part Material	:	SS-316L
	03.	Case Material	:	Cast Aluminium
	04.	Output	:	4~20 mA DC
	05.	Electrical connection	:	½" NPT
	06.	Enclosure Class	:	IP-65
	07.	Local Display	:	Digital 5 digit, density display with temp. compensation
	08.	Accuracy	:	±1.0 %
	09.	Power Supply	:	240V AC (UPS)
	10.	Location	:	At the discharge of Gipsum bleed pump in FGD system.

1.38.00 RADAR TYPE LEVEL MEASUREMENT

	01.	Type	:	Radar based on Time Domain Reflectometry
	02.	Antena	:	Co axial / single rod type guided wave or Horn type as required for the application
	03.	Communication	:	Two wire 4-20mA DC, HART protocol
	04.	Environmental temperature	:	0 – 50ºC
	05.	Enclosure	:	Explosion proof /IP 65 as per application
	06.	Cable Entry	:	½" NPT
	07.	Calibration	:	a) Self calibration with internal reference b) Zero & Span calibration
	08.	Programming	:	Handheld programmer & Local key pad
	09.	Process Connection	:	Flanged /screwed

	10	Transmitter Beam Angle	:	10 degree or less
	11	Blocking distance	:	less than 300 mm
	12.	Electronic Housing	:	Epoxy painted Die-Cast aluminium alloy
	13.	Antenna / Flange assembly	:	316 SS or Hestalloy (as required)
	14.	Output Indicator	:	Digital Integral Display (Backlit LCD/LED)
	15.	Accuracy	:	5 mm or 0.1% of probe length
	16.	Accessories	:	a) Programming tool kit b) Gasket

1.39.00 CHLORINE LEAK DETECTOR

	01.	Type	:	Electrochemical
	02.	Resolution	:	0.1 ppm
	03.	Display Type	:	Digital Indicating Meter
	04.	Operating Temperature	:	0~45°C
	05.	Alarm Contacts	:	Dual Alarm setpoints (240V AC, 5A)
	06.	Enclosure Class	:	IP-65
	07.	Mounting	:	Wall mounting
	08.	Power Supply	:	240V AC
	09.	Output	:	4~20 mA DC (600 Ω load)

1.40.00 RESIDUAL CHLORINE ANALYZER

	01.	Type	:	Amperometric
	02.	Electrode	:	Platinum/ Gold and copper electrode shall be provided with cell cleaning system
	03.	Display Type	:	LCD in Analyzer Panel
	04.	Range	:	0 to 20.0 mg/L (ppm)
	05.	Accuracy	:	2% or better . The measurement accuracy shall not be affected by presence of treatment chemicals as chromates,

phosphates, de-former highly polluted water, change in temperature etc.

06.	Sensitivity	:	0.01 mg/L
07.	Alarm Contacts	:	Dual Alarm setpoints (240V AC, 5A)
08.	Enclosure Class	:	IP-65
09.	Power Supply	:	240V AC
10.	Output	:	4~20 mA DC (600 Ω load)
11.	Calibration	:	Zero & Span adjustment. Final calibration adjustments of the analyzer to be done at site and duly verified bt titration. Temperature compensation range 0-50°C.
12.	Mounting	:	Field mounting conform to IP-65
13.	Accessories	:	Chemical reagents, sample drain, pumping system (if required) etc.

1.41.00 ELECTRIC TO PNEUMATIC (E/P) CONVERTERS

01.	Air Supply	:	1.5 kg/cm2
02.	Max. supply Pressure	:	7 kg/cm2
03.	Input Signal	:	4-20 mA DC (as required by the design of control system).
04.	Output Signal	:	0.2 to 1.0 kg/cm2
05.	Control Action	:	Air to Close, Air to Open and Fail freeze-field selecable
06.	Response Time	:	5 seconds for 0 to 90% output pressure
07.	Repeatibility	:	+/- 0.1% span typical
08.	Accuracy	:	+/- 0.25% span typical
09.	Linearity	:	0.5% of span or better
10.	Hysteresis	:	0.1% of span or better
11.	Ambient Temp. effect	:	Less than 0.02% of span per ºC between

-20 ºC to +60 ºC

12. Supply pressure effect: less than 1%

13. Span and zero adjustment : screw

14. Mounting : Close to Actuator (but not on the actuator)

15. Output Capacity : To suit the actuator

16. Protection Class : IP 65

17. Allowable Drift Rate : ± 2% of set point / hour maximum

On loss of control signal, the last set point pressure shall be maintained so that the associated control valve remains in stay put condition.

1.42.00 SMART POSITIONER

01. Type : Universal design (linear or rotary application)

02. Input Signal : 4-20mA DC , 2 wire loop with 24V DC.

03. Output Signal (position F/B) : i) 4-20mA
ii) Configurable end position switch

04. Supply Pressure : Single acting 1.2 to 7.0 bar
Double acting 1.2 to 10.5 bar

05. Air Delivery : Single acting 10.0 SCFM at 2.1 bar supply
Double acting7.2 SCFM at 2.1 bar supply

06. Housing : IP 65

07. Repeatibility : +/- 0.3% of span or better

08. Accuracy : +/- 0. 1% of span or better

09. Communication : Hart protocol

10. Power-up with position : < 150 ms or better control

11 Power interruption without reset : <100ms or better

12. Body Material : Aluminium

13. Response Time : Less than 10 sec

14.	Features	:	i) Noncontact position feedback sensor ii) Integral Electro-Pneumatic convertor ii) Self calibration with tunable response time iii) Online diagnostics iv) Pressure guages to be provided on positioner (I/P & O/P pressure)

1.43.00 MAGENETIC LEVEL INDICATOR

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

1.44.00 FLOW SWITCH

01.	Type	:	Paddle /Piston/Disk
02.	Wetted part material	:	Stainless steel or Hastelloy for acidic application
03.	End connection Tee	:	i) Threaded upto 1" line size with integral ii) Flanged for line size > 1 ½"
04.	Enclosure material	:	Die cast aluminium
05.	Enclosure class	:	IP 65
06.	Switch configuration	:	2 SPDT
07.	Contact rating	:	240V AC 15A
08.	Repeatibility	:	2%
09.	Cable connection	:	½"NPTF
10.	Accessories	:	Tee, counter flange

	Logging Facilities	:	Yes. Should be able to compute cumulative flow over intervals selectable by Owner i.e., daily, weekly, monthly etc. The data shall be stored in the memory of flow computer for access in future.
10.	Software features	:	Compensation for any cross path errors Programming, configuration, shall be possible from front panel.
11.	Diagnostics	:	False signal tolerance , power supply failure etc.
12.	Protection Class	:	IP-65 or better, Weather protection against direct sunlight, rain etc for Flow meter and suitable for Cooling water for Transducer.
13.	Accuracy	:	± 1%
14.	Electrical connection	:	Plug and socket
15.	Accessories	:	All mounting hardware required like clamping fixtures, mechanism to remove the transducers online, interconnecting cables etc. All weather canopy for protection from direct sunlight and direct rain. Material of all fittings shall be SS 316

g) Bidder shall submit certified flow calculation and differential pressure Vs. flow curves for each element for Owner's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for Owner's approval.

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 requird)

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

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

	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 ^{O} C
07.	Ambient Humidity	:	0-95% RH (max.)

4.10.03 Positioners shall be capable of functioning under hot, humid and vibrating conditions.

4.10.04 Positioner casings shall be dust tight, corrosion resistant and weatherproof (IP-55).

4.10.05 In general, positioner shall operate at signal range 4 – 20 mA DC for the full travel of the valve. Split range operation in few cases may be required. Remote calibration from control room shall be possible through HART management station.

4.11.00 VALVE ACCESSORIES

The accessories of the valves shall include side mounted hand wheels, smart positioner, limit switches, tubing and air set, junction boxes, airlock relays, volume booster, solenoid valves, and any other devices as required.

4.12.00 TESTS

All valves shall be tested in accordance with the Quality Assurace Programme (QAP). Bidder shall submit QAP for Owner's approval. The tests shall include but not be limited to the following :

01. Non destructive test as per ANSI B 16.34.

02. Hydrostatic shell test as per ANSI B 16.34 prior to seat leakage test.

03. Valve closure test and seat leakage test as per ANSI B 16.34 and as per the leakage class

04. Functional test : The fully assembled valves with actuator and all accessories shall be functionally tested to demonstrate from open to close position and vice versa. Valve lift shall be checked at 5 points at 0, 25, 50, 75 and 100% in both the directions with increasing and decreasing inputs. Performance of the valve with Positioner shall be as follows :

    a. Linearity : +/- 1%
    b. Hysteresis : +/- 1%
    c. Sensitivity : +/- 0.5%
    d. Deadband : +/- 1%
    e. Reproducibility : 0.3% of total stroke
    f. Overall accuracy : +/- 1%

05. CV test : Cv test shall be carried out as type test on each size, type and design of the valves as per ISA 75.02 standard and test report shall be submitted for Owner's approval.

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..

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 lampwith door switch, space heater with thermostat and 5A, 3 Pin receptacle with plug. Exhasut/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.

5.01.00 UNIT CONTROL DESKS

5.01.01 All devices mounted on the control desks shall be flush type. Instruments / devices shall be so mounted that the removal and replacement can be accomplished individually without interruption of services to others.

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 seperator, 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-IIE 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 guage 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.

5.04.01 Closed Type Transmitter Racks

a) Required number of transmitter racks shall be furnished to house transmitters, switches and converters by grouping them suitably, area-wise / function-wise. Closed type Instrument rack to have the list of the Transmitters & Switches along with the service and KKS tag on the inner face of the front door. Moreover each Transmitter/switches mounted on the 2" pipe shall have label indicating the KKS tag.

b) The transmitter enclosures shall be constructed of 3 mm thick steel plate. The enclosures shall preferably be of modular construction and with two end plate assembly bolted to the frame. Base frame shall be made of ISMC 100 and black colour finish

c) The enclosure shall approximately be 1200 millimeters wide, 1000 millimeters deep and 2200 millimeters high to allow easy access to the internals. Racks shall be reinforced as required to ensure true surfaces and to provide adequate support for instruments and equipment mounted therein. Double interlocking doors shall be provided and shall be arranged for maximum possible access to the interior. Center posts or any member which would reduce access shall not be provided.

d) 2"NB Galvanised pipes shall be laid horizontally and supported at two end channels to mount transmitters/switches at accessible height. Adequate support for Manifold, impulse pipe and cable tray to be provided and the same shall be adjustable.

e) Doors shall have concealed quick removal type pinned hinges and locking handles. Doors locks shall accept the same key all over the plant. Gaskets shall be used between all mating sections to achieve dust proof enclosure rating for the modules and a IP-65 waterproof

and dust tight rating on the terminal boxes. All enclosures shall have access doors on front side. Doors shall have three point Locking system. Doors shall have concealed quick removal type pinned Stainless steel hinges.

f) Bulkheads, especially designed to provide isolation from process line vibration shall be installed on modular bulkhead plates of the transmitter enclosures to meet the process sensing line connection requirements. Removable top and bottom plates shall be furnished. Removable bulk head plates of thickness not less than 6mm shall be mounted on the racks with suitable high temperature gasket impulse line within the enclosures shall be properly clamped..

g) All internal wirings and/or data bus connections, if any, between the transmitters and terminal junction box shall run through flexible dust tight conduits connected to the terminal box hub. No exposed wirings within transmitter racks, both open and closed type, is admissible.

h) All racks shall have a common closed drain trough to connect transmitter drain points to a common header after suitable pressure breaking. Covered funnels shall be used for saturated liquid and steam service, whereas, open funnels may be used for cold liquid services. The trough shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header. 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

i) Vibration dampeners shall be installed for supporting each enclosure. The loading at each corner of the enclosure shall be determined by actual test weighting when construction is complete to determine the correct length of each dampener for proper loading of the dampener in accordance with manufacturer's recommendations.

j) Service Power and Lighting

i) Each enclosure shall be provided with one receptacle, one light fixture with wire guard and one lighting switch. Lighting switches may be door actuated & mounted inside the panel. Outlet box, switch box and device covers shall be of galvanized stamped steel. Light switches and receptacles shall be installed inside the enclosure on the wall near the latch side of the enclosure door. Light fixtures shall be installed on the ceilings of the enclosures.

ii) Power supplies for miscellaneous devices shall be provided with MCB located within the enclosures. MCB shall be mounted in fuse blocks. Nameplates shall be furnished above the MCB blocks, identifying the devices being served.

k) Control Air

i) A control air supply header shall be furnished in each enclosure having pneumatic devices. The header shall be 25 mm NB brass header stock drilled and tapped for 8 millimeter valves.

ii) A valve with double compression end fittings shall be installed in each tap. Not less than three spare connections shall be furnished in each enclosure. The air header shall originate at a bulkhead penetration or fitting located in one of the bulkhead plates. Each pneumatic instrument shall have an individual air shut-off valve.

iii) Pressure reduction shall be achieved by air filter regulator sets. One filter regulator shall be furnished for each group of components making a system.

l) Service Air

In case of Continuous air purging, a 25NB (1") service header shall be formed which shall receive air through isolation valve and air filter regulator. Air shall be fed from air header to impulse pipes near to take-off points through isolation valves and flow regulators. Service Air header shall be Stainless steel. Impulse pipe for such applications shall have four-way valve. one port of the valve shall have an adaptor to connect flexible stainless steel braided nylon to the service air. Rating of the hose having a burst pressure 15 Kg/Sq.cm. four way valve shall have two position operations. One position for service and other one for purging. Required pressure guages shall be provided for monitoring of air pressure. Complete purging arrangement shall be integral to the enclosure and racks.

m) Power Supplies

Contractor shall supply all required transformers, regulators and other power supply equipment to adapt sources of power to the requirements of the enclosure mounted equipment. This shall include but not be limited to internal instrument illumination transformers. The circuits shall be separately isolated with MCBs.

n) Equipment Installation

Special attention shall be given in the piping layout to avoid air traps in liquid filled piping, or water pockets in piping.

o) Impulse Piping /Tubing

i) Transmitter enclosures shall be complete with impulse piping & tubing, valves from enclosure bulkhead connection to all instruments and necessary drain / blow down connections. The type, size, material and pressure class of pipes/tubes, fittings, valves etc. shall be suitable for the intended applications.

ii) Blow down piping / tubing may be shared, but individual instrument piping / tubing and valves shall be furnished. Piping / Tubing material

within enclosures shall conform to the application requirements. The final flexible connection to each instrument shall be fabricated with a double offset so that it may readily be disconnected to permit "in situ" calibration of the instrument.

iii) Bulkhead connection shall be used when instrument piping/ tubing enters the enclosure. For instrument lines which enter through the bottom of the enclosure, the primary process line from the instrument valve shall be neatly installed, anchored and terminated at approximately 150 millimeters above the floor of the enclosure. The enclosure shall have a removable, gasketted floor plate to provide an effective seal around the incoming field primary process line. An angle shall be installed 600 millimeters above the floor, running the length of the enclosure for anchoring of incoming field process lines.

iv) Pulsation dampeners shall be furnished wherever required.

v) Drain pots shall be furnished for instruments measuring flue gas parameters and vacuum.

vi) All liquid filled blow down lines, except those measuring vacuum shall be connected to a header extended through one end of the enclosure and turned downward for directing the blow down into drain. Gas filled lines and lines equipped with drain pots shall not be connected to the blow down header. The connection between the blow down valve and blow down header shall be constructed so that it can be removed to permit the connection of test instruments to the blow down valves.

vii) The draft instrument line four-way valves shall be installed so that the quick disconnect fitting is readily accessible for connection with the service air hose.

viii) Pipe and stainless steel tube welding shall comply with the provisions of the latest applicable ANSI Code for Pressure Piping.

ix) Instrument piping and tubing shall be hydrostatically tested at one and one-half times the maximum system pressure for that instrument except for low pressure and vacuum measurement the test pressure will be as per piping standard.

p) Instrument Tubing

i) Pneumatic tubing shall be installed in a neat workmanlike. It shall be supported frequently enough that it does not shake when subjected to vibration. All tubes which enter or leave the enclosure shall be terminated on bulkhead fittings in the bulkhead plate.

ii) Pneumatic tubing material shall be 6 mm OD stainless steel tubing, unless otherwise specified. Flareless tubing fittings shall be used for tubing connections smaller than one inch. Tubing shall be stretched before installation to assure straightness. Special tools shall be used for all bending and forming operations. Tubing shall be carefully

handled to avoid flat spots, kinks, and short bends. All piping and tubing shall be air blown after erection and before attachment to equipment at either end.

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 though 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

6.02.00 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.

6.11.00 Burn-In And Elevated Temperature Test

Solid-state equipment / system shall be certified to be tested for a minimum period of 168 hours continuously under power. Solid-state logic systems shall be subject to the elevated temperature test and burn-in test as complete assemblies.

6.12.00 Elevated Temperature Test

a) During the first 48 hours the ambient temperature shall be maintained at 50^{0} C and the equipment shall be made to repeatedly perform operations it will be expected to perform in service with loads on various components being equal to those which will be experienced in actual service.

b) The 48 hours test period shall be continuous but shall be divided into four 12-hour segments. The power supply voltage during each 12 hours segment shall be nominal voltage for 11 hours; followed by 110 percent of nominal voltage for 30 minutes; followed by 90 percent of nominal voltage for 30 minutes.

c) During the elevated temperature test the cubicle doors shall be kept closed and inside temperature in the zone of highest heat dissipating

component /module shall be monitored. Temperature rise inside the cubicle shall not exceed 10 Deg.C above the ambient temperature of 50 Deg.C.

6.13.00 Burn in Test

The 48 hours elevated temperature test shall be followed by 168 hours of burn in test at normal operating temperature. This test shall also be conducted as per above procedure.

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 □urface shall be applied to all exterior and interior surfaces, each coat of primer □urface 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.

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 mili 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 gasketted 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, pushbuttons etc.)	: 1.5 Sq.mm
Power supply /receptacle /illumination wiring	: 2.5 sq. mm or higher as per load

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

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 mm^2. 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.

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 seperate with seperate 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/cm^2
	Differential Pressure	: mm of H_2O column / Kg/cm^2
ii)	Draught	: mm of H_2O column
iii)	Vacuum	: Kg/cm^2 (abs)/mm of Hg column

iv)	Temperature	: Degree Celsius (^{O} 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.

	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.

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

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.

3.3.5 Control / Selector Switches

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

3.3.6 Push Buttons / Indicating Lights

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

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

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

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

3.3.7 Ammeters

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

3.3.8 Miniature Circuit Breaker (MCB)

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

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

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

4.0 TESTING AND INSPECTION

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

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

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, corrossion, incidental damage due

to vermin, sunlight, high temperature, rain moisture, humidity, dust, sea-water spray (where applicable) as well as rough handling and delays in Transit and storage in open.

8.0 APPLICABLE DATA SHEET FORMS

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

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

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 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	

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

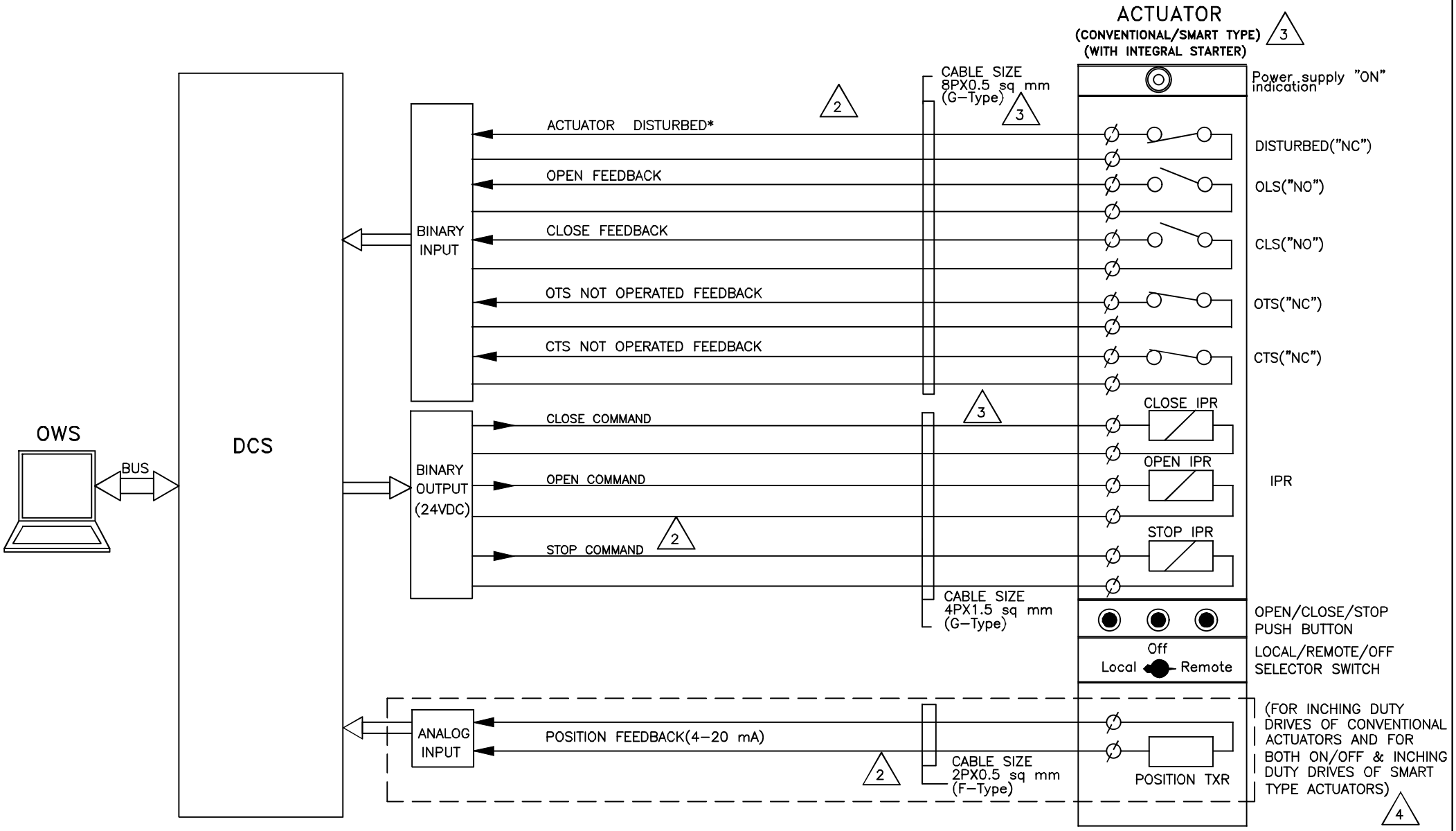
DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

* TO BE CO-ORDINATED WITH PEM ELECTRICAL

	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL
NAME				NAME:
SIGNATURE				SIGNATURE:
DATE				DATE:

SIGNL EXCHANGE BETWEEN DRIVES & DCS

DCS INTERFACE FOR BIDIRECTIONAL DRIVE(WITH INTEGRAL STARTER)



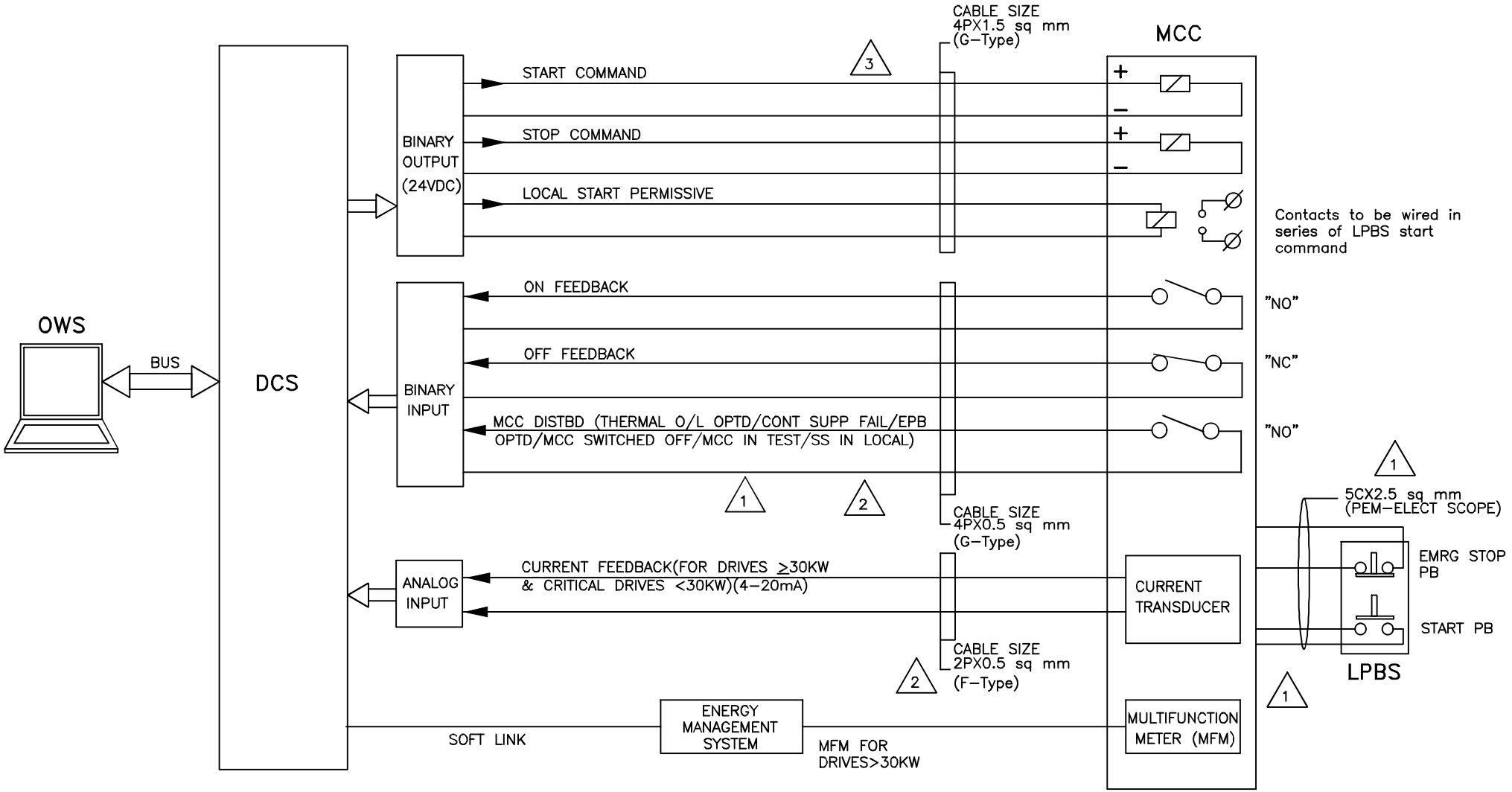
NOTE:

* 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

1

PROJECT:	1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	DRG.NO. PE-DM-445-145-I002
TITLE	DDCMIS INTERFACE FOR BIDIRECTIONAL DRIVE	DATE 15.03.2021
		REV.NO. 04
		SHT 7 OF 11

DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE (CONTACTOR OPERATED) 1

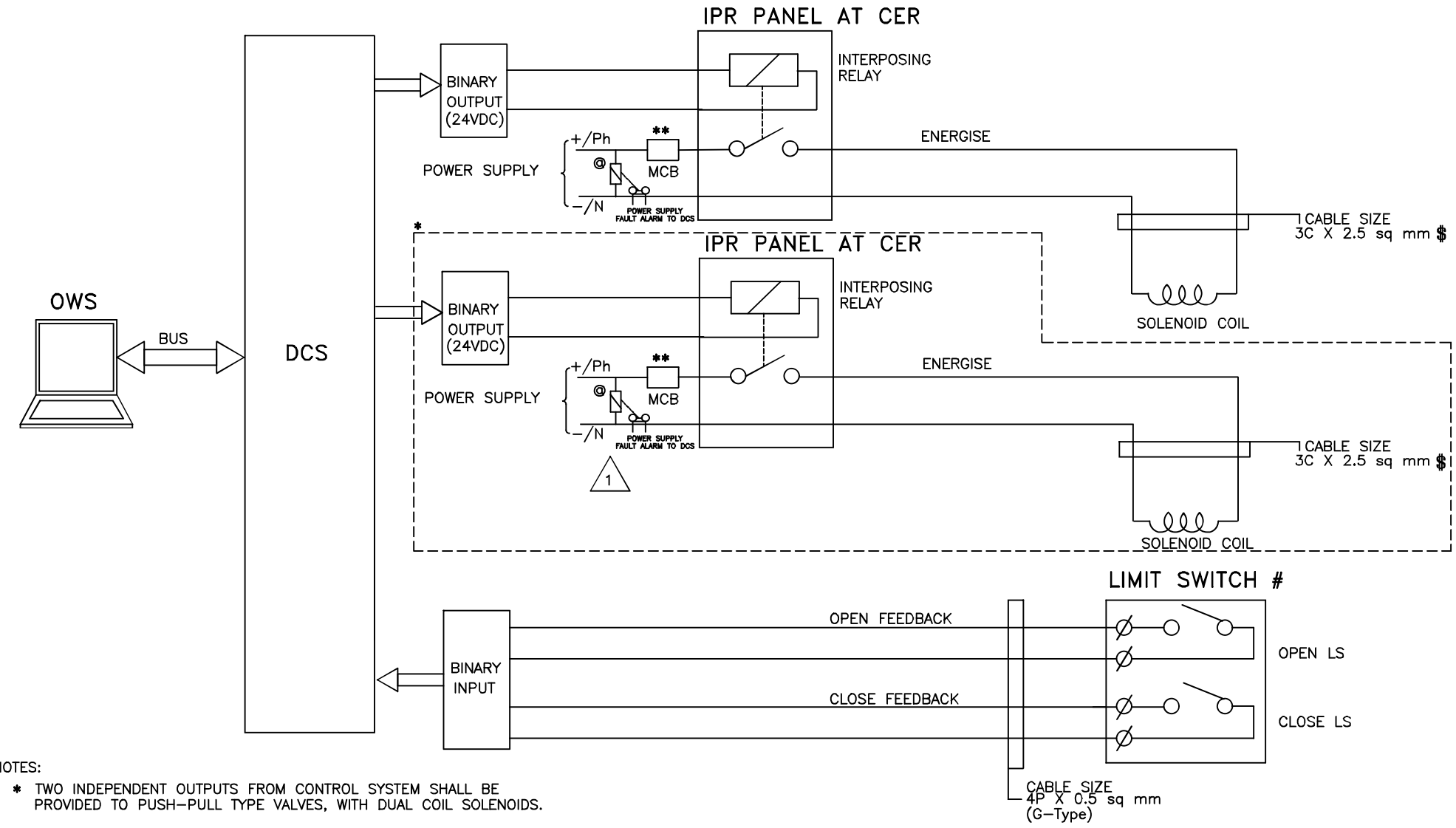


NOTES:

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

PROJECT: 1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	DRG.NO.	PE-DM-445-145-I002
	DATE	15.03.2021
TITLE DDCMIS INTERFACE FOR UNIDIRECTIONAL LT DRIVE (CONTACTOR OPERATED)	REV.NO.	04
	SHT	8 OF 11

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

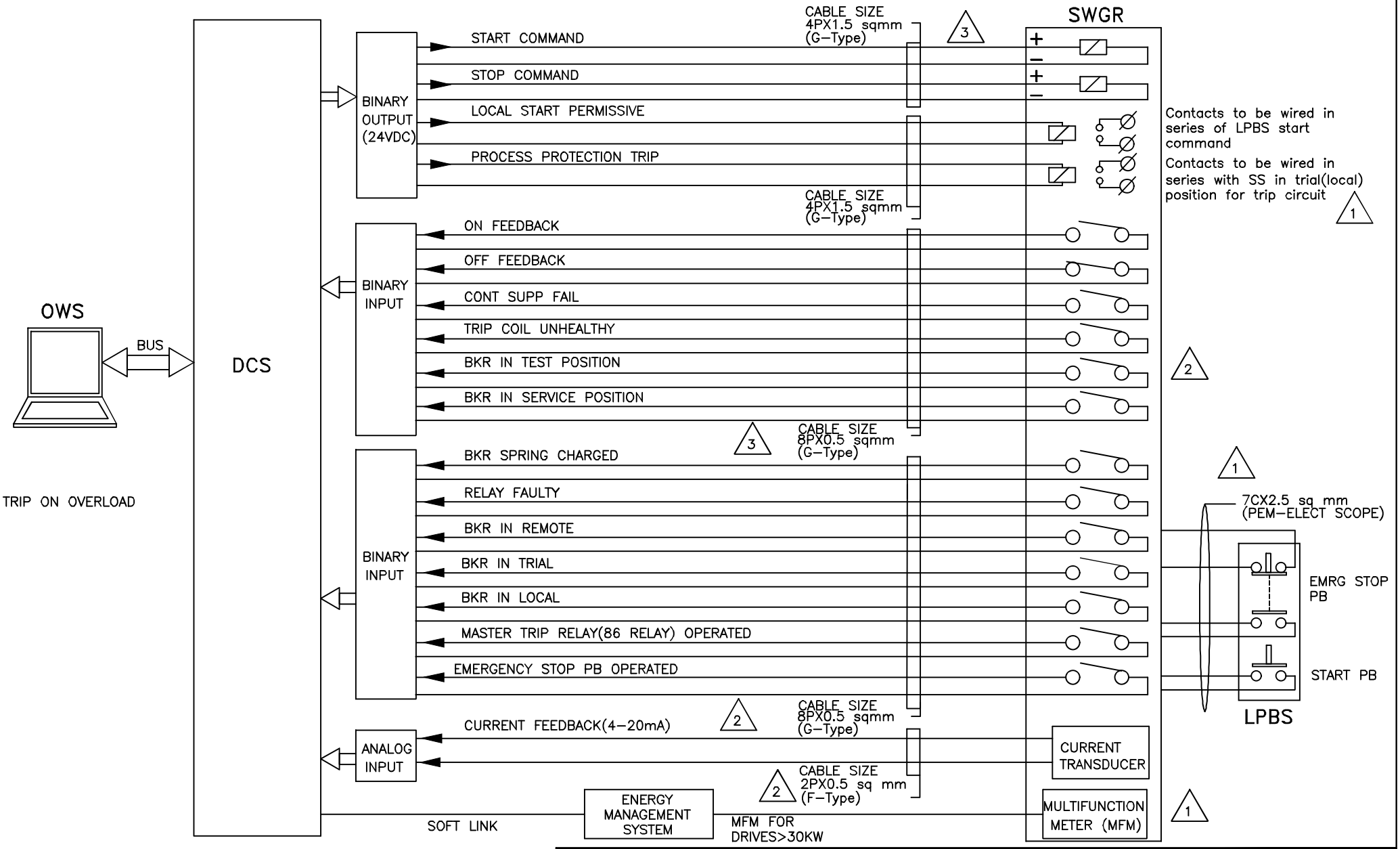
\# FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL/ PNEUMATIC VALVE. △1

@ COMMON FOR ALL SOLENOID VALVES SIMILAR COIL VOLTAGE RATING PER PANEL. △2

$ POWER CABLE CROSS SECTION SHALL BE AS PER CABLE SIZING CALCULATION. △3

BHEL	PROJECT: 1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	DRG.NO. PE-DM-445-145-I002
		DATE 15.03.2021
	TITLE DDCMIS INTERFACE FOR SOLENOID DRIVE	REV.NO. 04
		SHT 9 OF 11

DCS INTERFACE FOR HT/LT UNIDIRECTIONAL DRIVES(BREAKER OPERATED)

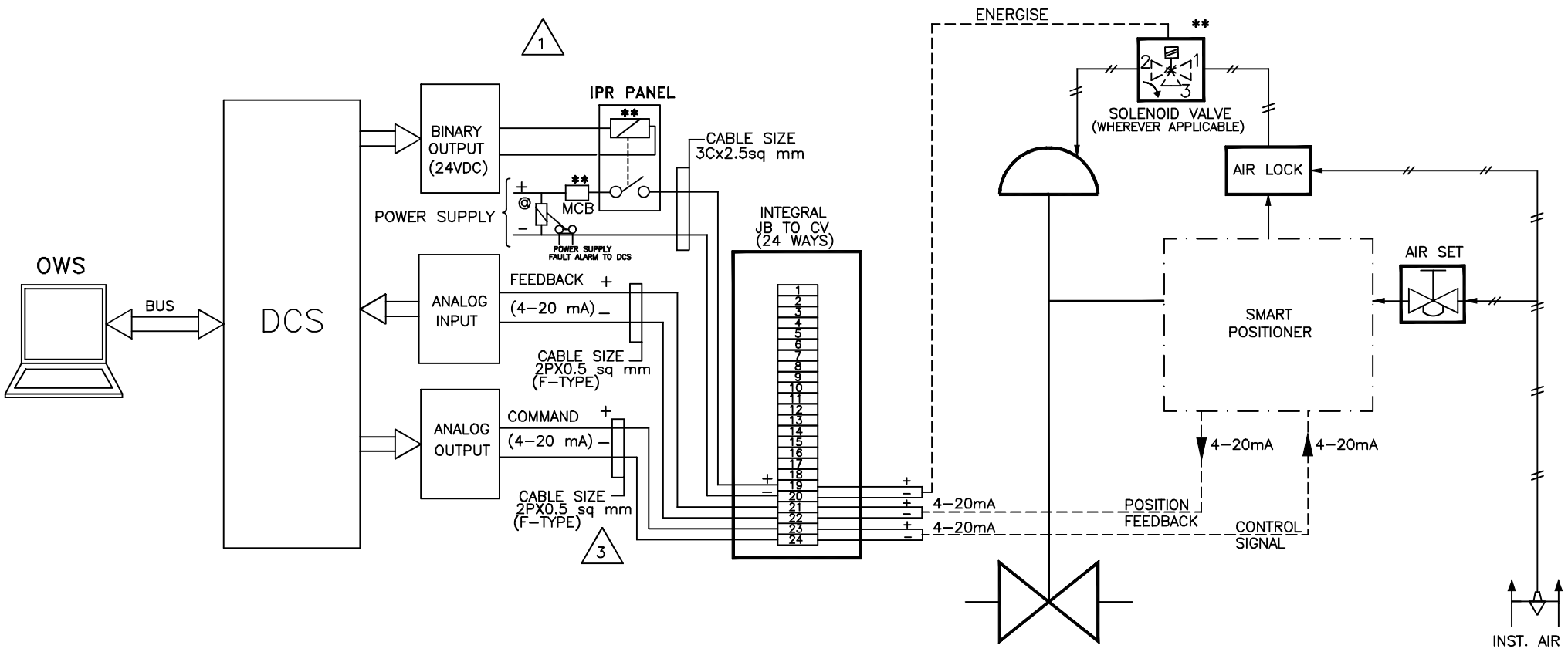


NOTES:

REDUNDANCY IN OUTPUT SHALL BE PROVIDED FOR ALL HT AND CRITICAL LT DRIVES

PROJECT:	1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	DRG.NO. PE–DM–445–145–I002
TITLE	DDCMIS INTERFACE FOR UNIDIRECTIONAL HT DRIVE	DATE 15.03.2021
		REV.NO. 04
		SHT 10 OF 11

DCS INTERFACE FOR ANALOG DRIVE (WITH SMART POSITIONER)



NOTES:

** APPLICABLE TO VALVES WHERE PROTECTION OPEN/CLOSE ACTION FOR CONTROL DEMAND OVERRIDING IS REQUIRED.

@ COMMON FOR ALL SOLENOID VALVES PER PANEL.

1 REDUNDANCY IN OUTPUT SHALL BE PROVIDED FOR ALL MODULATING DRIVES

PROJECT: 1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	DRG.NO.	PE-DM-445-145-I002
	DATE	15.03.2021
TITLE: TYPICAL HOOK-UP DIAGRAM ANALOG DRIVE (WITH SMART POSITIONER)	REV.NO.	04
	SHT	11 OF 11

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 JBs 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.

11.04.00 CONTROL & POWER CABLE

Bidder shall refer to Volume IIF of the electrical specification for detail.

11.05.00 OPTICAL FIBER CABLE

11.05.01 This specification defines the minimum general requirements for the Design, manufacture, supply, inspection, installation, testing & commissioning of optical fiber cables and accessories, such as fiber distribution (patch) panels, adapters, connectors, joint boxes, pigtails and other components, as required to complete the system. Bidder shall consider all related activities, such as cable stripping, cable entry in boxes and panels, cable fiber splicing/fusion, cable performance testing and other services, to achieve a properly documented and operational cable network. all Fibre Optic cables shall be Single Mode type.

11.05.02 Fiber Optic Cables shall be installed on cable tray, duct bank, cable trench installation as necessary. For outdoor applications the cable shall be armoured with Poly Ethylene sheathing. In all cases cable shall be routed through suitable grade HDPE permanently lubricated protection pipe as per IS 4984, IS 12235 & TEC.G/CDS-08 /01of suitable size @ 53% fill factor. Permanent route marking in FRP (Fibre Reinforced Plastic) material shall be provided at intervals not exceeding 5 meters for all FO cables layed outdoor buried under the ground.

11.05.03 The Optical Fiber core shall be of ultra pure fused silica glass coated with UV-cured acrylate suitable to withstand temperature of about 80°C (continuous).

11.05.04 Fiber optic cable shall be of loose tube design. Typically, fibers shall be housed in-groups of 6 (minimum) within gel-filled buffer tubes to protect against ingress of moisture and vibration. The tubes shall be manufactured with industry standard material like Poly-Butylenes Terathylate (PBT). They shall be colored for easy identification. Buffer tubes shall be approachable with industry standard tools and practices. The buffer tubes shall be stranded around the Central Strength Member utilizing Reverse Oscillating Lay (ROL). Blank fillers shall be used as necessary to maintain circular cable structure. The fiber optic cable shall withstand water penetration when tested with a one meter static head or equivalent continuous pressure applied at one end of a one meter length of filled cable for one hour. No water shall leak through the open cable end.

11.05.05 The central strength member of the cable shall be Fiberglass Reinforced Plastic (FRP) or other material with equivalent mechanical strength to provide both tensile and anti buckling strength to the cable.

11.05.06 In addition to central strength member, additional strengthening substance like aramid yarns shall be helically applied over the cable core to provide additional tensile strength to the cable.

11.05.07 The cable shall be of dual jacket & armoured. Inner sheath consists of a medium density polyethylene (MDPE) jacket extruded over the cable core. Two highly visible ripcords are placed under the jacket to aid in sheath removal. A co-polymer coated steel tape is corrugated and wrapped around the inner jacket to provide additional cable compression strength and rodent protection. The armor is covered with an outer black FRLS MDPE jacket. A ripcord is also placed underneath the armor for easy outer jacket removal.

11.05.08 Minimum bending radius shall be equal or more to 15 D (D= Diameter). A continuous strength member shall be provided for the entire length of the cables. Every tube and fiber shall be colour coded to provide easy identification. The outer sheath shall be marked to show fiber type and cable classification at suitable intervals.

11.05.09 The entire length of each cable shall be marked with the following items:

- Manufacturer's Name
- Month and year of manufacturing
- Coded description of the cable based on Telcordia's (Bellcore) SR-2014 Suggested Optical Cable Code (SOCC).
- Sheath Identification Number
- Sequential Length Marking in meter
- A Telephone Handset symbol to distinguish communication from power cable as per NESC section –35 G.

11.05.10 Fiber optic cable shall provide a long life expectancy of minimum 25 years and shall meet the industrial standard of operation at temperature of 55^0 C

and humidity to 100% without degradation to optical or mechanical performance.

11.05.11 Optical fiber used in the plant shall generally conform to the following specification.

SPECIFICATION FOR G.652 MONOMODE FIBER

	ATTRIBUTES	VALUE
1.	Cladding Diameter	125 μm ± 1.0 μm
2.	Cladding non-circularity	≤ 1.0%
3.	Attenuation Coefficient at (a) 1290 nm to 1340 nm (b) 1525 nm to 1575 nm	 < 0.36 dB/km < 0.25 dB/km
4.	Chromatic Dispersion Coefficient at (a) 310 nm (b) 1550 nm	 < 3.5 ps/nm.km < 18 ps/nm
5.	Polarization Mode Dispersion (PMD)	≤ 0.5 ps/√ km
6.	Mode Field Diameter at (a) 1310 nm (b) 1550 nm	 9.2 ± 0.4 μm 10.50 ± 1.0 μm
7.	Mode Field Concentricity Error	≤ 0.5 μm
8.	Proof Test	≥1%
9.	Fiber Curl (ROC)	≥ 4.0 m
10.	Macro-bend Test on Fiber at 1550 nm	≤ 0.1 dB

11.06.00 Cable Assembly

11.06.01 Optical Fiber Environmental Splice Enclosure

Optical fiber environmental splice joint enclosures shall be re-enterable and rack / wall mountable. The interior splice case shall be equipped to mechanically accommodate single-mode optical fibers connected by the fusion method. Splice case shall be equipped to organize the splice trays and the required service loops of buffered incoming optical fibers and outgoing 'pigtails' in such a way that allows each completed splice and associated optical fiber to be maintained in an unstrained configuration. Splice enclosure shall be dust and weather proof.

11.06.02 Fiber Optic Distribution Patch Panel

Fiber optic distribution panels shall be provided as required. The fiber optic distribution panels shall be of a standard wall mounted sheet metal enclosure type. Fiber optic distribution panels shall be equipped to secure optical fiber patch cables and pigtails to prevent damage during all operation and maintenance functions. In general splice enclosure are envisaged. However, If no optical fiber splice enclosures are implemented, than the fiber optic distribution panels shall be equipped with splice trays for storage and protection of fusion splice connections of single-mode fiber optic cable and pigtails. Each fiber optic distribution panel shall be fully equipped with 'SC' type bulk head connector sleeves or equivalent. Unused sleeve ports shall be equipped with reusable caps to prevent the intrusion of dust.

11.06.03 Pigtail and Patch Cord

All pigtails shall be factory SC-connectorized, and satisfy specified performance for optical links. All unused pigtails (including spares) shall be terminated with the connector to a bulkhead connector sleeve, protected by a reusable cap on the opposite sleeve port, to prevent the intrusion of foreign material or dust. All necessary connectorized pigtails shall be provided in the lengths required.

11.06.04 Fiber Optic Tool Kit

Fiber Optic Splicer, Terminator And Tool Kit Box

Bidder shall provide new unused tools comprise of Splicer and Fusion Jointer and tool kit comprise of cutter, stripper, polishing tool, handheld microscope, heat shrinkable sleeve, scissor, knife etc. as required for maintenance and commissioning.

11.07.00 Tests

Following minimum test as per any approved standards shall be carried out on the cables

a. Attenuation And Dispersion Characteristics Tests
b. Proof Tests
c. Macro-Bend Resistance Test
d. Mechanical Tests
e. Low And High Temperature Cable Bend Test
f. Impact Resistance Test
g. Compressive Strength Test
h. Tensile Strength Test
i. Cable Twist Test
j. Cable Cyclic Flexing Test
k. Environmental Characteristics Test
l. Temperature Cycling Test

m. Color Permanence Test Cable Aging Test

n. Water Penetration Test

o. Lightning Test

p. Routine Test / Sample Test

Site Test (Like Continuity & Attenuation)

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.
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

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 (½ 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 (½ 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 (½ 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 (½ INCH)	ASTM-A105	ASTM-A-182 GR. F6A	3000 LB	800
08.	AIR / FLUE GAS OUTSIDE FURNACE	M	ASTM-A106 GR. B/C	80 (¾ INCH)	ASTM-A105	ASTM-A-182 GR. F6A	3000 LB	800
09.	AIR / FLUE GAS INSIDE FURNACE	N	ASTM-A335 GR. P-22	80 (¾ 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 (½ 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

QUALITY ASSURANCE PLAN/CHECK LIST

2.00.00 GENERAL REQUIREMENTS - QUALITY ASSURANCE

2.01.00 All materials, components and equipment covered under this specification shall be procured, manufactured and tested at all the stages, as well as Services provided for erection, commissioning and testing shall be as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the Bidder for some of the major items is given in the respective technical specification. This is however, not intended to form a comprehensive programme as it is the Bidder's responsibility to draw up and implement such programme and reviewed by by the Owner/Consultant. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder, separately in the format attached at Annexure-I and will be submitted to Owner/Owner's representative for review. Schedule of finalisation of such quality plans will be finalised before award.

2.02.00 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Bidder's Quality Control organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing.

2.03.00 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Bidder's site Quality Control organisation, during various stages of site activities from receipt of materials/equipment at site.

2.04.00 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality plans and reference documents/standards etc. will be subject to Consultant's approval without which manufacture shall not proceed. In these approved quality plans, Owner/Authorised representative/Consultant shall identify Customer Hold Points (CHP), test/checks which shall be carried out in presence of the Owner/Consultant/Owners Owner's Engineer or his Authorised Representative and beyond which the work will not proceed without consent of Owner/Authorised representative/Consultant in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner/Authorised Representative/Consultant for acceptance and dispositioning.

2.05.00 The Bidder shall provide adequate notice to the Owner for inspection before the material is dispatched as per the provisions of the Contract. No material shall be despatched from the manufacturer's works before the same is accepted subsequent to pre-despatch final inspection including verification of records of

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3.00.00 QUALITY ASSURANCE DOCUMENTS

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

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

b) The inspection plan with verification, inspection plan check points, verification sketches, if used and methods used to verify that the inspection and testing points in the inspection plan were performed satisfactorily.

c) Non-destructive examination results /reports including radiography interpretation reports.

d) Factory tests results for testing required as per applicable codes and standards referred in the specification.

e) Welder identification list listing welder's and welding operator's qualification procedure and welding identification symbols.

f) Sketches and drawings used for indicating the method of traceability of the radiographs to the location on the equipment.

g) Stress relief time temperature charts.

h) Inspection reports duly signed by QA personnel of the Owner and Bidder for the agreed inspection hold points. During the course of inspection, the following will also be recorded :

i) When some important repair work is involved to make the job acceptable.

ii) The repair work remains part of the accepted product quality.

i) Letter of conformity certifying that the requirement is in compliance with finalised specification requirements.

4.00.00 INSPECTION, TESTING AND INSPECTION CERTIFICATES

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

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

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.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR TEMPERATURE SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	100%	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE						
	MODEL/TAG NO.						
	RANGE/SCALE						
	END CONNECTION						
2	DIMENSIONS CHECK	100%		P	W	V	
3	ACCURACY	100%		P	W	V	
4	SWITCHING DIFFERENTIAL	100%		P	W	V	
5	CONTACT RATING / No. OF CONTACTS	RANDOM		P	W	V	
6	MATERIAL TC FOR BULB, CAPILLARY, ARMOUR	ONE / LOT		P	V	V	
7	HV / IR	RANDOM		P	W	V	
8	DEGREE OF PROTECTION	TYPE TEST		P	V	V	
9	THERMOWELLS						
	DIMENSIONS,PROCESS CONN	100%		P	W	V	
	MATERIAL TC	ONE / LOT		P	V	V	
	HYD TEST	100%		P	W	V	
	IBR CERTIFICATE, IF APPLICABLE			P	V	V	
10	REPEATABILITY	100%		P	V	V	
11	HYSTERISIS	100%		P	V	V	
12	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		P	W	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL,
P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.
4. Manufacturer to carry out routine test for 100%

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR PRESSURE SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	V	V	
	1.1 MODEL NO/TAG NO						
	1.2 RANGE						
	1.3 END CONN						
	1.4 NO. OF CONTACT						
2	CALIBRATION			P	V	V	
	2.1 REPEATABILITY						
	2.2 SET POINT ADJUSTMENT						
	2.3 DIFFERENTIAL						
3	OVER PR & LEAK TEST			P	V	V	
4	ELECT. INSULATION/HV TEST	ONE		P	V	V	
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT		V	V	V	
	5.1 SENSOR						
	5.2 MOVEMENT						
	5.3 PROCESS CONNECTION						
	5.4 HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	REVIEW OF TC OF MICROSWITCH	FOR LOT		V	V	V	

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P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to carry out ROUTINE TEST on 100 %.
3. Contractor to provide compliance certificate for tests/checks verifid by contractor and the same alongwith test certificates to be verified by BHEL

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR FLOAT OPERATED LEVEL SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	V	V	
	MODEL NO/TAG NO						
	TYPE						
	END CONNECTION						
2	ON/OFF DIFFL			P	W	V	
3	REPEATABILITY			P	W	V	
4	IR TEST			P	W	V	
5	HV TEST			P	V	V	
6	PR. TEST ON CHAMBER	SEE NOTE-5		P	V	V	
7	MATL. TC FOR CHAMBER & FLOAT	FOR LOT	---	V	V	V	
8	CONTACT CONFIG. & RATING FOR MICROSWITCH	FOR LOT	---	V	V	V	
9	TC FOR DEGREE OF PROTECTION	TYPE TEST	---	V	V	V	
10	MANUFACTURER TO ENSURE WELDING PROCEDURE,WELDERS & NDT AS PER ASME FOR PR >40 KG/CM2		---	P	V	V	
11	CHECK FOR TEMP. SUITABILITY FOR MICROSWITCH AND LEAD WIRE	SEE NOTE-1 BELOW	---	V	V	V	
12	ACCESSORIES AS APPLICABLE		APPROVED SPEC./ DATA SHEETS	V	V	V	

Legend :

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P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. When material corelation is not available, MFR's compliance to be provided
5. IBR certificates shall be provided wherever required.
6. Contractor to provide compliance certificate for tests/checks verifid by contractor and the same alongwith test certificates to be verified by BHEL

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR ANNUNCIATORS

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE/ MODEL						
	DIMENSIONS OF HARDWARE						
	MODULARITY						
	SEQUENCE						
	FACIA DETAILS						
2	FUNCTIONAL TEST	100%		P	W	V	
3	IMMUNE TO STEP VARIATIONS IN THE POWER SUPPLY	SEE NOTE-1 BELOW		P	W	V	
4	DEGREE OF PROTECTION FOR ENCLOSURE	TYPE TEST		P	W	V	
5	I/R CHECK	SEE NOTE-1 BELOW		P	W	V	
6	RESPONSE			P	W	V	

Legend :

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P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR TRANSMITTER

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECKS FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	VISUAL.						
	MODEL/TAG No						
2	PROCESS CONNECTION			P	W	V	
3	ACCURACY			P	W	V	
4	REPEATABILITY			P	W	V	
5	HYSTERESIS			P	W	V	
6	EFFECT OF TEMP VARIATION ON ACCURACY			P	W	V	
7	SPAN / ZERO ADJUSTMENT	ONE / TYPE		P	W	V	
8	EFFECT OF SUPPLY VOLTAGE VARIATION			P	W	V	
9	EFFECT OF LOADING (500 OHM METERS)			P	W	V	
10	HIGH PRESSURE TEST	SEE NOTE-1 BELOW		P	W	V	
11	BURN-IN TEST	ONE / TYPE		P	W	V	
12	DEGREE OF PROTECTION			P	W	V	
13	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

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P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. When material corelation are not available manufacturer's compliance to be provided.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR TEMPERATURE ELEMENT

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE						
	MODEL No./TAG No.						
	PROCESS CONNECTION						
2	STABILITY			P	W	V	
3	INSULATION RESISTANCE			P	W	V	
4	ENCLOSURE CLASS			P	W	V	
5	RESPONSE TIME			P	W	V	
7	ACCURACY			P	W	V	
8	HYDROSTATIC TEST			P	W	V	
9	ELECTRICAL CHARACTERISTIC OF SENSOR (CONTINUTY OF T/C WIRES & INSULATION RESISTANCE OF RTD LEADS w.r.t. BODY			P	W	V	
10	TEMP CURVES / CHARTS			P	V	V	
11	AMBIENT TEMP. EFFECT CHECK			P	W	V	
12	HV TEST			P	W	V	

Legend :

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P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.
4. IBR certificate to be provided, if applicable

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR SOLENOID VALVES

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE						
	MAKE						
	MODEL No.						
2	MATERIAL (BODY. PLUNGER/TRIM)			P	W	V	
3	PORT SIZE			P	W	V	
4	CABLE CONNECTION SIZE			P	W	V	
5	ENCLOSURE CLASS			P	W	V	TYPE TEST CERTIFICATE TO BE FURNISHED BY VENDOR
6	No. OF COILS & INSULATION CLASS			P	W	V	TEST CERTIFICATE TO BE FURNISHED FOR INSULATION CLASS BY VENDOR
7	POWER SUPPLY CHECK			P	W	V	
8	IR / HV TEST			P	W	V	
9	FUCTIONAL TEST			P	W	V	

Legend :

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P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR TEMPERATURE GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	DIAL SIZE						
	MODEL NO./TAG NO./TYPE						
	RANGE/SCALE						
	END CONNECTION						
2	CALIBRATION			P	W	V	
	ACCURACY						
	REPEATABILITY						
	HYSTERESIS						
3	OVER TEMP. TEST			P	W	V	
4	AMBIENT TEMP. COMPENSATION CHECK	1 OF TYPE		P	V	V	
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT		V	V	V	
	SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	THERMOWELL						
	HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	THERMOWELL	SEE NOTE-1 BELOW	AS PER APPD DWG		V	V	
	MATERIAL TC & DIMN. CHECK						
	HYD.TEST						
	OVER RANGE TEST						

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL,
P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. IBR certificate to be provided if called for in specn.
5. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR PRESSURE & DP GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	SENSOR TYPE						
	DIAL SIZE						
	MODEL NO/TAG NO						
	RANGE/SCALE						
	SWITCH CONTACT RATING & NOS.						
	END CONNECTION						
2	CALIBRATION			P	W	V	
	ACCURACY						
	REPEATABILITY						
	SET POINT ADJUSTMENT						
3	OVER PRESSURE & LEAK TEST			P	W	V	
4	OPERATION OF PRESSURE. RELIEF DEVICE	ONE		P	W	V	
5	REVIEW OF TC FOR	FOR LOT		V	V	V	
	MATERIALS OF SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL,
P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. When material corelation is not available, MFR's compliance to be provided
5. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR LEVEL GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS / DRWGS	P	W	V	
	TYPE						
	MODEL/ TAG NO.						
	DAIL SIZE						
	RANGE/SCALE						
	END CONNECTION						
2	DIMENSIONS, PROCESS CONNECTION			P	W	V	
3	ACCURACY			P	W	V	
4	MATERIAL TC FOR	ONE / LOT		P	V	V	
	BODY ISO.						
	VALVE						
	GAUGE GLASS						
5	HYD. TEST	SEE NOTE-1 BELOW		P	W	V	
6	ACCESSORIES AS APPLICABLE			P	W	V	

Legend :

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P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR SIGHT FLOW INDICATOR

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	MODEL						
	TAG No.						
	VISUAL						
2	DIMENSIONS,			P	W	V	
3	PROCESS CONNECTION			P	W	V	
4	RANGE / SCALE			P	W	V	
5	ACCURACY			P	W	V	
6	MATERIAL TC FOR METERING TUBE, ORIFICE PLATE, FLANGES AND FASTNER			P	V	V	
7	CALIBRATION REPORT	ONE / SIZE		P	V	V	
8	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	
9	TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	

Legend :

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P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and the same alongwith test certificates to be verified by BHEL

PEM :: C&I

STANDARD QUALITY PLAN
FOR
LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	1 OF 7

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

LEGEND:
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V - Agency Verifying the Test.

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2 - Vendor
3 - Sub-vendor

PEM :: C&I

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
		3. Conductor a) Resistance b) Size c) Sheet colour	 MA MA MA	 Electrical Measurement Visual	 100% 100% 100%	 BHEL Spec. and IS:1554 or IS:694	 BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	3	---	2	
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type	CR	Visual	Sample	BHEL Spec. and BOM	BHEL Spec. and BOM	Log Book	2	---	---	
		2. Verification of Test Certificates	CR	Scrutiny of Type / Routine T.Cs.	100%	Relevant IS	Relevant IS	Log Book	2	---	---	
		3. Operation / Functional check	CR	Electrical	Sample+ 100%@	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---	+ for relay & contactors only
		4. I.R.	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---	@ for all components except relays & contactors.
		5. H.V.	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---	
		6. Calibration	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	1	
		7. Pick up / Drop off Voltage	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---	

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PEM :: C&I

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		2. Surface defects	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		3. IR / HV on Terminal Blocks	MA	Electrical	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
	IN PROCESS											
6.0	Blanking / Bending / Forming	1. Dimensions	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Surface defects after bending	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	---	
7.0	Nibbling / Punching	1. Cutout Sizes	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Deburring	MA	Visual	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
	ASSEMBLY											
8.0	Frame Assembly & Sheet fixing	1. Dimensions	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		2. Alignment	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		3. Welding Quality	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		4. Surface defects	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		3. Dipping / Removal Time	MA	Measurement	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		4. Surface quality after every dip	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		5. Primer after phosphating	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		6. Putty Application & Rubbing after primer	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		7. Paint first coat	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	

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PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

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

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PEM :: C&I

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

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

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TYPE TEST REQUIREMENT

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.

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	IS-2147	NO	YES	
		AMBIENT TEMP. EFFECT	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
			●	SHRINKAGE	VDE 0472			
	D)	OUTER SHEATH	●	LOSS OF MASS	VDE-0472			
			●	AGING IN AIR OVENS	VDE 0472 **			
			●	TENSILE STRENGTH AND ELONGATION TEST BEFORE AND AFTER AGEING	VDE 0472 **			
			●	HEAT SHOCK	VDE 0472 **			
			●	HOT DEFORMATION	VDE 0472			
			●	SHRINKAGE	VDE 0472			
			●	BLEEDING & BLOOMING	IS-5831			
			●	COLOUR FASTNESS TO WATER	IS-5831			
			●	COLD BEND / COLD IMPACT TEST	IS-5831			
			●	OXYGEN INDEX TEST	ASTMD-2863			
			●	SMOKE DENSITY TEST	ASTMD-2843			
			●	ACID GAS GENERATION TEST	IEC-754-I			
	E)	FIILERS	●	OXYGEN INDEX TEST	ASTMD-2863			
			●	SMOKE DENSITY TEST	ASTMD-2843			
			●	ACID GAS GENERATION TEST	IEC-754-I			
	F)	AL-MYLAR SHIELD	●	CONTINUITY TEST				
			●	SHIELD THICKNESS				
			●	OVERLAP TEST				
			●	NOISE INTERFERENCE	IEEE TRANSACTIONS			
	G)	OVERALL CABLE	●	FLAMMABILITY	IEEE 383			
			●	NOISE INTERFERENCE				

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	
17.	LIE / LIR / JUNCTION BOX	DEGREE OF PROTECTION TEST	IS-2147	YES	YES	

APPLICABLE CODES AND STANDARDS

5.00.00 CODES AND STANDARDS

The design, manufacture, inspection, testing, site calibration and installation of all C&I equipment and systems covered under this specification shall conform to the latest editions of applicable codes and standards eg. ANSI, ASME, IEEE, ISO, IEC, IGCI, AWS, NFPA, AISC, IGS, SAMA, UBC, UL, NESC, NEMA, ISA, DIN, VDE , IS etc. Generally, the following latest edition of codes and standards prevailing at the time of award of contract shall be applicable.

1) Temperature Measurement

a) Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974).

b) Temperature Measurement - Thermocouples - ANSI - MC 96.1 - 1982.

c) Temperature Measurement by electrical resistance thermometers - IS: 2806

d) Thermometer-element-Platinum resistance - IS: 2848 / DIN 43760.

2) Pressure Measurement

a) Instrument and apparatus for pressure measurement - ASME PTC 19.2 (1964).

b) Bourdon tube pressure and vacuum gauges - IS: 3624/1996.

3) Flow Measurement

a) Instruments and apparatus for flow measurement - ASME PTC 19.5 (1972) Interim supplement, Part-II

b) Measurements of fluid flow in closed conduit - BS 1042.

4) Electronic Measuring Instruments and Control Hardware

a) Automatic null balancing electrical measuring instruments -ANSI C 39.4 (Rev. 1973), IS 9319

b) Safety requirements for electrical and electronic measuring and controlling instrumentation - ANSI C 39.5 / 1974.

c) Compatibility of analog signals for electronic industrial process instruments - ISA-S 50.1: ANSI MC 12.1 / 1975.

d) Dynamic response testing of process control instrumentation - ANSI MC 4.1 (1975) - ISA -S26 (1968).

e) Surge withstand capability (SWC) tests - ANSI C 37.90A (1989), IEC-255.4.

f) Printed circuit boards - IPC TM-650, IEC 326C.

g) General requirements and tests for printed wiring boards - IS-7405 (Part-I)/1973.

h) Edge socket connectors - IEC 130-11.

i) Requirements and methods of testing of wire wrap terminations--DIN 41611 Part-2.

j) Dimensions of attachment plugs and receptacles- ANSI C73-1973.(Supplement ANSI C73a – 1980)

k) Direct Acting Electrical Indicating Instruments - IS - 1248 - 1968

5) Instrument Switches and Contacts

a) Contact Rating - AC services NEMA ICS Part-2 125, A-600

b) Contact Rating - DC services NEMA ICS Part-2 125, N-600

6) Enclosures

a) Enclosures for Industrial Controls and Systems–NEMA ICS-6-110.15 through 110.22

b) Racks, panels and associated equipment -EIA: RS-310-B-1983 (ANSI C83.9 - 1972) / IEC 60947 / IEC 60529

c) Protection Class for Enclosures , Cabinets Control Panels and Desks - IS 2147 1962

7) Apparatus, Enclosures and Installation Practices in Hazardous Area

a) Classification of hazardous area - NEMA Article 500, Volume-6, 1978./ NFPA Article 500 , Vol.70-1984

b) Electrical Instruments in hazardous dust locations - ISA-RP 12.11.

c) Intrinsically safe apparatus - NFPA Article 493 Volume-4 1978.

d) Purged and pressurized enclosure for electrical equipment in hazardous location - NFPA Article 496 Volume-4, 1982.

8) Sampling System

a) Stainless Steel material of tubing and valves, for sampling system - ASTM A 269-79 GRTO-316.

b) Submerged helical coil heat exchangers for sample coolers -- ASTM D11-98.

c) Steam and water sampling ,conditioning and analysis in the power cycle - ASME PTC - 19.11

d) Standard methods of sampling system - ASTM D 1066-69

9) Annunciators

a) Specifications and guides for the use of general-purpose annunciators - ISA RP 18.1.

b) Surge withstand capability tests -ANSI C37.90 a -1971 and IEEE Standard 472-1974.

10) Interlocks, Protections

a) Relays and relay system associated with electric power apparatus - IEEE Standards 3.13.

b) Surge withstand capability tests - ANSI C37.90 a - 1971 and IEEE Standard 472-1974.

c) General requirements and tests for switching devices for control and auxiliary circuits including contactor relays - IS-6875 (Part-I)/1973.

d) Turbine water damage prevention - ASME-TDP-1-1980.

e) Boiler safety interlocks - NFPA Section 85B, 85D, 85E, 85F, 85G.

f) Installation and operation of Pulverized fuel system - ANSI / NFPA 8503

g) Functional diagramming of Instrument and control systems - SAMA PMS 22.1

h) Digital interface for programmable instrumentation - ANSI / IEEE 488

11) Control Valves

a) Control valve sizing (Incompressible fluids) - ISA-S39.2 / 1972.

b) Control valve sizing (Compressible fluids) - ISA-S39.4 / 1972.

c) Control Valve seat leakage – ANSI / FCI 70.2

d) Face to face dimensions of Control Valves - ANSI B16.10

e) Control Valve Capacity Test Procedure – ISA – S75.02

12) Process connection Piping and Tubing

a) Seamless Carbon Steel Pipe - ASTM-A-106.

b) Forged carbon steel fittings - ASTM-A-105.

c) Dimensions of fittings - ANSI-B16.11.

d) Code for pressure piping, welding, hydrostatic testing - ANSI-B 31.1.

e) Nomenclature for instrument tube fittings - ISA-RP 42.1 / 1982.

f) Seamless Stainless Steel Tube ASTM A-213 TP 316 / ASTM A-269 TP 316

g) Seamless Alloy Steel Pipe ASTM A 335 P22

h) Seamless Stainless Steel Pipe ASTM A-312 TP 316

i) Forged and Rolled alloy steel pipe flanges , forged fittings , valves and parts ASTM A - 182

j) Pipe fittings of wrought carbon steel and ally steel - ASTM A - 234

k) Composition bronze metal castings ASTM B - 62

l) Seamless copper tube , bright annealed ASTM B- 168

m) Valves flanged and butt welding ends ANSI B 16.34

13) Cables

a) Thermocouple extension wires / cables - ANSI MC96.1.

b) Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy-IPCEA S-61-402

c) Guide for design and installation of cable system in power generating station (insulation, jacket materials) -IEEE Standard 422.

d) Requirements of vertical tray flame test - IEEE 383

e) Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B33.

14) Electronic Cards, Subassemblies and Components

a) Unpackaged

i)	Vibration	:	IEC-68.2.6
ii)	Shock	:	IEC-68.2.27
iii)	Drop & Topple	:	IEC-68.2.31

b) Packaged

Vibration, Drop & Static Compression - NSTA.

c) Electromagnetic Compatibility

i)	Electrical Fast Transient	:	IEC-801.4
ii)	Surge Withstand	:	IEC-255.4
iii)	Radiated Electromagnetic Field	:	IEC-801.3
iv)	Electrostatic Discharge	:	IEC-801.2
v)	Electromagnetic Emissions	:	VDE 0871, Class-B

15) Cable Trays, Conduits

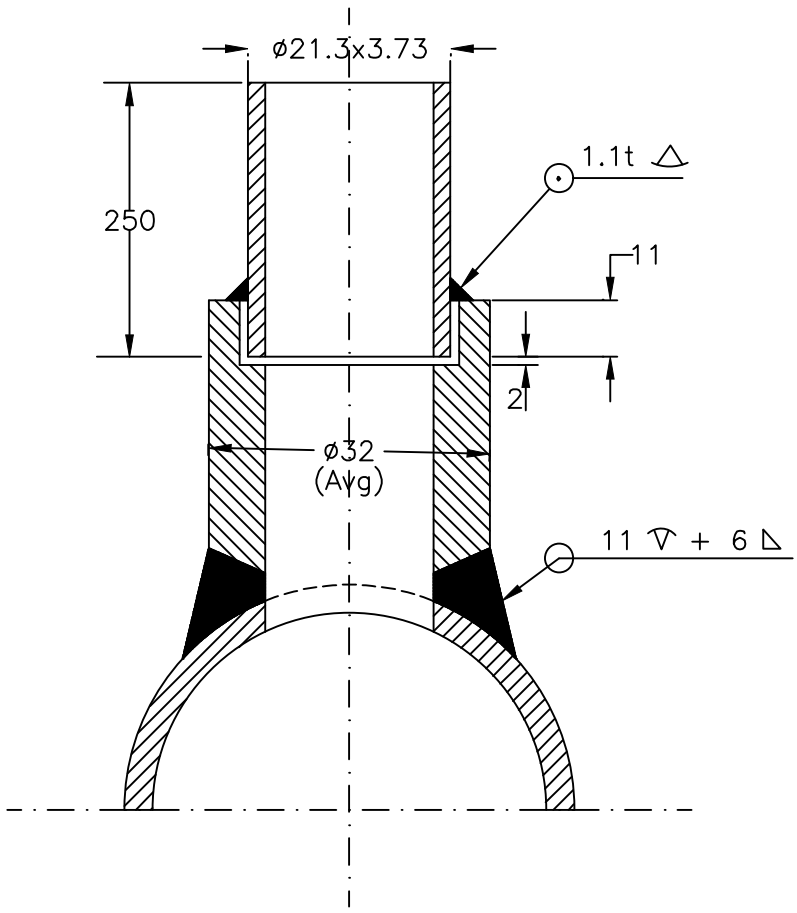
a) Guide for the design and installation of cable system in power generating station (cable trays, support systems, conduits)- IEEE Standard 422, NEMA VE-1, NEC-1981. Test Standards NEMA VE-1-1979.

b) Galvanizing of carbon steel cable trays - ASTM A-386.

Codes and standards as described in different sub-sections of this specification shall also be followed .

Items such as thermowells, control valves, flow elements and other in line devices in high and medium pressure steam, feed water and similar services, which fall under the purview of Indian Boiler Regulation Act shall be either certified by IBR or shall be certified by authorities acceptable to IBR. It shall be responsibility of Bidder to obtain the necessary approval of the concerned Authority / Chief Inspector of Boilers for the design and design calculations, manufacturing and erection procedure as called for under the IBR Act for all items requiring such certification.

INSTRUMENT STUB DETAILS



NOTE :

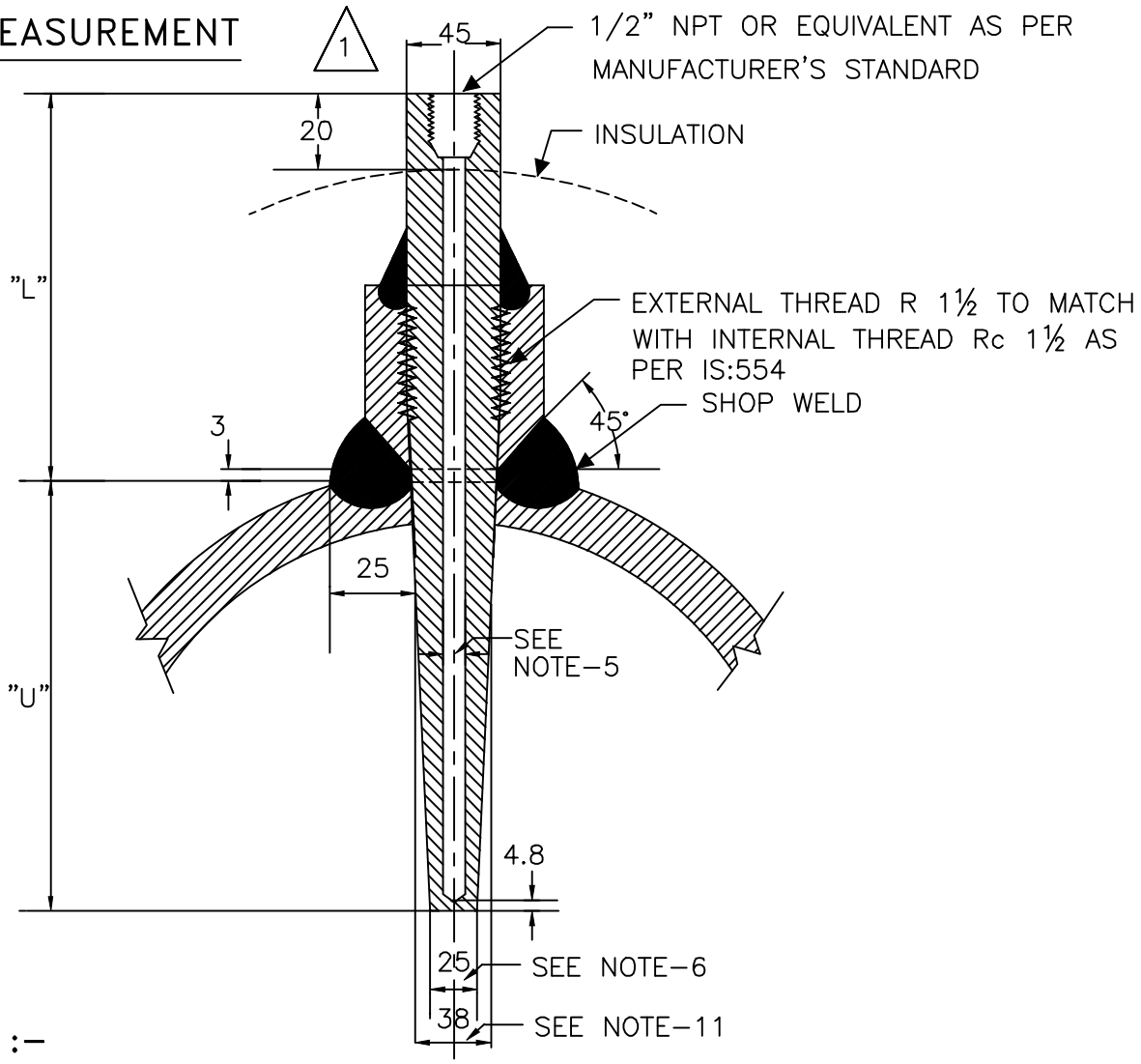
1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B16.11.
2. THE LENGTH OF NIPPLE SHALL BE 250 MM.
3. STUB LENGTH SHALL BE 64mm UPTO 200Nb PIPE, 45mm ABOVE 200Nb PIPE SIZE.
4. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED
5. EDGE HOLE MUST 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 PROCESS DATA. (1)

BHEL

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.

TEMP. MEASUREMENT



NOTES :–

1. THIS TYPE OF TEMPERATURE BOSS SHALL BE USED FOR THE DESIGN PRESS EQUAL/ ABOVE 40 KG/CM2(g) AND FOR DESIGN TEMP EQUAL/ABOVE 400 DegC EVEN IF THE DESIGN PRESSURE IS LESS THAN 40 Kg/Cm2(g)
2. THE MATERIAL OF THE BOSS SHALL BE SIMILAR TO PIPING MATERIAL.
3. MATERIAL OF THE THERMOWELL SHALL BE OF 316SS.
4. THERMOWELL SHALL BE DRILLED BAR STOCK TYPE.
5. INTERNAL BORE OF THE THERMOWELL SHOULD BE SELECTED BASED ON THE NORMAL SIZE OF THE SENSING ELEMENT AS PER ASME PTC–19.3.
6. THE BOTTOM DIAMETER OF THE THERMOWELL TYPICALLY SHOWN HERE SHALL BE SUBJECT TO VARIATION BASED ON THE INTERNAL BORE OF THERMOWELL AND THICKNESS OF THERMOWELL MATERIAL TO WITHSTAND THE PROCESS PRESS AND TEMP AS PER ASME PTC–19.3.
7. THE 'U' & 'L' DIMENSIONS SHALL BE SELECTED BASED ON PARTICULAR APPLICATION.
8. ORIENTATION OF STUB ON VERTICAL/ HORIZONTAL PIPES SHALL BE 90° TO THE CENTRE LINE OF THE PIPES, FOR PIPE SIZE LARGER THAN 4". HEIGHT OF STUB SHALL BE 64mm FOR PIPE OD < 200Nb AND 45mm FOR PIPE OD ⩾ 200Nb.
9. STUB SHALL HAVE IBR CERTIFICATION, AS APPLICABLE, ACCORDING TO PROCESS DATA. 1
10. BOSS OD SHALL BE DEPENDENT ON PROCESS PRESS, TEMP & PIPE DIAMETER.
11. THERMOWELL SHALL BE SUITABLE TO MATCH THE STUB DIMENSIONS AS PER Rc 1½.
12. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED.

BHEL

TITLE :

INSTRUMENT STUB DETAILS FOR TEMPERATURE MEASUREMENT

(APPLICABLE FOR PIPE SIZE ABOVE 4")

[(i) DESIGN PRESS =/> 40 Kg/Cm2(g) OR (ii) DESIGN TEMP =/>400 DegC]

1

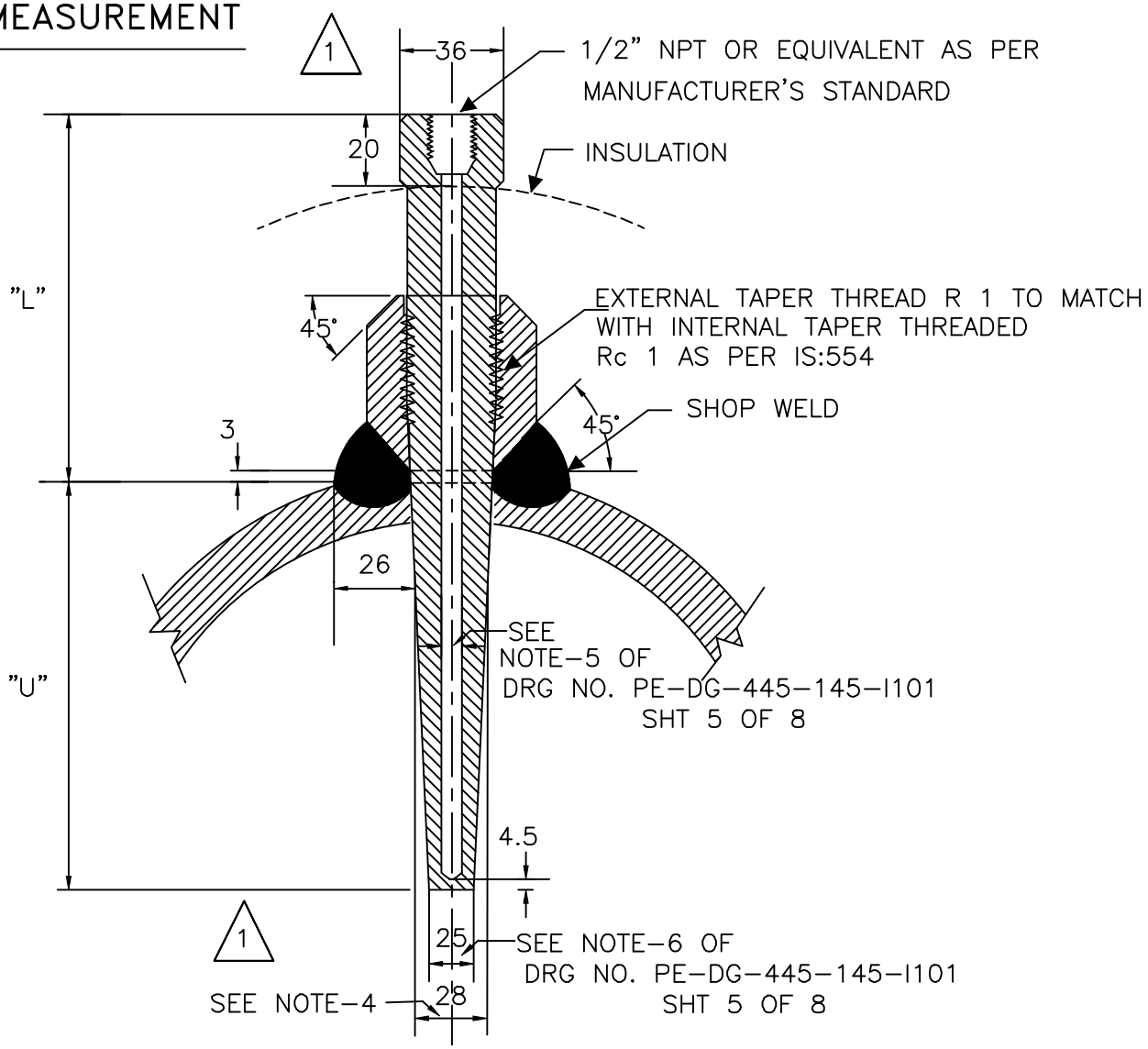
DRG. NO.

PE–DG–445–145–I101

REV. 01

SH. 5 OF 8 SHS.

TEMP. MEASUREMENT



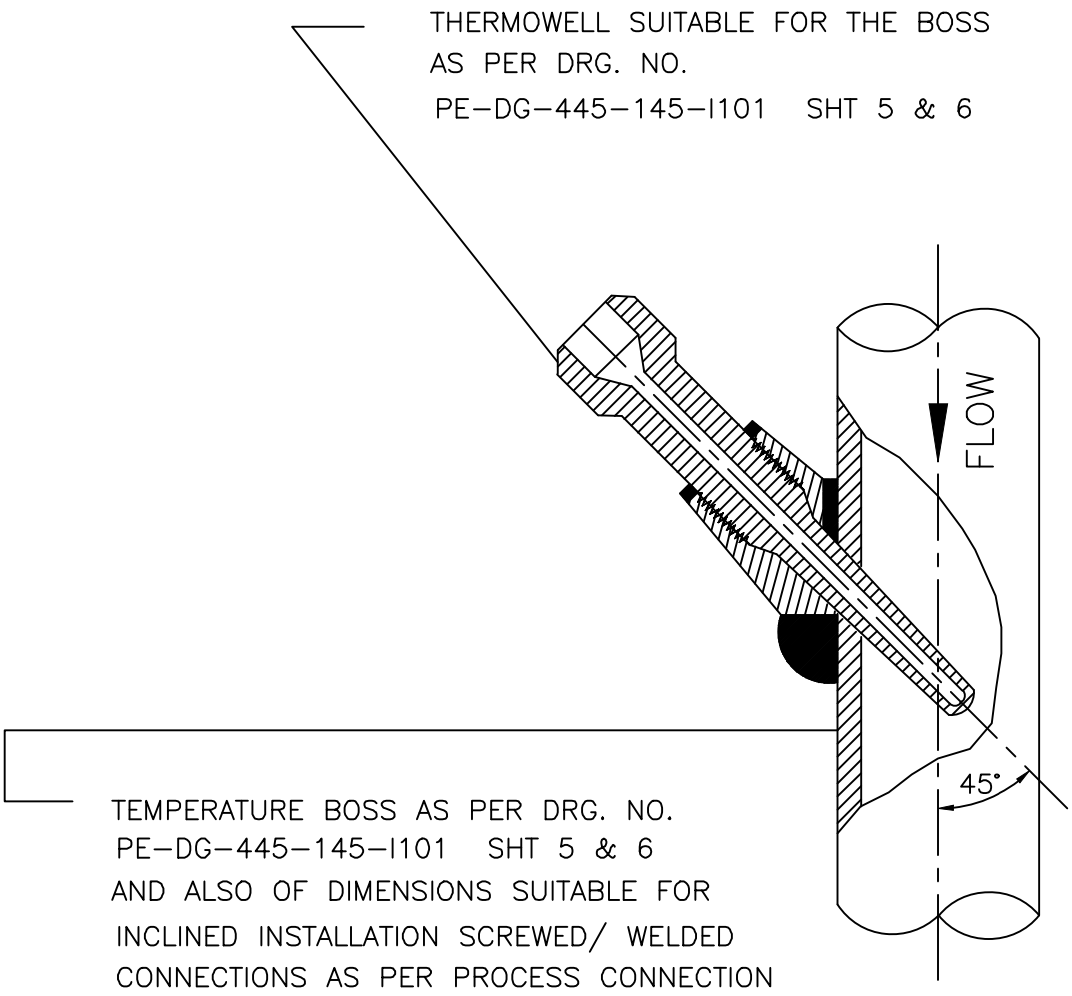
NOTES :-

1. THIS TYPE OF TEMPERATURE BOSS IS APPLICABLE FOR THE DESIGN PRESS/ TEMP BELOW 40 KG/CM2(g)/400°C.
2. FOR PRESS. TIGHT JOINTS THE BOSS SHOULD HAVE INTERNAL TAPERED PIPE THREAD Rc 1 AS PER IS:554. THE LENGTH OF THREAD ENGAGEMENT SHOULD BE AS PER ABOVE STANDARD.
3. SEE NOTES-2 TO 10 IN SHT. 5 OF 8 OF THIS DRG. (1)
4. THERMOWELL SHALL BE SUITABLE TO MATCH THE STUB DIMENSIONS AS PER Rc 1.
5. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED.

BHEL

TITLE :
INSTRUMENT STUB DETAILS
FOR TEMPERATURE MEASUREMENT
(APPLICABLE FOR PIPE SIZE ABOVE 4")
[DESIGN PRESS < 40 Kg/Cm2 (g) & DESIGN TEMP < 400 C]

DRG. NO.
PE-DG-445-145-I101
REV. 01
SH. 6 OF 8 SHS.



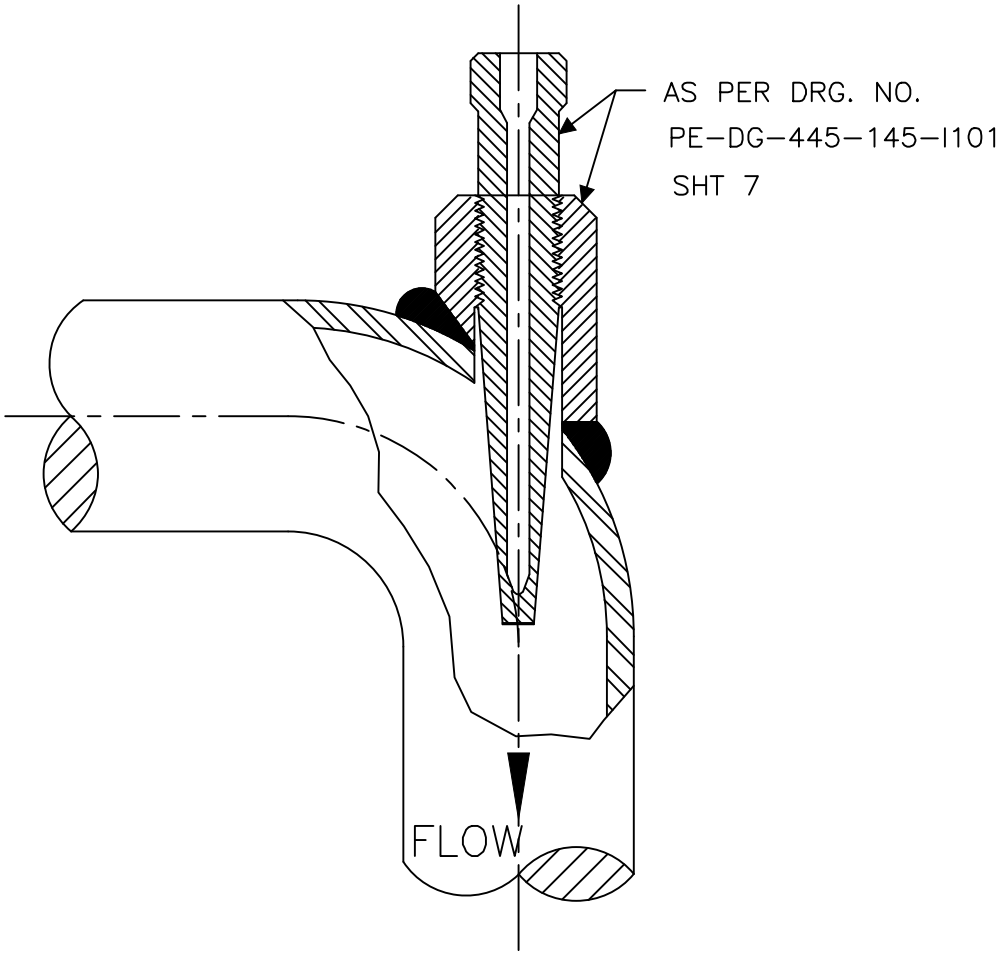
NOTES :–

1. INCLINED INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MIN. 3" LINE SIZE.
2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF MIN. 3" SIZE OF MAIN PIPING SPECIFICATION SHALL BE USED.
3. THIS TYPE OF INSTALLATION IS APPLICABLE FOR HORIZONTAL AND VERTICAL PIPE SECTION.
4. FOR STEAM SERVICES EXPANDER SECTION TO BE USED ONLY IN VERTICAL RUN.
5. THE EXPANDER SECTION SHALL BE OF ADEQUATE LENGTH (AT LEAST 3–4 TIMES DIA OF THE MAIN PROCESS PIPE AT BOTH SIDES OF THE INSTALLED THERMOWELL).

बीएचईएल BHEL

TITLE :
INSTRUMENT STUB DETAILS
FOR TEMPERATURE MEASUREMENT
THERMOWELL INSTALLATION

DRG. NO.
PE–DG–445–145–I101
REV. 01
SH. 7 OF 8 SHS.



NOTES :–

1. THIS INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MINIMUM 3" LINE SIZE. THIS DETAIL IS APPLICABLE FOR THERMOWELL INSTALLATION IN BEND PIPES. △1
2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF ELBOW FORM (AS SHOWN) OF MINIMUM 3" SIZE SHALL BE USED.
3. ELBOW EXPANDER SECTION IN HORIZONTAL PLANE TO BE USED FOR LIQUID SERVICE. FOR STEAM SERVICES EXPANDER SECTION TO BE USED IN VERTICAL PLANE.

TITLE :

INSTRUMENT STUB DETAILS FOR TEMPERATURE MEASUREMENT THERMOWELL INSTALLATION

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

INSTRUMENT INSTALLATION & HOOKUP DIAGRAM

NOTES :

1..PROVISION OF SINGLE OR DOUBLE ROOT VALVE AND DRAIN VALVE SHALL BE IN ACCORDANCE WITH THE PRESSURE/TEMPERATURE REQUIREMENT. FOR LINE PRESSURE EQUAL TO OR GREATER THAN 40 KG/SQ.CM 2 NOS ROOT VALVE AND 2 NOS DRAIN VALVE SHALL BE REQUIRED.

2..MATERIAL, SIZE AND RATING OF THE PROCESS HOOK UP ITEMS SHOWN IN THE DRAWING ARE INDICATIVE ONLY. ACTUAL REQUIREMENT SHALL BE AS PER PROCESS CONDITION & SPECIFICATION V.IIE/S-VI/CLAUSE NO. 12.02.00..

3..DRAIN PIPE IN RACK AND ENCLOSURE SHALL BE 2" NB ASTM A 106 SCH 80 Gr.C. DRAIN HEADER SHALL BE TO THE NEAREST DRAIN PIT AS PER SITE CONDITION.

4..ALL FITTINGS SHALL BE WITH DOUBLE COMPRESSION FERRULE & NUTS.

5..UNION SHALL BE USED AT EVERY 6M INTERVAL OF IMPULSE LINE OR AS REQUIRED.

6..IMPULSE LINE SHALL BE SUPPORTED WITH U-CLAMPING AT EVERY 2.5M SPAN.

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

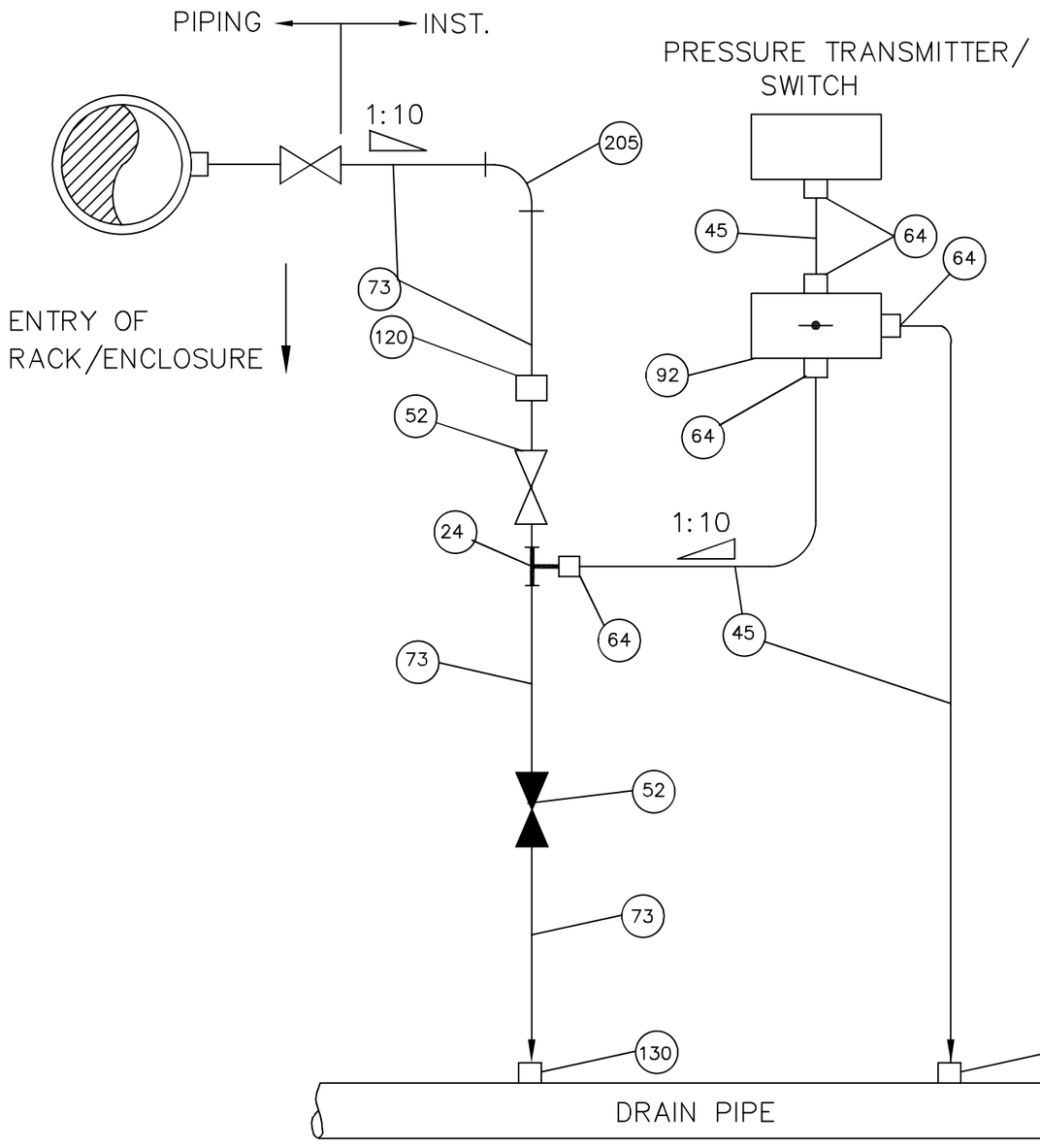
JOB NO. DCL- 12A05 | SCALE : NIL

DWG. NO. 12A05-DWG-I-0022 | REV. 0

12A05-DWG-I-0022-R-0-SHT-3 OF 27 C 22.06.2017

A3 (9-96) [420x297]

PRESSURE TRANSMITTER/PRESSURE SWITCH MOUNTED BELOW SOURCE POINT



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.

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

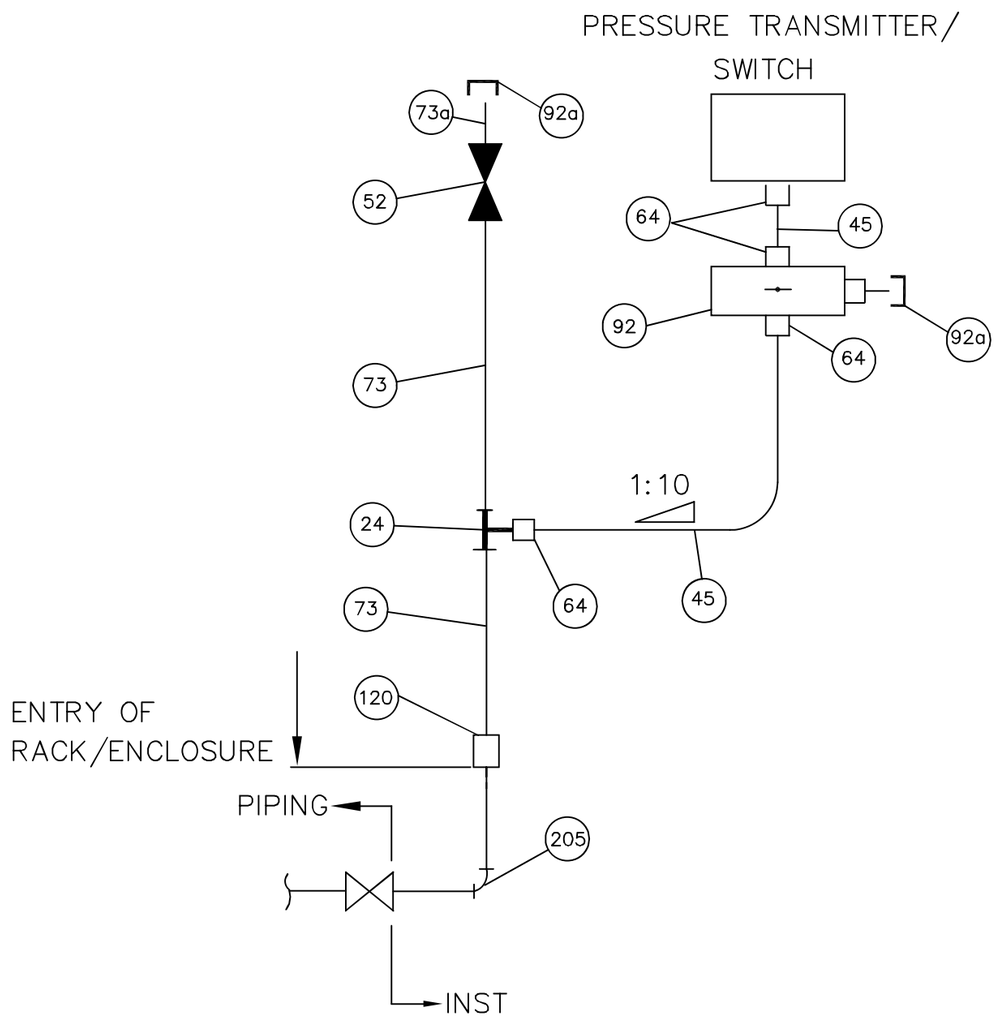
JOB NO. DCL– 12A05 | SCALE : NIL

DWG. NO. 12A05–DWG–I–0022 | REV. 0

12A05-DWG-I-0022-R-0-SHT-5 OF 27 C 22.06.2017

A3 (9–96) [420x297]

PRESSURE TRANSMITTER/PRESSURE SWITCH MOUNTED ABOVE SOURCE POINT



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	1	GLOBE VALVE, 1/2" SW
64	4	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD
73	15 M	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	2	VENT PLUG, 1/2" NPT (M)
120	1	BULK HEAD UNION/COUPLING, 1/2" SW
205	1	90° ELBOW, 1/2" SW

SERVICE : INSTRUMENT AIR

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

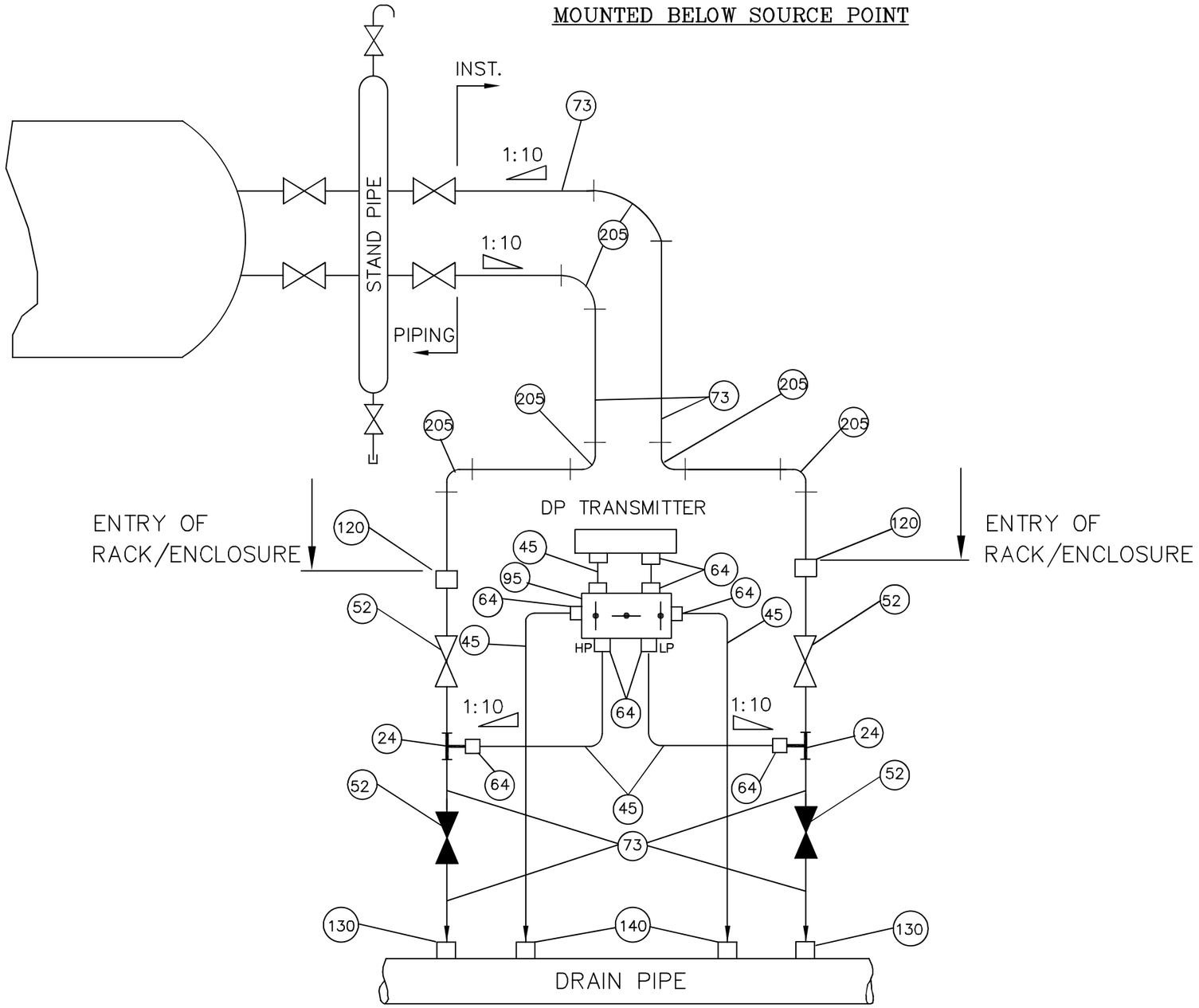
DWG. NO. 12A05-DWG-I-0022 | REV. 0

C 22.06.2017

D 12A05-DWG-I-0022-R-0-SHT-8 OF 27

A3 (9-96) [420x297]

DIFF. PRESS. TRANSMITTER (LEVEL)
MOUNTED BELOW SOURCE POINT



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
24	2	UNEQUAL TEE, 1/2" SW X 1/2" NPT (F)
45	6 M	TUBE, 1/2" OD
52	4	GLOBE VALVE, 1/2" SW
64	8	MALE CONNECTOR, 1/2" NPT (M) X 1/2" OD
73	30 M	IMPULSE PIPE, 15 NB
95	1	5 VALVE MANIFOLD, 1/2" NPT (F)
120	2	BULK–HEAD UNION, 1/2" SW
130	4	HALF COUPLING, 1/2" SW
205	6	90° ELBOW, 1/2" SW

SERVICE : WATER

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

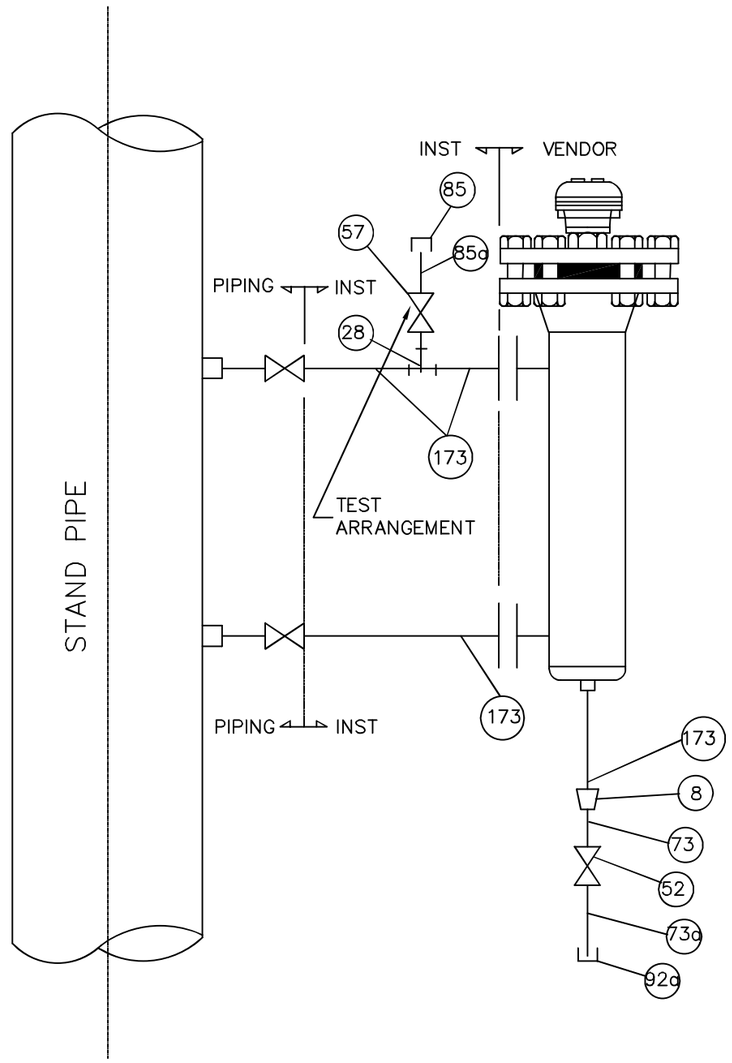
DWG. NO. 12A05–DWG–I–0022 | REV. 0

C 22.06.2017

D 12A05-DWG-I-0022-R-0-SHT-12 OF 27

A3 (9–96) [420x297]

FLOAT OPERATED LEVEL SWITCH



BILL OF MATERIALS		
ITEM NO	QTY/ INST	DESCRIPTION
8	1	REDUCER, 1" SW X 1/2" SW
28	1	EQUAL TEE, 1" SW
52	1	GLOBE VALVE, 1/2" SW
57	1	GLOBE VALVE, 1" SW
73	1 M	IMPULSE PIPE, 15 NB
73a	1	NIPPLE, 1/2" SW X 1/2" NPT (F)
85	1	PLUG, 1" NPT (M)
85a	1	NIPPLE, 1" SW X 1" NPT (F)
92a	1	DRAIN PLUG, 1/2" NPT (M)
173	1 M	IMPULSE PIPE, 25 NB

SERVICE : CONDENSATE

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

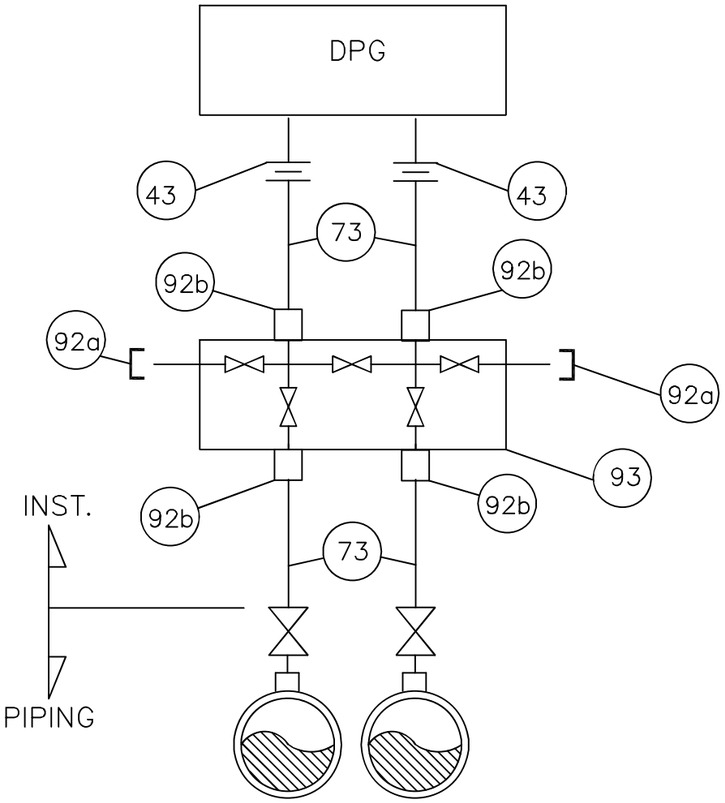
DWG. NO. 12A05–DWG–I–0022 | REV. 0

C 22.06.2017

D 12A05-DWG-I-0022-R-0-SHT-13 OF 27

A3 (9–96) [420x297]

DIFFERENTIAL PRESSURE GAUGE



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
43	2	THREE PIECE UNION, 1/2" SW X 1/2" NPT (F)
52	2	GLOBE VALVE, 1/2" SW
73	30 M	IMPULSE PIPE 15 NB
93	1	5 VALVE MANIFOLD, 1/2" NPT (F)
92a	2	VENT PLUG, 1/2" NPT (M)
92b	4	ADAPTOR, 1/2" SW X 1/2" NPT (M)

SERVICE : WATER, STEAM, AIR 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

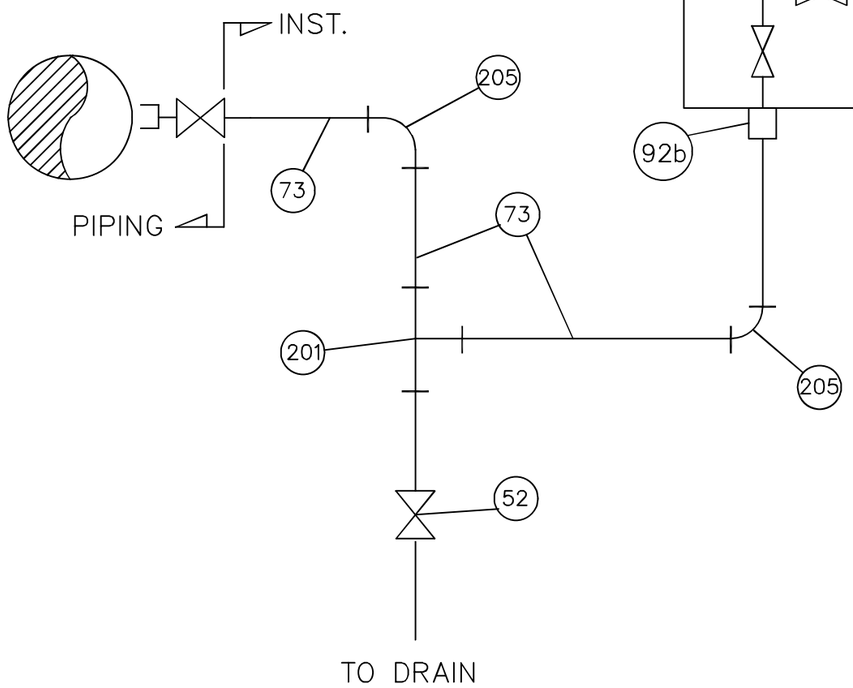
DWG. NO. 12A05–DWG–I–0022 | REV. 0

C 22.06.2017

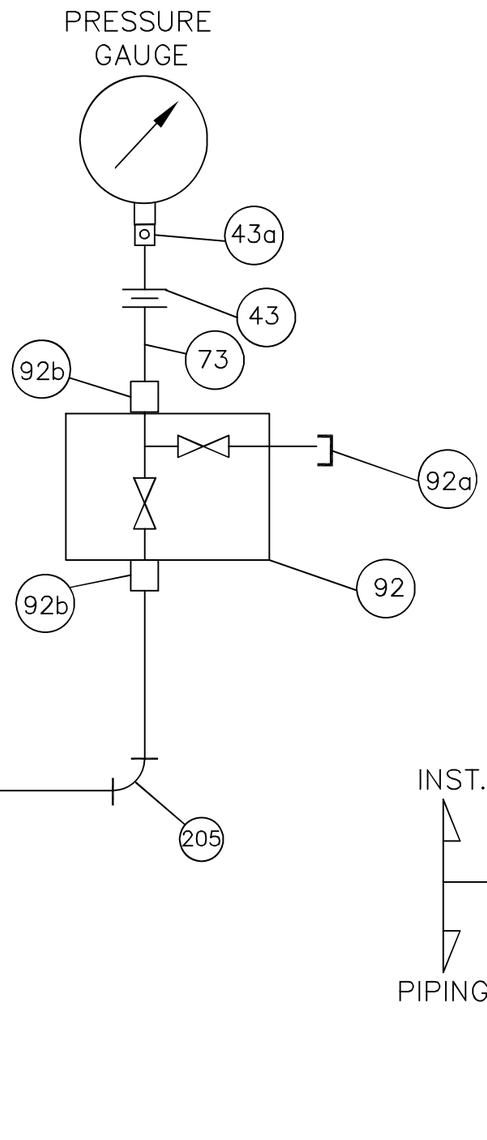
D 12A05-DWG-I-0022-R-0-SHT-14 OF 27

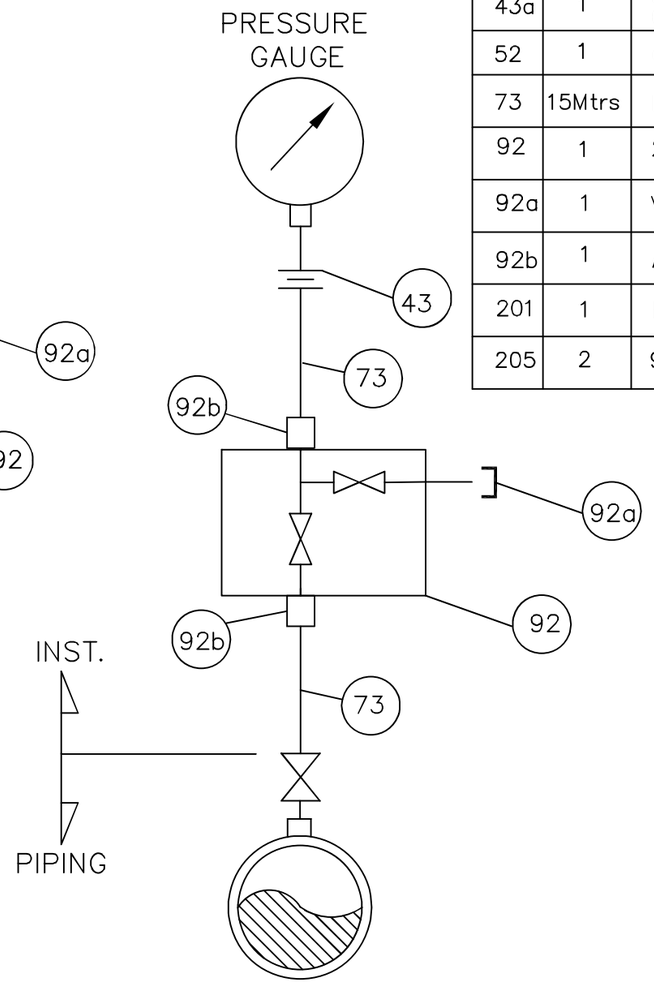
A3 (9–96) [420x297]

PRESSURE GAUGE



REMOTE MOUNTING





ON TAP MOUNTING

BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
43	1	THREE PIECE UNION, 1/2" SW X 1/2" NPT (F)
43a	1	SNUBBER, 1/2" NPT (M) X 1/2" NPT (F) (AT PUMP DISCHARGE)
52	1	GLOBE VALVE, 1/2" SW
73	15Mtrs	IMPULSE PIPE 15 NB
92	1	2 VALVE MANIFOLD, 1/2" NPT (F)
92a	1	VENT PLUG, 1/2" NPT (M)
92b	1	ADAPTOR, 1/2" SW X 1/2" NPT (M)
201	1	EQUAL TEE 1/2" SW
205	2	90° ELBOW 1/2" SW

SERVICE : WATER, CONDENSATE 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

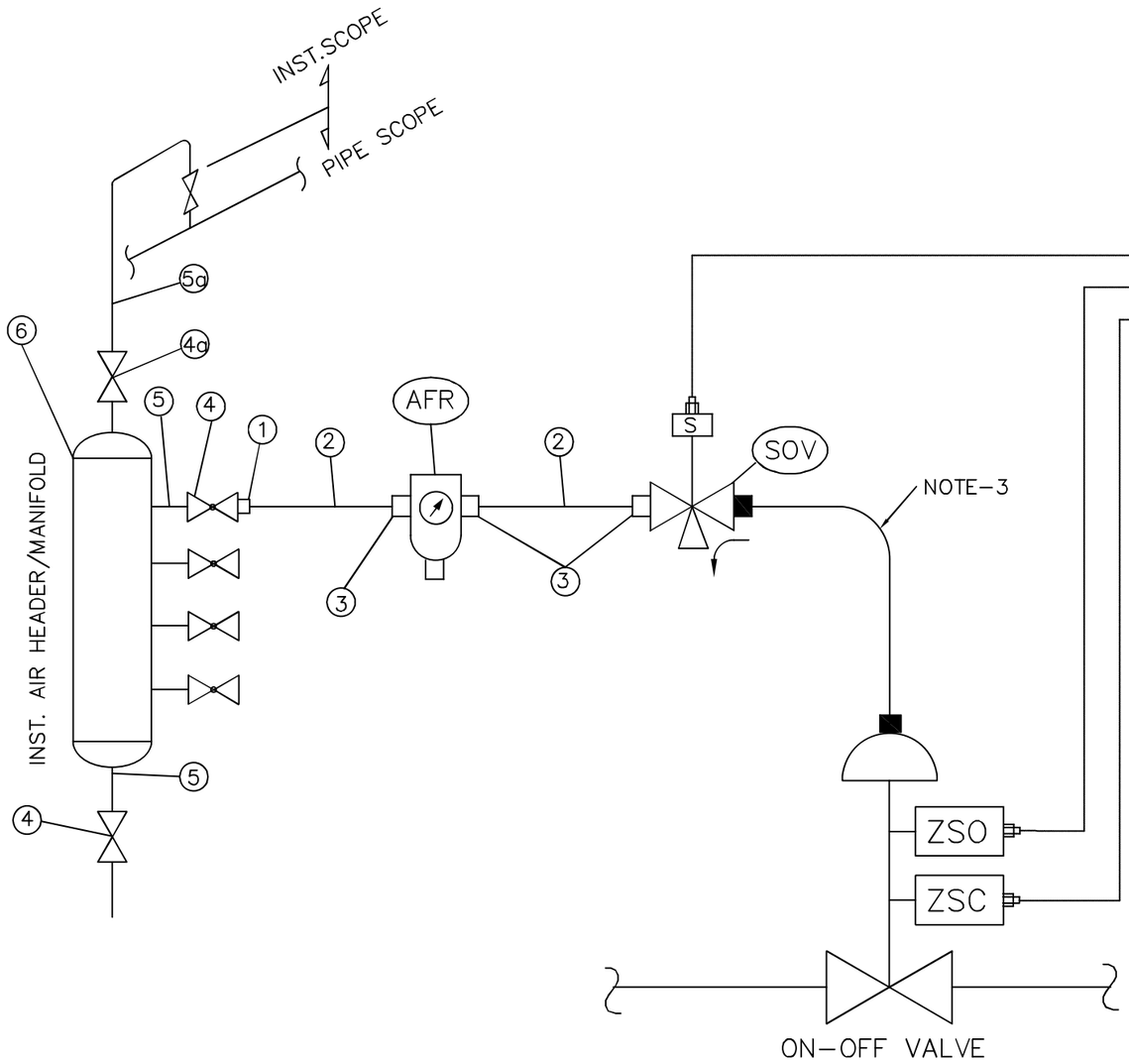
JOB NO. DCL– 12A05 | SCALE : NIL

DWG. NO. 12A05–DWG–I–0022 | REV. 0

C 22.06.2017

D 12A05-DWG-I-0022-R-0-SHT-15 OF 27

A3 (9–96) [420x297]



ITEM	DESCRIPTION	SPECIFICATION	QTY.	REMARKS
1	MALE CONNECTOR	1/2"NPT(M) X 6 mm OD	1	
2	TUBE	6 mm OD X 1 mm THK.	10 MTRS.	
3	MALE CONNECTOR	1/4"NPT(M) X 6 mm OD	3	
4	ISOLATION VALVE	BALL TYPE 1/2" SW X 1/2" NPT(F)	2	
4a	ISOLATION VALVE	BALL TYPE 1" SW	1	
5	PIPE	1/2" NB	A/R	
5a	PIPE	1" NB	A/R	
6	AIR MANIFOLD	2" NB	1	

PNEUMATIC SOV HOOK UP SCHEME

NOTES.

1...ALL TUBE FITTINGS ARE OF DOUBLE COMPRESSION TYPE AND OF SS 316 MATERIAL.

2...QTY. SHOWN ARE TYPICAL FOR ONE INSTALLATION ONLY.

3...TUBE & FITTINGS MARKED ■ ARE INTEGRAL TO THE VALVE.

4...JUNCTION BOX WILL BE INTEGRAL TO ACTUATOR.

5...ISOLATION VALVE SHALL BE INSTALLED CLOSE TO THE VALVE ASSEMBLY.

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

C 22.06.2017

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A3 (9–96) [420x297]

MANDATORY SPARES

Sl. No.	Equipment/Package Name	Quantity to be supplied for the Package
8.03.27	Micro PLC system (i.e. inegrated CPU & I/O system, where above mentioned components are not applicable)	One Complete Set
8.04.00	Field Instrument	
8.04.01	Electronic Transmitters	
(i)	Pressure	1(One) no. complete set for each type and model/range used in the system
(ii)	Differential Pressure	1(One) no. complete set for each type and model/range used in the system
(iii)	Level	1(One) no. complete set for each type and model/range used in the system
(iv)	Speed	1(One) no. complete set for each type and model/range used in the system
(v)	FlowTransmitter	1(One) no. complete set for each type and model/range used in the system
(vi)	3-D Ultrasonic level Transmitter	1(One) no. complete set for each type and model/range used in the system
8.04.02	Different type of Switches	
(i)	Pressure Switch	2(two)no. of each type & model/range used in the system
(ii)	Differential Pressure Switch	2(two)no. of each type & model/range used in the system
(iii)	Level Switch	2(two)no. of each type & model/range used in the system
(iv)	Flow Switch	2(two)no. of each type & model/range used in the system
(v)	Temperature Switch	2(two)no. of each type & model/range used in the system
(vi)	Dust Detector	1(one)no. of each type & model used in the system
8.04.03	Thermocouple	100% of each type and length used in one unit
8.04.04	RTD	100% of each type and length used in one unit
8.04.05	Thermo-well for both TC and RTD	2(Two) nos. for each type and rating/length used in the system
8.04.06	Solenoid Valve	
(i)	Complete Solenoid Valve Assembly	2Nos. for each type and rating used in the system
(ii)	Coil (single or double coil type)	10% of total nos. used in the system or minimum 5(five) Nos. whichever is more for each type and rating.
8.04.07	Different types of Gauge	10% of total nos. used in the system or minimum 1(one) no. whichever is more for each type and range.
(i)	Pressure Gauge	10% of total nos. used in the system or minimum 1(one) no. whichever is more for each type and range.
(ii)	Differential Pressure Gauge	10% of total nos. used in the system or minimum 1(one) no. whichever is more for each type and range.
(iii)	Temperature Gauge	10% of total nos. used in the system or minimum 1(one) no. whichever is more for each type and range.

10% of each type and length used in one unit

Sl. No.	Equipment/Package Name	Quantity to be supplied for the Package
(iv)	Magnetic Level Gauge	10% of total nos. used in the system or minimum 1(one) no. whichever is more for each type and range.
8.04.08	Air Filter Regulator including moisture separator complete set with pressure gauges	10Nos.
8.04.09	Rotameter	10% of total nos. used in the system or minimum 2(Two) nos. whichever is more for each type, rating,/model and size used in the system.
8.04.10	Gauge Glass	1No. for each type and size
8.04.11	Erection Hardware	
(i)	Transmitter's Manifold	10% of total nos. used in the system or minimum 2(Two) nos. whichever is more for each type, rating,/model and size used in the system.
(ii)	Impulse Line Root/Source valve	10% of total nos. used in the system or minimum 4(four) nos. whichever is more for each type, rating,/model and size used in the system.
(iii)	Impulse Line Isolation valve	10% of total nos. used in the system or minimum 4(four) nos. whichever is more for each type, rating,/model and size used in the system.
(iv)	Impulse Line Drain valve	10% of total nos. used in the system or minimum 4(four) nos. whichever is more for each type, rating,/model and size used in the system.
(v)	Impulse Line fittings	Each type/size 25Nos.
(vi)	Impulse Pipe	Each type/size 100Mtrs.
(vii)	Copper/SS Tube	Each type/size 100Mtrs.
(viii)	Fittings for Copper/SS Tube	Each type/size 100Nos.
8.04.13	Conductivity Type Level Switch	
(i)	Conductivity Ttype level Probes	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.
(ii)	Complete Electronics unit	1Set
(iii)	Isolating/Root Valve	2Nos.
8.04.14	Cable This particulat items shall be common for BTG , CHP and AHP areas.	
(i)	Thermocouple Cable	3(three)Kms. of each type, size & rating of Cables
(ii)	Control & Instrumentation Cable	3(three)Kms. of each type, size & rating of Cables
8.04.15	Cold Junction Compensation Boxes	10% of total nos. used in the system or minimum 2(two) nos. for each type/size whichever is more.
8.04.16	Current/Voltage Transducers	1(one) no. each type/rating used in the system
8.04.17	MWatt/MVAR Transducer	1(one) no. each type/rating used in the system
8.04.18	Chlorine Leak Detector System	
(i)	Sensor Unit (complete)	2No.
(ii)	Transmitter/Processing Unit (complete)	2No.
8.05.00	SWAS	
8.05.01	Conductivity	
(i)	Conductivity Sensor/cell for each type of Cell Constant	20% of the total no. used in the system or minimum 2(two) nos. whichever is higher.
(ii)	Conductivity Transmitter Complete Set	20% of the total no. used in the system or

Sl. No.	Equipment/Package Name	Quantity to be supplied for the Package
(x)	Regulator & Gauge Assembly	1Set
8.06.03	Oxygen Analyser	
(i)	Field Sensor	4Nos. complete unit
(ii)	Field Transmitter/complete Electronic unit	2Nos. complete unit
(iii)	Power supply Card	2Nos.
(iv)	Instrumentation Hardware (viz, isolation valve, solenoid valve etc.)	2Nos. each items/type
8.07.00	Pneumatic Control Valve & Power Cylinder (Applicable for all Modulating Type & On-Off/Isolating Type)	
8.07.01	Control Valve	
(i)	Pneumatic Diaghragm for Diaghragm actuated valve	2(two) nos. for each type of Actuator
(ii)	Actuator Seal Kit for Pneumatic Cylinder actuated valve	2(two) nos. for each type of Actuator
(iii)	Gland Packing	1(one) set for each type of Control Valve
(iv)	Stem	1(one) No. for each type of Control Valve
(v)	Plug	1(one) No. for each type of Control Valve
(vi)	Seat	1(one) No. for each type of Control Valve
(vii)	Cage	1(one) No. for each type of Control Valve
(viii)	Retainer Ring	1(one) set for each type of Control Valve
(ix)	Seal Ring	1(one) set for each type of Control Valve
(x)	Gasket	2(two) Sets. for each type of Control Valve
(xi)	Smart Positioner of the Valve	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.
(xii)	Seal Kit for the Positioner	2(two) Sets. for each type of Positioner
(xiii)	Position Feedback Transmitter (applicable if it is not integral with the Smart Positioner)	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.
(xiv)	Complete Set of Solenoid Valve for Pneumatic type On/Off Valve	2Nos. for each type & ratings
(xv)	Solenoid Coil for Pneumatic type On/Off Valve	5Nos. for each type & ratings
8.07.02	Power Cylinder	
(i)	Actuator Seal Kit	2(two) nos. for each type of Power Cylinder
(ii)	Gasket	2(two) Sets. for each type of Power Cylinder
(iii)	Complete Set of Power Cylinder	1(one) no. each type for all application
(iv)	Smart Positioner of the Valve	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.
(v)	Seal Kit for the Positioner	2(two) Sets. for each type of Positioner
(vi)	Position Feedback Transmitter (applicable if it is not integral with the Smart Positioner)	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.
(vii)	Complete Set of Solenoid Valve for Pneumatic type On/Off Power Cylinder	2Nos. for each type & ratings
(viii)	Solenoid Coil for Pneumatic type On/Off Power Cylinder	5Nos. for each type & ratings
(ix)	Position Limit Switch for Pneumatic type On/Off Power Cylinder	10Nos. for each type & ratings

Sl. No.	Equipment/Package Name	Quantity to be supplied for the Package
8.07.03	I/P Converter for Control Valve/Power Cylinder (if applicable)	10% of total quantity used in the system or minimum 5(five) nos. whichever is more for each type and model.
8.07.04	Air Lock Relay	10Nos. for each type
8.07.05	Signal Air Booster Unit	2Nos. for each type
8.08.00	Turbine Supervisory Instruments & Plant Rotating Machinary Monitoring System	
8.08.01	Probes with extension cable	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.
8.08.02	Signal Converter/Proximitor for Transducer system	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.
8.08.03	Rack Mounted Monitors for Transducer system	10% of total quantity used in the system or minimum 1(one) no. whichever is more for each type and model.
8.08.04	Rack Interface Modules	10% of total quantity used in the system or minimum 1(one) no. whichever is more for each type and model.
8.08.05	Configurable type Relay Output Modules	10% of total quantity used in the system or minimum 1(one) no. whichever is more for each type and model.
8.08.06	Communication/Gateway Modules	10% of total quantity used in the system or minimum 1(one) no. whichever is more for each type and model.
8.08.07	Rack Mounted Power Supply Modules	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.
8.09.00	Closed Circuit Television System	
8.09.01	Complete Camera Unit	Each type 1(one) no.
8.10.00	Control Panel And Local/Remote Control Desk	
8.10.01	Mosaic/Conventional Type Push button Station	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.
8.10.02	Mosaic Type Push button Station with LED Indication	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.
8.10.03	Mosaic Type LED Indication Station	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.
8.10.04	Simaphore Indicator	2(two)Nos. each type
8.10.05	Annunciation System	
(i)	Each type of PCB (for non-PLC driven system)	1(one) No. each
(ii)	Lamp Box with Facia & Lamps (LED type)	10(ten)Nos.
(iii)	Hooter	1(one) No.
8.11.00	Thermocouple for Furnace Temperature Probes	2Nos.
8.12.00	Mill and Air Heater Fire Detection System	
8.12.01	Thermocouple	10% or 1 no. whichever is more
8.12.02	Process Actuator Switches	10% or 1 no. whichever is more

Sl. No.	Equipment/Package Name	Quantity to be supplied for the Package
7.12.00	Control Panel/Desk Mounted Items	
7.12.01	Push Button Complete assembly	10Nos for each colour
7.12.02	Push Button Contact Element (1NO + 1NC) Block	20Nos.
7.12.03	Selector Switch	10Nos. for each type and rating
7.12.04	Meter (Analog and Digital)	
(i)	Ammeter	2Nos. for each type and range
(ii)	Voltmeter	2Nos. for each type and range
(iii)	Frequency	2Nos. for each type and range
(iv)	MW	2Nos. for each type and range
(v)	MVAR	2Nos. for each type and range
(vi)	Power Factor	2Nos. for each type and range
(vii)	Synchroscope	1No. for each type and range
(viii)	Synchrocheck Relay complete set	1No. for each type and range
(ix)	Transducer	1No. for each type and range
7.12.05	Indicating Lamps complete assembly	20Nos. for each Colour and type
7.12.06	Mimic Lamps	10Nos. for each Colour and type
7.12.07	MCB	5Nos. for each type and rating
7.12.08	Door Limit Switch	5Nos.
7.12.09	Annunciation system	
(i)	Lamp Box with Facia & Lamps (LED type)	25Nos.
(ii)	Hooter	1No.
(iii)	Each type of PCB (for non-PLC driven system)	1(one) no.
7.13.00	Actuator	
7.13.01	Complete set of Actuator	2Nos. for each type, make and rating, 1 no. for H2 cooler Temperature controller and 1 no. for stator water temperature controller
7.13.02	Power Unit for Modulating Actuator	4Nos. of each type

Sl. No.	Equipment/Package Name	Quantity to be supplied for the Package
7.13.03	DC-DC Power Pack Unit	4Nos. of each type
7.13.04	Electronic cards	4Nos. of each type
7.13.05	Position Feed Back Transmitters	4Nos. of each type
7.13.06	Control Unit	4Nos. of each type
7.13.07	Limit Switch Assembly	2 Nos each type and rating
7.13.08	Torque Switch Assembly	2 Nos each type and rating
7.13.09	Power Contactor	5Nos. for each type and rating
7.13.10	Auxiliary Contactor	5Nos. for each type and rating
7.13.11	Thermal Over Load Relay	2Nos. for each type and rating
7.13.12	Motor	1No. each type and rating
7.13.13	Complete Seal kit	2Sets for each type and rating
7.13.14	Complete O-Ring Set	2Sets for each type and rating

SUB VENDOR LIST

"The Vendor list as included is not exhaustive and prepared from prior experience of WBPDCL. 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 WBPDCL enclosing the vendor credentials. Maximum effort should be exercised to include only such proven vendors who are already registered in the Bidder's Vendor directory and the bidder has prior experience of supply items from such reputed vendors."

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

Sl. No.	Item Description	Vendor Name	
83	LOCAL STARTER PANEL, LOCAL CONTROL PANEL, LIGHTING PANEL, ACELP, DCELP	1	PYROTECH
		2	L&T
		3	CONTROL DEVICE
		4	SCHNEIDER

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

Sl. No.	Item Description	Vendor Name	
	CONTROL & INSTRUMENTATION SYSTEM VENDORS		
1	DISTRIBUTED CONTROL SYSTEM	1	ABB
		2	HONEYWELL
		3	EMERSON
		4	VALMET (FORMERLY METSO)
2	PLC (Programmable Logic Controller)	1	ROCKWELL AUTOMATION INDIA LTD.
		2	GE
		3	SCHNEIDER ELECTRIC INDIA PVT.LTD.
3	DIGITAL INDICATOR	1	ABB
		2	GOSSEN / CAMILLE BAUER / METRAWATT
		3	YOKOGAWA
4	VERTICAL MOVING COIL INDICATOR	1	ABB
		2	GOSSEN
		3	CAMILLE BAUER
		4	METRAWATT
		5	YOKOGAWA
5	TRANSDUCERS	1	SIEMENS
		2	ABB
		3	CAMILLEBAUER
		4	ELSTER
		5	PYROTECH
		6	SOUTHERN TRANSDUCERS
		7	ADEPT
6	LARGE VIDEO SCREEN	1	BARCO
		2	PLANAR
7	PC	1	DELL
8	TFT MONITOR	1	DELL
		2	HP
		3	IBM-LENOVO
9	DOT MATRIX PRINTERS	1	EPSON
		2	TVS
10	PRINTERS (LASER)	1	HP
		2	IBM
11	COMPUTER FURNITURE	1	ADARSH CONTROLS
		2	COSMOS MEDIA
		3	FEATHER LITE
		4	GODREJ
		5	OTS

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

Sl. No.	Item Description	Vendor Name	
		3	INDUSTRIAL INSTRUMENTS
		4	PYRO ELEC INSTRUMENTS GOA P. LTD.
		5	TEMPSENS INSTRUMENTS (I) PVT. LTD.
19	ROTA METER	1	EUREKA
		2	FLUIDYNE 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	DETRIECH / EMERSON PROCESS
		2	MIDWEST
		3	STARMECH
		4	SWITZER INSTRUMENT CO.
		5	VERIS INC.
23	LEVEL GAUGE	1	CHEMTROLS ENGG. (P) LTD.
		2	LEVCON INSTRUMENTS (P) LTD.
		3	S. B. ELECTRO-MECHANICALS PVT. LTD.
		4	V. AUTOMAT & INSTRUMENTS PVT. LTD.
		5	DK INSTRUMENTS
		6	SIGMA INSTRUMENTS COMPANY
24	LEVEL SWITCH (FLOAT TYPE)	1	CHEMTROLS
		2	MAGNETROL INTERNATIONAL NV
		3	DK INSTRUMENTS
		4	LEVCON INSTRUMENTS P LTD.
25	LEVEL SWITCH (CONDUCTIVITY TYPE)	1	LEVEL STATE, UK
		2	SOLARTON/MOBREY, UK
		3	YARWAY
26	LEVEL SWITCH	1	ENDRESS + HAUSER

Sl. No.	Item Description	Vendor Name	
	(CAPACITANCE TYPE)	2	DK INSRTUMENTS
27	LEVEL SWITCH (DISPLACEMENT TYPE)	1	DRESSER VALVES INDIA LTD.
		2	CHEMTROLS
		3	DK INSRTUMENTS
		4	ECKARDT
28	LEVEL TRANSMITTER (ULTRASONIC TYPE)	1	EMERSON PROCESS
		2	ENDRESS + HAUSER
		3	SIEMENS MIL TRONICS
		4	VEGA
29	LEVEL TRANSMITTER (RADAR Type)	1	ENDRESS + HAUSER
		2	VEGA
30	BUNKER/SILO LEVEL 3D MONITORING (ULTRASONIC TYPE)	1	E & H
		2	SIEMENS
		3	VEGA-GERMANY
31	VIBRATION MONITORING SYSTEM /TURBINE SUPERVISORY MONITORING SYSTEM	1	GE (for BENTLY NEVADA SYSTEM)
		2	MEGGIT
		3	SHINKAWA, JAPAN
32	MERCURY MONITORING	1	DURAG GMBH AND CO KG
		2	SICK
		3	SHINKAWA
33	Dust Density Monitor	1	CODEL INTERNATIONAL LTD.
		2	DURAG GMBH AND CO KG
		3	LAND INSTRUMENTS INTERNATIONAL
		4	SICK GMBH
34	CO Analyzer (in situ type)	1	CODEL INTERNATIONAL LTD.
		2	LAND INSTRUMENTS INTERNATIONAL
		3	SICK GMBH
35	Oxygen Analyzer (Zirconia Probe type)	1	EMERSON PROCESS MANAGEMENT
36	SO_2-NOx/CO/CO_2 Analyzer(Insitu Type)	2	CODEL INTERNATIONAL LTD
		3	PROCAL
		4	SICK GMBH
37	SWAS system (with selected analysers from Rosemount Analytical / Hack Ultra-France, Orion – USA, Hach-USA. ABB – UK, Polymetron-France/Zeltwegger -Analyticals)	1	ABB LTD.
		2	EMERSON PROCESS MANAGEMENT INDIA PVT.
		3	FORBES MARSHALL
38	DUST MONITOR	1	SIEMENS MILLTRONICS

Sl. No.	Item Description	Vendor Name	
		2	FILTER SENSE
		3	BIN MASTER
39	PULSE JET CONTROLLER	1	SWITCHING CIRCUIT
		2	ADVANCE CONCEPT
		3	VOLTCRAFT
		4	SQUARE M
		5	MICRO SYSTEM
40	AIR FILTER REGULATOR	1	JRU INSTRUMENTS (Formerly PLACKA)
		2	SHAVO NORGREN (INDIA) PVT. LTD.
41	ELECTRO PNEUMATIC CONTROLLER	1	MTL INDIA PVT. LTD.
		2	WATSON SMITH LTD.
		3	FAIRCHILD
42	SMART POSITIONER	1	EMERSON PROCESS MANAGEMENT
		2	SIEMENS
		3	ABB
43	SOLENOID VALVE	1	ASCO (I) LTD.
		2	ROTEX AUTOMATION LTD.
		3	NUCON INDUSTRIES PVT LTD
46	INSTRUMENTATION CONTROL CABLE/ COMPENSATING CABLE / THERMOCOUPLE EXTENSION CABLES	1	ADVANCE CABLES TECHNOLOGIES
		2	CORDS CABLE INDUSTRIES PVT. LTD.
		3	DELTON CABLES LTD.
		4	HAVIA CABLES
		5	KEI INDUSTRIES LTD.
		6	KERPEN CABELS

Sl. No.	Item Description	Vendor Name	
		7	LAPP CABLES
		8	NICCO CABLE
		9	POLYCAB WIRES PVT.LTD
		10	THERMO CABLES LTD.
		11	THERMO ELECTRIC
		12	UNIVERSAL CABLES LTD.

Sl. No.	Item Description	Vendor Name	
53	PUBLIC ADRESSING SYSTEM (ANALOG SYSTEM)	1	BOSCH SECURITY SYSTEMS
	PUBLIC ADRESSING SYSTEM (IP ADDRESSABLE)	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.

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

PACKAGE WISE REGISTERED SUPPLIER LIST (PERMANENT CATEGORY) AS ON 7/19/2021 2:41:14 PM

Sl No	Package Code	Package Name	Supplier Communication Address	Supplier Works Address
207	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	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	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	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	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	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	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	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	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	MR.L.C.VENKATRANGAN/MR.B.KANNAN New No.17, II Floor, Adwave 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	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	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	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 Â GIDC Â 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	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 : shikhahazra@hgurusouth.com
220	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	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	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 : info@general-
222	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	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_ani@hotmail.com
223	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Mr. Partha Bose 44, Saheed Hemanta Kumar Bose, Sarani, Kolkata Phone- +91 33 2548 7220 Pincode : 700074 Email : parthabosebpi@gmail.com; bosepanda@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 bosepanda@vsnl.net
224	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	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, mumbra,Thane -Mumbai-MAHARASHTRA INDIA Phone- 022-25491409,9892230623 FAX : Pincode : 400612 Email : sdbpl@vsnl.com
225	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	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, bkapadia@nesstech.co.in
226	145-10000-A	TEMPERATURE GAUGE	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 Â GIDC Â 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	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	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 : info@general-
229	145-10000-A	TEMPERATURE GAUGE	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	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 : shikhahazra@hgurusouth.com
231	145-10000-A	TEMPERATURE GAUGE	FLAT -B , GF, HILL CROWN APTS., COLLEGE ROAD, MAPUSA Phone- Pincode : 403525 Email : gtilworks@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	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
233	145-10000-A	TEMPERATURE GAUGE	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_ani@hotmail.com
234	145-10000-A	TEMPERATURE GAUGE	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 :
235	145-11000-A	LEVEL GAUGE	WORKS:TOSHNIWAL IND.PVT.LTD, INDUSTRIAL ESTATE MAKHUPURA, AJMER Phone- 441171 Pincode : 305002 Email : toshniwalprocess@gmail.com	
236	145-11000-A	LEVEL GAUGE	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com	Works-1->Mr. Bharat Kumar/ Mr. Sasi Kumar Plot No. 92B & 93B,Sec-V, IMTManesar -GURGAON-HARYANA INDIA Phone- 0124-4366000 TO 9 FAX : 0124-2290884 Pincode : 122002 Email : bharat@blissanand .com
237	145-11000-A	LEVEL GAUGE	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in	Works-1->R Gopinath 27 Nahur Udyog Industrial Premises,M.M.Malviya Road, Mulund(-MUMBAI-MAHARASHTRA INDIA Phone- +912225918567 FAX : +912225918566 Pincode : 400080 Email : sales@sigmainstruments.co.in
238	145-12000-A	FLOW ELEMENT	MR. ANTONIO NOVIELLO/Mrs. Enrica Bazzocc VIA DELLE INDUSTRIE, 36 CREMONA Phone- 39037221574 Pincode : 26100 Email : info@tmtecnomatic.com	Works-1->Mrs. Enrica Bazzocchi VIA DELLE INDUSTRIE, 36, -CREMONA- Italy Phone- 39037221574 FAX : 39037228318 Pincode : 26100 Email : sales@tmtecnomatic.com

PACKAGE WISE REGISTERED SUPPLIER LIST (PERMANENT CATEGORY) AS ON 7/19/2021 2:41:14 PM

Sl No	Package Code	Package Name	Supplier Communication Address	Supplier Works Address
239	145-12000-A	FLOW ELEMENT	SUSHILLOTAM, SUSHILLOTAM, 29/3A/3, SASANE NAGAR, HADAPSAR, PUNE Phone- 02026970450 Pincode : 411028 Email : marketing@starmech.net	Works-1->VIVEK GOTE/ MAHúNDRA BANSODE Sr no.54, Plot No.II0,Swami ViVekanand Industrial Est.HADAPS -PUNE-MAHARASHTRA INDIA Phone- 02026970450 FAX : 02026970470 Pincode : 411028 Email :
240	145-12000-A	FLOW ELEMENT	KANJIKODE WEST, PALALKKAD, PALAKKAD Phone- 2566127-130,2567128 Pincode : 678623 Email : icvldil@gmail.com;fa2@ilpgt.com	
241	145-12000-A	FLOW ELEMENT	Mr. Anil Bhati, H.B. No.-40, Revenue Estate, Village-Dudhola,Tehsil & Distt. Palwal FARIDABAD Phone- 9560742713;095607427 Pincode : 121002 Email : anil.bhati@wika.com	
242	145-13000-A	TEMP. ELEMENT	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, bkapadia@nesstech.co.in
243	145-13000-A	TEMP. ELEMENT	320, TV INDUSTIAL ESTATE, OFF.DR.A.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	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 : ramk@giconindia.com
245	145-13000-A	TEMP. ELEMENT	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 À GIDC À 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	M. D. BICHU/R. 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	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 : info@general-
248	145-13000-A	TEMP. ELEMENT	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	Industrial Estate, Makhupura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,	Works-1-> Khasra No.: 218-230& 235, Industrial Estate,Makhupura, -Ajmer-RAJASTHAN India Phone- 9887865856, FAX : 0145-2695174, Pincode : 305002, Email : rajeev.gupta@tipl.com
250	145-13000-A	TEMP. ELEMENT	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, mumbra,Thane -Mumbai-MAHARASHTRA INDIA Phone- 022-25491409,9892230623 FAX : Pincode : 400612 Email : sdbpl@vsnl.com
251	145-13000-A	TEMP. ELEMENT	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	MR. RAJIV GOVIL 14, MATHURA ROAD, FARIDABAD Phone- 09971085678 Pincode : 121003 Email : vipin.swami@in.abb.com	
253	145-14000-A	TRANSMITTERS	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 : production@vautomat.com
254	145-14000-A	TRANSMITTERS	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com	
255	145-14000-A	TRANSMITTERS	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	Industrial Estate, Makhupura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,	Works-1-> Khasra No.: 218-230& 235, Industrial Estate,Makhupura, -Ajmer-RAJASTHAN India Phone- 9887865856, FAX : 0145-2695174, Pincode : 305002, Email : rajeev.gupta@tipl.com
257	145-14000-A	TRANSMITTERS	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	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@wetzer.endress.com
259	145-14000-A	TRANSMITTERS	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	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	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	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	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	Mr. Ritwij Kulkarni 917, INTERNATIONAL TRADE TOWER, NEHRU PLACE, NEW DELHI Phone- 9890200584 Pincode : 110019 Email : rajesh.chaudhary@honeywell.com	Works-1->Mr.Kedar Tillu 53, 54, 56 & 57,Hadapsar Industrial Estate -PUNE-MAHARASHTRA INDIA Phone- 9665034625 FAX : 020 66039905 Pincode : 411013 Email : kedar.tillu@honeywell.com
265	145-14000-A	TRANSMITTERS	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	
266	145-15000-A	TEMPERATURE SWITCH	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 02764-233682 Pincode : 382729 Email : Nishit.patel@ashcroftindia.com	
267	145-15000-A	TEMPERATURE SWITCH	WORKS:TOSHNIWAL IND.PVT.LTD, INDUSTRIAL ESTATE MAKHUPURA, AJMER Phone- 441171 Pincode : 305002 Email : toshniwalprocess@gmail.com	
268	145-15000-A	TEMPERATURE SWITCH	MR.L.C.VENKATRANGAN/MR.B.KANNAN New No.17, II Floor, Adwave Towers, Dr.Sevalia Shivaji Salai, T.Nagar Chennai Phone- +91 44 24353407 Pincode : 600017 Email : delhi@indfos.com	
269	145-15000-A	TEMPERATURE SWITCH	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
270	145-15000-A	TEMPERATURE SWITCH	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

PACKAGE WISE REGISTERED SUPPLIER LIST (PERMANENT CATEGORY) AS ON 7/19/2021 2:41:14 PM

Sl No	Package Code	Package Name	Supplier Communication Address	Supplier Works Address
271	145-16000-A	SIGHT FLOW INDICATORS	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-34, OKHLA INDL.AREA,PHASE-I -NEW DELHI-DELHI INDIA Phone- 011-47627200 Extn. 3 FAX : 011- 26819440 Pincode : 110 020 Email : production@vautomat.com
272	145-16000-A	SIGHT FLOW INDICATORS	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com	Works-1->Mr. Bharat Kumar/ Mr. Sasi Kumar Plot No. 240, Sector-3, HSIIDC, Bawal -Rewari-HARYANA INDIA Phone- 0124-4366000 TO 9 FAX : 0124-2290884 Pincode : 123501 Email : bharat@blissanand .com
273	145-16000-A	SIGHT FLOW INDICATORS	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	
274	145-16000-A	SIGHT FLOW INDICATORS	T. BALAKRISHNAN/S.VENKATESH 217 , ARCOT ROAD PORUR , CHENNAI Phone-9444057761 Pincode : 600116 Email : bkequip@gmail.com	Works-1->V.KARUNANIDHI/P.BABU 217 , ARCOT ROAD,PORUR , -CHENNAI-TAMIL NADU INDIA Phone- 9444131187 FAX : 044-24766852 Pincode : 600116 Email : bkequip@gmail.com
275	145-16000-A	SIGHT FLOW INDICATORS	SH.N.V.RAM GOPAL/MS. N.NIHARIKA PLOTS 1,2,3, PHASE-III, IDA, JEEDIMETLA HYDERABAD Phone- 9848407365 Pincode : 500055 Email : iedelhi@ieflowmeters.com	Works-1->MR. A.V.MURTHY/MR. K.T. RAVISANKER PLOTS 1,2,3, PHASE-III,IDA, JEEDIMETLA -HYDERABAD-TELANGANA INDIA Phone- 9885107312 FAX : 040-23096401 Pincode : 500055 Email : sales@ieflowmeters.com
276	145-16000-A	SIGHT FLOW INDICATORS	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in	Works-1->R Gopinath 27 Nahur Udyog Industrial Premises,M.M.Malviya Road, Mulund(-MUMBAI-MAHARASHTRA INDIA Phone- +912225918567 FAX : +912225918566 Pincode : 400080 Email : sales@sigmainstruments.co.in
277	145-21000-A	DIFFERENTIAL PRESSURE SWITCH	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	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	NO-2,OPP-27 AECS LAYOUT 2ND STG REJAMAHALVILAS EXTN 2ND STG BANGALORE Phone- Pincode : Email : suchitra.industriesblr@gmail.com	Works-1->B. Srinivas Suchitra Industries, Opp No 53, Muneshwara Black Devinagar, Lottagal hal -BANGALORE-KARNATAKA INDIA Phone- 080-23511247 FAX : Pincode : 560094 Email : suchitra_industries@yahoo.com
289	145-25000-A	JUNCTION BOX	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. Kaloesh Parmar 39 A/3 ,Panchratna Industrial Est,Sarkhej-Bavla Road, Changodhar -Ahmedabad-GUJARAT INDIA Phone- 98250 80339 1 FAX : 079-26932424 Pincode : 382213 Email : sales@sumip.com
290	145-25000-A	JUNCTION BOX	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	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	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	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	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	Sophie Y. Moochhala/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@hyd-
300	145-34000-A	ROTAMETER	SH.N.V.RAM GOPAL/MS. N.NIHARIKA PLOTS 1,2,3, PHASE-III, IDA, JEEDIMETLA HYDERABAD Phone- 9848407365 Pincode : 500055 Email : iedelhi@ieflowmeters.com	Works-1->MR. A.V.MURTHY/MR. K.T. RAVISANKER PLOTS 1,2,3, PHASE-III,IDA, JEEDIMETLA -HYDERABAD-TELANGANA INDIA Phone- 9885107312 FAX : 040-23096401 Pincode : 500055 Email : sales@ieflowmeters.com
301	145-34000-A	ROTAMETER	Mr V. K. Pandit/Mr Ashish Shaha 17-20, Royal chambers, Paud Road Pune Phone-9370469466 Pincode : 411038 Email : sales@eurekaflow.com	Works-1->Mr S. M. Alawani/Mr V. V. Deshpande J-501, M.I.D.C. Pimpri, -PUNE-MAHARASHTRA INDIA Phone- 9325751732 FAX : 020-30681731 Pincode : 411018 Email : works@eurekaflow.com
302	145-34000-A	ROTAMETER	Mr. Vardhan Tamhankar, Unit No35/36/41,Om Anand Industrial Est. Mohanjee Sundarjee Road,Raghunath Nagar, Thane Phone- 022-25832323 Pincode : 400604 Email : tansaindia@gmail.com	Works-1-> Others Mohanjee Sundarjee Road, Raghunath Nagar, Thane -Mumbai-MAHARASHTRA INDIA Phone- FAX : Pincode : 400604 Email :
303	145-34000-A	ROTAMETER	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 Centre, S.No. 65, Hissa No. 7,By-Pass Juction, Kausa, -Mumbai-MAHARASHTRA INDIA Phone- 9892230623, FAX : 022-25491408/9 Pincode : 400 612, Email : sales@scientificdevices.com
304	145-35000-A	LEVEL SWITCH-CAPACITANCE TYPE	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 : production@vautomat.com
305	145-35000-A	LEVEL SWITCH-CAPACITANCE TYPE	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, mumbra,Thane -Mumbai-MAHARASHTRA INDIA Phone- 022-25491409,9892230623 FAX : Pincode : 400612 Email : sdbpl@vsnl.com
306	145-35000-A	LEVEL SWITCH-CAPACITANCE TYPE	Mr Shayak Gupta/Badal Jana Rajkamal', 7th floor, 13, Camac Street KOLKATA Phone- 0 33 2283 2766 Pincode : 700017 Email : b_jana@levcongroup.com	
307	145-35000-A	LEVEL SWITCH-CAPACITANCE TYPE	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com	
308	145-35000-A	LEVEL SWITCH-CAPACITANCE TYPE	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 À GIDC À Phase 1, VAPI-GUJARAT INDIA Phone- +91 11 4161 7111 FAX : 022 2687 3613 Pincode : 396 195 Email : pbajaj@baumer.com
309	145-35000-A	LEVEL SWITCH-CAPACITANCE TYPE	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in	Works-1->R Gopinath 27 Nahur Udyog Industrial Premises,M.M.Malviya Road, Mulund(-MUMBAI-MAHARASHTRA INDIA Phone- +912225918567 FAX : +912225918566 Pincode : 400080 Email : sales@sigmainstruments.co.in
310	145-36000-A	LEVEL SWITCH-CONDUTIVITY TYPE	131, PALSHIKAR COLONY Contact Person- Mr. Ashwin (9826080207) INDORE Phone- +91-731-4085751, Pincode : 452004 Email : sales@sapconinstruments.com	Works-1->Mr. Ashwin R Palshikar/Mr. Navin Bodse 131 PALSHIKAR COLONY, -INDORE-MADHYA PRADESH INDIA Phone- 9754261005 FAX : 0731-2475475 Pincode : 452004 Email : sales@sapcon.in
311	145-36000-A	LEVEL SWITCH-CONDUTIVITY TYPE	Mr Shayak Gupta/Badal Jana Rajkamal', 7th floor, 13, Camac Street KOLKATA Phone- 0 33 2283 2766 Pincode : 700017 Email : b_jana@levcongroup.com	Works-1-> 38G, PICNIC GARDEN ROAD, -KOLKATA-WEST BENGAL INDIA Phone- FAX : Pincode : Email :
312	145-36000-A	LEVEL SWITCH-CONDUTIVITY TYPE	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com	Works-1->Mr. Bharat Kumar/ Mr. Sasi Kumar Plot No. 92B & 93B,Sec-V, IMTManesar -GURGAON-HARYANA INDIA Phone- 0124-4366000 TO 9 FAX : 0124-2290884 Pincode : 122002 Email : bharat@blissanand .com
313	145-36000-A	LEVEL SWITCH-CONDUTIVITY TYPE	Mr. Vikash Agrawal/Mr. Tarun Debnath 119, PARK STREET , KOLKATA Phone-033-22290045 Pincode : 700016 Email : sandeep@hitech.in	Works-1->Mr. Jitendra Kumar/Mr. Debasis Dey 82/1, Sarsuna Main Road, -KOLKATA-WEST BENGAL INDIA Phone- 9883994030 FAX : Pincode : 700061 Email : jitendra@hitech.in
314	145-36000-A	LEVEL SWITCH-CONDUTIVITY TYPE	Mr. N R Shenoy/Mr G B Vijh 8, First Floor.Plot : 160A Bait-Ush-Sharaf, 29th Road,Bandra(W) MUMBAI Phone- 09892331381 Pincode : 400050 Email : ramanbpl@vsnl.com	Works-1->NA -- Phone- FAX : Pincode : Email :
315	145-36000-A	LEVEL SWITCH-CONDUTIVITY TYPE	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 : production@vautomat.com

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Sl No	Package Code	Package Name	Supplier Communication Address	Supplier Works Address
316	145-36000-A	LEVEL SWITCH-CONDUTIVITY TYPE	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
317	145-36000-A	LEVEL SWITCH-CONDUTIVITY TYPE	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in	Works-1->R Gopinath 27 Nahur Udyog Industrial Premises,M.M.Malviya Road, Mulund(-MUMBAI-MAHARASHTRA INDIA Phone- +912225918567 FAX : +912225918566 Pincode : 400080 Email : sales@sigmainstruments.co.in
318	145-37000-A	LEVEL SWITCH-FLOAT TYPE	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com	
319	145-37000-A	LEVEL SWITCH-FLOAT TYPE	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 : production@vautomat.com
320	145-37000-A	LEVEL SWITCH-FLOAT TYPE	N.SIKDAR/ SUMIT SIKDAR 76/2,SELIMPUR RD DHAKURIA Kolkata Phone- 033-2415-1310. Pincode : 700031 Email : dkinst@vsnl.net	
321	145-37000-A	LEVEL SWITCH-FLOAT TYPE	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, mumbra,Thane -Mumbai-MAHARASHTRA INDIA Phone- 022-25491409,9892230623 FAX : Pincode : 400612 Email : sdbpl@vsnl.com
322	145-37000-A	LEVEL SWITCH-FLOAT TYPE	Mr Shayak Gupta/Badal Jana Rajkamal', 7th floor, 13, Camac Street KOLKATA Phone- 0 33 2283 2766 Pincode : 700017 Email : b_jana@levcongroup.com	
323	145-37000-A	LEVEL SWITCH-FLOAT TYPE	Mr. Amarendra Kulkarni 194/195, Gopi Tank Road, Off. Pandurang Naik Marg, Mahim Mumbai Phone- 9323195251 Pincode : 400016 Email : amarendra@general-gauges.com	
324	145-37000-A	LEVEL SWITCH-FLOAT TYPE	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
325	145-37000-A	LEVEL SWITCH-FLOAT TYPE	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 À GIDC À Phase 1, -VAPI-GUJARAT INDIA Phone- +91 11 4161 7111 FAX : 022 2687 3613 Pincode : 396 195 Email : pbajaj@baumer.com
326	145-37000-A	LEVEL SWITCH-FLOAT TYPE	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in	Works-1->R Gopinath 27 Nahur Udyog Industrial Premises,M.M.Malviya Road, Mulund(-MUMBAI-MAHARASHTRA INDIA Phone- +912225918567 FAX : +912225918566 Pincode : 400080 Email : sales@sigmainstruments.co.in
327	145-37000-A	LEVEL SWITCH-FLOAT TYPE	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
328	145-38000-A	INSTRUMENTS PIPE FITTINGS	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	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
330	145-38000-A	INSTRUMENTS PIPE FITTINGS	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	Sophie Y. Moochhala/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@hyd-
361	145-45000-A	INSTRUMENT FITTINGS	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	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 Vishweshwar 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	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,Devdal, -Vasai East-MAHARASHTRA India Phone- 9920044113 FAX : 07303178243 Pincode : 401208 Email : ab@fluidfitengg.com
364	145-45000-A	INSTRUMENT FITTINGS	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	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	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com	
367	145-45000-A	INSTRUMENT FITTINGS	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-
368	145-45000-A	INSTRUMENT FITTINGS	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- 044-25252537 FAX : 044-26252538 Pincode : 600037 Email : sales@hpvalvesindia.com
369	145-45000-A	INSTRUMENT FITTINGS	Sophie Y. Moochhala/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@hyd-
370	145-45000-A	INSTRUMENT FITTINGS	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

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.

SUB SECTION-IIA

STANDARD TECHNICAL REQUIREMENT (MECHANICAL)

Mill Discharge Spout and Pyrite Hopper

- Each coal mill has a discharge spout with a pneumatic cylinder operated knife gate valve for discharging rejects into a pyrite hopper of adequate capacity. This hopper shall serve to store the mill rejects between each operating cycle of dense phase system. Minimum effective storage capacity shall be 2-3 times the effective (batch capacity) of the conveying vessel.

- Each pyrite hopper shall be provided with a knife gate valve of approved design at the bottom, adequately sized manhole/inspection door, sizing gird and emergency chute with Knife gate valve and reject quenching arrangement (water spray) shall be provided. Any platform/ structural support (as per IS 2062 Gr A/B) required to maintain the above equipment before transporter vessel's inlet valve. Necessary explosion vent (rupture disc with MOC Aluminium) of proven design shall be provided in each pyrite hopper.

- Each emergency chute shall be provided with a knife gate valve to transfer mill rejects from pyrite hopper to ground or to Owner's trolley. Necessary access and platform shall be provided. Limit switches shall be provided to indicate the valve position on control panel.

- Each pyrite hopper shall be provided with two level switches – one to start the operating sequence and the other to indicate the hopper above grid chocked condition.

- Open & Close Limit switches shall be provided in all KGVs and these limit switches shall be interlocked with MRS control system. Solenoid box cum local control panel shall be provided. Same shall house system start stop, vessel pressure indication, probe over ride, purge button so that system can be locally optd. It shall be possible to operate individual vessel from local pneumatic panel for few cycles in emergency.

- Following control modes shall be provided

- Remote mode: System shall be controlled through MRS control System.

- Local Mode:

a) Energized mode: Manual override shall be selected from MRS control System. System logic shall be executed in MRS control system itself.
b) De-energized mode: MRS control system shall be delinked and system (individual stack up assembly) shall be operated manually.

- The sizing grid shall be provided inside the pyrite hopper to prevent oversized mill rejects, tramp iron etc. from entering the conveying vessel. The arrangement for collecting bigger pieces of coal rejects from the grid includes, among others, Knife Gate Valve, chute work etc. Bigger pieces of coal rejects shall roll down from the grid and through KGVs, chute work etc. Bigger pieces of coal rejects shall roll down from the grid and can be removed through the over sized seized reject removal gate (to be provided preferably at the bottom of inspection door) be discharged to Owners trolley. The arrangement shall be finalized during detail engineering. The grid shall be made of minimum 10 mm dia.

CONVEYING VESSEL

1.0 GENERAL

This specification covers the PURCHASER'S general requirement of design, materials, constructional features, manufacture, inspection and testing at VENDOR''S works and/or his sub vendor's works of Conveying Vessel and accessories specified hereinafter.

2.0 CODES AND STANDARDS

2.1 The design, material, construction, manufacture, inspection and performance of the Transporter and accessories, shall comply with all statutory regulations and safety codes currently applicable in the locality where the equipment will be installed. The equipment shall also conform to the latest applicable Indian/British/USA/DIN Standards.

2.2 The material of construction and other works of the Transporter and accessories shall in general conform to the following standards/codes but will be subjected to any modification and requirement as specified in Section C of Technical Speciation.

i) Transporter Vessel – Mild Steel to IS 2062 (Gr. A min); Construction as per IS-2825 / BS5500/ASME SEC-VIII, Div-1
ii) Material Handling Valve – As indicated in Sec-C of the specification
iii) Flange – MS as per ANSI B 16.5

2.3 Where the above standards are in conflict with the stipulations of this specification, this specification supersedes them. In case of any further conflict in this matter, the decision of the Engineer will be final and binding.

3.0 DESIGN REQUIREMENTS

3.1 The dense phase pneumatic conveying system shall be designed for low velocity for conveying of materials as indicated in Section C.

3.2 The system shall consist of dome shaped vessels made of Carbon Steel complete with pneumatically operated dome/metering valves capable of closing through a solid head of material to make a pressure tight seal.

3.3 The bottom of vessel shall have transition bend and a control air supply system to the side of the conveying vessel.

3.4 Airtight seal system shall be provided between the transporter and the feeding point.

3.5 Transporter shall be equipped with **air strainer** to prevent pipe scale /dirt from causing pressure regulator malfunctioning.

3.6 Automatic drain filter and oil fog lubricator set shall be fitted into the air line to dome valve/metering valve for use with pneumatic controls.

3.7 Any air line stop valve fitted in the air supply line of transporter shall be of ball type to avoid any restriction to air flow, when open.

4.0 CONSTRUCTIONAL FEATURES

4.1 The transporter vessel shall be fabricated from mild steel plate to the design of vendor. The vessel shall be of welded structure and shall be provided with necessary supporting structure. The vessel shall be airtight/leak proof in fully assembled condition. Conveying vessel shall be designed and tested as per IS 2825 vessel. Temperature of mill reject coming into the conveying vessel shall be considered as 200 °C. Conveying vessel shall be designed for a pressure 10% above the maximum pressure encountered

in the vessel. The conveying vessel shall be constructed with tested quality mild steel plates. They shall withstand the abrasive & hot condition of the mill rejects and operating air pressure. The conveying vessel shall be supported independently on steel columns. The vessel shall have suitably located and adequately numbered air connections for supply of compressed air for conveying mill rejects through pipes to overhead bin.

4.2 Dome/Metering valve shall be of manufacturer's standard construction and will be easily openable and closeable type. All joints will be flanged with asbestos free or silicon rubber gaskets suitable for 200 °C.

4.3 All bends will be of long radius cast bends (R = 5D). Conveying pipes will be of mild steel heavy duty type.

5.0 TESTING AND INSPECTION

5.1 The purchaser shall have free access to those parts of manufacturer's works which are concerned with the fabrication of the steel work and shall be afforded with all reasonable facilities at all stages of preparation, fabrication and trial assemblies for satisfying himself that the fabrication is being undertaken in accordance with the provisions of this specification

5.2 Should any structure or part of a structure be found not to comply with any of the provision of this specification, it shall be liable to rejection. No structure or part of the structure, once rejected shall be resubmitted for inspection/test except in cases where the purchaser or his authorized representative considers the defect as rectifiable defects which may appear during fabrication shall be made with the consent of and according to the procedure laid down by the purchaser, the purchaser may, at his discretion, check the test results obtained at the manufacturer's works by independent tests at the Government test house or elsewhere, and should not be found to be unsatisfactory shall be rejected. The costs of such tests shall be borne by the contractor.

5.3 Scope of inspection shall include but not limited to the following:

i) Material used in the fabrication shall be with manufacturer's test certificate with proper correlation for physical properties and chemical analysis. In the absence of correlation actual tests shall be done.

ii) Welders shall be qualified as per ASME Standard. Only qualified welders shall be employed for the fabrication purpose.

iii) Electrodes shall be of makes approved by BHEL.

iv) All fillet welds, root run and trial run of butt welds shall be subjected to visual dye penetrating test with no linear indication. Acceptable norm for dye-penetrating test shall be as per Appendix-8 of ASME SEC. VII Div. 1.

v) Special tests like NDT as per relevant code will be carried out for fabrication items.

vi) Chemical analysis and hardness tests of linear plates shall be carried out.

vii) Dimension shall be maintained as per approved drawings.

MILL REJECT BUNKER AND ACCESSORIES

1.0 GENERAL

1.1 This specification covers the PURCHASER'S general requirement of design, manufacture, fabrication, assembly, inspection, testing and delivery to site or mill reject bunker and accessories specified.

2.0 CODES AND STANDARDS

2.1 The design, material, construction, manufacture, inspection, testing and performance of the mill reject bunker shall comply with all statutory regulations and all safety codes currently applicable in the locality where the equipment will be installed.

2.2 The material of construction and other works of the mill reject bunker shall in general conform to the following standards /codes but will be subject to any modification and requirements as specified in the specification.

a)	Structural steel	:	IS-2062 Gr A (min)
b)	Rolled Steel Beams, Channels and Angle Sections	:	IS-808
c)	Scheme of Symbols for Welding	:	IS-813
d)	Covered Electrodes for Metal Arc Welding of Structural Steel	:	IS-814
e)	Code of practice for use of Metal Arc Welding for general Construction in Mild Steel	:	IS-816
f)	Code of practice for inspection of Welds	:	IS-822
g)	Code of practice for use of structural steel in general building construction	:	IS-800
h)	Dimension for steel plate, sheet and Strip for structural and general Engineering purposes	:	IS-1730
i)	Recommendation for metal arc welding	:	IS-9575

2.3 Where the above standards are in conflict with the stipulations of this specification, the specification supercedes them. In case of any further conflict in this matter, the decision of the ENGINEER shall be final binding.

3.0 DESIGN REQUIREMENT

3.1 The coal mill reject bunker shall be fabricated of mild steel plate with adequate stiffeners welded on. The bunker shall be supported on the concrete foundation provided by the purchaser. Foundation bolts, gratings etc. shall be provided by the bidder.

3.2 The reject bunker shall be complete with twin sector discharge gate, stainless steel liners, flanged connections, platforms, gratings/chequered plates, access staircase, hand railings etc. The equipment shall be designed and equipped for outdoor operation, complete with all accessories.

4.0 CONSTRUCTIONAL FEATURES

4.1 The bunker shall be of welded structure and shall be provided with necessary supporting structure. Flanged opening shall be provided at the bottom of the bunker for attaching the twin sector gate. The inclined part of the bunker shall be designed with a valley angle of not less than 60 deg. To the horizontal. The design of the bunker shall be such that the problem of formation of arch is eliminated. The inside surface shall be provided with liner MOC as specified elsewhere in the specification. Explosion diaphragm/Pressure relief valve shall be provided to release air from the bunker in case pressure inside the bunker exceeds 1 .0 kg/cm^2(g)

4.2 Vendor shall furnish all steel work required for support and access for operation and maintenance. This shall include platforms, grating/chequered plates, stairways, hand railings, base plates, foundation bolts etc. Purchaser will provide only the foundation with pockets. The bunker shall have shed over it and shall be provided with monorail & hoist for equipment handling.

4.3 The storage bunker shall be so arranged that any 10 ton capacity truck can be conveniently loaded under it by an operator standing on the platform.

4.4 Access and platform shall be provided with 32 mm thick MS grating & 32 mm MS GI pipe hand railing.

4.5 The storage bunker shall be provided with filter bags as specified elsewhere in the specification. Filter bags shall be suitably treated to minimize the chances of filter catching fire. It shall be possible to plug opening for damaged bag filters, if any, to facilitate un-interrupted operation. Suitable explosion vents shall be provided for the bag filter unit. Sequential cleaning cycle shall be initiated with pressure drop signal across the bag filter once sufficient cleaning air pressure is available. Solenoid/pneumatic valves shall be provided for this purpose. Bag cleaning mechanism shall be automatic and shall comprise of solenoid valves. Air nozzles shall be provided just above the filter to facilitate individual cleaning of each bag.

4.6 The terminal boxes for terminating reject conveying pipes shall be of steel construction with necessary deflector or impingement plate to take care of impact and wear due to high velocity reject particles discharging into the bunker.

5.0 INSPECTION AND TESTING

5.1 The purchaser shall have a free access at all reasonable times to these parts of manufacturer's works which are concerned with the fabrication of the steel work and shall be afforded all reasonable facilities at all stages of preparation, fabrication and trial assemblies for satisfying himself that the fabrication is being undertaken in accordance with the provisions of this specification.

5.2 Should any structure or part of a structure be found not to comply with any of the provisions of this specification, it shall be liable to rejection. No structure or part of structure, once rejected shall be resubmitted for inspection/ test except in cases where the purchaser or his authorized representative considers the defect as rectifiable. Defects which may appear during fabrication shall be made good with the consent of and according to the procedure laid down by the purchaser. The purchaser may, at his discretion, check the test results obtained at the manufacture's works by independent tests at the government test house or elsewhere and should the material so tested be found to be unsatisfactory shall be rejected. The cost of such tests shall be borne by the contractor.

5.3 Examination of material of construction, verification, correlation and identification with material test certificate.

5.4 Ensuring that the relevant weld procedure and welder qualifications tests are in accordance with fabrication code.

5.5 Inspection during fabrication at appropriate stage including fit up. Witness of dye penetrant testing at root and final run for all groove welds and final run for fillet welds as per ASTM E 165. All surfaces examined shall be free of:

a) Relevant linear indications (Linear indications are those indications in which length is more than three times the width and only indication with major dimension greater than 1.6 mm shall be considered relevant).

b) Four or more rounded defects in a line separated by 1.6 mm or less (edge to edge). Rounded indications are those where length less than three times the width.

5.6 Any other tests as specified in the fabrication code.

5.7 Dimensional check match marking as per approved drawings.

6.0 SCOPE OF INSPECTION FOR RACK AND PINION GATE

6.1 Examination of materials of construction, verification, correlation/testing and identification of material with test certificate for important items like body, drives, warm shaft, rack & pinion, wheel etc.

6.2 Dye Penetration check on drive shaft & warm shaft as per IS-3658 and there shall be no surface defects.

6.3 Dimensional check

6.4 For chain proof load shall be carried out.

6.5 Hardness of rubber component

6.6 Check for overall dimension, completeness, no load working after assembly.

6.7 Clearing, marking and painting.

AIR RECEIVER

1.0 GENERAL

This standard specification covers the design, material of construction, features, manufacture, inspection & testing at VENDOR'S and/or his sub-vendors' works, suitable painting and packing requirements of air receiver

2.0 CODES & STANDARDS

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As far as possible, the design, manufacture and performance of air receivers shall be in accordance with the latest applicable Indian/British/American/DIN standards.

The latest editions of the following shall be followed in particular:

IS: 2825 – Code for unfired pressure vessels

ASME – Section-VIII, Division-1

BS – 487-Fusion welded steel air receivers

IS: 7938 – Air receivers for compressed air installation

The materials of the various components shall conform to applicable IS/BS/ASTM/DIN standards.

3.0 DESIGN AND CONSTRUCTION

3.1 The air receivers shall be vertical self-supporting cylindrical vessels with supporting stands for resting on the civil foundation.

3.2 Other design parameters and design internal pressure of the receiver shall be as per the data specification sheet, if any, enclosed. The receiver shall be designed as per IS:7938.

3.3 Receivers shall be of welded construction with a minimum number of joints. Longitudinal seams in adjacent section of shell shall not be in the same line.

3.4 Receivers shall be provided with gasket inspection openings. Receivers below 500 mm diameter shall have at least two inspection holes. For receivers of larger diameter, manhole of minimum 450 mm diameter shall be provided. These openings shall be placed as far as possible from any welded seam and in no instance shall pierce any seam.

3.5 All welding shall be performed in accordance with relevant codes. Filler material that will deposit weld metal with a composition and structure as near as that of the material being welded shall be used. All welding electrodes shall be got approved by the Owner. The electrodes shall be dried in ovens immediately before use to ensure freedom from porosity. All the circumferential and longitudinal butt welds of the air receiver shall be subjected to spot radiography. Tee joints and dished welding shall be subjected to 100% radiography.

3.6 All other welding on the air receiver, including filet weld and nozzle connection shall be DP tested as per IS: 2825 (Para 8.7.11).

3.7 Each finished receiver complete with all welded attachments shall be hydraulically tested at 150% of the design pressure. The test pressure shall be maintained for at least 30 minutes. All joints shall be gentle hammered during the test.

3.8 Receivers shall be provided with relief valve of the capacity and set pressure of the same at least 10% above working pressure. The spring in the relief valve in service for pressure up to and including 250 psi shall not be reset for any pressure more than 10% above or below the design set pressure. For higher pressures, the spring shall not be reset for any pressure more or below 5% design set pressure.

3.9 Each air receiver shall be complete with drain connection of 25 mm NB with a trap station consisting of a trap, strainer, isolation and bypass valves.

3.10 The receiver shall be provided with necessary number of nozzles. The orientation of the nozzles shall be subjected to the approval of the Owner.

3.11 Local instruments like pressure gauge, switch and temp. gauge of suitable range shall be supplied. Please refer specification for conveying air compressor for other instrumentation required.

3.12 The vendor will have all welding procedures & welders qualified in accordance with the relevant codes prior to commencing any welding at the works. These tests shall be witnessed by customer/client representative.

CHAIN PULLEY BLOCK & MONORAIL

1.0.0 GENERAL

This specification covers the design**,** manufacture, assembly, inspection and testing at manufacturer's and/or his sub-constructor's works of hand operated chain pulley block.

2.0.0 CODES AND STANDARDS

The design, manufacture, inspection and testing and performance of hand operated chain pulley blocks shall confirm to latest editions of the following standards: -

a) IS: 3832 Specification for hand operated chain pulley block

b) IS 807: 1976 Codes of Practice for Design, Manufacture, Erection and Testing (Structural Portion) of cranes and hoists

c) IS: 3109(Part II) Calibrated load chain for pulley blocks and other lifting appliances

d) IS: 2429(Part II) Calibrated hand chain for pulley blocks and other lifting appliances

e) IS: 4460 Method for rating of machine cut spur and helical gears

f) Material Specification IS or approved

3.0.0 EQUPIMENT

3.1.0 CHAIN PULLEY BLOCK

The block shall be so designed that all components shall withstand without failure, an application to the block of a load equal to at least four times the working load limit.

3.1.1 Frame

Frame shall be robust in design and of welded construction. The frame shall be selected in such a way that head room requirement is minimum. Frame shall maintain alignment under all expected conditions of services.

3.1.2 Chain

The load chain shall be electrically welded, accurately calibrated, and pitched arid polished conforming to IS: 6216 Grade 80 as specified in data sheet 'A'.

The hand chain shall also be electrically welded, calibrated, pitched and polished and shall conform to IS: 2429 (Part II) grade 30. The length of chain and link dimension shall be as per IS: 3832.

3.1.3 Hook

The forged hook shall be properly heat-treated and so designed that in loaded condition, it is free to swivel without twisting the load chain. The hook shall conform to IS: 3815.

3.1.4 Reduction Gear

The reduction gear shall be spur or worm/worm wheel type. The spur gear and worm shall be of high-

grade carbon steel and heat treated. The worm wheel shall be of bronze. A detachable steel cover shall be provided for total enclosure of the gear train and ample lubrication to be provided.

3.1.5 **Brakes**

Brakes shall be of screw friction disc type self-actuating or any other approved type as per manufacturer's standard practice. Brake capacity shall be ample and humid atmosphere shall not affect materials used. The brake shall prevent self lowering of load and arrest and sustain load in all working positions. The load brake shall also allow smooth lowering of the load without serious overheating which may impair sufficient working of block

3.1.6 **Bearing**

Bearing used shall be as per guidelines laid down in IS: 3832.

3.1.7 **Wheel**

The load chain wheel shall be made of heavy duty malleable casting and shall be designed to ensure, effective operation of the chain. Load chain, wheel shall be mounted on two ball bearings. Hand chain wheel shall be made from malleable casting/pressed sheet steel. The idler wheel shall be so shaped as to avoid the twisting of the chain during operation. The P.C.D of idler wheels shall be such that the bending action of the link is avoided. The hand chain wheel shall be provided with flanges and designed to ensure effective operation with hand chain.

3.1.8 **Other components**

All other components of chain pulley block such as anchorage, guide, pawl, stripper etc. shall be designed and provided as per IS: 3832.

3.2.0 MONORAIL TROLLEY

Monorail trolley shall be provided if called for in the enclosed Data Sheet—A. Monorail trolley frame shall be of heavy section rolled steel, held together by bolts. Wheels shall be of high grade cast iron mounted on ball bearings. Axles and shafts shall be of carbon steel, accurately machined and suitably supported. The trolley shall be suitable for variations in I section beams. The trolley shall be geared travel type.

The hand chain required for trolley travel shall be as per clause 3.1.2 of this specification.

Hand chain wheel shall be as per clause 3.1.7 of this specification.

4.0.0 INSPECTION AND TESTING

The scope of inspection shall include but not limited to the following:

a) Material identification/co-relation for important items like hook, load chain, hand chain, wheels, nut and pawl etc.
b) Hardness for pawl and ratchet
c) Dye penetration test for hooks
d) Operational test including operational effort, velocity ratio etc,

e) Proof load test up to 1.5 times of working load limit.

f) Dimensional check of hook

g) Marking

DATASHEET

S. No.	Parameter	Description
1	Capacity (In Kg)	Suitable for lifting the heaviest load but not less than One (1) ton
2	Service condition	Class II outdoor
3	No. of CPB	1 per bunker
4	Lift (m)	To suit bunker height and equipment on bunker roof top to be handled.
5	Type of suspension	Travelling Trolley
6	Head Room	Minimum permissible
7	Type of gear in CPB	Spur Gear
8	Type of bearing	Ball/Roller
9	Grade of Load Chain	Alloy Steel /Gr 80
10	Grade of Hand Chain	Steel / Gr. 30
11	Factor of Safety	As per Relevant IS

ANNEXURE-VIII

MAKES OF SUB VENDORS ITEMS

1) The vendor list at **Customer's Specification** "Annexure to Project Management and Site Services", Volume: II-A, Section: VI , of shall be applicable.

2) The items / makes indicated below but not covered at "Annexure to Project Management and Site Services, Volume: II-A, Section: VI , Project Management and Site Services" of Customer's Specification for makes as proposed by bidder shall be put up for Customer's approval during detailed engineering stage without any commercial & delivery implication to BHEL.

3) Bidder to propose sub vendor within 4 weeks of placement of LOI, thereafter no request for additional sub-vendor shall be entertained.

4) The inspection category will be finalized after award of contract during detailed engineering. Same will be adhered by the bidder without any commercial and delivery implication to BHEL

Sl. No	ITEM/SERVICE	QAP/ INSP.CAT.	Scope of supply/manufacturer	Place	Remarks
I	**SELF MFG ITEMS**				
1	Pyrite Hopper	I	SELF MANUFACTURED		
2	Blow Tank	I	SELF MANUFACTURED		
3	Local Control Panel with accessories	I	SELF MANUFACTURED		
4	Mill Reject Conveying fittings/Bends	I	SELF MANUFACTURED		
5	Swing Valve(Pneumatic operated)	I	SELF MANUFACTURED		
6	Bunker Discharge Gate (Sector Gate)	I	SELF MANUFACTURED		
7	Pressure Relief Valve	I	SELF MANUFACTURED		
II	**BOUGHT OUT ITEMS**				
A	**MECHANICAL**				
1	Terminal Box	I	BHEL/ WBPDCL/DCPL APPROVED FABRICATORS	INDIA	
2	AIR RECEIVER	I	PARKARE	DELHI	
		I	UNITED ENGG WORKS	NASIK	
		I	INTEGRATED ENGINEERS	PUNE	
		I	TEMASME VESELLEX	NOIDA	
		I	DIAMOND FABRICATIONS	PUNE	
3	DRAIN TRAP	III	SPIRAX MARSHAL	MUMBAI	
		III	GREAVES COTTON	MUMBAI	
		III	TRIDENT	COIMBOITORE	
4	Gate, Globe, Check valves/ NRV - C.I	II	LEADER	JULLANDHAR	
		II	BANKIM	HOWRAH	
		II	H SARKAR	HOWRAH	
		II	KBL	PUNE	
		II	AV VALVES	AGRA	Upto 300 NB
5	Gate, Globe, Check valves/ NRV - G.M	III	LEADER	JULLANDHAR	
		III	BOMBAY METALS & ALLOYS (GG)	MUMBAI	
		III	SANT VALVES	JULLANDHAR	

6	Knife Gate/Plate Valve (H/W Operated & Cylinder Optd)	I	FOURESS	MUMBAI	
		I	VASS	CHENNAI	
		I	(ORBINOX)	COIMBATORE	
7	Ball Valves	III	PRECISION ENGG	MUMBAI	
		III	Weir BDK	HUBLI	
		III	LEADER	JULLANDHAR	
		III	FLOW CHEM	GUJRAT	
8	Safety Relief Valve	III	LEADER	JULLANDHAR	
		III	SPIRAX MARSHAL	PUNE	
		III	KAYSTONE(TYCO FLOW CONTROL)	HALOL	
		III	BHEL	TRICHY	
9	M.S G.I / ERW PIPES	I	JINDAL	GHAZIABAD	UPTO 350 NB
		I	SURYA ROSHINI	BAHADURGARH	
		II	SAIL	ROURKELA	
		I	WELLSPUN	ANJAR	
		I	INDUS	GB NAGAR	UPTO 300NB
		II	TISCO	JAMSHEDPUR	UPTO 150NB
		I	MAHARASHTRA SEAMLESS	MAHARASHTRA	200NB TO 400NB IS 3589
10	Metallic Expansion Bellow(Metallic)	I	METALLIC BELLOWS	CHENNAI	
		I	SUR INDUSTRIES	KOLKATA	
		I	LONESTAR	CHENNAI	
11	Rupture Disc	II	BS & B SAFETY SYSTEM	CHENNAI	
12	Chain pulley Block (1 Ton)	II	hercules (INDEF)	mumbai	
		II	TRACTEL	FARIDABAD	
		II	LIFTING EQUIPMENTS & ACESSORIES	DELHI	
13	Conveying Air Compressor (Reciprocating Type)	I	KIRLOSKAR PNEUMATIC	PUNE	
		I	INGERSOLL RAND	AHMEDABAD	
14	Sump Pump (Water Service)	II	KSB PUMP	PUNE	
		II	MATHER & PLATT	PUNE	
		II	SAM	COIMBOITORE	
		II	FLOW MORE	GHAZIABAD	
		II	B & C	CHENNAI	
		II	KIRLOSKAR	PUNE	
		II	WORHTINGTON	GHAZIABAD	
15	Pneumatic Actuator/Cylinder(Metallic)	III	SCHRADDER	MUMBAI	
		III	NUCON	HYDERABAD	
		III	ROTEX	MUMBAI	
		III	VAAS	CHENNAI	
16	Tools and Tackles	III	BRANDED		
17	Steel Plate/ Structure/ Section/ SS liner	III	SAIL		
		III	JSW STEEL LTD		
		III	JINDAL STEEL & POWER LTD		
		III	TISCO		
		III	ESSAR		
		III	IISCO		
		III	LLOYDE		
		III	RINL		
18	Grating	III	INDIANA	PUNE	

19	Bag Filter	II	ACCO	KOLKATA	
		II	THERMAX	PUNE	
		II	BATLIBOI	DELHI	
B	**ELECTRICAL & INSTRUMENTATION**				
1	Motor (LT)	I	MARATHON	KOLKATA	Refer Note 3
		I	SIEMENS	MUMBAI	
		I	NGEF	BANGALORE	Upto 15KW, refer note 3
		I	KEC	BANGALORE/HUBLI	HUBLI upto 90 kw,refer note 3
		I	CGL	AHMED NAGAR	Refer note 3
		I	ABB	FARIDABAD/BANGLORE	Faridabad upto 55kw, Bangalore above 55kw & upto 200kw, refer note 3
		I	BBL	MUMBAI	upto 100kw refer note 3
2	Air Filter/Lubricator/Regulator	III	SHAVONORGAN	MUMBAI/BANGLORE	
		III	PLACKA	CHENNAI	
3	Level Probes(RF)	II	EIP ENVIRO LEVEL CONTROL	NOIDA	
		II	E&H	GERMANY / AURANGABAD	
		III	FLOW STAR	FARIDABAD	
4	Annunciator	III	HC	MUMBAI	
		III	PECON	AHEMDABAD	
		III	PROCON	CHENNAI	
5	Solenoid Valves	III	NUCON	HYDERABAD	For Nucon Cylinder only
		III	JEFFERSON	ARGENTINA	
		III	HARION	GERMANY/ AURANGABAD	
		III	ASCO(I)	CHENNAI	
		III	SCHRADDER DUNCAN LTD.	MUMBAI	For Schrader Duncan cylinder only
		III	AVCON CONTROLS	MUMBAI	
		III	ROTEX AUTOMATION	BARODA/VV NAGAR	
6	Pressure Switch ,DP Switch/ Temp.Switch	II	SWITZER	CHENNAI	Except 900 series
		II	GAUGE BOURDON (FOR PRESSURE SWITCH)	PANVEL	Not for temp switch
		II	TRAFAG	RANIPET	
			INDFOS IND	GHAZIABAD	
		II	ASHCROFT	USA /GERMANY	
		II	ASHCROFT	GHAZIABAD	
7	Pressure Gauge & DP Gauge	III	GAUGES BOURDON INDIA	PANVEL	
		III	AUXITROL	UK	
		III	MANOMETER INDIA	MUMBAI	
		III	BUNDENBURG	UK	
		III	AN INSTRUMENTS	KOLKATA	
		III	GOA THERMOSTATIC	GOA	
		III	GUCK INDIA	MUMBAI	
		III	WIKA	PUNE	
		III	SWITZER (DP INDICATOR)	CHENNAI	
		III	H GURU (SI)	BANGALORE	
8	Temperature Gauge	III	WIKA	PUNE	

		III	AN INSTRUMENTS	KOLKATA	
		III	GENERAL INST	MUMBAI /GOA	
		III	BUDENBURG	UK	
		III	H GURU (SI)	BANGALORE	
		III	GOA THERMOSTATIC	GOA	
		III	WAREE	MUMBAI	
9	Pulse Jet Valves	III	ASCO	CHENNAI	
		III	MANIK	CHENNAI	
10	Cable Lug	III	DOWELLS	MUMBAI	
		III	BILLET (3D)	VALSAD	
		III	CHETNA	NASIK	
11	Limit Switch	III	SIEMENS	MUMBAI	
		III	JAIBALAJI	NEWDELHI	
12	Junction Boxes & Earthing Material ROD, FLAT etc.	III	WBPDCL/DCPL / BHEL APPROVED VENDOR		Main contractor approved sources with galvanizing at WBPDCL/DCPL accepted sources
13	INSTRUMENT CABLE / SIGNAL CABLE	II	DELTON CABLES	BANGALORE	
		II	PARAMOUNT CABLES	FARIDABAD	
		II	POLYCAB	DAMAN	
		II	UNIVERSAL CABLES	SATNA	
		II	NICCO	KOLKATA	
		II	CORDS	BHIWADI	
		II	INCAB	PUNE	
14	Cable Tray	II	MJ ENGG	DELHI /BHIWADI	
		II	JAMUNA METALS	DELHI / SONEPAT	
		II	INAR PROFILES	ANAKAPALLI	
		II	INDIANA	MUMBAI	
		II	TECHNO	CHANDIGARH	
		II	INDUSTRIAL PERFORATION	KOLKATA	
15	Cable Gland	III	COMMET	MUMBAI	
		III	SUNIL & CO.	KOLKATA	
		III	ARUN ENGG.	KOLKATA	
		III	QUALITY PRECISION	KOLKATA	
16	Local panel/ LPBS	I	CONTROL DEVICES	KOLKATA	
		I	PYROTECH	UDAIPUR	
		I	C&S	NOIDA/ HARDWAR	
		I	INDUST CONTROLS & APPLIANCES	MUMBAI	
		I	POSITRONICS	BARODA	
		I	SWITCHING CIRCUIT	KOLKATA	
		I	JACKSON	GR. NOIDA	
		I	JOLLY ENGG.	KOLKATA	
17	FRP JUNCTION BOXES	III	BHEL/WBPDCL/DCPL approved sources	India	
18	LEVEL INDICATOR / GAUGE	III	SBEM PVT LTD	PUNE	
		III	PUNE TECHTROL	PUNE	
		III	LEVCON	KOLKATA	
		III	SIGMA	MUMBAI	
		III	DK INSTRUMENTS	KOLKATA	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS

LEGENDS

1. QP/ INSPECTION CATEGORY :

CAT-I : For these items the Quality Plans are approved by WBPDCL/DCPL and the final acceptance will be on physical inspection witness by WBPDCL/DCPL.

CAT-II : For these items the Quality Plans approved by WBPDCL/DCPL. However no physical inspection shall be done by WBPDCL/DCPL. The final acceptance by WBPDCL/DCPL shall be on the basis review of documents as per approved QP.

CAT -III : For these items main supplier approves the quality plans. The final acceptance by WBPDCL/DCPL shall be on the basis certificate of conformance by the main supplier.

UNIT/WORKS : Place of manufacturing Place of Main Supplier of multi units/works.

NOTE-1

For steel following modalities to be adopted

a) Steel plate, structural steel and section shall be procured from main producers like SAIL/ TISCO/ ISSCO/ RINL/ JINDAL/ ESSAR/ ISPAT/ LLOYD'S STEEL/ JSW.

b) Material will be delivered directly from manufacturer's plant/ stock yard/ godown to WBPDCL/DCPL project site.

c) Correction of material with MTC will be done by main contractor before delivery and correlated MTC along with deelivery challan will be WBPDCL/DCPL-RIO for issuance of MDCC.

NOTE-2

It that the same Quality Plans as approved for main equipment and identified in the vendor list shall be applicable for the type of control measure i.e. make /test/ check the procurement of mandatory spares. However, for those spares which are not covered in the approved QP, main supplier shall furnish Certificate of Conformance (COC) along with guarantee and interchangeability certificate shall be generated by the main item manufacturer, for which the spares are made.

ANNEXURE IX

Standard Quality Plans

The following Quality plans/ Check lists of mechanical items are attached for ready reference of supplier. Details of same shall be finalized during detail engineering in conjunction with "QUALITY ASSURANCE REQUIREMENTS, Volume II-A" of Customer's specification.

a) Local control Panel
b) Transport Vessel
c) Pyrite Hopper
d) Terminal Box
e) Bunker Discharge Gate
f) Pressure Relief Valve
g) Air Receiver
h) Rupture Disc
i) Chain Pulley Block
j) Bag Filter
k) Pipes
l) ACI Bends
m) Knife Gate Valves
n) Sump Pumps
o) Expansion bellow
p) Plates & Structures

The inspection requirements indicated in the above QP's / CL's shall be adhered to as a minimum. Inspection requirement of some of the items are also elaborated in the technical specification under Sec-IIA. The QP's for above items as well as other items not listed above but required, as part of the system shall be prepared by the successful bidder in project specific format to be finalised with the successful bidder after award of contract.

Standard Quality Plans of few instruments & motors are enclosed elsewhere in the specification, for compliance by the bidder.

All QP's/CL's shall be submitted by the bidder for Customer/Consultant's review and approval. All comments made by customer / consultant shall be incorporated by the successful bidder without any commercial and delivery implication.

	S/Contactor : Mfgr:-	Manufacturing Quality Plan Item :-Local Panels QAP No. LOI Nos:- Contractor :- M/s BHEL	Project:-SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III. Package :- Mill Rejects System Client :-

Sl. No.	Components / Operations	Characteristics Checked	Category	Type/Method of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Records		Agency for Checking			Remarks
1	2	3	4	5	6	7	8	9		10			11
								TYPE	D	M	C	N	
1	**Materials**												
	CRCA Sheet	Visual	Major	Visual	100%	Appr. Drg / IS: 513	Appr. Drg / IS: 513	IR	-	P	-	-	
		Chem. & Physical.	Major	Chem.& Physical.	100%	Do	Do	TC	√	V	V	V	
		Thickness	Major	Measurement	100%	App. Drawing	App. Drawing	IR/TC	√	V	V	V	
2	**Bought outs**												
	Verification of type, size & Make of FLV unit, PG, PS, SV	Visual	Major	Visual	100%	Appr. Drawing / Data Sheet	Approved Drawing / Data Sheet	IR/TC	√	V	V	V	
3	**Painting**												
	Pre Treatment 7 tank process	Physical	Major	DFT / Shade / Finish	100%	Appr. Painting Schedule	Appr. Painting Schedule	IR/TC	√	V	V	V	
4	**Final Inspection**	Visual	Major	Visual	100%	Appr. Drawing / Data Sheet	Appr. Drawing / Data Sheet	IR/TC	√	P	**W**	V	
		Dimension	Major	Measurement	100%	Appr. Drawing / Data Sheet	Appr. Drawing / Data Sheet	IR/TC	√	P	**W**	V	
		Check for Pneumatic Circuit	Major	Visual	100%	Appr. Drawing / Data Sheet	Appr. Drawing / Data Sheet	IR/TC	√	P	**W**	V	
		Check for Wiring / Mountings / Terminations	Major	Visual / Continuity	100%	Appr. Drawing / Data Sheet	Appr. Drawing / Data Sheet	IR/TC	√	P	**W**	V	
		Functional Check for Solenoid Valve	Major	Functional	100%	Appr. Drawing / Data Sheet	Appr. Drawing / Data Sheet	IR/TC	√	P	**W**	V	
5	**QA Documents**	Review	Major	verification	100%	-	-	-					

Manufacturer / Sub Vendor	Contractor	**LEGENDS:-** Records identified by √ shall be essentially included in QA documentation. TC-Test Certificate , IR - Insp. Report M-> Manufacturer/Sub Contractor, C-> Contractor (BHEL) or their nominated agency & N ->CLIENT	For Client Use:-	**Document. No.:**
SIGNATURES		**P->Perform, V-> Verification, W-> Witness**	Name & Signature of Approving Authority with Seal	

	S/Contactor : Mfgr:-	Manufacturing Quality Plan Item :- Transport vessel QAP No. LOI Nos:- Contractor :- M/s BHEL	Project: SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III. Package :- Mill Rejects System Client :

Sl. No.	Components / Operations	Characteristics Checked	Category	Type/Method of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Records		Agency for Checking			Remarks
1	2	3	4	5	6	7	8	9		10			11
								TYPE	D	M	C	N	
1	**Raw Materials**												
1.1	Dome & dome Valve Body	Dimensions	Major	Measurement	100%	App. Drg. / Data Sheet / Standard	App. Drg. / Data Sheet / Standard	-	-	P	-	-	
		Surface Defects		Visual	100%			-	-	P	-	-	
		Physical Check		TS & Hardness	1/Heat			TC	√	P/V	V	V	
		Chemical Check		Chemical Comp.	1/Heat			TC	√	P/V	V	V	
1.2	Plates for Vessel	Dimensions	Major	Measurement	100%	App. Drg. / Data Sheet / IS Standard	App. Drg. / Data Sheet / IS Standard	-	-	P	-	-	
		Surface Defects		Visual	100%			-	-	P	-	-	
		Physical Check		TS & Elongation	1/Heat			TC	√	P/V	V	V	
		Chemical Check		Chemical Comp.	1/Heat			TC	√	P/V	V	V	
1.3	Insert Seal	Surface Defects	Major	Visual	100%	Mfr's Drg. / Std	Mfr's Drg. / Std	-	-	P	-	-	
		Hardness		Measurement	1/Lot			IR	√	P/V	V	V	
1.4	Shaft	Physical Check	Major	TS & Elongation	1/Heat	App. Drg./ IS Std.	App. Drg./ IS Std.	TC	√	P/V	V	V	
		Chemical Check		Chemical Comp.	1/Heat								
2	**In - Process Insp.**												
2.1	Welders & Welding	WPS / PQR / WPS	Major	Procedure / Qualification	100%	ASME sec - IX	ASME sec - IX	WPS / PQR	√	P/V	V	V	Welders to be approved by BHEL / CLIENT
		Welding Defects	Major	DPT on Root run	100%	ASTM E-165	ASTM E-165	IR	√	P/V	V	V	
			Major	DPT on Final run	10%	ASTM E-165	ASTM E-165	IR	√	P/V	V	V	
2.3	Machining of Dome & dome Valve	Visual & Dimension	Minor	Visual, Measurement	100%	Mfr's Drg / Standard	Mfr's Drg / Standard	-	-	P	-	-	
2.4	Hydotest of Vessel	Soundness / Leakage	Major	Visual, Hydro Pressure Test	100%	App. Drg. / Data sheet	App. Drg. / Data sheet	IR	√	P/V	**W**	**W**	
3	**Final Inspection**												
3.1	Final Assly	Completeness & Dimension	Major	Visual / Measurement	100%	App. Drg. / Data sheet	App. Drg. / Data sheet	IR	√	P/V	**W**	**W**	At Painted Condition
3.2	Run Test / Performance	Operation of Dome Valve	Minor	Visual, 5 times Cycle operation	100%	Mfr's Standard	Mfr's Standard	IR	√	P/V	**W**	**W**	
3.3	Painting	Finish / DFT	Major	Visual, Measurement	100%	App. Painting Schedule	App. Painting Schedule	IR	√	P/V	**W**	**W**	
4	**QA Documentation**												
4.1	TC & IR	Completeness	Major	Verification & approval	100%	App. Quality Plan	App. Quality Plan		–	P/V	V	V	

Manufacturer / Sub Vendor	Contractor	**LEGENDS:-** Records identified by √ shall be essentially included in QA documentation. TC-Test Certificate , IR - Insp. Report M-> Manufacturer/Sub Contractor, C-> Contractor (BHEL) or their nominated agency & N -> CLIENT	For Client Use:-
SIGNATURES		**P->Perform, V-> Verification, W-> Witness**	Name & Signature of Approving Authority with Seal

Document No.

	S/Contactor : Mfgr:-	Manufacturing Quality Plan Item :- Pyrite Hopper QAP No. LOI Nos Contractor :- M/s BHEL	Project:SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III. Package :- Mill Rejects System Client :-

Sl. No.	Components / Operations	Characteristics Checked	Category	Type/Method of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Records		Agency for Checking			Remarks
1	2	3	4	5	6	7	8	9		10			11
								TYPE	D	M	C	N	
1	**Raw Materials**												
1.1	Plates for Body	Dimensions	Major	Measurement	100%	App. Drg. / Data Sheet / IS Standard	App. Drg. / Data Sheet / IS Standard	-	-	P	-	-	
		Surface Defects		Visual	100%			-	-	P	-	-	
		Physical Check		TS & Elongation	1/Heat			MTC	√	P/V	V	V	
		Chemical Check		Chemical Comp.	1/Heat			MTC	√	P/V	V	V	
1.2	Spray Nozzle	Surface Defects	Major	Visual	100%	Mfr's Drg. / IS Standard	Mfr's Drg. / IS Standard	-	-	P	-	-	
		Chemical Check		Chemical Comp.	1/Lot			MTC	√	P/V	V	V	
		Dimensions		Measurement	100%			IR	√	P	V	V	
2	**In - Process Insp.**												
2.1	Welders & Welding	WPS / PQR / WPQ	Major	Procedure / Qualification	100%	ASME sec - IX	ASME sec - IX	WPS / PQR	√	P/V	V	V	Welders to be approved by BHEL
		Welding Defects		DPT on Root run	100%	ASTM E-165	ASTM E-165	IR	√	P/V	V	V	
				DPT on Final run	10%	ASTM E-165	ASTM E-165	IR	√	P/V	**W**	**W**	
2.2	Fabrication	Fit up, Marking, Cutting, Grinding	Minor	Visual, Measurement	100%	Mfr's Standard	Mfr's Standard	-	-	P	-	-	
3	**Final Inspection**												
3.1	Final Assly	Completeness & Dimension	Major	Visual	100%	App. Drg. / Data sheet	App. Drg. / Data sheet	IR	√	P/V	**W***	**W***	* -> Witness10%
3.2	Painting	Finish / DFT	Major	Visual, Measurement	100%	App. Painting Schedule	App. Painting Schedule	IR	-	P/V	**W**	-	Painting shall be Heat Resistance
4	**QA Documentation**												
4.1	TC & IR	Completeness	Major	Verification & approval	100%	App. Quality Plan	App. Quality Plan		–	P/V	V	V	

Manufacturer / Sub Vendor	Contractor	**LEGENDS:-** Records identified by √ shall be essentially included in QA documentation. TC-Test Certificate , IR - Insp. Report M-> Manufacturer/Sub Contractor, C-> Contractor (BHEL) or their nominated agency & N -> Client **P->Perform, V-> Verification, W-> Witness**	For Client Use:-
SIGNATURES			Name & Signature of Approving Authority with Seal

Document No.:-

	S/Contactor :-. Mfgr:-	Manufacturing Quality Plan Item :- Terminal Box QAP No. :- LOI Nos:- Contractor :- M/s BHEL	Project:-SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III. Package :- Mill Rejects System Client :-

Sl. No.	Components / Operations	Characteristics Checked	Category	Type/Method of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Records		Agency for Checking			Remarks
1	2	3	4	5	6	7	8	9		10			11
								TYPE	D	M	C	K	
1	**Raw Materials**												
1.1	Plates for Body	Dimensions	Major	Measurement	100%	App. Drg. / Data	App. Drg. / Data	-	-	P	-	-	
		Surface Defects		Visual	100%	Sheet / IS Standard	Sheet / IS	-	-	P	-	-	
		Physical Check		TS & Elongation	1/Heat		Standard	MTC	√	P/V	V	V	
		Chemical Check		Chemical Comp.	1/Heat			MTC	√	P/V	V	V	
2	**In - Process Insp.**												
2.1	Welders Qualification & Welding	WPS / PQR / WPQ	Major	Procedure / Qualification	100%	ASME sec - IX	ASME sec - IX	WPS / PQR	√	P/V	V	V	Welders to be approved by BHEL / KPCL
		Welding Defects	Major	DPT on Root run	100%	ASTM E-165	ASTM E-165	IR	√	P/V	V	V	
			Major	DPT on Final run	10%	ASTM E-165	ASTM E-165	IR	√	P/V	**W**	V	
2.2	Flange Machining and Drilling	Dimensions	Major	Measurement	100%	Mfr/Appr. Drg	Mfr/Appr. Drg	IR	–	P	-	-	
2.3	Connection -pipe to flange, pipe to body	Fit up	Major	Joint set up, PCD, Orientation	100%	Mfr/Appr. Drg	Mfr/Appr. Drg	IR	–	P	-	-	If Applicable
2.4	Fabrication	Fit up, Marking, Cutting, Grinding	Minor	Visual, Measurement	100%	Mfr's Standard	Mfr's Standard	-	-	P	-	-	
3	**Final Inspection**												
3.1	Final Assly	Completeness & Dimension	Major	Visual	100%	App. Drg. / Data sheet	App. Drg. / Data sheet	IR	√	P/V	**W**	**W**	
3.2	Painting	Finish / DFT	Major	Visual, Measurement	100%	App. Painting Schedule	App. Painting Schedule	IR	–	P/V	**W**	-	Painting before disp.
4	**QA Documentation**												
4.1	TC & IR	Completeness	Major	Verification & approval	100%	App. Quality Plan	App. Quality Plan		–	P/V	V	V	

Manufacturer / Sub Vendor	Contractor	**LEGENDS:-** Records identified by √ shall be essentially included in QA documentation. TC-Test Certificate , IR - Insp. Report M-> Manufacturer/Sub Contractor, C-> Contractor (BHEL) or their nominated agency & N -> CLIENT **P->Perform, V-> Verification, W-> Witness**	For Client Use:- **Document No.:-** Name & Signature of Approving Authority with Seal
SIGNATURES			

	S/Contactor :-. Mfgr:-	Manufacturing Quality Plan Item :- Bunker Discharge Gate QAP No. :- LOI Nos:- Contractor :- M/s BHEL	Project:-SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III. Package :- Mill Rejects System Client :-

Sl. No.	Components / Operations	Characteristics Checked	Category	Type/Method of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Records		Agency for Checking			Remarks
1	2	3	4	5	6	7	8	9		10			11
								TYPE	D	M	C	K	
1	**Raw Materials**												
1.1	Plates for Body	Dimensions	Major	Measurement	100%	App. Drg. / Data	App. Drg. / Data	-	-	P	-	-	
		Surface Defects		Visual	100%	Sheet / IS Standard	Sheet / IS Standard	-	-	P	-	-	
		Physical Check		TS & Elongation	1/Heat			TC	√	P/V	V	V	
		Chemical Check		Chemical Comp.	1/Heat			TC	√	P/V	V	V	
1.2	Shaft	Physical Check	Major	TS & Elongation	1/Heat	do	do	TC	√	P/V	V	V	
		Chemical Check		Chemical Comp.	1/Heat			TC	√	P/V	V	V	
		UT If Dia > 50 mm		Internal defect	100%			IR	√	P/V	V	V	
1.3	Cylinder / Actuator	Visual / Specification	Major	Visual	100%	do	do	Mfr's TC	√	V	V	V	
2	**In - Process Insp.**												
2.1	Welders & Welding	WPS / PQR / WPQ	Major	Procedure / Qualification	100%	ASME sec - IX	ASME sec - IX	WPS / PQR	√	P/V	V	V	Welders to be approved by BHEL / CLIENT
		Welding Defects	Major	DPT on Root run	100%	ASTM E-165	ASTM E-165	IR	√	P/V	V	V	
			Major	DPT on Final run	10%	ASTM E-165	ASTM E-165	IR	√	P/V	**W**	V	
3	**Final Inspection**												
3.1	Final Assly	Completeness & Dimension	Major	Visual	100%	App. Drg. / Data sheet	App. Drg. / Data sheet	IR	√	P/V	**W**	**W**	
3.2	Operation with job / shop actuator	Opening & Closing of Gate	Major	Visual	100%	Proper Working	Smooth Operation	IR	√	P/V	**W**	**W**	
3.3	Painting	Finish / DFT	Major	Visual, Measurement	100%	App. Painting Schedule	App. Painting Schedule	IR	–	P/V	**W**	-	Painting before disp.
4	**QA Documentation**												
4.1	TC & IR	Completeness	Major	Verification & approval	100%	App. Quality Plan	App. Quality Plan		–	P/V	V	V	

Manufacturer / Sub Vendor	Contractor	**LEGENDS:-** Records identified by √ shall be essentially included in QA documentation.TC -Test Certificate,IR - Insp. Report M-> Manufacturer/Sub Contractor, C-> Contractor (BHEL) or their nominated agency & N-> CLIENT **P->Perform, V-> Verification, W-> Witness**	For Client Use:-
SIGNATURES			Name & Signature of Approving Authority with Seal

Document No.:-

	S/Contactor :-	Manufacturing Quality Plan	Project:-SAGARDIGHI THERMAL POWER PROJECT,
		Item :- Pressure Relief Valve	1 X 660 MW UNIT NO 5, STAGE III.
		QAP No. :	Package :- Mill Rejects System
	Mfgr:-	LOI Nos:-	Client :- .
		Contractor :- M/s BHEL	

Sl. No.	Components / Operations	Characteristics Checked	Category	Type/Method of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Records		Agency for Checking			Remarks
1	2	3	4	5	6	7	8	9		10			11
								TYPE	D	M	C	K	
1	**Raw Materials**												
1.1	Plates for Body	Dimensions	Major	Measurement	100%	App. Drg. / Data Sheet	App. Drg. /	-	-	P	-	-	
		Surface Defects		Visual	100%	/ IS Standard	Data Sheet / IS	-	-	P	-	-	
		Physical Check		TS & Elongation	1/Heat		Standard	MTC	√	P/V	V	V	
		Chemical Check		Chemical Comp.	1/Heat			MTC	√	P/V	V	V	
2	**In - Process Insp.**												
2.1	Welders & Welding	WPS / PQR / WPQ	Major	Procedure / Qualification	100%	ASME sec - IX	ASME sec - IX	WPS / PQR	√	P/V	V	V	Welders to be approved by BHEL / KPCL
		Welding Defects	Major	DPT on Root run	100%	ASTM E-165	ASTM E-165	IR	√	P/V	V	V	
			Major	DPT on Final run	10%	ASTM E-165	ASTM E-165	IR	√	P/V	**W**	V	
2.2	Fabrication	Fit up, Marking, Cutting, Grinding	Minor	Visual, Measurement	100%	Mfr's Standard	Mfr's Standard	-	-	P	-	-	
3	**Final Inspection**												
3.1	Final Assly	Completeness & Dimension	Major	Visual	100%	App. Drg. / Data sheet	App. Drg. / Data sheet	IR	√	P/V	**W**	**W**	
3.2	Painting	Finish / DFT	Major	Visual, Measurement	100%	App. Painting Schedule	App. Painting Schedule	IR	–	P/V	**W**	-	Painting before disp.
4	**QA Documentation**												
4.1	TC & IR	Completeness	Major	Verification & approval	100%	App. Quality Plan	App. Quality Plan		–	P/V	V	V	

Manufacturer / Sub Vendor	Contractor	**LEGENDS:-** Records identified by √ shall be essentially included in QA documentation. TC-Test Certificate , IR - Insp. Report M-> Manufacturer/Sub Contractor, C-> Contractor (BHEL) or their nominated agency & N -> CLIENT **P->Perform, V-> Verification, W-> Witness**	For Client Use:- Name & Signature of Approving Authority with Seal
SIGNATURES			**Document No.:-**

	S/Contactor :-			Manufacturing Quality Plan Item :- Air Receiver QAP No. :- Contractor :- M/s BHEL			Project:-SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III. Package :- Mill Rejects System					
Sl. No.	**Components / Operations**	**Characteristics Checked**	**Category**	**Type/Method of Check**	**Quantum of Check**	**Reference Documents**	**Acceptance Norms**	**Format of Records**		**Agency for Checking**			**Remarks**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**		**10**			**11**
								TYPE	**D**	**M**	**C**	**K**	
1	**Raw Materials**												
1.1	Plates for Shell, Dished End & Flange	Dimensions	Major	Measurement	100%	App. Drg. / Data	App. Drg. / Data	-	-	P	-	-	
		Surface Defects		Visual	100%	Sheet / IS Standard	Sheet / IS Standard	-	-	P	-	-	
		Physical Check		TS & Elongation	1/Heat			TC	√	P/V	V	V	
		Chemical Check		Chemical Comp.	1/Heat			TC	√	P/V	V	V	
1.2	Formed Dished End	Dimensions	Major	Measurement	100%	App. Drg. / Data	App. Drg. / Data	IR	√	P	-	-	
		Thickness/Thinning		Measurement	100%	Sheet	Sheet	IR	√	P	-	-	
		DPT of Knuckle		DP Test	100%	ASTM E-165	ASTM E-165	TC	√	P/V	V	V	
2	**In - Process Insp.**												
2.1	Welders & Welding	WPS / PQR / WPQ	Major	Procedure / Qualification	100%	ASME sec - IX	ASME sec - IX	WPS / PQR	√	P/V	V	V	Welders to be approved by BHEL / CLIENT
		Welding Defects	Major	DPT on Root run	100%	ASTM E-165	ASTM E-165	IR	√	P/V	V	V	
		do	Major	DPT on Final run	10%	ASTM E-165	ASTM E-165	IR	√	P/V	**W**	**W**	
		do	Critical	Radiography Test on all C/S & L/S including T & X	100%	IS 2825 Class-II / ASME Sec VIII	IS 2825 Class II / ASME Sec VIII	RT Film / Report	√	P/V	V	V	
2.2	Fabrication	Marking, Cutting, Rolling, Edge Preparation, Joint & Nozzle set up	Major	Visual, Measurement (Ovality, off set orientation)	100%	Mfr's Standard / Approved Drg.	Mfr's Standard / Approved Drg.	IR	-	P	-	-	
3	**Final Inspection**												
3.1	Final Assly	Completeness & Dimension	Major	Visual / Measurement	100%	App. Drg. / Data sheet	App. Drg. / Data sheet	IR	√	P/V	**W**	**W**	
3.2	Hydotest of Vessel	Soundness / Leakage	Major	Visual, Hydro Pressure Test	100%	App. Drg. / Data sheet	App. Drg. / Data sheet	IR	√	P/V	**W**	**W**	
3.3	Painting	Finish / DFT	Major	Visual, Measurement	100%	App. Painting Schedule	App. Painting Schedule	IR		P/V	**W**	-	Painting before disp.
4	**QA Documentation**												
4.1	TC & IR	Completeness	Major	Verification & approval	100%	App. Quality Plan	App. Quality Plan	-	–	P/V	V	V	

Manufacturer / Sub Vendor	Contractor	**LEGENDS:-** Records identified by √ shall be essentially included in QA documentation. TC -> Test Certificate , IR - Inspection Report M-> Manufacturer/Sub Contractor, C-> Contractor (BHEL) or their nominated agency & N-> CLIENT	For Client Use:-
SIGNATURES		**P->Perform, V-> Verification, W-> Witness**	Name & Signature of Approving Authority with Seal

Document No.:-

	S/Contactor :- Manufacturer :-	Manufacturing Quality Plan Item :- Rupture Disc QAP No. :- LOI Nos:- Contractor :- M/s BHEL	Project:-SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III. Package :- Mill Rejects System Client :-

Sl. No.	Components / Operations	Characteristics	Classification	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Records		Agency for Checking			Remarks
1	2	3	4	5	6	7	8	9		10			11
								TYPE	D	M	C	K	
1 ->	**Materials** Rupture Disc Material	Physical & Chemical Properties	Major	Chemical Analysis, YTS & UTS	1 per Heat	ASTM A240 Type - 304 / Appved Data Sheet / Drg.	ASTM A240 Type - 304 / Appved Data Sheet	MTC		V	V	V	
2 -> ->	**Final Inspection** Dimension Burst Test of Rupture Disc	Measurement Functional	Major Major	Mesurement Burst Test @ 200 Degree Centigrade	100% 1 per lot offered	App. Drawing Approved drawing / Datasheet	App. Drawing Min 0.4 bar (g) @ 200 degree C Max 0.6 bar (g) @ 200 degree C / App. Data Sheet	IR IR / Burst Test Certificate	√ √	P P	**W** **W**	**W** **W**	

Manufacturer / Sub Vendor	Contractor	**LEGENDS:-**	For Client Use:-	**Document No.:-**
SIGNATURES		Records identified by √ shall be essentially included in QA documentation. TC- Test Certificate, IR - Insp. Report M-> Manufacturer/Sub Contractor, C-> Contractor (BHEL) or their nominated agency & K ->Client **P->Perform, V-> Verification, W-> Witness**	Name & Signature of Approving Authority with Seal	

Note :- In case of any difference in parameters specified in Drawing / Data Sheet & QAP, Value specified in Drg / Data Sheet shall be Final

	S/Contactor :- **Manufacturer :-**			**Manufacturing Quality Plan** **Item:- CHAIN PULLY BLOCK** **QAP No. :-** **LOI Nos:-** **Contractor :- M/s BHEL**				**Project:-SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III.** **Package :- Mill Rejects System** **Client :-**					
Sl. No.	**Components / Operations**	**Characteristics**	**Classification**	**Type of Check**	**Quantum of Check**	**Reference Documents**	**Acceptance Norms**	**Format of Records**		**Agency for Checking**			**Remarks**
1	2	3	4	5	6	7	8	9		10			11
								TYPE	**D**	**M**	**C**	**K**	
1	**Materials**												
->	Load Chain	Mech. Properties Breaking Load Test, Proof Load test	Major	Review of Mfr's Test Certificate	1 per Lot	IS:6216 /Appr. Drg / Appr. Data sheet	IS:6216 /Appr. Drg / Appr. Data sheet	MTC	√	P/V	V	V	
->	Load Sheave	Mech. Properties Chemical Composition	Major	Lab Analysis	1 per Heat	IS:1865 /Appr. Drg / Data sheet	IS:1865 /Appr. Drg / Data sheet	MTC	√	P/V	V	V	
->	Gear & Pinion	Chemical Composition	Major	Lab Analysis	1 per Heat	IS:4432/Appr. Drg / Data sheet	IS:4432/Appr. Drg / Data sheet	MTC	√	P/V	V	V	
->	Hook	Mech. Properties Chemical Composition	Major	Lab Analysis	1 per Heat	IS:8610 / IS:1875 /Appr. Drg / Data sheet	IS:8610 / IS:1875 /Appr. Drg / Data sheet	MTC	√	P/V	V	V	
2	**In Process**												
->	Hook	Proof Load Test	Major	Load Test	100%	IS:8610 /Appr. Drg / Appr. Data sheet	IS:8610 /Appr. Drg / Appr. Data sheet	MTC / IR	√	P	V	V	
		DPT after Load Test	Major	DPT	100%	ASTM E-165	ASTM E-165 / No Defects	IR	√	P	V	V	
3	**Final Inspection**												
->	Assembly	Operation Check	Major	Visual	100%	Smooth Operation / IS 3832 Appr. Drg / App. Data Sheet	Smooth Operation / IS 3832 Appr. Drg / App. Data Sheet	IR	√	P	**W**	V	
		Functional Test	Major	Visual	100%			IR	√	P	**W**	V	
		Load Test & Over Load Test	Major	Load Test	100%			IR	√	P	**W**	V	
		Overall Dimensions	Major	Measurement	100%			IR	√	P	**W**	V	
		Visual (After Load Test)	Major	Visual	100%	IS 3832	IS 3832	IR	√	P	**W**	V	

Manufacturer / Sub Vendor	Contractor	**LEGENDS:-** Records identified by √ shall be essentially included in QA documentation. TC- Test Certificate, IR - Insp. Report M-> Manufacturer/Sub Contractor, C-> Contractor (BHEL) or their nominated agency & N -> CLIENT	For Client Use:- **Document No.:-**
SIGNATURES		**P->Perform, V-> Verification, W-> Witness**	Name & Signature of Approving Authority with Seal

Note :- In case of any difference in parameters specified in Drawing / Data Sheet & QAP, Value specified in Drg / Data Sheet shall be Final

	S/Contactor :- Manufacturer :-			Manufacturing Quality Plan Item :- Bag Filter (Without Enclosure) QAP No. :- LOI Nos:- Contractor :- M/s BHEL			Project:-SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III. Package :- Mill Rejects System Client :- Consultant :-					
Sl. No.	**Components / Operations**	**Characteristics**	**Classification**	**Type of Check**	**Quantum of Check**	**Reference Documents**	**Acceptance Norms**	**Format of Records**		**Agency for Checking**			**Remarks**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**		**10**			**11**
								TYPE	**D**	**M**	**C**	**K**	
1	**Materials**												
1.1	Manifold Body / Casings (MS Plate / Sheet / Pipe)	Chemical & Physical	Major	Chemical & Mechanical	1 per Lot	App. Drawing / Data Sheet / IS:2062 Gr. A / IS:1079 Gr. 0 / IS: 1239 Class Med.	App. Drawing / Data Sheet / IS:2062 Gr. A / IS:1079 Gr. 0 / IS : 1239 Class Med.	MTC	√	V	V	V	
1.2	Bag Cages (Inserts)	Chemical & Physical	Major	Chemical & Mechanical	1 per Lot	App. Drawing / data sheet / IS:7887 Gr.8 / IS:1079 Gr. 0	App. Drawing / data sheet / IS:7887 Gr.8 / IS:1079 Gr. 0	MTC	√	V	V	V	
1.3	Solenoid Valves	Functional	Major	Operational	100%	Approved Drawing / Appr. Data Sheet	Approved Drawing / Appr. Data Sheet	MTC	√	P	V	V	
1.4	Sequence Controller	Functional	Major	Operational	100%	Approved Drawing / Appr. Data Sheet	Approved Drawing / Appr. Data Sheet	MTC	√	P	V	V	
1.5	Filter Bags (Make :- Charminar / Supreme)	Physical	Major	Visual / Measurement	100%	Approved Drawing / Appr. Data Sheet	Approved Drawing / Appr. Data Sheet	MTC	√	P	V	V	
2	**In Process**												
2.1	Manifold	Dimensional & Visual	Minor	Dimensional & Visual	100%	As per Mfr's Drg.	As per Mfr's Drg.	IR	√	P	V	V	**** -> DPT & Hydro - Test of Manifold to be witnessed by vendor**
2.2		Welding	Major	DPT on Final Weld	100%	ASTM E-165	No Defect	IR	√	P	**V****	V	
2.3		Hydro Test for 30 Minutes	Major	Leakage	100%	Appr. Data sheet	No Leakage	IR	√	P	**V****	V	

Document No.:-

3	**Final Inspection**												
3.1	Assembly	Dimensional	Major	Measurement	100%	Appr. Drawing	Appr. Drawing	IR	√	P	**W**	V	**Pressure Drop across**

Sl. No.	Components / Operations	Characteristics	Classification	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Records		Agency for Checking			Remarks
1	2	3	4	5	6	7	8	9		10			11
								TYPE	D	M	C	K	
	$-> Pneumatic Test at 1.1 times W/Pressure	Pne. test $of Manifold in Assly.	Major	Leakage by soap solution	100%	Appr. Data Sheet	No Leakage	IR	√	P	**W**	V	**Filter Bags & Emission Level at Filter outlet shall be checked at Site**
		Functional Test of Pulsing System	Major	Pulse Sequence	100%	Appr. Data sheet / Testing Procedure	Appr. Data sheet / Testing Procedure	IR	√	P	**W**	V	
4	**Painting**	Measurement & Visual	Major	DFT / Finish	100%	Appr. Painting Schedule	Appr. Painting Schedule	IR	√	P	-	-	

TESTING PROCEDURE TO BAG FILTER

1-> Functional test through compressed air , Sequential pulsing through valves and sequential controller on **No - Load Condition** to be conducted.

2-> The Soenoid valve shall be connected to the sequential timer and suitable electric supply shall be provided. Air header to be connected to supply of compressed air. The Timer is set and Sequential operation of Solenoid operated valve is observed.

		LEGENDS:- Records identified by √ shall be essentially included in QA documentation. TC- Test Certificate, IR - Insp. Report	For Client Use:- **Document No.:-**
Manufacturer / Sub Vendor	Contractor	M-> Manufacturer/Sub Contractor, C-> Contractor (BHEL) or their nominated agency & N -> CLIENT	
SIGNATURES		**P->Perform, V-> Verification, W-> Witness**	Name & Signature of Approving Authority with Seal

Note :- In case of any difference in parameters specified in Drawing / Data Sheet & QAP, Value specified in Drg / Data Sheet shall be Final

• Test on bag filter casing: In case bag filter is assembled in casing at site, smoke/ bubble test shall be carried out on the bag filter casing to ensure that the casing is free of welding defect. However, if assembly of bag filter & casing is done at shop, relevant NDT shall be carried out as per approved MQP for checking the soundness of weld

		S/Contactor :-			**Manufacturing Quality Plan**			**Project:-SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III.**						
					Item :- MS GI ERW Pipes (IS:1239/IS3589)									
		Manufacturer :-			**QAP No. :-** **LOI Nos:-** **Contractor :- M/s BHEL**			**Package :- Mill Rejects System** **Client :-**						
Sl. No.	**Components / Operations**	**Characteristics**	**Classification**	**Type of Check**	**Quantum of Check**	**Reference Documents**	**Acceptance Norms**	**Format of Records**		**Agency for Checking**			**Remarks**	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**		**10**			**11**	
								TYPE	**D**	**M**	**C**	**K**		
1	Final Inspection of Finished Pipes	Physical	Major	Visual	100%	IS:1239 / IS:3589 / Approved Data Sheet	IS:1239 / IS:3589 / Approved Data Sheet	IR	-	P	W*	V	* -> Random 5% of offered lot irrespective of size	
		Dimensional	Major	Measurement	100%			IR	√	P	W*	W*		
		Mechanical Properties	Major	Tensile, elon- gation, Bend or Flattening	IS: 4711			IR / TC	√	P / V	V	V		
		Chemical	Major	Chemical Analysis	1 per heat			TC	√	P / V	V	V		
		Hydro Test	Major	Pressure Testing	100%			IR / TC	√	P	W *	W*		
2	Galvanising (For GI Pipes	Uniformity & mass of Zinc Coating, Adhesion test, Free bore test	Major	As per IS:4736	As per IS:4736	As per IS:4736 / Approved Data Sheet	As per IS:4736 / Approved Data Sheet	IR	√	P	W #	V	# one sample for each size	
3	Identification	Verification of Batch No. / Mfg stamp / Heat No.	Major	Visual	100%	Mfgr Practise / IS 1239 / IS 3589	Mfgr Practise / IS 1239 / IS 3589	IR	√	P	W	V		
4	Review of QA Documents	----------	----------	----------	----------	As per QAP	As per QAP	----------	√	V	V	V		

NOTES :-

For SAIL Pipes verification of reports for the tests mentioned in Sl. No. 1 & 2 by BHEL & WBPDCL.
For GI Pipes, Galvanising Check as per relevant standard shall be done.
All material shall be as per approved data sheet in case of ambiguity in QAP, material as data sheet shall be final.

Manufacturer / Sub Vendor	Contractor	**LEGENDS:-** Records identified by √ shall be essentially included in QA documentation. TC- Test Certificate, IR - Insp. Report M-> Manufacturer/Sub Contractor, C-> Contractor (BHEL) or their nominated agency & N -> CLIENT	For Client Use:- **Document No.:-**
SIGNATURES		**P->Perform, V-> Verification, W-> Witness**	Name & Signature of Approving Authority with Seal

Note :- In case of any difference in parameters specified in Drawing / Data Sheet & QAP, Value specified in Drg / Data Sheet shall be Final

	S/Contactor :- Manufacturer :-	Manufacturing Quality Plan Item :- ACI Bends QAP No. :- LOI Nos:- Contractor :- M/s BHEL	Project:-SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III. Package :- Mill Rejects System Client :-.

Sl. No.	Components / Operations	Characteristics	Classification	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Records		Agency for Checking			Remarks
1	2	3	4	5	6	7	8	9		10			11
								TYPE	D	M	C	K	
1	**Raw Material**												
1.1	Scrap Receipt	Chemical	Major	Lab Analysis	Random Sample / Lot	Mfg's Std	Mfg's Std	Mfg's Log Sheet	–	P	–	–	
1.2	Ferro Alloys	Chemical	Major	Lab Analysis	Random Sample / Lot	Mfg's Std	Mfg's Std	Mfg's Log Sheet	–	P	–	–	
2	**Final Inspection**												
2.1	Product Analysis	Chemical Analysis	Major	Chemical	1 / heat	Mfg's Standard	Mfg's Standard	MTC	√	P	V**	V	** Chemical. Analysis to be Witnessed by Vendor
2.2	Leakage	Hydro Test	Major	Pressure Test	100%	Approved Drg / Data Sheet	No Leakage	IR	√	P	W*	W*	* 10% by Vendor / BHEL / CLIENT
2.3	Dimension	Dimension	Major	Measurement	100%	Approved Drg / Data Sheet	Approved Drg / Data Sheet	IR	√	P	W*	W*	
2.4	Hardness	Hardness	Major	Measurement	100%	Approved Drg / Data Sheet	Approved Drg / Data Sheet	IR/TC	√	P	W*	W*	

Manufacturer / Sub Vendor	Contractor	**LEGENDS:-** Records identified by √ shall be essentially included in QA documentation. TC- Test Certificate, IR - Insp. Report M-> Manufacturer/Sub Contractor, C-> Contractor (BHEL) or their nominated agency & N -> CLIENT **P->Perform, V-> Verification, W-> Witness**	For Client Use:-	**Document No.:-**
SIGNATURES			Name & Signature of Approving Authority with Seal	

Note :- In case of any difference in parameters specified in Drawing / Data Sheet & QAP, Value specified in Drg / Data Sheet shall be Final

		S/Contactor :- **Manufacturer :-**			**Manufacturing Quality Plan** **Item :- Knife Gate Valve [Manual / Pneumatic]** **QAP No. :** **LOI Nos:-** **Contractor :- M/s BHEL**			**Project:-SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III.** **Package :- Mill Rejects System** **Client :-**					
Sl. No.	**Components / Operations**	**Characteristics**	**Classification**	**Type of Check**	**Quantum of Check**	**Reference Documents**	**Acceptance Norms**	**Format of Records**		**Agency for Checking**			**Remarks**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**		**10**			**11**
								TYPE	**D**	**M**	**C**	**K**	
1	**Raw Material / Bought Out's**												
1.1	Body	Chemical & Mechanical	Major	Foundary TC	1 per Heat	Relevent IS / Appr. Drg / Data Sheet	Relevent IS / Appr. Drg / Data Sheet	TC	√	P/V	V	V	
1.2	Gate	do	Major	Lab Analysis	1 per lot	do	do	Mill / Lab TC	√	P/V	V	V	
1.3	Stem (For Manual Valve)	do	Major	Lab Analysis	1 per batch	do	do	do	√	P/V	V	V	
1.4	Pneumatic Cylinder (For Pneu. Valve)	Visual & Functional	Major	Mfr's TC Review	100%	Smooth Operation	Smooth Operation	Mfr's TC	√	P/V	V	V	
2	**In - Process Inspection**												
2.1	Body, Gate	Dimensional	Major	Measurement	100%	Mfr's Drawing	In-Process Insp. Record	-		P	V	V	**# -> Test Pressure as per Data Sheet**
2.2	Body Shell Test	Leak Tightness	Major	Hydro Static Test #	100%	Approved Drg / Data Sheet	No Leakage	IR	√	P	V	V	
3	**Final Inspection**												
3.1	Assembled Valve	Dimension	Major	Measurement	100%	Approved Drg / Data Sheet	Approved Drg / Data Sheet	IR	√	P	**W**	**W**	**BHEL / Vendor/CLIENT to Witness 10 % of Quantity.**
3.2	do	Function	Major	Operation	100%	Smooth Opertaion	Smooth Opertaion	IR	√	P	**W**	**W**	
3.3	do	Seat Leakage	Major	Hydro Static Test #	100%	Approved Drg / Data Sheet	Approved Drg / Data Sheet	IR	√	P	**W**	**W**	

Manufacturer / Sub Vendor	Contractor	**LEGENDS:-** Records identified by √ shall be essentially included in QA documentation. TC- Test Certificate, IR - Insp. Report M-> Manufacturer/Sub Contractor, C-> Contractor (BHEL) or their nominated agency & N -> CLIENT **P->Perform, V-> Verification, W-> Witness**	For Client Use:- Name & Signature of Approving Authority with Seal
SIGNATURES			**Document No.:-**

Note :- In case of any difference in parameters specified in Drawing / Data Sheet & QAP, Value specified in Drg / Data Sheet shall be Final

	S/Contactor :-	Manufacturing Quality Plan	Project:-SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III.
	Manufacturer :-	Item :- Compressor QAP No. :- LOI Nos:- Contractor :- M/s BHEL	Package :- Mill Rejects System Client :-

Sl. No.	Components / Operations	Characteristics	Classification	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Records		Agency for Checking			Remarks
1	2	3	4	5	6	7	8	9		10			11
								TYPE	D	M	C	K	
1	**Raw Material / Bought Out's**												
1.1	Cylinder	Chemical & Mechanical	Major	Mfr's TC	1 per Heat or Lot	Relevent IS / Appr. Drg / Data Sheet	Relevent IS / Appr. Drg / Data Sheet	TC	√	P/V	V	V	
1.2	Frame Head	do	Major	do	do	do	do	do	√	P/V	V	V	
1.3	Outer Head	do	Major	do	do	do	do	do	√	P/V	V	V	
1.4	Crank Shaft	do	Major	do	do	do	do	do	√	P/V	V	V	
1.5	Connecting Rod	do	Major	do	do	do	do	do	√	P/V	V	V	
1.6	Temp. Switch	Mfr's TC	Major	Visual Review	100%	do	do	do	√	V	V	V	
1.7	Control Panel	Mfr's TC	Major	Visual Review	100%	do	do	do	√	V	V	V	
2	**In - Process Inspection**												
2.1	Cylinder, Frame Head & Outer Head	Leak Tightness	Major	Hydro Static Test	100%	Appr drg. / Data Sheet	No Leakage	IR	√	P	V	V	
2.2	After Cooler	Leak Tightness	Major	Hydro Static Test	100%	Approved Drg / Data Sheet	No Leakage	IR	√	P	V	V	
3	**Final Inspection**												
3.1	After Cooler	Dimension / Visual	Major	Measurement	100%	Approved Drg / Data Sheet	Approved Drg / Data Sheet	IR	√	P	W	W	
3.2	Control Panel	Dimension / Visual	Major	Measurement	100%	Approved Drg / Data Sheet	Approved Drg / Data Sheet	IR	√	P	W	W	
3.3	Compressor Assly	Nozzle Test (Mech. Run Test)	Major	Performance	100%	Approved Drg / Data Sheet / BS 1571 Part-2	Approved Drg / Data Sheet	IR	√	P	W	W	

Manufacturer / Sub Vendor	Contractor	**LEGENDS:-** Records identified by √ shall be essentially included in QA documentation. TC- Test Certificate, IR - Insp. Report M-> Manufacturer/Sub Contractor, C-> Contractor (BHEL) or their nominated agency & N -> CLIENT	For Client Use:-
SIGNATURES		**P->Perform, V-> Verification, W-> Witness**	Name & Signature of Approving Authority with Seal

Document No.:-

Note :- In case of any difference in parameters specified in Drawing / Data Sheet & QAP, Value specified in Drg / Data Sheet shall be Final

	S/Contactor :- Manufacturer :-			Manufacturing Quality Plan Item :- Sump Pump QAP No. :- LOI Nos:- Contractor :- M/s BHEL			Project:-SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III. Package :- Mill Rejects System Client -					
Sl. No.	**Components / Operations**	**Characteristics**	**Classification**	**Type of Check**	**Quantum of Check**	**Reference Documents**	**Acceptance Norms**	**Format of Records**		**Agency for Checking**			**Remarks**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**		**10**			**11**
								TYPE	**D**	**M**	**C**	**K**	
1	**Raw Material / Bought Out's**												
1.1	Casing	Chemical, Mechanical, Hardness, Surface Defect	Major	Chem. Comp. Mechanical Hardness Visual	1 per Heat 1 per Heat 1 Per Heat 100 %	Relevent IS / Appr. Drg / Data Sheet	Relevent IS / Appr. Drg / Data Sheet	TC	√	P/V	V	V	
1.2	Impeller	do	Major	do	do	do	do	do	√	P/V	V	V	
1.3	Shaft	Chemical, Mechanical, Surface Defect	Major	Chem. Comp. Mechanical Visual & UT if Dia >50 mm	1 per Heat 1 per Heat 100 %	Relevent IS / Appr. Drg / Data Sheet / ASTM E 388 for UT	Relevent IS / Appr. Drg / Data Sheet / ASTM E 388	do	√	P/V	V	V	
1.4	Shaft Sleeve	Chemical Hardness	Major	Chem. Comp. Hardness	do	do	do	do	√	P/V	V	V	
2	**In - Process Inspection**												
2.1	Casing	Soundness of Casting / Leakage	Major	Hydro Static Test	100%	Appr drg. / Data Sheet / IS 5120	No Leakage	IR	√	P	V	V	Hyd. Test at 200% of pump rated head or 150% of Shut off head which ever is higher for 30 min.
2.2	Impeller	Residual unbalance	Major	Dyanamic / Static Balancing	100%	Approved Drg / Data Sheet / ISO 1940 Gr. 6.3	ISO 1940 Gr. 6.3	IR	√	P	V	V	
3	**Final Inspection**												

Sl. No.	Components / Operations	Characteristics	Classification	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Records		Agency for Checking			Remarks
1	2	3	4	5	6	7	8	9		10			11
								TYPE	D	M	C	K	
3.3	Performance Test with Calibrated Test Lab Motor	Q Vs Head, Power & Efficiency, Noise & Vibration	Major	Measurement & Curves	100%	Approved Drg / Data Sheet / HIS	Approved Drg / Data Sheet / HIS	IR	√	P	**W**	**W**	Noise - 85 db max. & Vibration - 50 microns max.
3.2	Pump strip test in case of doubt due to abnormal sound	Undue Wear	Major	Visual / Strip Test	100%	Mfr's Standard	No Undue Wear	IR	√	P	**W**	**W**	
3.3	Painting	Visual & Measurement	Major	Visual & Measurement	100%	As per approved Painting Schedule	As per approved Painting Schedule	IR	–	P	-	-	

Manufacturer / Sub Vendor	Contractor	**LEGENDS:-** Records identified by √ shall be essentially included in QA documentation. TC- Test Certificate, IR - Insp. Report M-> Manufacturer/Sub Contractor, C-> Contractor (BHEL) or their nominated agency & N -> CLIENT	For Client Use:- **Document No.:-**
SIGNATURES		**P->Perform, V-> Verification, W-> Witness**	Name & Signature of Approving Authority with Seal

Note :- In case of any difference in parameters specified in Drawing / Data Sheet & QAP, Value specified in Drg / Data Sheet shall be Final

	S/Contactor :- **Manufacturer :-**			**Manufacturing Quality Plan** **Item :-EXPANSION BELLOW** **QAP No. :-** **LOI Nos:- -** **Contractor :- M/s BHEL**			**Project:-SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III.** **Package :- Mill Rejects System** **Client :-**					
Sl. No.	**Components / Operations**	**Characteristics**	**Classification**	**Type of Check**	**Quantum of Check**	**Reference Documents**	**Acceptance Norms**	**Format of Records**		**Agency for Checking**			**Remarks**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**		**10**			**11**
								TYPE	**D**	**M**	**C**	**K**	
1	**Raw Material**												
1.1	Bellows	physical & Chemical	Major	Lab Analysis	1 per Heat	AS204 TP304/ Approved Drg.	AS204 TP304/ Approved Drg.	MTC	√	V	V	V	
1.2	Fianges/ End Pipe	physical & Chemical	Major	Lab Analysis	1 per lot	IS 2062 / Approved Drg.	IS 2062 / Approved Drg.	MTC	√	V	V	V	
2	**In - Process Inspection**												
2.1	Bellows & Pipe	Dimension	Major	Measurement	100%	Approved Drg.	Approved Drg.	IR	√	P	V	V	
	** For Bellows	Soundness Of Weld of L-Seam	major	DPT **(Before & After Forming)	100%	ASTM E- 165	No Cracks/ Linear Indication	IR		P	V	V	
3	**Final Inspection**												
3.1	Assembly	DP Test of Fillet Weld of Bellows to Pipe & Pipe to Fiange	Major	visual	100%	ASTM E-165	No Crack / Linear Inication	IR	√	P	**W**	V	
3.2	Testing	Dimensions	Major	Measurement	100%	Approved Drg	Approved Drg	IR	√	P	**W**	**W**	
		pressure	Critical	Hydraulic	100%	EJMA D.3.2.1/ Data sheet	EJMA D.3.2.1/ Approved Drg.	IR	√	P	**W**	**W**	
		Spring Rate Test (Axial)	Critical	Stiffness Test	100%	EJMA / Data Sheet	EJMA / Data Sheet	IR	√	P	**W**	**W**	
		Deflection	Critical	Deflection Test	100%	EJMA / Data Sheet	EJMA/Data Sheet	IR	√	p	**W**	**W**	
3.3	Painting	Visual/ Measurement	Major	DFT	100%	Approved Painting Schedule	Approved Painting Schedule	IR	√	p	–	–	

		LEGENDS:-	For Client Use:- **Document No.:-**
		Records identified by √ shall be essentially included in QA documentation. TC- Test Certificate, IR - Insp. Report	
Manufacturer / Sub Vendor	Contractor	M-> Manufacturer/Sub Contractor, C-> Contractor (BHEL) or their nominated agency & N -> CLIENT	
SIGNATURES		**P->Perform, V-> Verification, W-> Witness**	Name & Signature of Approving Authority with Seal

Note :- In case of any difference in parameters specified in Drawing / Data Sheet & QAP, Value specified in Drg / Data Sheet shall be Final

	Manufacturer's Name & Address :		MANUFACTURING QUALITY PLAN										
			Item : MS Plates & Structures		QP No. :			Project SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III.					
					Rev. No. : 0			BHEL Ref. :					
			Sub-System :		Date :			Contract No.:					
					Page No.: 11 of 1			Contractor : BHEL SUB-CONTRACTOR-					

Sl. No.	Components & Operations	Characteristic/Item	Class	Type/method of check	Extent of Check	Reference Document	Acceptance Norm	Format of Record		Agency P	Agency W	Agency V	Remarks
1	2	3	4	5	6	7	8	9	D	10			11
	RAW MATERIAL												
1	Steel Plates	Chemical composition and Mechanical test	Major	Review of corelated MTC	One/heat	IS:2062	IS:2062	Mfgr. TC	√	3		2,1	Refer Note Below
2		Visual and dimensional Check	Major	Visual and measurement	100%	Mfgr. TC	Mfgr. TC IS 1852	Mfgr. TC	√	3	2,1		
3		Identification / Marking	Major	Co-relation establish	100%	AS per manufacturing practice	AS per manufacturing practice IS 2062	Mfgr. TC	√	3	2	1	

		LEGEND :		BHEL Doc. No. PE-QP-279-166-A801	Rev. 0
		1 - BHEL / CUSTOMER	P - Agency Performing the Test		
		2 - VENDOR	W - Agency Witnessing the Test		
MANUFACTURER/ SUBCONTRACTOR	**CONTRACTOR**	3 - Manufacturer	V - Agency Verifying the Test		
		CR - Critical Characteristics MA - Major Characteristics			
SIGNATURE		MI - Minor Characteristics		REVIEWED BY	NAME & SIGNATURE OF APPROVING AUTHORITY

Notes:

1 In case material is despatched directly from SAIL/TISCO plant/stockyard or procured from dealer against co-related TC's witnessing by BHEL is waived off and material will be accepted based on MTC of SAIL/TISCO.

2 In case material is procured from dealer and co- related TC's are not available, check on 100% quantity of plates will be performed on sample drawn from each plate at NABL certified/ approved laboratory or any govt approved laboratory for chemical & physical properties, However dimensional check shall be witnessed by BHEL.

3 There will not be any inspection by CUSTOMER.

ANNEXURE -X

Check List for Operation & Maintenance Manual

0 Project name :
1 Project number :
2 Package Name :
3 PO reference :
4 Document number :
5 Revision number :

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
1.	**Cover page**				
1.1	Project Name				
1.2	Customer/consultant Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX ,email address , Emergency Contact number				
1.5	Name and sign of prepared by , checked by & approved by				
1.6	Revision history with approval Details				
2.0	**Index**				
2.1	showing the sections & related page nos All the pages should be numbered section wise				
3.0	**Description of Plant/System**				
3.1	Description /write up of operating principle of system equipment/ associated sub-systems & accessories/controls system , operating conditions, performance parameters under normal , start up and special cases				
3.2	Equipment list and basic parameter with Tag numbers				
3.3	Data sheets approved by Customer/for information and catalogues provided by original manufacturer				
3.4	Associated other packages and Interface /terminal points				
3.5	P&ID & Process Diagrams				
3.6	GA Layout drawings, As-built drawings , Actual photograph of items/system (Drawings of A2 & bigger sizes are to be attached in the last)				
3.7	Single line/wiring diagrams				
3.8	Control philosophy /control write-ups				
4.0	**Commissioning Activities (if not covered in separate document i.e. erection manual, commissioning manual)**				
4.1	Pre-Commissioning Checks				

4.2	handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	**Operation Guidelines for plant personal/user/operator**				
5. 1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
5. 2	Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5. 3	Do's & Don't of the equipments.				
5. 4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5. 5	Parameters to be monitored with normal values and limiting values				
5. 6	Trouble shooting with causes and remedial measures				
5. 7	Routine operational checks, recommended logs & records				
5. 8	Changeover schedule if more than one auxiliary for the same purpose is given				
5. 9	Painting requirement and schedule				
5. 10	Inspection, repair , Testing and calibration procedures				
6.0	**Maintenance guidelines for plant personal**				
6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				
6.3	Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to be given				
6.4	Long term maintenance schedules especially for structural, foundations etc.				
6.5	Consumable list along with the estimated quantity required during commissioning,				

	normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/handling requirement of consumables/self-life.				
6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest addresses, service centres ,Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts list				
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				
6.10	Guarantee and warranty clauses				
7.0	**Statutory and other specific requirements considerations.**				
8.0	**List of reference documents**				
9.0	**Binding as per requirement**				

Checked by
Dealing Engineer

Key Resource Person

Section Head

PACKING PROCEDURE

COMMON GUIDELINES FOR PACKING

1. GENERAL:

The Components/Assemblies need to be packed suitably to avoid physical damage & corrosion during transit & storage. This packing shall be suitable for different handling operations and for the adverse conditions during transportation and during indoor / outdoor storage of materials.

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. The Contractor shall be responsible for all loss or damage during transportation, handling and storage due to improper packing.

The identification marking indicating the name and address of the consignee shall be clearly marked in indelible ink on two opposite sides and top of each of the packages. In addition the Contractor shall include in the marking gross and net weight, outer dimension and cubic measurement.

Each package shall be accompanied by a packing note (in weather proof paper) quoting specifically the name of the Contractor, the number and date of contract and names of the office placing the contract, nomenclature of contents and Bill of Material.

2. TYPES OF PACKING:

The following 5 types of packing have been standardized for packing of General Components/ Assemblies.

1) '**OP**' - Open Type.

2) **'PP**' - Partially Packed.

3) '**CP**' – Crate/Box Packing - Components/Equipment requiring physical protection.

4) '**CQ**' - Case Packing – Machined components-Small & Medium Components/ Assemblies/ Equipment which require corrosion & physical protection.

5) **'CR'** - Case Packing – Electrical/Electronic Components/ Assemblies, which require special packing viz. Water Proof, Shock Proof etc…

3. DESCRIPTION OF TYPES OF PACKING:

The various types of packing, as standardized above, are described below.

3.1 'OP' - Open Type

In case, of components which are not affected by water & dust and do not require special protection, are generally not machined, shall be sent as open packages. However, these components may be sent in crates, wherever necessary.

3.2 'PP' - Partially Packed

Components which need special protection at selected portions only shall be despatched partially packed. Machined surfaces should not be allowed to come directly in contact with the wood. Such surfaces should be protected with 100GSM(Colourless) Multi Layered Cross Laminated Polyethylene
Film. All sharp corners and edges shall be protected by rubber mats to prevent damage to the polyethylene film.

3.3 'CP' - Crate Packing

Assemblies/Components which need only physical protection from the point of view of handling shall be despatched duly packed in crates.

3.4 'CQ' - Case Packing - Machined Components/Assemblies/Equipment

Small and medium sized components/assemblies/equipment due to size/weight and to avoid handling and pilferage problems shall be packed in Case/Containers. Wherever required adequate quantity of silica gel or VCI Powder/Tablets, packed in thin muslin cloth cotton bags shall be suitably placed. Small machines/components of less weight shall be provided with suitable cushioning by Rubberised coir. The components inside the case shall be entirely covered with100GSM(Colourless) Multi Layered Cross Laminated Polyethylene Film, wherever required. This may be prescribed for electronic parts/critical machined components/surfaces.

For mechanical product like valves where motors are separately securely wrapped in polyethylene, the requirement of individual component wrapping shall be exempted.

3.5 'CR' - Case Packing - Electrical & Electronic Components/Assemblies

Delicate components likely to be damaged e.g. Gauges, Instruments etc. are to be wrapped in waxed paper or polyethylene air bubble film and packed in cartons. Adequate quantity of Silica gel packed in cotton bags of 100grams each are to be suitably placed in the cartons. The cartons shall be entirely covered with 100GSM(Colourless) Multi Layered Cross Laminated Polyethylene Film before being packed in the cases. VCI Powder/Tablets can be used as an alternative to Silica Gel.

Empty space in the cartons shall be filled with rubberized coir to get proper cushioning effect. The cartons shall be manufactured from corrugated Fiber Board.

4 PREPARATION OF PACKING CASES

4.1 DIMENSIONS:

a) Thickness of planks for Front, rear, top and bottom sides and binding, jointing battens shall be 25/20mm +2/-3 mm as per applicable drawings of the respective units.

b) Width of all planks including the tongue shall be more than 125mm and after plaining it shall be minimum 100mm.

c) Minimum number of planks shall be used for a shook.

d) Horizontal, vertical, diagonal planks shall be given for binding (number of such planks depend on the dimension of panel.

e) Width of binding planks shall be minimum 100mm.

f) Distance between any 2 binding planks shall be less than 750mm.

g) diagonal planks shall be used in between vertical binding planks when distance between inner to inner of vertical planks is more than 750mm

h) Distance of the outer edges of these planks from the edge of case shall be less than 250mm.

i) Diagonal planks are not required for top planks and width side, if the width of pallet is less than 750mm.

4.2 JOINTING OF PLANKS

Single length planks shall be used for cubicles whose overall length is less than 2400mm. For cubicles of length more than 2400mm, jointing is permitted. The jointing shall be done with one single or maximum of 2 planks of wood same as other planks of width 250 mm (minimum) with two rows of nails on either side of the joint in zigzag manner. From the joint along height side, it shall be of lap joint with overlap of at least the width of plank.

4.3 TONGUE AND GROOVE JOINTS

Two consecutive planks shall be joined by tongue and groove joint. Depth of tongue shall be 12+1 mm, thickness of tongue shall be 8 +1 mm. The groove dimensions shall be such that the tongue fits tightly into the groove to make a good joint. This type of joint can be done based on the product requirement wherever required.

4.4 PERMISSIBLE DEFECTS

Wood shall be free from knots, bows, visible sign of infection and any kind of decay caused by insects, fungus, etc.

End splits: Longest end splits at each end shall be measured and lengths added together. The added length shall not exceed 60mm per meter run of shook's. Wood pins shall be used to prevent further development of split.

Surface cracks: Surface cracks with a maximum depth of 3mm are permissible. A continuous crack of any depth all along the length is not allowed.

4.5 OTHER MATERIALS

4.5.1 NAILS

The dia. of the nails shall be 3.15mm. The length of the nails shall be 65mm wherever two planks of 25mm thickness are joined and 75mm wherever a 25mm planks is joined to a 50mm plank.

4.5.2 BLUE NAILS

These are used for nailing bituminized Kraft paper/hessian cloth to the planks. The length of the nails shall be 16mm.

4.5.3 HOOP IRON STRIPS

These are used for strapping the boxes. The width of the strips shall be 19+1mm and thickness 0.6+0.01mm. The material shall be free from rust.If sufficient nailing is done for bigger boxes, strapping need not be done.

4.5.4 CLIPS

These shall be used for strapping the hoop iron strips on the boxes.

4.5.5 BRACKETS

These brackets are used for nailing to the corners of cubicle boxes. The brackets shall be of mild steel of thickness min 2mm and width 25+1mm. The brackets shall be of "L" shape, the length of each side being 100+2mm. Two holes shall be provided towards the end of each side for screwing /nailing.

4.5.6 FASTENERS

Bolts, double nuts, spring washers will have to be used for packing of some special items like transformers, reactors, breakers, etc., to hold the job to the bottom plank of the box. The bolts, nuts, washers will be provided by the vendor. Drilling of holes will have to be done using contractor's tools.

4.5.7 MULTI LAYERED CROSS LAMINATED POLYTHELENE FILM

100GSM (Colourless) Multi Layered Cross Laminated Polythelene Film are used to make covers to the jobs individually. The cross lamination gives qualities of extra toughness, together with flexibility and lightness coupled with good weather resistance to ultra violet rays.

4.5.8 RUBBERISED COIR:

The rubberized coir is used as cushioning material. For the packing of loose items, items are to be arrested by using rubberized coir. For the packing of cubicles rubberized coir of thickness 25mm and width 75mm shall be used.

4.5.9 FOAM RUBBER / 'U' FOAM:

This is used for covering the delicate items. This material is provided by the vendor.

4.5.10 MARKING PLATE:

This shall be of anodized aluminium sheet. Size of the marking plate shall be maintained minimum of size as

per the details specified in the Figure 4.

4.5.11 PACKING SLIP HOLDER:

This shall be of galvanized iron tinned sheet /Aluminium sheet

4.5.12 SILICA GEL:

Silical gel shall be used for such products only where moisture needs to be avoided.

4.5.13 COTTON BAGS:

These are used for holding silica gel. The bags shall have the following matter indicated on them:

BHEL-UNIT NAME PLACE -PINCODE
SILICA GEL -INDICATING TYPE
BLUE : -ACTIVE
ROSE : -REDUCED ACTIVITY
WHITE : -NO ACTIVITY. TO BE REPLACED WITH FRESH SILICA GEL

4.5.14 COTTON/ PLASTIC TAPE:

This is used for tying small items. And also to prevent vibrations of moving parts within the cubicles.

4.5.15 MARKING INK:

The ink used normally is black in color. In some special cases other color also will have to be used. The ink shall be non-fading/indelible and non-washable by water.

4.5.16 POLYETHYLENE BAGS:

These are to be used for keeping the Packing slips. The bag shall be of size 70mm X 100mm (minimum).

4.5.17 Hessian cloth, twine thread, paint will have to be used in packing certain items.

4.5.18 Mechanical Latching clamps:

For CLW Railway panels and similar Panels self-locking clamps can also be used on need basis in conjunction with or apart from regular bolt and nut fixing arrangement. For reusable boxes, these clamps provide easy locking and unlocking arrangement. These clamps will be made available from BHEL in some cases.

4.5.19 STICKERS

The following stickers to be put by the vendor on cubicles/Boxes after packing.

1) Case No sticker: 2 nos. Size 25.Cm x 0.45Cm
2) BHEL Monogram sticker: 1 no. Size 1.75Cm x 2.3Cm
3) Address sticker: 2 nos. Size 3.8Cm x 3.0Cm
4) Direction sticker “Front” & “Back” - 4 nos. Size 2.0Cm x 0.75Cm
5) Chain Mark Sticker: 4 Nos. Size – 3.0Cm x 0.75Cm
6) "Fragile” sticker: 2 Nos. Size. 2.1Cm x 1.5Cm
7) "DO NOT STACK” sticker - 2 Nos. Size 3.0Cm x 2.2Cm

In place of stickers, writing all the details legibly with paint shall be allowed & respective units may take decision accordingly.

5. PACKING OF CUBICLES:

5.1 The packing is to be done as per clause 4 in all respects.

5.2 The cubicles are already fixed on wooden pallets. Hence the contractor need not arrange the bottom pallets normally.

5.3 The cubicles will be of different sizes both width wise and lengthwise. The cubicles may be made up of single suite, 2 Suite, 3 Suite, 4 Suite, etc., The width of the cubicles generally varies from 400 mm to 1650mm.The length of the cubicle, generally varies from 1500 mm to 4800 mm. The height is normally 2430 mm. In some cases, the height may be less/more.

5.4 MULTI LAYER CROSS LAMINATED POLY FILM

The inner surface of 4 sides of shook's shall be nailed with Multi-layer cross laminated poly film (as per 4.5.7) using blue nails (as per 4.5.2) wherever 2 pieces of Cross laminated poly film are used, the joint shall have an overlap of minimum 20mm.

The inner surface of top cover shall be nailed with Multi-layer cross laminated poly film (as per 4.5.7). This sheet shall project outside on 4 sides by at least 100mm and shall be nailed properly on sides. Joining of sheets should have overlap of minimum 20mm.

The cubicles shall be covered with Multi-layer cross laminated poly film (as per 4.5.7).

5.5 SILICA GEL:

Silica gel (as per 4.5.12) packed in cotton bags shall be kept at different places inside the cubicle as per BHEL-Unit directions. Each suit of cubicle shall be provided with 1 kg of Silica gel (for a 4 suit cubicle 4 kgs of Silica Gel to be used. The bag containing silica gel to be as per 4.5.13).

5.6 LOOSE PARTS:

Any loose parts in the cubicles shall be tied using cotton/ plastic tape. Wooden battens shall be provided wherever necessary.

5.7 WOODEN BATTENS:

In case of cubicle which are not rectangular in shape like control desks, sufficient number of wooden rafters/battens of proper size shall be provided to give strength to the package.

5.8 RUBBERISED COIR:

Gap between the cubicle and the case shall be filled with rubberized coir (as per 5.5.8) with distance between consecutive layers less than 500mm.

5.9 CLAMPING:

Packing shall be bound at edges by nailing M.S. Clamps / Brackets (as per 5.5.5). Each vertical edge shall have minimum 3 clamps. Top horizontal edges will have one clamp for every meter length of package. However, minimum 4 clamps shall be nailed at the top for any cubicle.

5.10 PACKING SLIP:

Packing slip kept in the polyethylene bag (As per 5.5.16) shall be placed in the box at appropriate place. In addition, one more packing slip covered in polyethylene cover and packing slip holder (as per 5.5.11) shall be nailed to front / rear of case.

5.11 MARKING PLATE:

One no. (As per 5.5.10) shall be nailed to the front side of the case.

5.12 CASE MOUNTING:

After complete packing, stencil marking of various details and marking of symbols shall be done as per BHEL instructions using indelible / non washable marking ink.

5.13 Different types (Typical) of Cubicles with sizes for Packing

1. Single suite cubicle - 900 x 950 x2500
2. Two suite cubicle - 1650 x 950 x 2500
3. Three suite cubicle - 2400 x 950 x2500
4. Four suite cubicle - 3150 x 950 x 2500
5. Regulation cub - 1300 x 1350 x 2500
6. Thy cub - 2870 x 1350 x 2500
7. VFD Cub - 3800 x 1550 x 2500

6 PACKING OF LOOSE ITEMS/SPARES

1) Shape of cases shall be square, rectangular with single gabled roof or with double gabled roof depending on the nature of the job to be packed. Construction shall be as per drawings enclosed. Only gable will be additional as required.

2) Wood with Tongue and Groove joint as per clause 4.3.

3) Width of planks shall be at least 100 mm. Width of binding planks (battens) shall be at least 75mm.

4) External surface of planks on front and rear shall be plane 100% (except bottom plank).

5) Inner surfaces of all 6 sides shall be lined with Multi Layered Cross Laminated Polythelene Film (as per clause 4.5.7) using blue nails.

6) Rubberized coir of minimum 25mm thickness and 100 mm width shall be nailed to inner surfaces of bottom and 4 sides of box.

7) Internal packing: Items that go into the box shall be packed using 100GSM, (Colourless) Multi Layered Cross Laminated Polyethylene Film. Any space left between the job and the sides and the top of the box shall be filled with rubberized coir to get proper cushioning effect.

8) Certain items like transformers, reactors, breakers, etc., shall be bolted to the bottom of the box using bolts, nuts and washers.

9) Silica gel as per clause 4.5.12 held in cotton bags as per clause 4.5.13 shall be kept at proper places in the box.

10) Packing slip kept in polyethylene bag (clause 4.5.16) shall be placed in the box.

11) Marking plate as per clause 4.5.10 shall be nailed to side of the box.

12) Two numbers of hoop iron strips as per clause 4.5.3 shall be strapped tightly on the case using clips.

13) Stencil marking of various details and marking of various symbols shall be done as per BHEL instructions using indelible/non-washable marking ink.

14) Loose items to be kept inside the cubicle

- The components which are removed from cubicle for shipping purpose only, such as meters shall be kept inside the cubicle individually, kept in wooden box and tied firmly in bottom of Cubicle.
- Other items which are given loose in addition to cubicle shall be packed in separate boxes.

7 BOX SIZES

7.1 BOX SIZES

Table 1 – SPARES WOODEN BOX DETAILS

SNO	BOX TYPE	BOX SIZE (in mm)	BOX Wt (in KG)	Carrying Capacity
1	A	800 X 200 X 200	15	
2	B	1500 X 200 X 200	22	
3	C	2000 X 200 X 200	27	
4	D	1100 X 200 X 200	15	
5	E	200 X 200 X 200	5	
6	F	320 X 250 X 260	13	
7	G	320 X 250 X 430	16	
8	H	430 X 370 X 430	23	
9	I	1100 X 400 X 400	45	
10	J	1500 X 500 X 400	65	
11	K	2000 X 500 X 400	93	
12	L	2500 X 500 X 400	88	
13	M	900 X 600 X 600	100	
14	N	3000 X 400 X 400	60	
15	P	600 X 500 X 400	35	
16	Q	710 X 630 X 600	90	
17	R	850 X 630 X 670	102	
18	S	1000 X 770 X 670	140	
19	T	2500 X 850 X 800	180	
20	U	1500 X 700 X 700	120	
21	W	1200X900X600	120	
22	Y	450 X 200 X 200	10	

Table 2 – WOODEN BOX DETAILS

BOX TYPE	BOX SIZE (in MM)	BOX Wt (in KG)	Carrying Capacity
1	320X250X260	10	
2	320X250X430	15	
3	430X370X430	25	
4	670X670X470	65	
5	720X630X600	75	
6	1000X770X660	100	
7	1100X430X670	80	
8	1200X1200X900	80	

9	1300X770X1050	155	
10	2500X850X800	225	
11	2000X1500X1200	305	
12	1850X1050X1250	260	
13	2000X800X800	180	
14	2600X1500X1600	470	
15	250X250X600	20	
16	250X250X880	30	
17	300X300X700	25	
18	380X380X880	45	
19	510X510X1400	60	
20	570X570X1400	80	
21	575X575X1875	105	
22	3600X1100X1100	390	
23	900X500X800	110	
24	2000X950X740	225	
25	1600X1120X700	220	
26	2500X2000X1200	490	
27	2900X1900X1400	525	
28	3000X1000X900	370	
29	3200X2200X950	450	
30	2150X1100X750	325	
31	2000X2000X700	130	
32	700X1200X1325	130	

TABLE 3 STEEL BOXES

S.NO.	TYPE	DIMENSION IN MM			WEIGHT	CARRYING CAPACITY (KGS)
		LENGTH	BREADTH	HEIGHT		
1	I	2480	1680	1500	339	4500
2	II	1200	900	600	61	2000
3	IIB	1800	850	950	115	2500
4	III	900	600	600	29	1000
5	IV	600	450	500	19	750
6	V	400	350	300	11	500

TYPICAL PATTERN OF WOODEN BOX

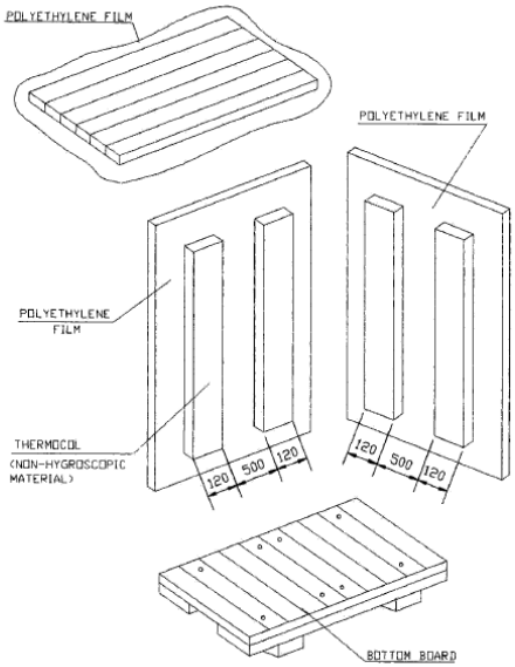


Figure 1

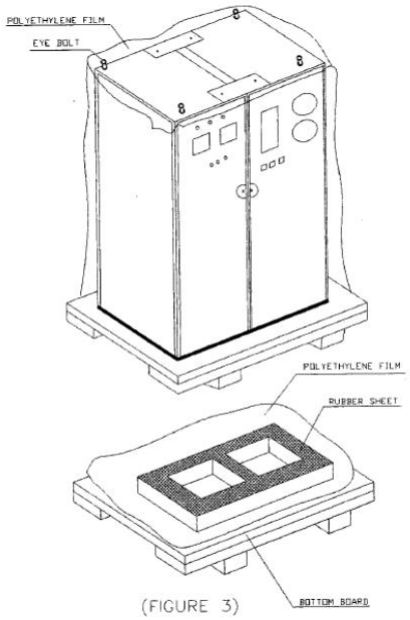
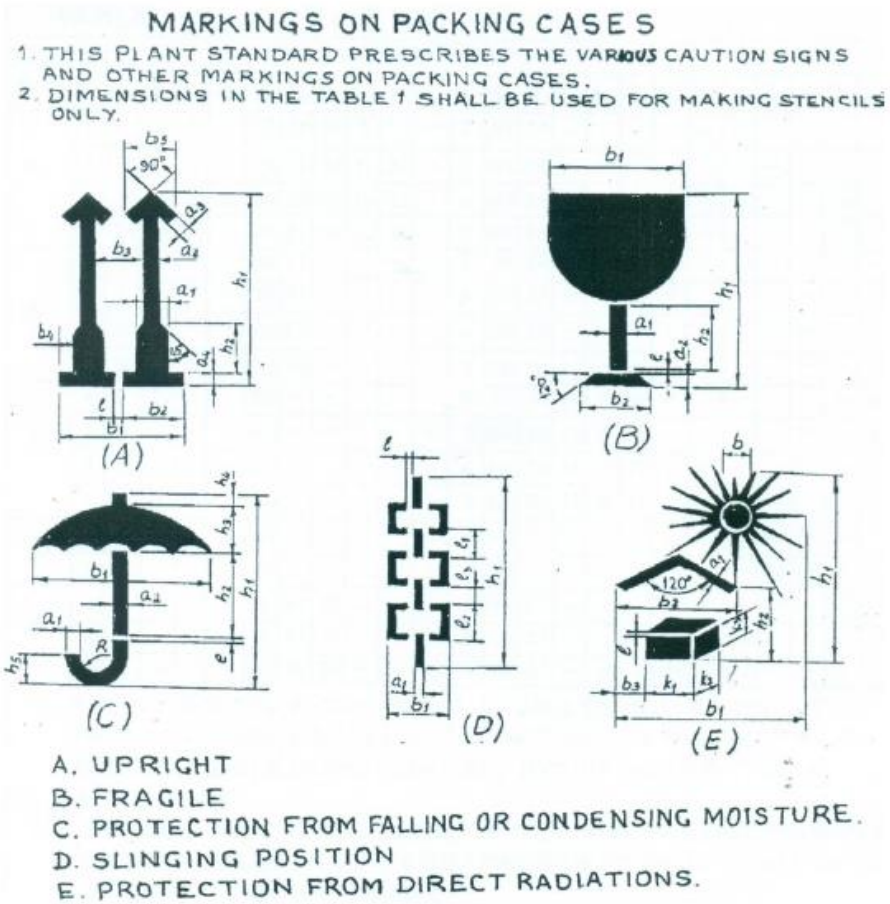


Figure 2

7.3 SEALED PACKING:

Components sub-assemblies and assemblies sensitive to climatic conditions shall be packed seal tight. All the openings of the sensitive components, sub-assemblies and assemblies shall be blanketed to prevent the ingress of dust and moisture. The components sub-assemblies and assemblies are completely covered with 2 layers of polyethylene sheet. All sharp corners and edges are to be protected by rubber mats to prevent the polyethylene sheet from damage. Top surface of the case shall be free from dents to prevent rain water pockets.

8 MARKINGS/STENCILINGS


MARKINGS ON PACKING CASES
1. THIS PLANT STANDARD PRESCRIBES THE VARIOUS CAUTION SIGNS AND OTHER MARKINGS ON PACKING CASES.
2. DIMENSIONS IN THE TABLE 1 SHALL BE USED FOR MAKING STENCILS ONLY.
(A)
(B)
(C)
(D)
(E)
A. UPRIGHT
B. FRAGILE
C. PROTECTION FROM FALLING OR CONDENSING MOISTURE.
D. SLINGING POSITION
E. PROTECTION FROM DIRECT RADIATIONS.

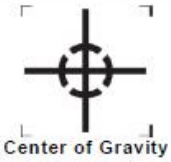

Center of Gravity

Figure 3

DESIGN-ATION		DIMENSION IN MM																						
		a1	a2	a3	a4	b1	b2	b3	b4	b5	b	l	h1	h2	h3	h4	h5	k1	k2	k3	l1	l2	l3	R
A	1	12	5	5	4	52	25	19	8	21		2	84	23										
	2	17	7	7	6	75	36	29	11	30		3	119	33										
	3	24	10	10	8	104	50	38	16	42		4	168	46										
	4	34	14	14	11	147	71	59	23	60		5	239	65										
B	1	5	5			50	33					2	84	25										
	2	7	7			71	47					3	119	36										
	3	10	10			100	66					4	168	50										
	4	14	14			142	94					5	239	71										
C	1	4	3			66						2	80	39	19	5	11							6
	2	6	4			85						3	114	55	27	7	16							9
	3	8	6			120						4	160	78	38	10	22							12
	4	11	9			170						5	227	110	54	14	31							17
D	1	6				30						4	148								30	30	10	
	2	9				42						5	209								42	42	14	
E	1	3				69	47	10			16	2	91	26				17	8	11				
	2	4				98	67	15			23	3	128	33				24	11	16				
	3	6				138	94	20			32	4	182	62				34	16	22				

Table 4

Black and Red Marking Ink to IS:1234 "Ink, Stencil, Oil Base, For Marking Porous Surfaces" or duplicating ink stencilling, oil base for marking porous surfaces.

All cases containing fragile items are to be stencilled with red marking and stencilling paint/ink **"HANDLE WITH CARE", "FRAGILE DO NOT TURN OVER".**

Besides the caution signs the product information's shall be stencilled of letters with 13mm to 50mm height. In case of consignment consists of more than one package, each package shall carry its package no as given in shipping list. All caution signs shall be stencilled in high quality full glossy out door finishing paint red in colour (AA56126). All other markings shall be carried out in black enamel.

Caution signs & other markings shall be stencilled on both the end shooks & the side shooks.

Caution sign (for slinging) shall be stencilled only on side shooks at the appropriate place.

Note: Incase the size of package is small for using the stencils, then hand written letters/figures shall be allowed.

	BHEL – <unit> - <location> - <pin>				
CONSIGNEE					
MATERIAL					
CUSTOMER REF.				MO. NO.	
DESPATCH ADVICE NOTE NO				CASE NO	
DIMENSIONS(MM) L x B x H				NET WT –KGS	GROSS WT –KGS
SPECIAL INSTRUCTIONS	HANDLE WITH CARE - KEEP DRY DO NOT DROP - DO NOT TILT				

Figure 4 – TYPICAL MARKING PLATE (225 X 170)

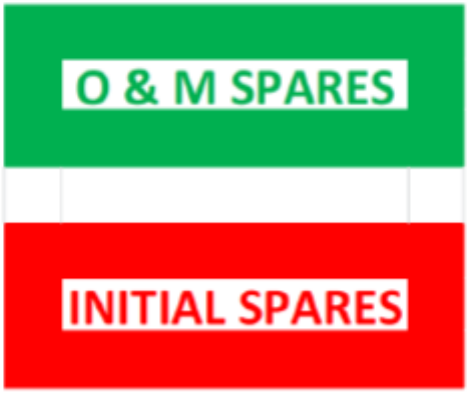


Figure 5

Easy spares [Initial and O&M] Traceability and Identification at units and as well as at sites:

9 STANDARD METHOD OF PACKING

Table 5 - Standard Method of Packing

DESCRIPTION	CASE	CRATE	SKID	BUNDLE	BARE	DRUM	METAL DRUM	FIBRE DRUM

PRESSUE VESSELS								
TOWERS					O			
TANKS					O			
VESSELS					O			
GASKETS	O							
FASTENERS	O							
COVERS		O						
EXCHANGERS								
HEAT EXCHANGERS					O			
TUBE BUNDLE	O							
SHELL					O			
AIR FIN COOLERS					O			
COLOUMNS, MOTOR SUSPENSIONS, PLENUM CHAMBERS, SCREEN GUARDS, ETC					O			
BEARING BLOCKS	O							
FANS	O	O						
MOTORS	O							
GASKETS	O							
FASTENERS	O							
TEST FLANGES			O					
TEST RINGS			O					
COVERS			O					
CRYOGENIC VESSELS								
COLD CONVERTERS					O			
HORIZONTAL STORAGE TANKS					O			
TRANSPORTATION TANK					O			
COLD BOX					O			
DRYING UNIT					O			
DRYING BOTTLES					O			
MOISTURE SEPARATORS					O			
SILENCERS					O			
ONGC SKIDS					O			
VAPORISER		O						
SPECIAL PRODUCTS								
SI/VI PIPING		O						
CRO BIO CONTAINERS	O							
DESCRIPTION	**CASE**	**CRATE**	**SKID**	**BUNDLE**	**BARE**	**DRUM**	**METAL DRUM**	**FIBRE DRUM**
AIR BOTTLES	O							
TITANIUM BOTTLE	O							

WAR HEAD CONTAINER	O							
MISSILE CONTAINER	O							
FUEL CONTAINER	O							
AIR LOCK ASSEMBLY	O							
BOILER DRUMS					O			
BOILER ITEMS								
COILS			O					
PANELS					O			
HEADERS			O		O			
FEEDERS								
MACHINED ITEMS								
SHELL SEGMENTS					O			
SHELL SEGMENTS IN STACKS					O			
SPHERE PETALS								
COLOUMNS, BASE PLATES, TIERCOS, PIPES, NOZZLE E1, F1, INTERNAL PIPES, PADS ETC.					O			
ROLLERS	O							
VALVE TRAYS								
VALVE TRAY COMPONENTS	O							
LATTICE GIRDERS		O						
FASTENERS	O							
GASKETS	O							
SUB CONTRACTS								
FAB STRUCTURALS					O			
SUPPORTING STRUCTURALS					O			
STRUCTURE SUB ASSEMBLY					O			
FAB PIPES					O			
GRATINGS					O			
STAIR CASES					O			
HANDRAILS/ PLATFORMS					O			
BOUGHT OUT COMPONENTS								
IRON & STEEL (LIKE PLATES, BEAMS, ANGLES, CHANNELS ETC.)					O			
PIPE FITTINGS								
CS PIPES, TUBES					O			
SS PIPES, TUBES					O			
FIN TUBES	O							
ELBOWS		O			O			
DESCRIPTION	**CASE**	**CRATE**	**SKID**	**BUNDLE**	**BARE**	**DRUM**	**METAL DRUM**	**FIBRE DRUM**
FLANGES	O	O						

VALVES	O							
GAUGES	O							
DEMISTERS		O						
ABSCRBANTS (LIKE MOLECULAR SIEVES, ACTIVATED ALUMINA, MOBILE SORBID)						O		
PAINT TINS		O						
PAINT DRUMS						O		
IGNITORS	O							
SPRAY NOZZLES	O							
ELECTRICAL INSTRUMENTATION								
MOTORS, PUMPS, COMPRESSORS, TURBINES	O							
SWITCH BOARDS, DISTRIBUTION BOARDS, STARTERS, JUNCTION BOXES		O						
INDICATORS, VIBRATOR SWITCHES	O							
CABLE BUNDLES, CABLE DRUMS					O			
CABLE TRAYS, CABLE RACKS, EARTHING MATERIAL		O						
OPERATIONAL SPARES	O							

10 PROCEDURE FOR HANDLING OF COMPONENTS

The purpose of this procedure is to protect the quality of the components/equipment while handling in various stages of manufacturing packing & despatching.

10.1 Adequate care shall be taken in handling the material, and components to avoid damage during receipts, storage issue manufacture & despatch operations.

10.2 Appropriate material handling equipment like fork lifters, cranes etc. shall be used where needed.

10.3 Lifting by crane and transportation by trolley of critical items and large components like rotors castings etc. shall be done carefully.

10.4 For critical items, where specified, special handling fixtures shall be used for lifting.

10.5 Slings and shackles used for lifting the components/equipment shall be checked for fitness and suitability before use.

10.6 Slings used on machined surfaces shall be suitably padded. No slings shall be used on journal surfaces.

10.7 Precision machined components like blades, catches, rollers etc. shall be lifted using suitable wooden

pallets.

10.8 HANDLING OF COMPONENTS ON RECEIPT/DESPATCH

Before loading/unloading a packing case from the carrier look for the following shipping instructions painted on the packing case.

a) The markings showing the upright position.

b) The markings showing the sling position

c) Markings showing the fragile contents.

d) Other required markings as per clause no.10

10.8.1 Appropriate cranes and slings should be used for different components/ cases. Slings should normally make an angle as minimum as possible (width wise) but in no case more than 15º.

10.8.2 Handling and lifting should be done without jerks or impacts.

10.8.3 Immediately after receipt of the goods, the packing should be examined all-round for any sign of damage. If necessary, lift the cover or a number of boards of the case so as to make the contents visible. In the event of sealed packing being used the plastic sheeting should not be damaged. It is imperative that the packing material is restored in original condition after the inspection.

10.8.4 On receipt of the equipment it should be checked with the shipping list and missing or damage if any should be reported immediately. It is important to arrange for immediate examination to determine the extent of the damage, the cause of the damage and where applicable the person or persons responsible for the damage. According to general practice when transporting by railway or by road vehicle the carrier concerned should be immediately called upon (within specified periods) for jointly establishing a statement of the damage. This is essential as a basis for a subsequent claim and possible damage report to the insurance company.

10.8.5 Protective coating applied on machined surfaces should not be disturbed. The plastic covering should be put back carefully so that it prevents ingress of dust and moisture. Some packing may have vapour phase inhibitor (VPI) paper enclosed inside the packing cases. This should be restored to its original place as far as possible.

10.8.6 Silica gel and such other chemicals kept in the box as desiccants and indicators should also be left in the box itself.

11 GENERAL GUIDELINES FOR ODC TRANSPORTATION/DESPATCH

Based on the Dimensions/Weight indicated in the Transportation Sketch, the type of Trailer is decided and indicated in the Tender Enquiry.

11.1 TRANSPORTATION:

1. LOW BED TRAILERS (LB 8):

Well Bed Length : 10000mm
Over Gooseneck : 13000mm
Width : 3000mm
Carrying Capacity : 40MT

2. LOW BED TRAILERS (LB 16):

Well Bed Length : 12000mm

Over Gooseneck : 16000mm
Width : 3000mm
Carrying Capacity : 75MT

3. TOW TYPE TRAILERS (WITH FRONT DOLLEY 16 TYRES): 12000MM length
(for Exceptional equipment length: 30000mm and above)

Bigger Dia equipment are loaded in the Well with overhanging.

Smaller Dia equipment with excess length are loaded over Gooseneck with rear hanging.
The Vehicle Dimensions are defined above are only guidelines for selection based on actual Dimensions/ Weight of the Consignment

11.2 PACKING:

For all ODCs, Wooden Saddles are cut to the diameter of equipment as per the Transportation Sketch.

Wooden Saddles	For Diameter up to 4000mm	For Diameter above 4000mm
Length:	1836/2743mm (6'0"/9'0")	3353mm (11'0")
Width:	300mm (1'0")	300mm (1'0")
Height:	Saddle + one/two wedges a top	Saddle + three/four wedges a top

Number of Saddles:	
Minimum	3 in case of Loading inside Well +1 when loaded on Gooseneck
Maximum:	4 in case of Loading inside Well +2 when loaded on Gooseneck

For Securing the equipment firmly on the Trailer, 19mm (3/4"), wire rope with 25mm (1") Heavy Duty Turn Buckles / BD Clamps are used as Lashing for the equipment.

12 GUIDELINES FOR HANDLING/LOADING/LASHING

- Jobs to be checked for complete painting before loading.
- Components to be lifted with Nylon belts. This protects painting, edges and attachments.
- All the components to be transported by putting inside the properly fabricated Crating
- Small components may fall down while transporting without closed crating and there are chances of missing of small parts. Hence, it is always better to transport small components in closed containers/crating. Loose to be being shipped in a closed crating.
- No component loaded over the crating.
- **LASHING:** Use Nylon belts only for lashing of all components. It prevents removal off painting and cut in the materials.

SITE STORAGE AND PRESERVATION GUIDELINES

FOR

MECHNANICAL BOPs

(Doc No: PE-DC-SSG-A001 REV.00)

PROJECT ENGINEERING MANAGEMENT, POWER SECTOR

BHARAT HEAVY ELECTRICALS LIMITED-NOIDA

CONTENT

1 SCOPE OF THE DOCUMENT

2 PURPOSE OF STORAGE & PRESERVATION

3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION

- a) GENERAL STORAGE REQUIREMENTS
- b) GENERAL PRESERVATION REQUIREMENTS
- c) GENERAL INSPECTION REQUIREMENTS

4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT

5. CONCLUSION

6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL

1. SCOPE OF THE DOCUMENT

This guideline is prepared in intent to provide proper site storage and preservation of the Mechanical, Electrical and C & I items / equipment supplied under various bought out packages/items. This storage procedure shall be followed at different power plant sites by concerned agency for storage and preservation from the date of equipment received at site until the same are erected and handed over to the customer.

2. PURPOSE OF STORAGE & PRESERVATION

Many of the items may be required to be kept in stores for long period. It shall therefore be essential that proper methods of storage and preservation be applied so that items do not deteriorate, loose some of their properties and become unusable due to atmospheric conditions and biological elements.

3. MEASURES TO BE TAKEN FOR STORAGE, HANDLING & PRESERVATION

a) GENERAL STORAGE REQUIREMENTS

1. To the extent feasible, materials should be stored near the point of erection. The storage areas should have adequate unloading and handling facilities with adequate passage space for movement of material handling equipment such as cranes, fork lift trucks, etc. The storage of materials shall be properly planned to minimise time loss during retrieval of items required for erection.
2. The outdoor storage areas as well as semi-closed stores shall be provided with adequate drainage facilities to prevent water logging. Adequacy of these facilities shall be checked prior to monsoon.
3. The storage sheds shall be built in conformity with fire safety requirements. The stores shall be provided with adequate lights and fire extinguishers. ‘No smoking’ signs shall be placed at strategic locations. Safety precautions shall be strictly enforced.
4. Adequate lighting facility shall be provided in storage areas and storage sheds and security personnel positioned to ensure enforcement of security measures to prevent theft and loss of materials.
5. Adequate number of competent stores personnel and security staff shall be deployed to efficiently store and maintain the equipment / material.
7. The equipment shall be stored in an orderly manner, preserving their identification slips, tags and instruction booklets, etc., required during erection. The storage of materials shall be equipment-wise. Loose parts shall be stored in sheds on racks,

preserving the identification marks and tags in good condition. The group codes shall be displayed on the racks

6. At no time shall any materials be stored directly on ground. All materials shall be stored minimum 200 mm above the ground preferably on wooden sleepers

b) GENERAL PRESERVATION REQUIREMENTS

1. All special measures to prevent corrosion shall be taken like keeping material in dry condition, avoiding the equipment coming in contact with corrosive fluid like water, acid etc.
2. Materials which carry protective coating shall not be wrapped in paper, cloth, etc., as these are liable to absorb and retain moisture. The material shall be inspected and in case of signs of wear or damages to protective coating, that portion shall be cleaned with approved solution and coated with an approved protective paint. Complete record of all such observations and protective measures taken shall be maintained.
3. Generally equipment supplied at site are properly greased or rust protective oil is applied on machined/ fabricated components. However periodic inspection shall be carried out to ensure that protection offered is intact.
4. While handling the equipment, no dragging on the ground is permitted. Avoid using wire rope for lifting coated components. Use polyester slings (if possible) otherwise protective material (e.g. clothes, wood block etc.) should be used while handling the components with rope / slings
5. For Equipment supplied with finished paint, touch paint shall be done in case any surface paint gets peeled off during handling. Otherwise such surfaces shall necessarily be wrapped with polythene to avoid any corrosion. Further for equipment wherein finish coat is to be applied at site, site to ensure that equipment is received with primer coat applied.
6. It shall be ensured by periodic inspection that plastic inserts are intact in tapped holes, wherever applicable.
7. Pipes shall be blown with air periodically and it shall be ensured that there is no obstruction.
8. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.
9. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion/jamming due to prolonged storage.

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.

11. Following preservatives/preservation methods can be used depending upon type of equipment

    a. Rust preventive fluid (RPF)

    b. Rust protective paints

    c. Tarpaulin covers, in case of outdoor storage

    d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –

    - Ingress of moisture and corrosion damages.
    - Damage to protective coating.
    - Open ends in pipes, vessels and equipment -
        - In case any open ends are noticed, same shall be capped.

2. Any damages to equipment / materials.

    - In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
    - Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

The types of storage are broadly classified under the following heads:

i **Closed storage with dry and dust free atmosphere**. (C)

The closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated asbestos sheets / galvanised iron sheets for roofing. Brick walls / asbestos sheets can be used to cover all the sides. The floor of the shed can be finished with plain cement concrete suitably glazed. The shed shall be provided with proper ventilation and illumination.

ii **Semi-closed storage**. (S)

The semi closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated / asbestos sheets for roofing. The floor shall be brick paved. If required a small portion of sides can be covered to protect components from rainwater splashing onto the components.

iii Open storage (O)

The open yard shall be levelled, well consolidated to achieve raised ground with the provision of feeder roads for crane approach along with access roads running all sides. One part of the open yard shall be stone pitched, levelled and consolidated with raised ground suitable for storing / stacking heavier and critical components with due space to handle them by cranes etc . Adequate number of sleepers, concrete block etc. to be provided to make raised platforms to stack critical materials.

A separate yard to be identified as “scrap yard” slightly away from main open yard to store wooden/steel scraps, which are to be disposed off. This is required to avoid mix up with regular components as well as to avoid fire hazard.

Some of the components, which are having both machined & un-machined surfaces and are bulky, shall be stored in open storage area on a raised ground and suitably covered with water proof / fire retardant tarpaulin.

The equipment listed below shall be stored and inspected as per requirement mentioned in the table below.

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
Raw material /mechanical items like pipes, plates, structure sections etc.)				
1.	Steel pipes (lined/unlined)	S	Damage , paint, corrosion, rubber lining peeling	Provide end cap
2.	MS Plates	S	Damage, paint, corrosion	
3.	SS Plates	S	Damage	
4.	Non-metallic pipes	S	Damage, cracks	Provide end cap
5.	Stainless steel pipes	S	Damage ,	Provide end cap
6.	MS sections, beams	S	Damage, paint, corrosion	
7.	Cable trays	S	Damage, condition of preservations	
8.	Insulation sheets	S	Damage	
9.	Insulation	C	Damage, packing	
10.	Hangers Rods	S	Damage, paint, packing	
11.	Tubes	S	Damage, paint , packing	Provide end cap
12.	Hume pipes	O	Damage	
13.	Castings	O	Damage, paint, corrosion	
Fabricated mechanical items (pressure vessels, tanks etc.)				
14.	Pressure vessels (unlined)	O	Damage, paint, corrosion,	Covered nozzles
15.	Atmospheric storage tanks (unlined)	O	Damage, paint, corrosion	Covered nozzles

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
16.	Pressure vessels (lined)	S	Damage, paint, corrosion, rubber lining	
17.	Atmospheric storage tanks(lined)	S	Damage, paint, corrosion, rubber lining	
18.	Support structures	O	Damage , paint, corrosion	
19.	Flanges	C	Damage , paint, corrosion	
20.	Fabricated pipes	S	Damage , paint, corrosion	Provide end cap
21.	Vessels internals	C	Damage , paint, corrosion ,packing	
22.	Grills	S	Damage , paint, corrosion	
23.	Angles	S	Damage , paint, corrosion	
24.	Bridge mechanism/clarifier mechanism	O	Damage , paint, corrosion	
25.	Cranes, rails	S	Damage , paint, corrosion	
26.	Stair cases	O	Damage , paint, corrosion	
27.	Ladders/handrails	O	Damage , paint, corrosion	
28.	Fabricated ducts	S	Damage , paint, corrosion	
29.	Isolation Gates	O	Damage , paint, corrosion	
30.	Fabricated boxes/panels	S	Damage , paint, corrosion	
Mechanical components like valves, fittings, cables glands, spares etc.)				
31.	Valves	S	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
32.	Fittings	S	Damage , packing	Provide end cap
33.	Cable glands	C	Damage , packing	
34.	Tools & tackles	C	Damage , packing	
35.	Nut , bolts, washers,	C	Damage , packing	
36.	Gasket & Packings	C	Damage , packing	
37.	Copper tubes	C	Damage , packing, corrosion	Provide end cap
38.	SS tubing	C	Damage , packing	Provide end cap
Rotating assemblies (pumps, blowers, stirrers, fans, compressors etc.)				
39.	Pumps	S	Damage , packing, corrosion	Shaft rotation
40.	Blowers/Compressors	S	Damage , packing, corrosion	Shaft rotation
41.	Agitators/stirrers/radial launders	C	Damage , packing, corrosion	Shaft rotation
42.	Rollers for chlorine tonner mounting	C	Damage , packing, corrosion	
43.	Centrifuge	S	Damage , packing,	
44.	Gear box	C	Damage , packing, corrosion	
45.	Bearings	C	Damage , packing, corrosion	
46.	Fans	S	Damage , packing, corrosion	
47.	Dosing skids	S	Damage , packing, corrosion	
48.	Pump assemblies	S	Damage , packing, corrosion	
49.	Air washers(INTERNALS)	S	Damage , packing	
50.	Air conditioners (split)	C	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H_2SO_4)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
68.	Sodium hydroxide (NaOH)	Store in canes/ storage tank in dyke area	Date of production/ leakage/ fumes/ breather	hazardous chemical ,breather to be checked for air ingress
69.	Sodium hypo chlorite	To be stored under shed	Date of production/ leakage/ fumes	hazardous chemical ,self-life normally 15-30 days after which strength of chemical decays
70.	Ammonia	S	Date of production/ leakage/ fumes	Store in closed storage tanks, hazardous chemical
71.	CW treatment chemicals	S	Date of production , Self-life	Store in closed canes
72.	RO/UF cleaning chemicals	S	Date of production , Self-life	Store in closed canes
73.	Lime	C	Damage to packing , seepage	Prevent moisture, rain
74.	Alum bricks	C	Damage to packing	Prevent moisture, rain
75.	Poly electrolyte	S		Store in closed storage tanks
76.	Laboratory chemicals(powder)	C	Damage, Packing self-life	
77.	Laboratory chemicals(liquid)	C	Damage, Packing self-life	
78.	Lubrication oils	C	Leakage	
79.	Paints	S	Leakage ,air tightness	
80.	Sand	O	Damage of packing	No hooks
81.	Salt (NaCl)	C	Damage of packing, water ingress	Prevent moisture, rain
82.	Anthracite	S	Damage of packing	
83.	Activated carbon	S	Damage of packing	

Sl. No.	**Description of the equipment**	**Type of Storage**	**Check for**	**Remarks**
84.	Thermal insulation	S	Damage of packing	
85.	Cement	C	Damage of packing	Prevent moisture, rain
86.	Gravels	O	Damage of packing	
87.	ION exchange resins	C	Damage , packing	Refer manufacturer guidelines
88.	RO membranes	C	Damage , packing	Refer manufacturer guidelines
89.	UF membranes	C	Damage , packing	Refer manufacturer guidelines
90.	Cleaning chemicals	C	Damage , packing	Refer manufacturer guidelines
91.	Chemicals for analysers/calibration	C	Damage , packing	Refer manufacturer guidelines
Electrical and C & I items (motors, cables etc.)				
92.	Motors	C	Damage , packing	
93.	Cable drums	O	Damage	
94.	Control Panel /control desk, UPS ,JB	S	Damage, Packing	
95.	Instruments(gauges/analysers)	C	Damage	
Special items		As per Manufacturer's item, like Hydrogen cylinders, Ozonator, Analyser, Chlorine dioxide generators etc.		

5. CONCLUSION

Concerned storage agency at site should make sure that loss in equipment performance and wear & tear are minimised through proper storage and preservation. The above are broad guidelines and cover major equipment / materials. However specific storage practices shall be followed as per manufacturer recommendation. All the necessary measures even in addition to the ones mentioned above, if found necessary, should be taken to achieve the objective.

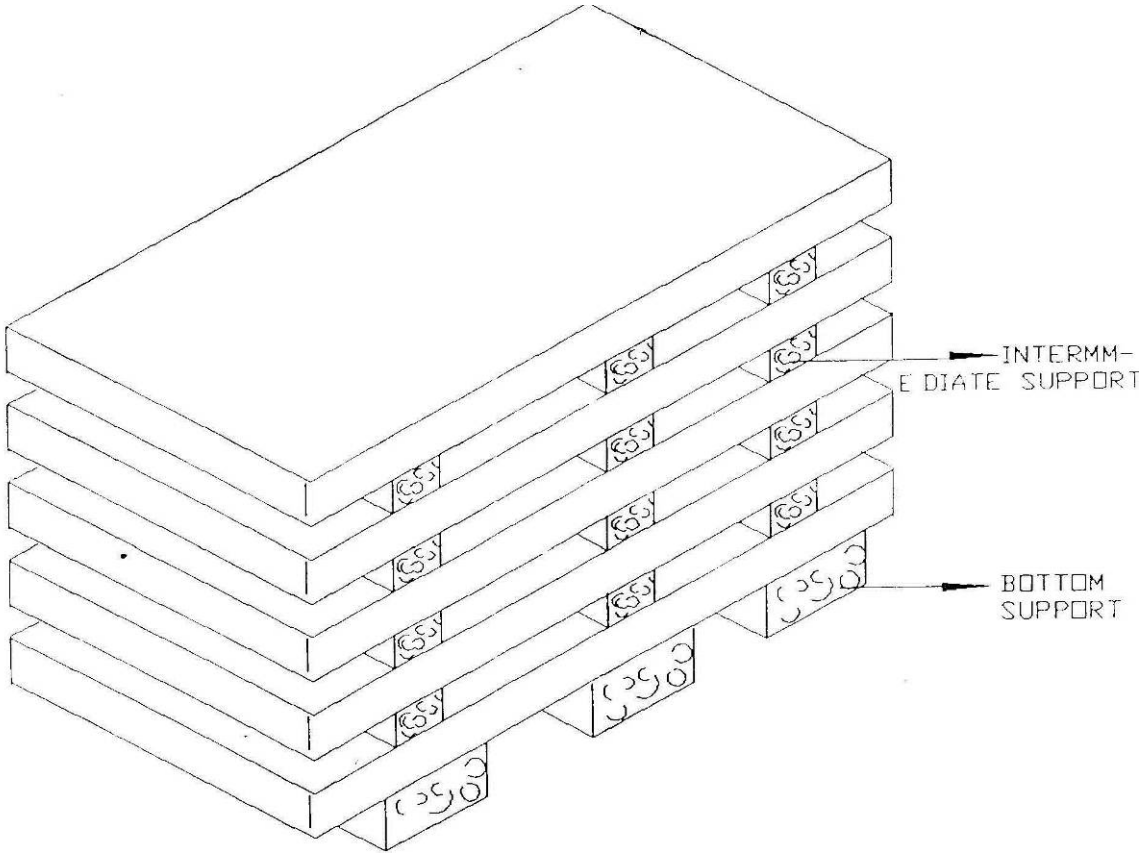


Figure – 1 – PLATE STACKING ARRANGEMENT

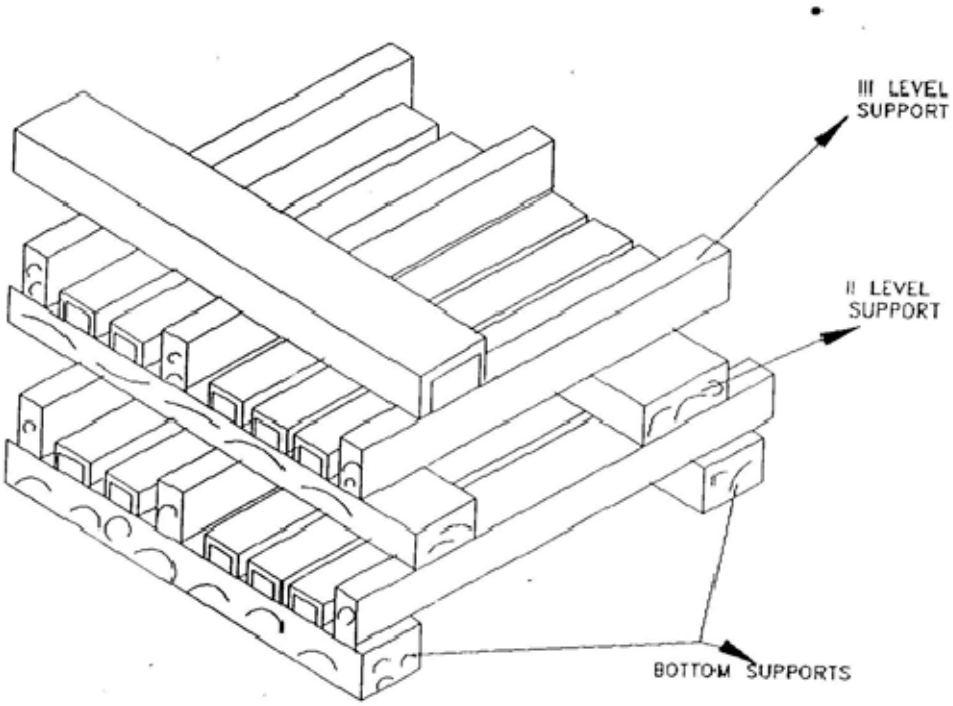


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

SECTION-III

DOCUMENTS TO BE SUBMITTED BY BIDDER

IIIA	LIST OF DOCUMENTS TO BE SUBMITTED ALONG WITH BID
IIIB	COMPLIANCE CUM CONFIRMATION CERTIFICATE
IIIC	PRE BID CLARIFICATION SCHEDULE
IIID	UTILITY REQUIREMENT
IIIE	GUARANTEED POWER CONSUMPTION

DRAWINGS/ DOCUMENTS TO BE SUBMITTED WITH THE BID FOR TECHNICAL EVALUATION

Bidder shall submit the following drawings / documents along with their techno-commercial bid:-

a) Copy of pre-bid clarifications, if any, duly signed & stamped.

b) Schedule of technical deviations (if any).

Deviation schedule with reference to specific clauses of the specification along with reason for such deviation and cost-of-withdrawal in the format given in GCC.

OR

"No deviation certificate" – Clearly mentioning that bidder has considered 'No - Deviation' from the technical specification provided by BHEL.

c) Signed and stamped copy of Compliance cum Confirmation Certificate.

d) Un priced copy of price format indicating quoted against each row/column.

e) Filled Electrical load list.

f) Pre-qualification requirement (PQR) documents.

g) Filled guaranteed power consumption format.

Note: OFFER WILL BE CONSIDERED AS INCOMPLETE IN ABSENCE OF ANY OF ABOVE DOCUMENTS. DOCUMENT OTHER THAN ABOVE, IF ANY, SUBMITTED WITH THE OFFER WILL NOT FORM PART OF CONTRACT AND ACCORDINGLY WILL NOT BE CONSIDERED FOR BID EVALUATION.

COMPLIANCE CUM CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate (every sheet) and furnish same with the offer.

a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions other than those mentioned under "exclusion" and those resolved as per 'Schedule of Deviations', if applicable, with regard to same.

b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'.

c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL/ CUSTOMER approval & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This shall be within the contracted price with no extra implications to BHEL after award of the contract.

d) All drawings/ data-sheets / calculations etc. submitted along with the offer shall not be taken cognizance of.

e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified / intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre-bid discussions, otherwise BHEL / Customer's decision shall be binding on the bidder whenever the deficiency is pointed out. For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.

f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.

g) All sub vendors shall be subject to BHEL / CUSTOMER approval in the event of order.

h) Guarantee for plant/equipment shall be as per relevant clause of GCC / SCC / Other Commercial Terms & Conditions.

i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities within the scope of work as tender specification. This clause will apply in case during site commissioning, additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account.

j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's / Customer's / Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.

k) As built drawings shall be submitted as and when required during the project execution.

l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.

m) Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.

n) Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

o) In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor’s account and shall not be used as a reason for extension in contract completion.

PRE-BID CLARIFICATION SCHEDULE

S. No.	Section/Clause /Page No.	Statement of the referred clause	Clarification Required

The bidder hereby certifies that above mentioned are the only clarifications required on the technical specification for the subject package.

SIGNATURE:_____

NAME:_____

DESIGNATION:_____

COMPANY: _____

DATE:_____

COMPANY SEAL

UTILITY REQUIREMENT

Sl. No	Description	Quantity	Pressure Requirement	Pressure Drop	Temp.	Scope	Tapping
1	Cooling water for compressor (DMCW)	30 m^3/hr	5 - 6 Kg/cm^2 (g) at 0.0m EL	1 MWC	Maximum inlet temperature- 39 ºC & Rise 10 ºC.	BHEL	80NB tapping with isolation valves at inlet and outlet header at 5 m distance from compressor house.
2	Service water	3-4 m^3/hr per mill bay	2.5-3 Kg/cm^2 (g)	_	_	BHEL	50NB tapping tentatively at elevation of 3-6 m at first column of each mill bay.
3	Instrument air	0.75 Nm^3/min per mill bay	5–7Kg/cm^2 (g)	_	_	BHEL	25NB tapping tentatively at elevation of 3-6 m at first column of each mill bay.

GUARANTEED POWER CONSUMPTION FORMAT

Mode: Pneumatic Conveying

Sl.No.	Description / Item	Working	Standby	Power Consumption (kW) (at motor input terminal)	Duty Factor	Total Power Consumption (KW)
1	**2**	**3**	**4**	**5**	**6**	**7 = 3 x 5 x 6**
1	Conveying Air Compressor for Mill Reject System	1	1		**1.0**	
					Total kW	

Notes

1	Power consumption (kW) of air compressors shall be measured at motor input terminals when operating at the rated capacity and pressure and performed on test rig at the vendor's works and actual motor shall be used for this purpose.
2	The base auxiliary power is **100kW for Conveying Air Compressor for Mill Reject System**. Quoted power by bidder at column no. (7) shall be evaluated with respect to base auxiliary power. For bid evaluation purpose, excess power quoted by bidder over base auxiliary power, shall be loaded with Rs. 462,000/- or equivalent foreign currency for every one (1) kW.
3	Power quoted by bidder shall be termed as 'Guaranteed Power consumption' (GPC). Bidder shall be liable to demonstrate actual power consumption during PG test/ Demonstration test at site. If the actual power consumption exceeds the guaranteed power consumption (indicated by bidder) or base auxiliary power (which is indicated at Sl no-2 above) whichever is higher, liquidated damages shall be payable by the vendor at the rate of Rs. 4,62,000/- or equivalent foreign currency for every one (1) kW. Such liquidated damages may be recovered by the BHEL by deduction from the contract price or by enforcing the contract performance guarantee or in any other manner deemed fit by the BHEL. For this purpose, the drives of standby equipment shall not be considered.
4	This document is to be submitted by the bidder along with the techno-commercial bid.