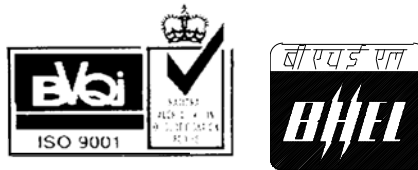


1X800MW WANAKBORI, TPS, UNIT#8


TECHNICAL SPECIFICATION FOR CONDENSER ON LOAD TUBE CLEANING SYSTEMS (COLTCS).

Specification No. : PE-TS- 408-165-N002 (REV. 0)

VOLUME -IIB



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

	TITLE : TECHNICAL SPECIFICATION FOR CONDENSER ON LOAD TUBE CLEANING SYSTEMS (COLTCS). PREAMBLE	SPEC. NO. PE-TS- 408-165-N002	
		VOLUME : II B	
		REV. NO. 0	DATE :27.11.2015
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1.0 The tender document contains three (3) volumes. The bidder shall meet the requirements of all the three volumes.

1.1 **Volume -I CONDITIONS OF CONTRACT**

This consists of four parts as below:

Volume - I A : This part contains instructions to bidders for making bids to BHEL.

Volume - I B : This part contains general commercial conditions of the tender and include provision that vendor shall be responsible for the quality of item supplied by their sub-vendors.

Volume - I C : This part contains special conditions of contract.

Volume - I D : This part contains commercial conditions for erection and commissioning site work, as applicable.

1.2 **Volume - II TECHNICAL SPECIFICATIONS**

Technical requirements are stipulated in Volume II which comprises of:

Volume - II A : General Technical Conditions

Volume - II B : Technical specification including drawings, if any

1.2.1 **Volume - II B:**

This volume is sub-divided into following sections:

Section - A : This section outlines the scope of enquiry.

Section - B : This section provides "Project Information"


Section - C : This section indicates technical requirements specific to the contract, not covered in Section-D.

Section - D : This section comprises of standard technical specifications of equipment's complete with data sheet A, B & C.

Data sheet-A specifies data and other requirements pertaining to the equipment.

Data sheet - B specifies data to be filled by the bidder (Data Sheet B is contained in Volume - III)

Data sheet - C indicates data documents to be furnished after the award of contract as per agreed schedule by the vendor (as applicable).

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1.2.2 **Volume - III TECHNICAL SCHEDULES**

- 1.0 This volume contains technical schedules and Data Sheets - B, which are to be duly filled by the bidder and the same shall be furnished with the technical bid as per instructions given in Document No.PES-100-901 in Volume-III.
- 2.0 The requirements mentioned in Section C/Data Sheets-A of Section-D shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the descriptive portion in Section -D.



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B	PROJECT INFORMATION
C	SPECIFIC REQUIREMENTS
C1	SPECIFIC TECHNICAL REQUIREMENTS FOR CONDENSER ONLOAD TUBE CLEANING SYSTEMS.
C2	SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)
C3	SPECIFIC TECHNICAL REQUIREMENTS (C&I)
D	STANDARD TECH. SPECIFICATIONS
D1	CONDENSER ON LOAD TUBE CLEANING SYSTEMS
	◆ STANDARD TECHNICAL SPEC.NO. PE-TS-999-165-N001
	◆ DATA SHEET-A
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**SECTION - A
SCOPE OF ENQUIRY**



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1.00.0 SCOPE

This enquiry covers the design, manufacture, assembly, inspection and testing at manufacturer's and/or his sub-contractors works properly packed for delivery of the items as follows:

1.01.0 Condenser On Load Tube Cleaning Systems :

Condenser On Load Tube Cleaning Systems (COLTCS) complete with all accessories as per the requirements specified in different sections of this specification **for** :

- **1X800MW WANAKBORI, TPS, UNIT#8**

The bidder's scope also includes installation checks, commissioning, trial runs & PG Testing at site of COLTCS.

1.01.0 The bids shall be evaluated as per NIT.

2.00.00 GENERAL TECHNICAL INSTRUCTIONS:

2.01.00 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 standard of design, engineering and workmanship, and shall be capable of performing the required duties in a manner acceptable to Engineer/ Owner, who will interpret the meaning of drawing and specifications, and shall be entitled to reject any component or material, which in his judgement is not in full accordance herewith.

2.0.2.00 The omission of specific reference to any component/ accessory necessary for the proper performance of the equipment's shall not relieve the bidder of the responsibility of providing such facilities to complete the supply of the equipment's at quoted prices.

2.03.00 In case of any deviation from this Technical specification (Vol. IIB) and General Technical Conditions (Vol. IIC), the same shall be indicated in the schedule of deviations enclosed in Volume-III, Part-A. In the absence of duly filled schedules it will be assumed that the bid strictly conforms to the specification.

2.04.00 BHEL's/ Customer's representatives shall be given full access to the shop in which the equipment's are being manufactured or tested and all test records shall be made available to him.

2.05.00 The equipment's covered under this specification shall not be despatched unless the same have been finally inspected, accepted and shipping release issued by BHEL/ Customer

2.06.00 Un-priced copy of price bid shall be furnished along with the technical bid.



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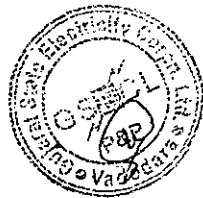
SECTION - B

PROJECT INFORMATION

VOLUME : IIA

SECTION-II

PROJECT SYNOPSIS AND GENERAL INFORMATION



DEVELOPMENT CONSULTANTS
(K9213R-EPC-SPC-001-Vol-IIA-Sec-1&2)

028



VOLUME : IIA

SECTION-II

PROJECT SYNOPSIS AND GENERAL INFORMATION

1.00.00 INTRODUCTION

The proposed 1x800 MW Supercritical Thermal Power Project would be set up by Gujarat State Electricity Corporation Limited (GSECL) at Kheda district of Gujarat.

The Bidder shall acquaint himself by a visit to the site, if felt necessary, with the conditions prevailing at site before submission of the bid. The information given here in under is for general guidance and shall not be contractually binding on the Owner. All relevant site data /information as may be necessary shall have to be obtained /collected by the Bidder.

2.00.00 APPROACH TO SITE

The proposed site is located in Kheda district about 13 kilometers from the nearest commercial town of Balasinor & 10 kilometers from Sevalia town. The National Highway, NH-08, connecting Dakor – Godhra is about 10 kilometers from the site. The State Highway SH – 59 connecting Balasinor – Sevalia is about 2 Kilometers from the site. Nearest railway station to the existing site is Sevalia, located about 8 kilometers from the site on Anand – Godhara main broad gauge line of Western Railway.

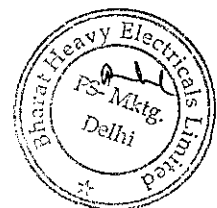
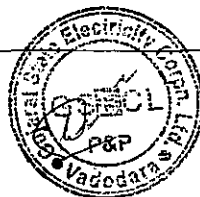
Nearby Air Ports are Ahmedabad at a distance of about 110 kilometers from the site and Vadodara at a distance of about 85 kilometers from the site.

3.00.00 LAND

The proposed extension unit will be developed in the existing Wanakbori Thermal Power Station and will be located north east side of the existing plot in the Kheda District of Gujarat. The land of the proposed plant will be filled in upto a desired level. Existing Ash Pond/ Dyke area will be utilized for the extension unit.

4.00.00 SOURCE OF COAL

Indian coal would be sourced from captive mines Machha Kata in Talcher, State – Orissa which are situated about 1800 Kms from the project site. GSECL will arrange for transportation of the coal required for the extension unit from these captive mines by the existing railway facilities for delivery of coal supply to the Wanakbori power station.



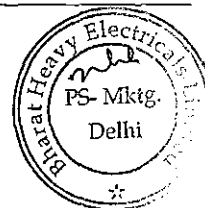
CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	INTRODUCTION
2.00.00	APPROACH TO SITE
3.00.00	LAND
4.00.00	SOURCE OF COAL
5.00.00	SOURCE OF WATER
6.00.00	ASH DISPOSAL AREA
7.00.00	SALIENT DESIGN DATA



DEVELOPMENT CONSULTANTS
(K9213R-EPC-SPC-001-Vol-IIA-Sec-1&2)

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5.00.00 SOURCE OF WATER

The water required for the new unit shall be obtained from River Mahi, flowing by the side of the existing Wanakbori Power Station.

One (1) new jackwell will be installed on Mahi river for supply of water for new plant. In addition, existing Canal Water and Jackwell Water will have interconnection with new plant to cater plant water requirement of new plant.

6.00.00 ASH DISPOSAL AREA

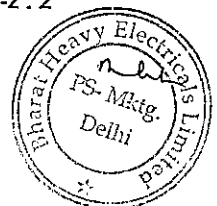
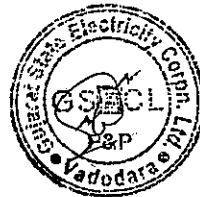
Existing Ash Pond / Dyke area will be utilized for the extension unit. Fly ash silos will be located outside plant boundary wall (but within GSECL land) in the vicinity of the Ash Dyke area.

7.00.00 SALIENT DESIGN DATA

7.01.00 Meteorological data of site is given below:-

Elevation above MSL	:	72 M
Max. daily average temp	:	34 °C
Min. daily average temp	:	11.7 °C
Max. Ambient air temp. (daily)	:	34°C
Max. Ambient air temp. (yearly)	:	30°C
Max. Ambient air temp.	:	42°C
Wet bulb temperature	:	28°C
Relative Humidity	:	RH varies within a range from 50% to 95%.
Average annual rainfall	:	750 mm

[Metrological data of Vadodara is attached for reference].



CLARIFIED WATER ANALYSIS

Sl no.	Particulars	Units	Value
1	pH	---	8.42
2	TSS	ppm	15 ppm
3	Conductivity	Micro S/cm	440
4	Calcium Hardness	ppm as CaCO ₃	52
5	Magnesium hardness	ppm as CaCO ₃	82
6	Sodium	ppm as CaCO ₃	79
7	Iron in solution	ppm as Fe	Nil
8	Manganese in solution	ppm as CaCO ₃	Nil
9	Total Cations		213
10	Bicarbonate	ppm as CaCO ₃	152
11	Carbonate	ppm as CaCO ₃	2
12	Hydroxide	-----	Nil
13	Sulphate	ppm as CaCO ₃	13
14	Chloride	ppm as CaCO ₃	46.48
15	Nitrate	ppm as NO ₃	Nil
16	Fluoride	ppm as CaCO ₃	Nil
17	Total Anions		213
18	Reactive Silica as SiO ₂	ppm	22
19	Colloidal Silica as SiO ₂	ppm	Nil.

*** Note: Other parameters not indicated above considering as Nil.**

Cycle of concentration for CW system is "5".



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SECTION – C

SPECIFIC REQUIREMENTS

- SECTION C1 : CONDENSER ONLOAD TUBE CLEANING**
- SECTION C2 : ELECTRICAL SYSTEMS**
- SECTION C3 : C&I SYSTEMS**



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**SECTION C1
CONDENSER ONLOAD TUBE CLEANING SYSTEMS
(MECHANICAL DETAILS)**



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1.0 GENERAL

The Condenser On load Tube Cleaning Systems (COLTCS) complete with all accessories shall conform to the standard technical specifications (Section-D) and Data Sheet-A enclosed herewith. In addition the requirements of this section C including customer specification attached at Annexure-IV shall also be complied with. However, wherever the details given in Section-D and Data Sheet-A are different, the requirements of Data Sheet-A shall prevail. Similarly in the event of contradictions between Section-C/ customer specification (Annexure-IV) attached in Section-C i.e. & Section-D/ Data Sheet-A, customer specification (Annexure-IV) attached in Section-C shall prevail.

Section C consists of 3 parts viz. Sec. C1, C2 and C3 for Mechanical, Electrical and C&I respectively, the requirements of all 3 sections shall be complied with.

2.0 DESCRIPTION OF EQUIPMENTS :

2.1 Condenser on load tube cleaning systems (COLTCS) :

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

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

3.1 The scope of supply for COLTCS covered under this specification is as under.

The size, MOC's and other particulars of the equipment's for various projects are detailed in Data Sheet A annexed with Section – D of the specification.

SL.NO.	PROJECT	COLTCS
1.	1X800MW WANAKBORI, TPS, UNIT#8	. TOTAL 2 SETS FOR UNIT.



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

3.2.1 Each set of COLTCS for each projects shall comprise of following :

- a) One No. Ball Separator at Condenser CW outlet pipe.
- b) One No. Ball recirculation pump with drive motor.
- c) One No. Ball collector.
- d) One No. Manual ball sorter (Bucket type sorter with sieves to manually sort out the undersized balls by shaking the sieved bucket manually) for each set of COLTCS.
- e) Differential pressure measuring system for ball separator. DP measuring system shall comprise of 2 nos. DPT +1 no. DPG for each COLTCS. Instrument shall be with *Remote seal* arrangement. Stubs for DPT and DPG shall be independent.
- f) Ball monitoring system comprising of an independent balls recirculation monitor and an independent balls oversize monitor. If bidder is not manufacturing Ball over size monitor then they can offer other alternatives like automatic ball sorter etc.
- g) Length of Ball separator, Scope of Counter Flange, Nuts, bolts and gaskets shall be as per Annexure- I of section C1.
Thickness of body flange and counter flange shall be as per Drg no PE-DG-999-141-MO17 enclosed at enclosures at Annexure-II.
- h) Complete Pipe work, including interconnection piping, flanges/counter flanges for valves & pipes, bends, fittings, distributors, nozzles and support installation materials shall be in Bidder's scope. Bidder shall finalize the pipework to suit the layout at contract stage in such a way that no site welding is required for his pipework otherwise the same shall be carried out by bidder at site.
- i) The Electrical and C&I item / accessory as specified in succeeding clause/ respective sections herein.
- j) Power and Control cables between **starter Panel (Switch Gear)** and various drives in bidder's scope of supply.
- k) Starter Panel (Switch Gear Panel) shall be as follows:
 - a) 2 Sets of COLTCS shall have one Common Starter Panel (Switch Gear Panel) for DCS based control system.



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Switch Gear Panel should have suitable arrangement like Bus Coupler for providing redundancy to incoming supply feeder (1Working + 1 Standby feeder).

- l) Control cables between field instruments and Switch gear panel.
- m) All the field instruments stipulated in this specification shall be in Bidder's scope.
- n) Commissioning balls and other commissioning spares on "As required basis".
- o) Set of mandatory spares as indicated in Data Sheet A.
- p) Supporting arrangement complete with saddle support, foundation plates, anchor bolts, nuts, sleeves, inserts, all installation materials, fixing bolts, clamps and other accessories etc. for complete equipment supplied under this package.
- q) Finish paints for touch up painting of equipment after erection at site, in sealed containers.
- r) Set of special tools and tackles if required for maintenance and erection of the equipment supplied.
- s) Various drawings, data test reports/ certificates instruction manuals for erection operation and maintenance etc. as specified in Data Sheet-C. and cables schedule indicating BOQ for power & control cables.
- t) Panels & Instruments: Scope and Type as specified in C&I section wherever required.

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

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

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

- a) Installation checks (Erection in BHEL's scope).
- b) Commissioning of equipment.
- c) Trial run for requisite period
- d) Performance Testing.



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

The no. of visits may be suitably assessed by bidders as per their experience with site stay periods on as required basis.

In the event of order number of visits as follows shall be made as a minimum with charges included in the bidder's base price itself.

- **For drawings/documents approval**

In the event of order all drawings / documents in soft as well as hard copy shall be submitted as per NIT.

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

- **Site Visits :**

- i. No. of site visits for combined activities of erection checks and commissioning for COLTCS as applicable shall be one per unit - for both sets of equipments of one unit. Time duration for erection and commissioning shall be "on as required basis" with equipments run for trial operation thereafter for requisite period to demonstrate satisfactory operation.

However the no. of visits may be suitably assessed by bidders as per their experience with site stay periods on as required basis.

- ii. Bidder shall demonstrate guarantees including balls recovery, life of balls, pressure drops, etc. at site during subsequent visit for COLTCS of each unit.
- iii. For trouble shooting on "as required basis".



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5.0 EXCLUSIONS :

The following are excluded from the bidder's scope .

- 5.1 Civil foundation works required for installation
- 5.2 Erection of Equipment at site.

6.0 DESIGN CONSTRUCTION :

In addition to the requirements of Section-D the following shall also be complied with for packages/ projects under scope of this specification:

- 6.1 For COLTCS - Layout Piping Arrangement Drg. is enclosed in the specifications at Annexure-III.
- 6.2 Thickness of body flange and counter flange of COLTCS shall be as per Drg no PE-DG-999-141-MO17 enclosed at enclosures at Annexure-II.
- 6.3 The materials of construction specified in Data Sheet-A are minimum requirements and materials of construction for other components not specified shall be similarly selected by the bidder for the intended duty which shall be subject to purchaser's approval during detailed engineering in the event of order.
- 6.4 Housing/ body of COLTCS shall be designed and manufactured as per the applicable codes for pressure vessels and to take care of force and moments as enclosed in the specification. However in no case thickness of housing/ body shall be less than connecting pipe thickness as specified in Data Sheet-A of COLTCS.
- 6.5 Adequate provision for future installation of Cathodic Protection for COLTCS (Sacrificial type) shall be kept by the bidder in the equipment.
- 6.6 Flow straightener for streamlining the CW flow in balls collecting strainer if required shall be supplied by the bidder along with mounting arrangement and the fixing details.
- 6.7 Velocity in the pipe work shall be less than 1.5 m/ sec for pump suction and less than 2.0 m/ sec. in other pipe work. All valves upto 150 NB shall be ball valves. For higher sizes, gate/ globe/ B.F. valves shall be provided. All instrument valves shall be needle valves.



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7.0 Performance Guarantee and Testing :

The Tube Cleaning Systems shall be guaranteed to meet the performance requirements specified in Section-D and also for trouble free operation after commissioning. Schedule of performance guarantees (enclosed in Volume III) duly filled and signed shall be furnished with the bid.

The Performance guarantees of equipment's shall stand valid till the satisfactory completion of performance testing & its acceptance by BHEL/ Consultant/Customer. If the guarantee period specified in the Commercial Specification is higher, same shall prevail.

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

8.1 Condenser On Load Tube Cleaning Systems.

8.1.1a Performance Parameters to be guaranteed by bidders for COLTCS-under penalty (Liquidated damages) shall be as under :

- i) Pressure drop in ball separator in clean condition (test to be conducted along with commissioning of COLTCS).

The cl. No. 8.1.2 in subsequent paragraphs shall be referred regarding liquidated damages.

8.1.1b Performance Parameters to be guaranteed by bidders for COLTCS-under demonstration category under compulsory corrections shall be as under:

- ii) Percentage recovery of balls (min. 90% recovery for 3 weeks with 8 hrs operation of COLTCS per day)
- iii) Life of Sponge Rubber Ball (Min. 3 weeks with 8 hrs operation of COLTCS per day).

For demonstrating the parameters at sl. No. (ii) & (iii) above, the COLTCS system shall be operated 24 hrs per day for one week.

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

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

In case bidder fails to demonstrate above parameters to purchaser's satisfaction



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even after modification carried by him at site, the purchaser has the right to reject the equipment out rightly.

8.1.2 Bidder to note that bids shall be evaluated on account of pressure drop across ball collecting strainer (in clean condition) and liquidated damages on account of not meeting the same during PG test shall be in accordance with following:

A) Bid Evaluation Criteria & Liquidated Damages:

The bids received shall be evaluated for Pressure drop across balls collecting strainers:

- The permissible limit of pressure drop across balls collecting strainers in clean condition shall be 0.15 MWC.
- If the pressure drops quoted are higher than above limit, the bids shall be technically loaded @ Rate as mentioned in Data Sheet-A on pro-rata basis for respective projects per **0.05 MWC** pressure drop across each balls collecting strainer.
- However no advantage shall be given for pressure drops quoted less than above permissible limit.
- The maximum acceptable limit for pressure drop across balls collecting strainer shall be (with technical loadings) 0.2 MWC.
The bids will be technically rejected for pressure drops quoted higher than above maximum limit.
- The guaranteed pressure drops shall be demonstrated at site by bidder and if found higher shall be subject to LD @ twice the bid evaluation factor as above.

9.0 SPARES :

9.1 Recommended Spares :

The supply of spare parts as necessary recommended by the manufacture for three (3) years of reliable operation and maintenance of COLTCS of respective projects shall be supplied. List of such spares along with the unit price shall not be included in base price but indicated separately in the schedule of prices for recommended spares enclosed in Vol. -III.

9.2 Mandatory Spares

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

10.0 Quality Plan

Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL/ Customer approval and customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. Charges for 3rd party inspection (TUV/ equivalent) for imported components wherever required shall be included by bidder in



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the base price itself. Witness for all the test identified under agency "C" & "N" in Quality plan shall be by third party.

If BHEL or BHEL customer decides to witness the tests along with third party, the cost of travel of BHEL or BHEL customer shall be borne by BHEL or BHEL customer themselves.

10.0 DELIVERY & DRAWINGS/ DOCUMENTS DISTRIBUTION SCHEDULE :

- a. Delivery of Equipment for each project shall be as per NIT.
- b. The drawings to be submitted by bidder in event of award of contract for COLTCS for each project shall be as follows:
 - Technical Data Sheets, P&ID, Installation Plan, for COLTCS.
 - GA drawings, Details of BR Skid and C& I Document (Part-I & II) of COLTCS as applicable.
 - Quality Plan.
 - O & M Manual.
- c. Drawings submission schedule shall be as per NIT/as advised by Project Group.:

11.0 The makes of various bought out items shall be subjected to purchaser's approval in the event of order.

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

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

- Compliance certificate duly signed and stamped (Enclosed at Schedules).
- Guarantee schedule duly signed and stamped (Enclosed at Schedules).
- GA drawings of following with empty/ filled-ups.
 - Balls Collecting Strainers (as applicable).
 - Balls recirculating Skids.



TITLE : TECHNICAL SPECIFICATION
FOR
CONDENSER ON LOAD TUBE CLEANING
SYSTEMS (COLTCS)

SPEC. NO: PE-TS-408-165-N002

VOLUME : II B

SECTION:C1

REV. NO. 0

DATE : 27.11.2015

SHEET 9 OF 10

➤ Other equipments considered necessary for Layout/ Civil.

- Electrical Load Data (Enclosed at Vol. III of Specification)
- Schedule of Deviation (Enclosed at Schedules).

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

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

14.0 Important Note:-

1. Bidder to note that C&I, Electrical, Fragile materials, cleaning balls shall be sent in separate proper packing (segregating from heavy items).
2. Bidder to include handling instructions in engineering drg/doc and packing to be done in such a way to avoid damage of items mention above in transit and long storage at site and same shall be approved in contract stage by BHEL/Customer.
3. For detail despatch instruction, please refer Special Conditions of Contract (SCC) for the project.



**TITLE : TECHNICAL SPECIFICATION
FOR
CONDENSER ON LOAD TUBE CLEANING
SYSTEMS (COLTCS)**

SPEC. NO: PE-TS-408-165-N002

VOLUME : II B

SECTION:C1

REV. NO. 0

DATE : 27.11.2015

SHEET 10 OF 10

ANNEXURE- I

COLTCS

SL.NO.	Projects	Size (NB)	Length of Ball Separator (Excluding Counter Flange)	Scope of Counter Flange	Scope of nuts, bolts and gaskets.
1	1X800MW WANAKBORI, TPS,	2700 NB	4350 mm	In Purchaser's Scope.	In Bidder's Scope

Notes:

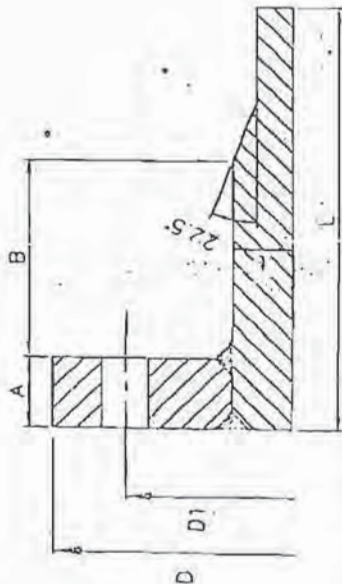
1. Ball separator shall be mounted directly on the existing Butterfly valve.
2. Flap of butterfly valve shall be extended to 1350 mm inside the Ball separator (GA of Butterfly valve has been enclosed).

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

ANNEXURE-II

L10W-141-666-OD-3d DR. DRAWING

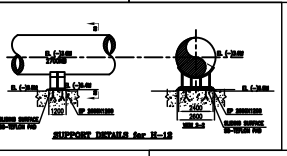
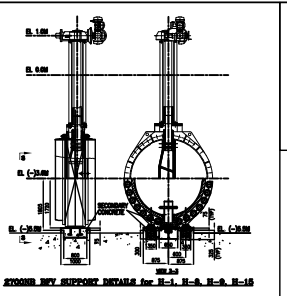
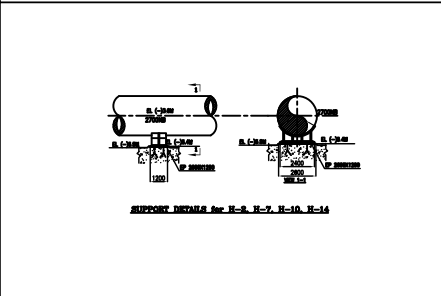
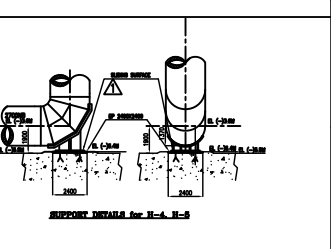
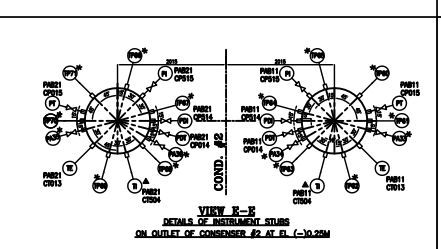
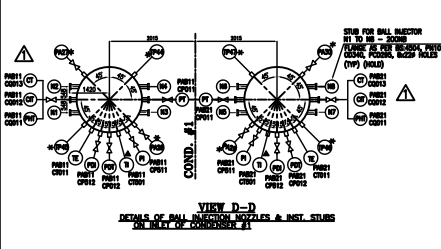
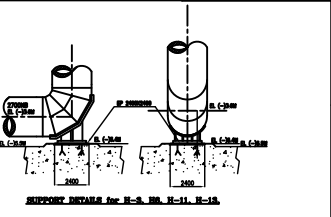
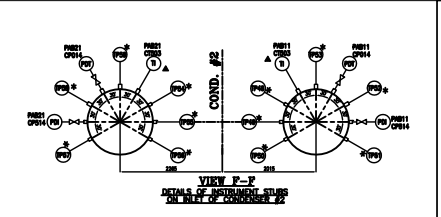
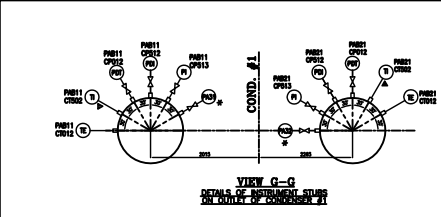
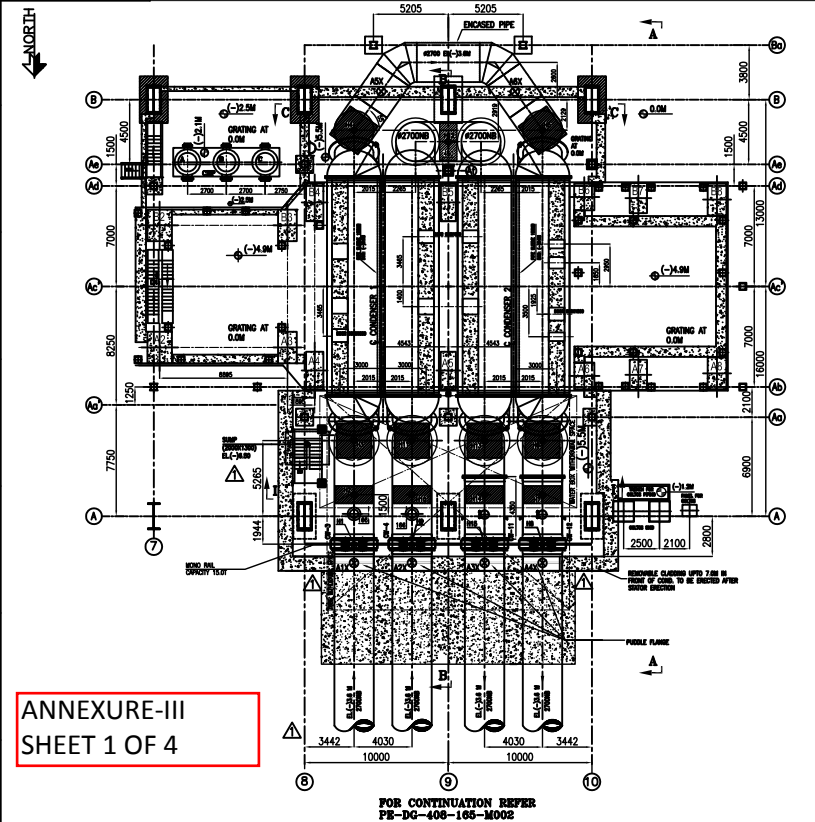


NOTES:-
 Flange thicknesses listed are for Design pressure=5Kg/cm²(g) and Flange dimensions as given in the table. Final thickness of the flange is to be checked for actual OD/Bolting PCD/Neck dimensions.

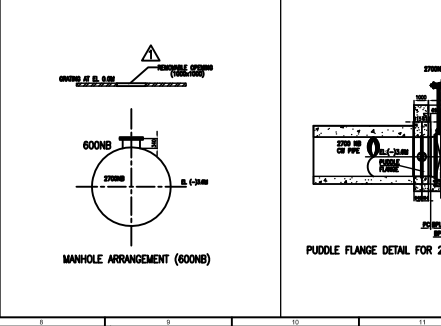
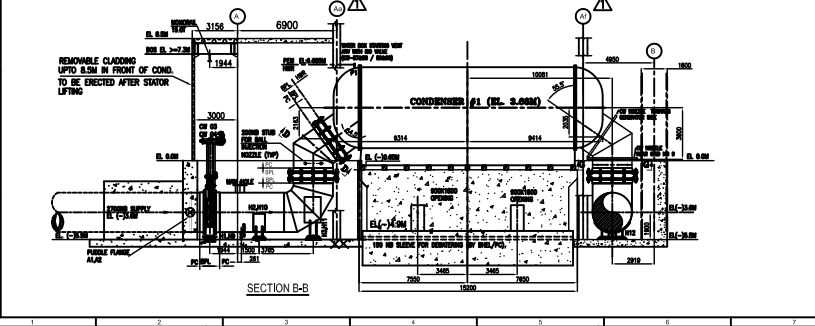
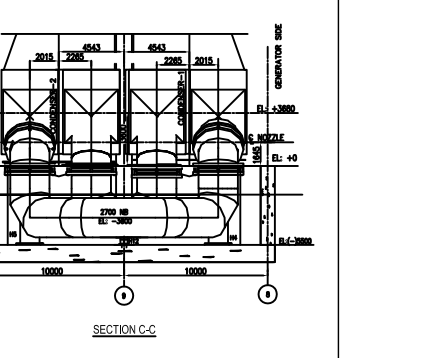
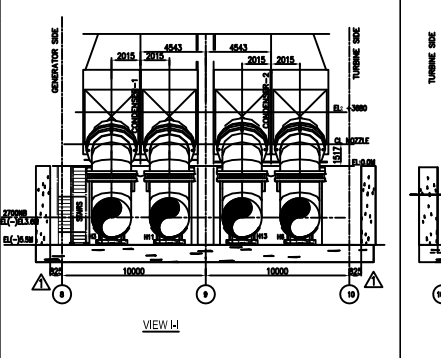
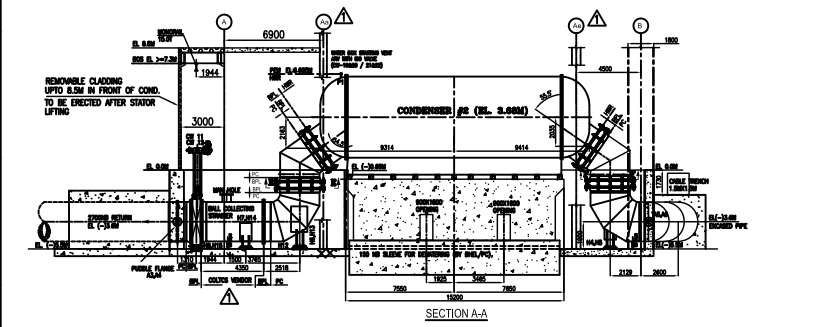
PIPE SIZE	PIPE THIK.	FLANGE OD 'D'	Bore PCD 'D1'	WELD NECK FLANGE		SLIP-ON FLANGE THICKNESS
				FLANGE THIK. 'A'	NECK THICK. 't'	
1200	10-12	1465	1380	40	24	200
1400	14	1675	1590	50	24	200
1600	14	1915	1820	60	32	220
1800	14-16	2115	2020	70	32	250
2200	18	2550	2420	80	36	300
2300	20			90	38	325
2500	20			90	38	325
2700	20			90	38	325

DRAWING FOR BAL. SEPARATOR COUNTER FLANGE

REV.	DATE	ALT.	CHG.	APPD.	JOB NO.	999
STATUS:						
DISTRIBUTION						
BHARAT HEAVY ELECTRICALS LTD POWER GROUP PROJECTS ENGINEERING MANAGEMENT PPEI, NOLDA						TITLC COUNTER FLANGE DETAILS
DRWG. NO.	PE-DG-999-141-M017	SHEET NO. OF 01		REV. 00		



S.NO.	MADEY SUPPORT NUMBER	LOAD (TONNES)	MINIMUM S.F. (TONNES)
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NOTES AND REMARKS ON WHICH ARE FOR PIPES FROM A.E. START UP TO BE OPENED FOR INSPECTION & REPAIRS FROM OUTSIDE PIPES IS TO BE CONSIDERED AS ACCORDING TO INDICATED REMARKS UNDER FE-DC-408-100-M002.

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SPECIFIED.
 2. ALL DIMENSIONS ARE TO FACE UNLESS OTHERWISE SPECIFIED.
 3. ALL DIMENSIONS ARE TO CENTERLINE UNLESS OTHERWISE SPECIFIED.
 4. ALL DIMENSIONS ARE TO CENTERLINE UNLESS OTHERWISE SPECIFIED.
 5. ALL DIMENSIONS ARE TO CENTERLINE UNLESS OTHERWISE SPECIFIED.
 6. ALL DIMENSIONS ARE TO CENTERLINE UNLESS OTHERWISE SPECIFIED.
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 8. ALL DIMENSIONS ARE TO CENTERLINE UNLESS OTHERWISE SPECIFIED.
 9. ALL DIMENSIONS ARE TO CENTERLINE UNLESS OTHERWISE SPECIFIED.
 10. ALL DIMENSIONS ARE TO CENTERLINE UNLESS OTHERWISE SPECIFIED.

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HOLD:
 1. CHECK
 2. VERIFY

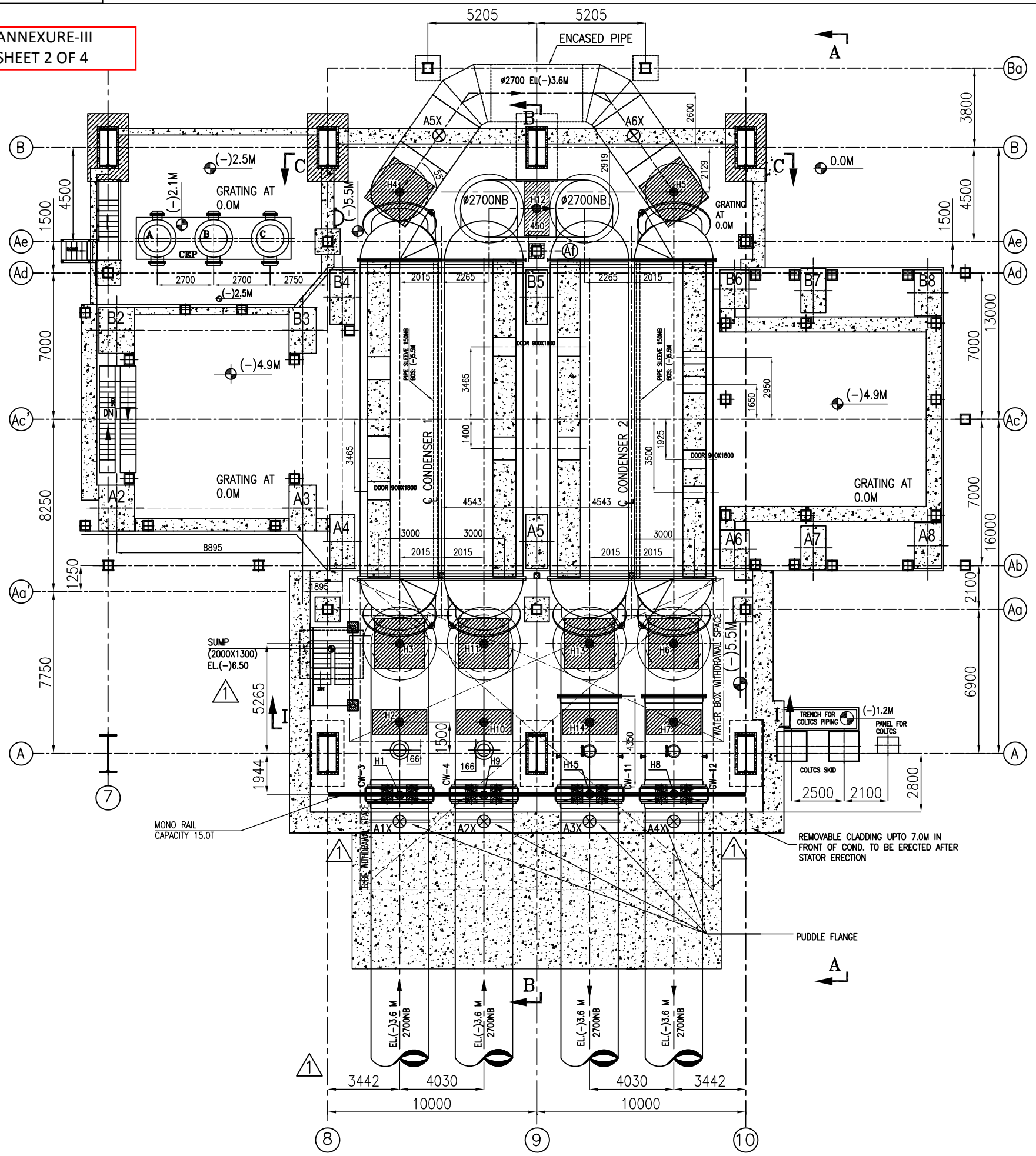
CUSTOMER: GUJARAT STATE ELECTRICITY CORPORATION LTD
 VADODRA, GUJARAT
 1x500 MW Vadodra Thermal Power Station Extn. Unit-0

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

PROJECT ENGINEERING MANAGEMENT: BEHARAT HEAVY ELECTRICALS LTD
 POWER SECTOR
 PROJECT ENGINEERING MANAGEMENT
 INDIA

DATE: 01/08/2018
SCALE: 1/80
DRWING NO.: FE-DC-408-100-M001
SHEET: 1 OF 1

ANNEXURE-III
SHEET 2 OF 4

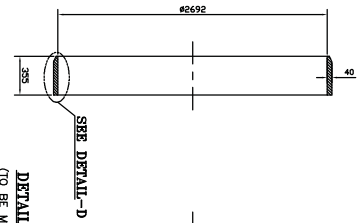
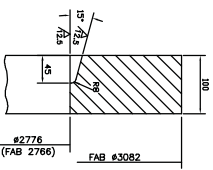
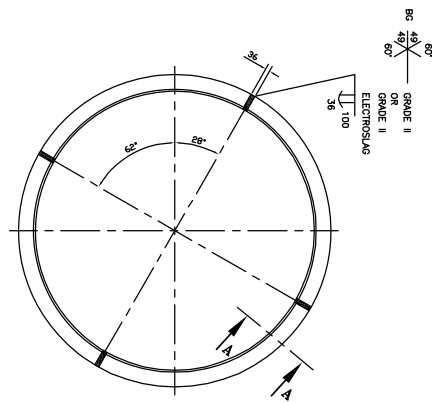


FOR CONTINUATION REFER
PE-DG-408-165-M002

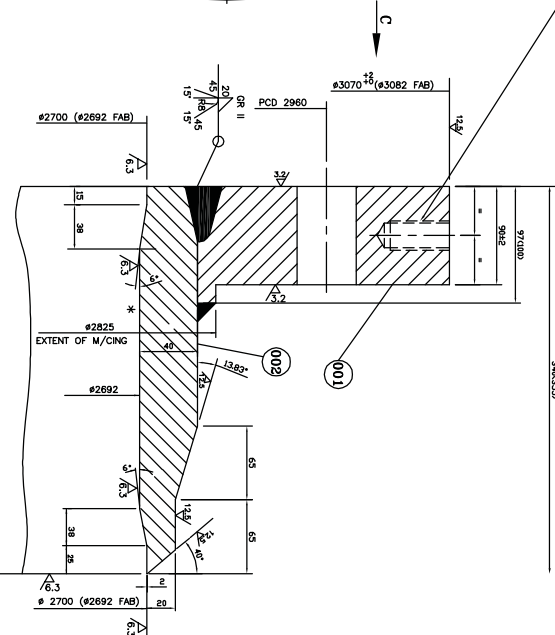
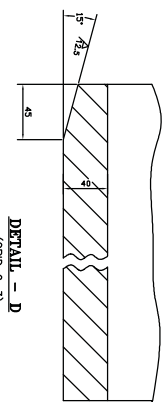
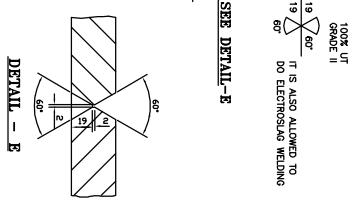
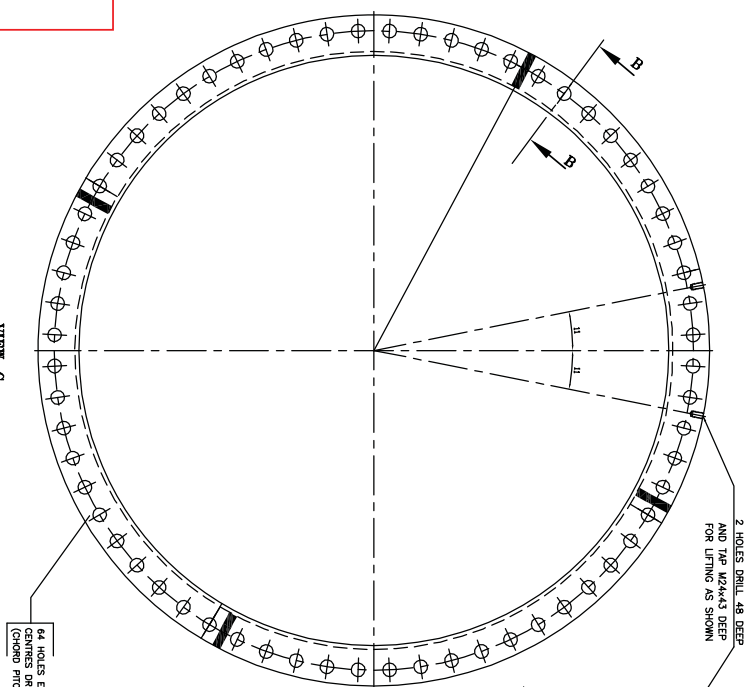
59000831922 ON R&D 2 3 4 5 6 7 8 9 10 11 12

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)



ANNEXURE-III
Sheet-4 of 4



TECH. REQUIREMENT

- WELDING TO BE AS PER CORPORATE STD:AA 0822101, (GRADES AS SPECIFIED) N.D.T. OF WELD TO BE DONE.
- AS PER AGREED QUALITY PLAN.
- REMOVE ALL SHARP EDGES AS PER BP 0640299
- WHILE DRILLING HOLES CARE TO BE TAKEN THAT NO HOLE SHOULD COME ON WELD JOINT.
- PAIN & PROTECT TO HT 00005 AS FOLLOWS
 - (i) UN-W/CEG SURFACE MARKED THUS K-2 COATS EACH OF EPOXY PRIMER & COATING FINISH EPOXY PAINT. CAT-C.
 - (ii) OTHER UN-W/CEG SURFACE - 2 COATS EACH OF EPOXY PRIMER & EPOXY FINISH PAINT; CAT - F.
 - (iii) W/CEG SURFACES (TEMP. RUST PREVENTIVE COAT) - CAT-G.

PRELIMINARY GA DRAWING OF COUNTERFLANGE ENCLOSED FOR REFERENCE. FINAL DRG SHALL BE PROVIDED DURING DETAILED ENGINEERING.

REV	DATE	ALTERED BY	REASON
01	02.03.13	...	...
02	02.03.13	...	...

REV	DATE	ALTERED BY	REASON
01	02.03.13
02	02.03.13

REV	DATE	ALTERED BY	REASON
01	02.03.13
02	02.03.13

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01	02.03.13
02	02.03.13

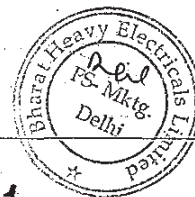
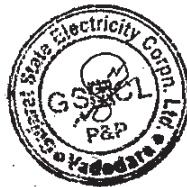
REV	DATE	ALTERED BY	REASON
01	02.03.13
02	02.03.13

REV	DATE	ALTERED BY	REASON
01	02.03.13	...	...
02	02.03.13	...	...

REV	DATE	ALTERED BY	REASON
01	02.03.13	...	...
02	02.03.13	...	...

ANNEXURE-IV OF SECTION C

VOLUME : IIC
SECTION-VII
CONDENSER TUBE CLEANING SYSTEM



CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE OF WORK
2.00.00	CODES AND STANDARDS
3.00.00	DESIGN AND MANUFACTURING/CONSTRUCTION REQUIREMENT
4.00.00	OPERATING CONDITIONS/ REQUIREMENT
5.00.00	INSPECTION AND TESTING
6.00.00	DRAWINGS, DATA AND MANUALS

ANNEXURES

ANNEXURE-I	DATA SPECIFICATION SHEET FOR CONDENSER ON LINE TUBE CLEANING SYSTEM
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VOLUME : IIC

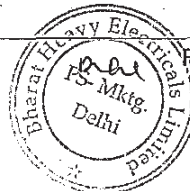
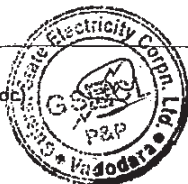
SECTION-VII

CONDENSER TUBE CLEANING SYSTEM

1.00.00 SCOPE OF WORK

The scope of supply under On Line Tube Cleaning System shall be as below. Items not mentioned but deemed necessary by the Bidder for making the system completely reliable and efficient shall also be included along with mandatory spares.

- a) Condenser On Line Tube Cleaning System consisting of -
- i) One (1) no. Ball separator on each C.W. outlet pipes. Each ball separator shall consist of Carbon Steel flanged shell, ball separator screens, ball extraction arrangement, drive units for actuation of screens, differential pressure measuring system etc.
 - ii) One (1) no. ball re-circulation units complete with pumps, drive motors, ball collectors, etc.
 - iii) One (1) no. Ball Re-circulation Monitor and ball injection arrangement with nozzles.
- b) All interconnecting pipes with necessary valves, fittings, pipe supports etc. for connecting ball separator section to ball re-circulating skid, re-circulating skid to injection point, drain line, vent line, drain collectors (floor level), sample points with suitable valves etc.
- c) All supporting steel structures for the equipment, piping and instrument for the skid.
- d) All foundation bolts and embedded inserts required for anchorage of machines, equipments, structures, and cable trays.
- e) Required number of cleaning balls (normal sponge balls as well as abrasive balls) for commissioning of the system.
- f) The scope of Instrumentation & Control shall include but not be limited to the following :
- i) One (1) local control panel for tube cleaning system with installed local instrumentation, controls, alarms, completely wired. The control panel shall be provided with segregated power compartment. This local control panel shall be supplied with anti vibrations supports.
 - ii) All field and local control board mounted instruments along with accessories; their supports and all logic necessary to satisfy the requirements described in this specification.



- iii) All necessary Pressure Gauges, Differential Pressure Gauges, D.P. Transmitters, Ball Monitoring Units required for the functional completeness of the above systems/equipments.
- iv) Instrumentation and control cables along with accessories as necessary.
- g) Cable trays, conduits, their supports and all mounting materials within the skid.

2.00.00 CODES AND STANDARDS

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

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

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



- h) OSHA : Occupational Safety and Health Act
i) IEEE : Institute of Electronics and Electrical Engineers
j) ISA : Instrument Society of America

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

Technical requirements of the condenser On Line Tube Cleaning System have been indicated in the "Data Sheet" in Annexure-I of this specification. In case of any contradiction between the above standards and data sheets, the stipulations in the data sheet shall prevail and shall be binding on the Contractor.

2.01.00 General Description

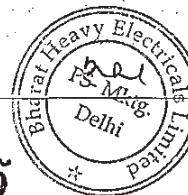
For maintenance of degree of cleanliness of the condenser tubes, this on load ball re-circulation type tube cleaning system at CW inlet line to condenser will be employed. The on line condenser tube cleaning system shall maintain a circulation of resilient balls in a closed loop through the condenser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

3.00.00 DESIGN AND MANUFACTURING / CONSTRUCTION REQUIREMENT

3.01.00 Design Considerations

The online condenser tube cleaning system shall overcome fouling, scaling and clogging of tubes thru micro-fouling caused by sludge, corrosion products/micro-organisms etc. which may result due to increased cooling water temperature and reduction in heat transfer co-efficient particularly due to disturbances in the calcium-carbonate, carbon-dioxide equilibrium as well as by precipitation of calcium carbonate, silicate, calcium sulphate, magnesium salts etc.

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



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

3.02.00 General Performance Requirement

3.02.01 Performance requirements of the tube cleaning system covered by this specification are as follows :

- i) The cleanliness of the condenser tubes utilising continuous operation of the system such that the contribution of the tube waterside fouling to the variation of the condenser vacuum from its design value is negligible.
- ii) The pressure drop across the ball separator screens during normal cleaning operation shall be minimum (it should not be more than 20 millibar).
- iii) In the automatic system, sequential operations of various equipment in tube cleaning system must be performed in such a manner that there is absolutely no loss of balls during any cleaning or washing mode of operation of the system.
- iv) The online condenser tube cleaning system shall perform satisfactorily under the specified flow indicated in the technical specification (in the condenser) and shall be capable of removing the various forms of fouling & scaling from condenser tubes. The condenser back pressure / overall heat transfer co-efficient shall be guaranteed to the close limits as specified as long as the tube cleaning system is in operation.
- v) The quantity of cleaning balls worn out and/or lost shall be as minimum as possible. The quantity of cleaning balls required for an operating period of one year shall be guaranteed.
- vi) Bidder shall prove the guaranteed performance figures for the unit during the performance testing. The performance testing of the complete tube cleaning system will be done at site after its installation after twelve months from the initial trial.
- vii) The EPC Contractor will be responsible for mechanical and chemical cleaning of the condenser when on line condenser tube cleaning system is to be commissioned and put into service for the first time. At this stage, the cleanliness of the condenser tube shall be assumed as 100%. This will ensure that condenser tubes are in clean condition when on line condenser tube cleaning system is commissioned.
- viii) The temperature difference between condensate & C.W. outlet shall be measured at the time of commissioning of the system after its operation is established. On completion of twelve months operation, when the ambient condition will be more or less same as at the time of commissioning the temperature difference between condensate &



C.W. outlet will be measured and should be the same as it was at the time of commissioning, with similar ambient temperature conditions.

- xi) The contractor shall prove the guaranteed performance figures during the performance guarantee test.

3.02.02 During the trial operation the temperature difference between condensate and CW outlet shall be measured after putting the unit on full load. The cleanliness of the condenser tubes shall be considered as 100% at this stage.

The operation of this system may be continuous/intermittent as mutually decided by the Owner and contractor. On completion of twelve months operation of online condenser tube cleaning system, when the ambient conditions will be more or less same as at the time of commissioning of the system, the temperature difference of condensate and CW outlet will be measured and should be same as it was at the time of commissioning, with similar ambient temperature conditions.

If the guarantees specified are not achieved by the contractor, then the contractor shall be given an opportunity to improve upon the performance & the performance shall be checked again after the corrections are carried out. If even after carrying out corrections in the system, the performance is not satisfactory, then the plant stands rejected.

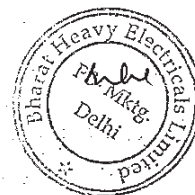
3.02.03 During trial operation the cleanliness factor shall be calculated on the basis of the ratio of the heat transfer rate obtained with the tube cleaning system in service for 12 months and the available Heat transfer rate at the time of commissioning (condenser tubes at 100% clean condition) of the system with similar ambient temperature conditions.

Heat Transfer rate will be calculated as per the standard formula for the steam surface condenser.

Before commissioning and putting the online condenser tube cleaning system into service for the first time, the EPC Contractor shall do the mechanical and chemical cleaning of the condenser tubes. This will ensure that condenser tubes are in clean condition and heat transmission rate will be calculated and will be denoted by U_f .

The operation of this system may be continuous/intermittent as mutually decided by the Owner and the contractor. On completion of 12 months operation of online condenser tube cleaning system when the ambient conditions will be more or less similar to conditions as at the time of commissioning of the system, the heat transmission rate will be calculated and will be denoted by U_o .

The ratio of U_o/U_f will be calculated for the cleanliness factor C_f . The plant stands rejected in the C_f is observed to be less than 85%.



3.03.00 Constructional Features

3.03.01 General

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

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

3.03.02 Ball Separator

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

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

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

3.03.03 Ball Collector

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

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

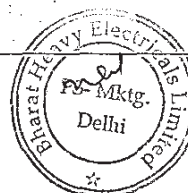
3.03.04 Ball injection system

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

3.03.05 Cleaning balls

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

Only a single type of ball to cater for the entire range of tube fouling may not adequate. The supplier shall furnish different types of balls as required in sufficient quantities to take care of all possibilities like (a) normal maintenance of tube cleanliness when function of the ball is more of that of polishing than removing of scales (b) removal of comparatively hard scale formed due to non-availability of the tube cleaning system for reasons like failure of the system, long shutdown of the generation unit, etc.



3.03.06 Schedule of Materials

Materials of construction of components of various equipment covered by this specification shall be as per data specification sheet.

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

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

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

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

3.03.07 Drive Motor

Drive motor and actuators for valves and screen shall be as per Vol. IIF of this specification.

3.04.00 Instrumentation and Control

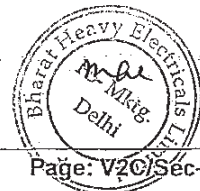
Operation of the condenser on line tube cleaning system with necessary audio / visual alarm / indications will be initiated through DCS based control system

The system shall be controlled from the DCS, either in 'Auto' or 'Manual mode, by means of a selector switch.

Following are the major control logics to be provided for operation of the automatic tube cleaning system. However, the bidder may offer additional control features also, if considered necessary by him for smooth and trouble-free operation of the system. Provision for manual over-ride of any automatic operation shall be made available in the panel. Potential free contacts for START/STOP signal interfaces with the MCC shall be provided.

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

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



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

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

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

The following minimum indications shall be provided :

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

The following minimum alarms shall be provided :

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

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

4.00.00 OPERATING CONDITIONS / REQUIREMENTS

4.01.00 Operational Features

The tube cleaning system shall be semi automatic and shall be operated from DCS.



4.02.00 **Ball Separator Strainer Section and
Differential Pressure Measuring System**

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

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

4.03.00 **Recirculation Pump and Injection Nozzles**

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

5.00.00 **INSPECTION AND TESTING**

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

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

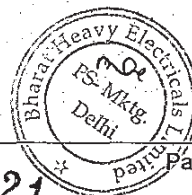
5.01.00 **Material test**

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

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

5.01.01 **Visual Tests**

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



5.01.02 Liquid Penetrant and Ultrasonic Tests

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

5.01.03 Radiography Test

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

5.02.00 Hydrostatic Testing

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

5.03.00 Performance Testing

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

6.00.00 DRAWINGS, DATA AND MANUALS

6.01.00 To be submitted with the bid

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

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

6.02.00 Drawing/Document To Be Submitted After Award

Final version of all drawings/documents listed in 6.01.00 above.



ANNEXURE-I
DATA SPECIFICATION SHEET
FOR
CONDENSER ON LINE TUBE CLEANING SYSTEM

1. Condenser Data

No. of condensers per generating unit : As per TG manufacturer's system design/configuration

2. Material of Construction

a) Ball Separator Section

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

b) Ball Recirculation pumps

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

c) Ball Collector

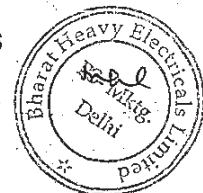
i) Housing : Stainless Steel
ii) Internals : SS-316

d) Ball Valves

i) Body : SA 351 CF8M
ii) Ball : SA 351 CF8M
iii) Stem : SS 316

e) Interconnecting piping

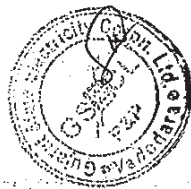
i) Interconnecting piping and fittings between ball separator section to ball re-circulating skid and re-circulating skid to injection point : SS 316



f) Details of cleaning balls for commissioning of the system

Normal sponge balls & abrasive balls

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





**TITLE : TECHNICAL SPECIFICATION
FOR
CONDENSER ON LOAD TUBE CLEANING
SYSTEMS (COLTCS)**

SPEC. NO. PE-TS- 408 -165-N002

VOLUME : IIB

SECTION : D

REV. NO. 0

DATE : 27-11-2015

SHEET 1 of 1

SECTION C2

CONDENSER ONLOAD TUBE CLEANING SYSTEMS

ELECTRICAL DETAILS



TITLE: ELECTRICAL EQUIPMENT SPECIFICATION FOR COLTCS 1 X 800 MW WANAKBORI TPS	SPECIFICATION NO.
	VOLUME NO. : II-B
	SECTION: C
	REV NO. : 00 DATE: 07.11.2015
	SHEET: 1 OF 1

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

- a) Services and equipment as per "Electrical Scope between BHEL and Vendor".
- b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The bidder without any extra charge shall provide the same.
- c) Supply of mandatory spares as specified in the specifications of mechanical equipment.
- d) Erection and commissioning spares.
- e) Erection & Maintenance tools & tackles.
- f) Electrical load requirement for COLTCS.
- g) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
- h) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer /BHEL approval without any commercial and delivery implications to BHEL.
- i) Various drawings, data sheet as per required format, quality plans, calculations, Type test & Routine test reports & certificates, operation and maintenance manuals, Complete technical literature with catalogues etc shall be furnished as specified at contract stage. All documents shall be subject to customer /BHEL approval without any commercial implications to BHEL.
- j) Motor shall meet minimum requirement of motor specification.
- k) LT power & control cables shall meet minimum requirement of LT power & control cables specification.
- l) Cabling, earthing & lightning protection shall meet minimum requirement of cabling, earthing & lightning protection specification.
- m) The sub-vendor list for various electrical items is subject to BHEL/Customer approval without any commercial implications.

2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:

Refer "Electrical Scope between BHEL and Vendor".

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

3.1 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/ quality assurance requirements stipulated. In line with this, the bidder as technical offer shall furnish two signed and stamped copies of the following:

- a) A copy of this sheet "Electrical Equipment Specification for COLTCS" and sheet "Electrical Scope between BHEL and Vendor" with bidder's signature and company stamp.
- b) List of Erection and Commissioning spares.
- c) List of Erection & Maintenance tools & tackles.
- d) Electrical load requirement.
- e) If there is any conflict, customer motor specification will prevail over BHEL motor specification.



TITLE:
**ELECTRICAL EQUIPMENT SPECIFICATION
FOR
COLTCS
1 X 800 MW WANAKBORI TPS**

SPECIFICATION NO.
VOLUME NO. : **II-B**
SECTION: **C**
REV NO. : **00** DATE: 07.11.2015
SHEET: 1 OF 1

3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc. is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

4.0 LIST OF ENCLOSURES

- 4.1 Electrical scope sheet between BHEL & Vendor.
- 4.2 Customer Spec. for LV Motors.
- 4.3 General requirement of LV Motors.
- 4.4 Data Sheet - A for LV Motors.
- 4.5 Electrical Load Data Format.
- 4.6 Datasheet-C (to be filled by Vendor)
- 4.7 QP for LV motors
- 4.8 Customer Specification for Cables
- 4.9 Customer Specification for Erection Cabling, Grounding And Lightning Protection
- 4.10 Customer Specification for LT Switchgear

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGES: COLTCS
SCOPE OF VENDOR: SUPPLY

PROJECT: 1X800 MW WANAKBORI TPS

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC Starter cum control panel (if applicable)	BHEL Vendor	BHEL BHEL	240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	BHEL Vendor BHEL	BHEL BHEL BHEL	1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Cabling/ termination by BHEL.
4	Junction box for control & instrumentation cable	Vendor	BHEL	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 mtrs) and trunk cable.
5	Any special type of cable like compensating, co-axial, prefab, MICC, fibre optical etc.	Vendor	BHEL	Refer scope/ C&I portion of specification for scope of fibre Optical cables if used between PLC/ micro processor & DCS.
6	Cable trays, accessories & cable trays supporting system	BHEL	BHEL	
7	Cable glands and lugs for equipment supplied by Vendor	Vendor	BHEL	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty copper lugs for power & control cables.
8	Conduit and conduit accessories for cabling between equipment supplied by vendor	Vendor	BHEL	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537.
9	Lighting	BHEL	BHEL	
10	Equipment grounding & lightning protection	BHEL	BHEL	

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGES: COLTCS
SCOPE OF VENDOR: SUPPLY

PROJECT: 1X800 MW WANAKBORI TPS

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
11	Below grade grounding	BHEL	BHEL	
12	LT Motors with base plate and foundation hardware	Vendor	BHEL	Makes shall be subject to customer/ BHEL approval at contract stage.
13	Mandatory spares	Vendor	-	Vendor to quote as per specification.
14	Recommended O & M spares	Vendor	-	As specified elsewhere in specification
15	Any other equipment/ material/ service required for completeness of system based on system offered by the vendor (to ensure trouble free and efficient operation of the system).	Vendor	BHEL	
16	a) Input cable schedules (Control & Screened Control Cables) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
17	Equipment layout drawings	Vendor	-	For preparation of cabling layout drawings by BHEL, vendor shall furnish Electrical equipment layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipment requiring cabling,
18	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

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



TITLE

LV MOTORS**DATA SHEET-A**

SPECIFICATION NO.

VOLUME II B

SECTION D

REV NO. 00 DATE 07/11/2015

SHEET 1 OF 1

- 1.0 Design ambient temperature : 50 °C
- 2.0 Maximum acceptable kW rating of LV motor : Upto 160KW
- 3.0 Installation (Indoors/ Outdoors) : As required
- 4.0 Degree Of Protection : IP55
- 5.0 Cooling : TEFC
- 6.0 Details of supply system
- a) Rated voltage (with variation) : 415V ± 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 box : 50 kA for 0.25 sec
 - f) LV System grounding : Solidly
- 7.0 Class of insulation : Class 'F', with temp rise limited to class B.
- 8.0 Minimum voltage for starting (As percentage of rated voltage) : 80% of rated voltage
- 9.0 Power cables data : Shall be given during Detailed engg.
- 10.0 Earth Conductor Size & Material : Shall be given during Detailed engg.
- 11.0 Space heater supply (**30KW & ABOVE**) : 240 V, 1Φ , 50 Hz
- 12.0 Rating up to which Single phase motor : Acceptable below 0.20 Kw
- 13.0 TYPE OF STARTER PROVIDED IN MCC : DOL
- 14.0 Locked rotor current
- a) Limit as percentage of FLC : As per IS 12615
 - b) Permissible tolerance, if any :
- 15.0 Additional tests : As per QP
- 16.0 Flame-proof motor
- a) Enclosure suitable (As per IS:2148) : As per requirement
 - b) Classification of Hazardous area (As per IS: 5572 part-I) : As per requirement
 - c) Degree of protection : IP65
- 17.0 Makes : AS PER ANNEXURE-I
- 18.0 Terminal box : Suitable to rotate at 90 degrees
- 19.0 Paint shade : Shade 632 of IS-5



TITLE

LV MOTORS

DATA SHEET-A

SPECIFICATION NO.

VOLUME II B

SECTION D

REV NO. 00 DATE 07/11/2015

SHEET 2 OF 1

NOTE :

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

ANNEXURE-I

SUB-VENDOR LIST

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

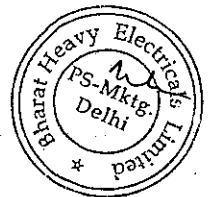
S.No.	LIST OF LT MOTORS
1.	BHARAT BIJLEE LTD.
2.	CROMPTON GREAVES
3.	ASEA BROWN BOVERI
4.	KIRLOSKAR ELECTRIC CO LTD.
5.	NGEF
6.	SIEMENS
7.	MARATHON
8.	GE-POWER
9.	RAJINDRA ELECT INDUSTRIES
10.	LAXMI HYDRAULICS PVT. LTD

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

VOLUME : IIF/1

SECTION-II

**TECHNICAL SPECIFICATION
FOR
A.C. & D.C. MOTORS**

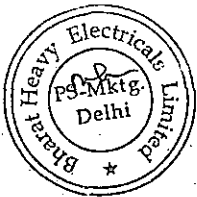


CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	STANDARDS
3.00.00	SERVICE CONDITIONS
4.00.00	TYPE AND RATING
5.00.00	PERFORMANCE
6.00.00	SPECIFIC REQUIREMENTS
7.00.00	ACCESSORIES
8.00.00	TESTS
9.00.00	DRAWINGS, DATA & MANUALS

ATTACHMENT

ANNEXURE-A	DESIGN DATA
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VOLUME : IIF/1

SECTION-II

TECHNICAL SPECIFICATION
FOR
A.C. & D.C. MOTORS

1.00.00 SCOPE

1.01.00 This section covers the general requirements of the drive motors for power station auxiliary equipment.

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 Major standards, which shall be followed, are listed below other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed :

IS-325

IS-12615

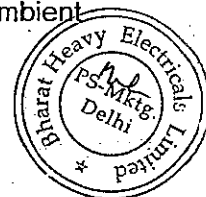
IEC-34

3.00.00 SERVICE CONDITIONS

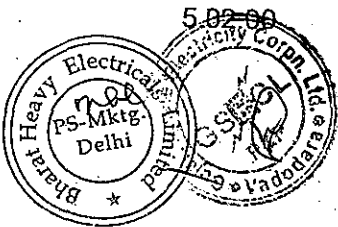
3.01.00 The motors will be installed in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash.

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

3.03.00 For motor installed outdoor and exposed to direct sunrays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

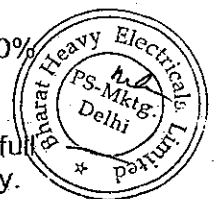
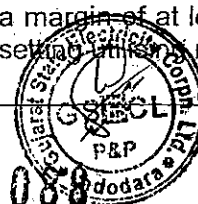


- 4.00.00 TYPE AND RATING
- 4.01.00 A.C. Motors
- 4.01.01 Motors shall be general purpose, constant speed, squirrel cage, three/single phase, induction type.
- 4.01.02 All motors shall be rated for continuous duty. They shall also be suitable for long period of inactivity.
- 4.01.03 The motor name-plate rating at 50°C shall have at least 10% margin over the input power requirement of the driven HT equipment and 15% for LT driven equipment at rated duty point unless stated otherwise in driven equipment specification or in general electrical specification.
- 4.01.04 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.
- 4.01.05 All HT & LT motors shall be energy efficient type as per IS. However for HT motors, if the same is not specified in IS, minimum efficiency of all HT motors shall be considered as 90%.
- 4.02.00 D.C. Motors
- 4.02.01 D.C. motor provided for emergency service shall be shunt/compound wound type. All DC motors shall be energy efficient type with minimum efficiency of 80%.
- 4.02.02 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.
- 5.01.03 The motor shall be designed to withstand momentary overload of 60% of full load torque for 15 second without any damage.
- 5.02.00 Starting Requirements
- Motor shall be designed for direct online starting at full voltage. Starting current shall not exceed 6 times full load current for all HT motors except boiler feed pump motor where the starting current shall be limited to 4.5 times. No further tolerances are applicable on starting current specified above



for HT motors. For LT motors, the applicable starting current shall be limited to 7.2 times of full load current including all tolerance.

- 5.02.01 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.
- 5.02.02 Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminal except BFP motor. In case of BFP motor, it shall be 80% rated voltage. Minimum starting requirement for mill motor (double cage) shall be 80% rated voltage at motor terminals. However for mill motors if the minimum starting voltage is more than 80% rated voltage at motor terminal and within 90% rated voltage, bidder shall provide necessary arrangement to keep the motor terminal voltage above that voltage to achieve smooth start of the motor.
- 5.02.03
- a) 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.
 - b) Cranking motor shall be capable of six equally spread starts per hour, three starts in quick succession from cold condition and one restart from hot condition. The coal conveyor and crusher motors shall be suitable for 3 consecutive hot starts with maximum 20 starts per day.
 - c) Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with shaft rotating at 125% rated speed in reverse direction.
- 5.02.04 HT pump motors shall be suitable to start with forward rotation.
- 5.02.05 The motors shall be designed to withstand 120% of rated speed for 2 minutes without any mechanical damage
- 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 The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 2.5 seconds for motors up to 20 seconds starting time and by 5 seconds for motor with more than 20 seconds starting time.
- 5.04.02 Starting time mentioned above is at minimum permissible voltage of 80% rated voltage.
- 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 within motor rated capacity.



6.00.00 **SPECIFIC REQUIREMENTS**

6.01.00 **Enclosure**

6.01.01 All motor enclosures for outdoor, semi-outdoor & indoor application shall conform to the degree of protection IP-55 unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather-proof construction with canopy.

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

6.01.03 For hazardous area approved type of increased safety enclosure shall be furnished.

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) or totally enclosed tube ventilated (TETV) type. Totally enclosed tube ventilated (TETV) type motors shall be acceptable for HT motors only.

6.02.02 For large capacity motors, closed air circuit water cooled (CACW) may be considered for acceptance.

6.03.00 **Winding and Insulation**

6.03.01 All insulated winding shall be of copper.

6.03.02 All motors shall have class F insulation but limited to class B temperature rise.

6.03.03 Windings shall be impregnated to make them non-hygroscopic and oil resistant.

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 hardwares shall be corrosion resistant.

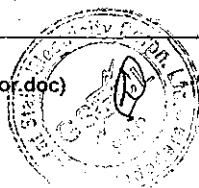
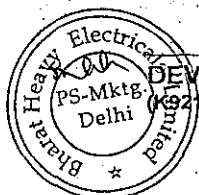
6.05.00 **Bearings**

6.05.01 Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application.

6.05.02 Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred.

6.05.03 Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.

6.05.04 Sleeve bearings shall be split type, ring oiled, with permanently aligned, close running shaft sleeves.



- 6.05.05 Grease lubricated bearings shall be prelubricated and shall have provisions for in-service positive lubrication with drains to guard against over lubrication.
- 6.05.06 Oiled bearing shall have an integral self cooled oil reservoir with oil ring inspection ports, oil sight glass with oil level marked for standstill and running conditions and oil fill and drain plugs.
- 6.05.07 Forced lubricated or water cooled bearing shall not be used without prior approval of Owner.
- 6.05.08 Lubricant shall not deteriorate under all service conditions. The lubricant shall be limited to normally available types with IOC equivalent.
- 6.05.09 Bearings shall be insulated as required to prevent shaft current and resultant bearing damage.
- 6.06.00 **Noise & Vibration**
- 6.06.01 The noise level shall not exceed 85db (A) at 1.5 metres from the motor at no load condition.
- 6.06.02 The peak amplitude of the vibration shall be within IS/IEC specified limits.
- 6.07.00 **Motor Terminal Box**
- 6.07.01 HT Motor terminal box (Phase side) shall be Phase Segregated (PSTB) type and LT motor terminal box shall be non-phase segregated type. Both HT & LT motor terminal box shall be located in accordance with Indian Standards clearing the motor base- plate/ foundation.
- 6.07.02 Terminal box shall be capable of being turned 360 Deg. in steps of 180 Deg. for HT motors and 90 Deg. for LT motors unless otherwise approved.
- 6.07.03 The terminal box shall be split type with removable cover with access to connections 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 XLPE insulated armoured aluminium cables.
- 6.07.05 Motor main terminal box shall be located right hand side of motor body looking from driving end.
- 6.07.06 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.
- 6.07.07 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.
- 6.07.08 The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.
- 6.07.09 HT motor phase side terminal box shall be phase-segregated type and HT motor neutral leads shall be brought out in a separate terminal box preferably

opposite side of phase terminal box & may not be necessarily phase segregated type with shorting links for star connection.

6.07.10 Motor terminal box shall be furnished with suitable cable lugs and nickel plated double compression brass glands to match with cable used.

6.07.11 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 :

HT Motor (11kV, 6.6kV & 3.3 kV) : 75 X 10 mm GS Flat

LT Motor above 90 KW : 50 x 6 mm GS Flat

Motor above 30 KW up to 90 KW : 35 x 6 mm GS Flat

Motor above 5 KW up to 30 KW. : 25 x 3 mm GS Flat

Motor up to 5 KW : 8 SWG GI Wire

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 Deg.C under rated condition and method of measurement.
- b) Degree of protection.
- c) Bearing identification no. and recommended lubricant.
- d) Location of insulated bearings.

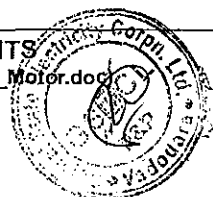
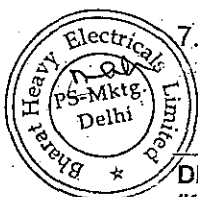
7.00.00 **ACCESSORIES**

7.01.00 **General**

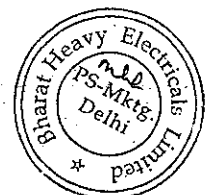
Accessories shall be furnished, as listed below, or if otherwise required by driven equipment specification or application.

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 11000V, 6600V and 3300V motors shall be provided with twelve (12) nos. simplex type winding temperature detectors, four (4) nos. per phase. Six (6) nos. duplex type winding temperature detectors, two (2) nos. per phase shall only be acceptable for special application motors only subject to approval of owner.
- 7.03.02 11000V, 6600V and 3300V motor bearing shall be provided with duplex type temperature detectors.
- 7.03.03 The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0°C.
- 7.03.04 Leads of all simplex type motor winding RTDS and motor bearing RTDS shall be wired up to respective switchgear metering & protection compartment. From which one set of RTDS will be connected to numerical protection relay and another set shall be kept free for DCS connectivity.
- 7.03.05 Five numbers of Temperature detectors / thermisters shall be provided for L.T. motors above 90 KW (3 nos. winding temperatures & 2 nos. bearing temperatures)
- 7.04.00 **Indicator/Switch**
- 7.04.01 Dial type local indicator with alarm contacts shall be provided for the following:
- a) 11000 V, 6600V and 3300V 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 1000 KW and above shall be provided with three differential current transformers mounted over the neutral leads within the enclosure. Loose 3 nos. CT for mounting on switchgear side shall be in bidder's scope.
- 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 and independent of motor (power) terminal box.

7.06.02 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit 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 eyebolt 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 of colour battle ship grey shade 632 of IS-5.

8.00.00 **TESTS**

Routine and Type Tests are to be conducted in presence of customer's representative as per IS:325 and required copies of test certificates are to be furnished for approval. In addition, following tests shall have to be carried out on the motors in presence of OWNER's representative on 3.3kV/6.6kV/11kV motors.

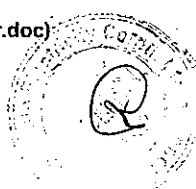
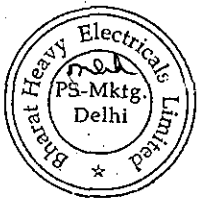
- a. Impulse test by 1.2 / 50 micro sec. On sample coil of Stator winding insulation as type test as per IEC-60034, part -15 test voltages as under :

Voltage rating of motor	Impulse Test Voltage
3.3 kV	18 kV peak
6.6 kV	31 kV peak
11 kV	49 kV peak

- b. Tan delta, charging current and dielectric loss measurements on each phase of motor stator winding as routine test.

- c. Polarization Index Test as per IS:7816 as routine test

- d. Test for suitability of IPW- 55 (Weather proof) as per IS 4691 as type test. Type test certificate for first numeral shall be acceptable in lieu to test, provided the test motor is identical to motor being supplied.



Second numeral test shall be carried out on one motor of each type and rating.

- e. Fault Withstand Test for main terminal box as type test. Type test certificate shall be acceptable, if the test is conducted on exactly identical terminal box.
- f. Test for noise level as routine test.
- g. Test for vibration as routine test.
- h. Tan delta measurement on coils.
- i. Surge withstand test for inter turn insulation.

Tests indicated at (h), (i), shall be carried out during manufacture of the coils and shall be furnished for verification.

Furnished type test certificates of motor shall not be older than five (5) years from the date of Inspection, otherwise type test shall be conducted without any price implication.

9.00.00 **DRAWINGS, DATA & MANUALS**

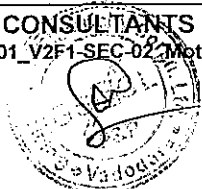
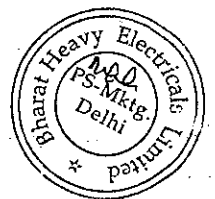
Drawings, data & manuals for the motors shall be submitted as indicated below:

9.01.00 **Along with the bid**

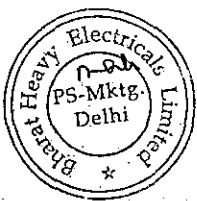
- a) List of the motors
- b) Individual motor data sheet as per format of the proposal data sheets.
- c) Scheme & write up on forced lubrication system, if any
- d) Type test report

9.02.00 **After Award of the Contract**

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



- i) Test reports
- j) Data sheets to be enclosed



ANNEXURE-A
DESIGN DATA

1.0 AUXILIARY POWER SUPPLY

Supply	Description	Consumer
H.T. Supply	11000 V, 3Ø, 3W, 50 Hz, non-effectively earthed	Motors above 2000 KW & all mill motors
	Fault level 44 KA symm.	
	3300 V, 3Ø, 3W, 50 Hz, non-effectively earthed	Motors above 160 KW upto and including 2000 KW
L.T. Supply	6600 V, 3Ø, 3W, 50 Hz, non-effectively earthed	Motors of CHP system and Water System above 160kW
	Fault level 40 KA symm for 3300V & 6600V	
	415V, 3Ø, 3W, 50 Hz effectively earthed	Motors upto and including 160KW
D.C. Supply	Fault level 50 KA symm.	
	240V, 1Ø, 2W, 50 Hz effectively earthed	Lighting, space hea- ting, A.C. control & protective devices
	220V, 2W, unearthed	D.C. alarm, control & protective devices
	Fault level 25* KA.	

* Indicative only, the actual value will be decided by the Bidder, after substantiating the same by calculation.

2.0 RANGE OF VARIATION

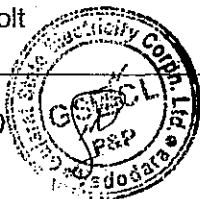
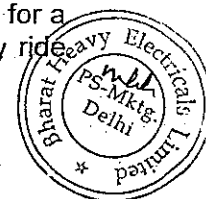
A.C. Supply :

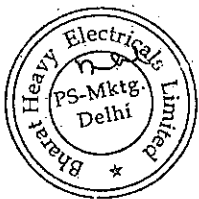
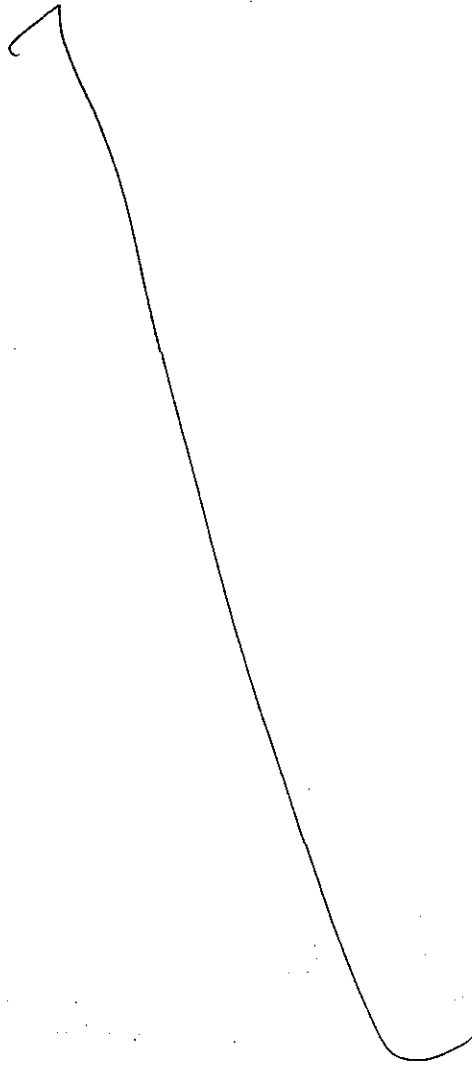
Voltage : $\pm 10\%$ Frequency : $\pm 5\%$ Combined Volt : 10% (absolute sum)
+ frequency

During starting of large motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.

D.C. Supply :

Voltage : 187 to 242 Volt





VOLUME : IIF/1

SECTION-III

**TECHNICAL SPECIFICATION
FOR
ELECTRIC MOTOR ACTUATORS**

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	STANDARDS
3.00.00	SERVICE CONDITIONS
4.00.00	RATING
5.00.00	PERFORMANCE
6.00.00	SPECIFIC REQUIREMENT
7.00.00	TEST
8.00.00	DRAWINGS, DATA & MANUALS

VOLUME : IIF/1

SECTION-III

**TECHNICAL SPECIFICATION
FOR
ELECTRIC MOTOR ACTUATORS**

1.00.00 SCOPE

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

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

2.00.00 STANDARDS

2.01.00 All electrical equipment shall conform to the latest applicable IS, ANSI and NEMA Standards, except when stated otherwise herein or in driven equipment specification.

2.02.00 Major standards, which shall be followed, are listed below. Other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed

i) IS-9334

ii) IS-325

3.00.00 SERVICE CONDITIONS

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

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

3.03.00 For actuator motor installed outdoor and exposed to direct sun rays , the effect of solar heat [manufacturer to decide] shall be considered or overhead shed shall be provided locally to avoid direct sun rays.

4.00.00 RATING

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

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

5.00.00 **PERFORMANCE**

The actuator shall meet the following performance requirements:

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

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

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

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

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

6.00.00 **SPECIFIC REQUIREMENT**

6.01.00 **Construction**

6.01.01 The actuator shall essentially comprise the drive motor, torque/ limit switches, gear train, clutch, hand wheel, position indicator/ transmitter, in-built thermostat for over load protection, space heater and internal wiring. Actuator shall be non integral type.

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

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

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

6.02.00 **Motor**

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

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

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

- 6.02.04 Motor leads shall be terminated in the limit switch compartment.
- 6.02.05 Motor actuators for valves/dampers shall be non-integral type with separate starter units and operable from remote.
- 6.02.06 Earthing terminals shall be provided on either side of the motor.
- 6.03.00 **Limit Switches**
- Each actuator shall be provided with following limit switches: -
- 6.03.01 2 torque limit switches, one for each direction of travel, self-locking, adjustable torque type.
- 6.03.02 4 end-of-travel limit switches, two for each direction of travel.
- 6.03.03 2 position limit switches, one for each direction of travel, each adjustable at any position from fully open to fully closed positions of the valve/damper.
- 6.03.04 Each limit switch shall have 2 NO + 2 NC potential free contacts. Contact rating shall be 5A at 240V A.C. or 0.5A at 220V D.C.
- 6.04.00 **Hand Wheel**
- Each actuator shall be provided with a hand wheel for emergency manual operation. The hand wheel shall declutch automatically when the motor is energized.
- 6.05.00 Position Indicator/Transmitter
- The actuator shall have:
- 6.05.01 One (1) built-in local position indicator for 0-100% travel.
- 6.05.02 One (1) position transmitter, potentiometer type, for remote indicator.
- 6.06.00 **Space Heater**
- A space heater shall be included in the limit switch compartment suitable for 240V, 1 phase, 50 Hz supply.
- 6.07.00 **Wiring**
- All electrical devices shall be wired up to and terminated in a terminal box. The internal wiring shall be of sufficient size for the power rating involved but in no case less than 1.5 Sq.mm copper. All wiring shall be identified at both ends with ferrules. All wires shall be fire resistance type.
- 6.08.00 **Terminal Box**
- The terminal box shall be weather proof, with removable front cover and cable glands for cable connection. The terminal shall be suitable for connection of 2.5 Sq.mm copper conductor.

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SECTION-VII

TECHNICAL SPECIFICATION
FOR
415V PMCC/MCC, 415V ACDB AND 220V DCDB

CONTENTS

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE OF SUPPLY
2.00.00	CODES AND STANDARDS
3.00.00	DESIGN CRITERIA
4.00.00	SPECIFIC REQUIREMENTS
5.00.00	TESTS
6.00.00	DRAWINGS, DATA AND MANUALS

ATTACHMENTS

ANNEXURE-A	RATINGS AND REQUIREMENTS
ANNEXURE-B	PROTECTIONS
ANNEXURE-C	INDICATIVE LIST OF 415V PMCCs / MCCs / DBs
ANNEXURE-D	MODULE SELECTION
ANNEXURE-E	BUS TRANSFER SCHEME FOR PMCC

**VOLUME : IIF/1
SECTION-VII
TECHNICAL SPECIFICATION
FOR
415V PMCC/MCC, 415V ACDB AND 220V DCDB**

1.00.00 **SCOPE OF SUPPLY**

1.01.01 The following equipment shall be furnished complete with all accessories :-

Power cum Motor Control Centre (PMCC)

Motor Control Centre (MCC)

AC Distribution Boards (ACDB)

DC Distribution Boards (DCDB)

1.01.02 The base channel frame with hardware and lifting angles.

1.01.03 One set of special tools and tackles.

1.01.04 Set of accessories as listed below :

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

1.01.04 Mandatory Spares.

1.01.05 All relevant drawings, data and instruction manuals

2.00.00 **CODES AND STANDARDS**

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

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

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

3.00.00 DESIGN CRITERIA

- 3.01.00 The PMCCs/MCCs/DBs will be used to provide power, control and protection for 415V A.C. auxiliary services (Motors & Feeders) of the generating units.
- 3.02.00 Duty involves direct-on-line starting of large squirrel cage motors upto 160kW. The starting current varies from 6 to 8 times rated current at very low power factor.
- 3.03.00 The equipment will be located in a hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash.
- 3.04.00 For continuous operation at specified ratings, the temperature rise of various equipment/components shall be limited to the permissible values stipulated in relevant standards and/or this specification.
- 3.05.00 All equipment and components thereof shall be capable of withstanding the mechanical forces and thermal stresses of the short-circuit currents without any damage or deterioration of the materials.
- 3.06.00 The PMCCs shall have two incomers and one bus-coupler. The MCCs / DBs shall have two incomers and one bus-coupler OR two incomers with no bus coupler. In addition to electrical interlocks, mechanical castle key interlock shall be provided between the two incomers and the bus-coupler so that any two of the three may be closed at a time.
- 3.07.00 Busbars of PMCCs shall be sized to carry continuously the associated transformer secondary current plus a 20% margin.

Busbars of MCC/DBs shall be sized to carry continuously the total running load of MCC/DB plus a 20% margin.
- 3.08.00 In cubicle of incomers & bus section breakers/MCCBs shall be identical to the associated busbar rating.
- 3.09.00 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.
- 3.10.00 Circuit breakers shall not produce any harmful over voltage during switching off of induction motors. If required, surge protective devices shall be included in the scope of supply to limit over voltages.
- 3.11.00 Incomers, Buscouplers & outgoing feeders rated upto & including 400A shall be MCCB controlled. Above 400A all incomers, Buscouplers & outgoing Feeders shall be ACB controlled.
- 3.12.00 All motor rated above 110kW, upto & including 160kW shall be ACB controlled. Motor rated upto & including 110kW shall be contactor operated.
- 3.13.00 MCC & PMCC shall have sufficient number of spare modules (at least 20% of various sizes used with a minimum of 1 no. for each rating and type).

- 3.14.00 Outgoing feeders of PMCC shall be limited to minimum number of different sizes so that max. standardization is achieved from MCCB & contactor size point of view.
- 3.15.00 Incomers & bus section breakers of PMCCs shall have provisions for remote operation from control room.
- 3.16.00 All breaker operated motor feeder shall be supplied from PMCC.

4.00.00 **SPECIFIC REQUIREMENTS**

4.01.00 **Construction**

- 4.01.01 PMCC / MCC / DB shall be indoor, metal-clad, air insulated and floor mounting type. ACB modules of PMCCs/MCCs shall be fully drawout type. MCCB / Switch Fuse modules shall also be fully drawout type. The design and construction shall be such as to allow extension at either end.
- 4.01.02 Generally PMCC / MCC / DB shall be of double front construction. Circuit Breaker panels of PMCC / MCC / DB shall be of single front construction.
- 4.01.03 PMCC / MCC / DB enclosure shall be dust and splash proof, conforming to a degree of protection IP-54. Minimum thickness of sheet metal used shall be 2 mm for load bearing members & 1.6 mm for other non-load bearing members.
- 4.01.04 PMCC / MCC / DB assembly shall comprise a continuous line up of dead front, free-standing vertical sections, housing the control modules in multi tier formation.
- 4.01.05 The design shall be fully compartmentalized with metal/insulating partitions between compartments. The working height shall be limited within 450 mm to 1800 mm from floor level.
- 4.01.06 Each control module shall be housed in a separate compartment, complete with an individual front access door having sufficient opening with concealed type hinges. Each vertical section shall have a removal back cover. All doors and covers shall be gasketed.
- 4.01.07 All push buttons, lamps, indicating instruments shall be flush / semi-flush mounted on respective module compartment.
- 4.01.08 A full height vertical cable chamber with cable supports shall be provided in each section to facilitate unit wiring. The chamber shall be liberally sized to accommodate all cables and shall have removable cover at the front for access.
- 4.01.09 A horizontal wireway, extending the entire length, shall be provided at the top of each PCC / MCC / DB for inter panel wiring.
- 4.01.10 The width of the cable alley shall not be less than 250 mm.

- 4.02.00 **Bus and Bus Taps**
- 4.02.01 All PMCCs/MCCs/DBs provided with three phase bus bars & neutral Bus bar. All DCDBs shall be provided with two busbars. All busbar compartments shall be completely enclosed.
- 4.02.02 The main buses and connections shall be of high conductivity Aluminium / Aluminium alloy, sized for specified current ratings with maximum temperature limited to 90°C (i.e., 40°C rise over 50°C ambient) for plain joint and 105°C (i.e., 55°C rise over 50°C ambient) for silver plated joint.
- 4.02.03 Vertical busbars shall be designed for minimum current rating of 200A. Separate vertical busbars shall be provided for each vertical panel.
- 4.02.04 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.
- Bimetallic connector shall be furnished for connection between dissimilar metals.
- 4.02.05 Busbars and connections shall be fully insulated for working voltage with adequate phase/ground clearances. Insulating sleeves for busbars and shrouds for joints and tap-off points shall be provided.
- Bus insulators shall be flame retardent, non-hygroscopic track-resistant type with high creepage surface.
- 4.02.06 Busbars shall be supported and braced to withstand the stresses due to maximum short circuit current and also to take care of any thermal expansion.
- 4.02.07 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.
- 4.03.00 **Control Modules**
- 4.03.01 Drawout type control module shall have self-aligning power/control disconnects. All disconnects shall be silver plated to ensure good contacts.
- 4.03.02 The design shall be such as to permit easy withdrawal/reinsertion of the unit with guide rails to ensure correct alignment.
- 4.03.03 Control Module shall house the control components for a circuit such as switch fuse / MCCB, contactors, relays, push buttons, lamps etc. as per requirement of the control circuit.
- 4.03.04 The equipment layout shall provide sufficient working space in between the components.
- 4.03.05 Various module/compartments sizes shall be multiple of one basic unit to facilitate modifications at site. Suitable provision for this purpose should also be incorporated in the vertical bus bars.

- 4.03.06 Drawout type control modules of same size and type shall be electrically and physically interchangeable.
- 4.04.00 **Air Circuit Breaker**
- 4.04.01 Circuit breaker shall be three pole, single throw, air-break type with stored energy, trip-free mechanism and shunt trip.
- 4.04.02 Circuit breaker shall be draw-out type, having service, test & isolated position with positive indication for each position.
- 4.04.03 Circuit breakers of identical rating shall be physically and electrically interchangeable.
- 4.04.04 Circuit breakers shall be provided with motor wound spring charging 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. In addition, facility for manual charging of spring shall be provided.
- 4.04.05 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. It shall not be possible to open the circuit breaker door cubicle unless the breaker is in 'OFF' position.
- 4.04.06 Automatic safety shutters shall be provided to cover up the stationary disconnects when the breaker is withdrawn.
- 4.04.07 Each breaker shall be provided with an emergency manual trip, mechanical ON-OFF indicator, an operation counter and mechanism charge/discharge indicator, and electrical anti-pumping feature.
- 4.04.08 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 4 NO + 4 NC 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 relay 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
- 4.04.09 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.
- 4.04.10 Limit/auxiliary switches shall be convertible type, that is, suitable for changing N.O. contact to N.C. and vice-versa.

- 4.04.11 Each breakers operated feeder shall be provided with protective devices as specified in Annexure–B.
- 4.05.00 **Switches**
- 4.05.01 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.
- 4.05.02 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.
- 4.05.03 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.
- 4.05.04 Switches shall be capable of withstanding the let-through fault current of back-up fuses or circuit breakers.
- 4.05.05 Wherever two incoming switches and one bus-section switch 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.
- 4.06.00 **Fuses**
- 4.06.01 Fuses shall be HRC, preferably link type, with a minimum interrupting capacity equal to the short circuit current of the LT system.
- 4.06.02 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.
- 4.06.03 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.
- 4.07.00 **Moulded Case Circuit Breaker (MCCB)**
- 4.07.01 The MCCBs shall be of drawout type with trip-free operating mechanism of quick make & quick break type. Each MCCB shall be equipped with thermal release for thermal overload and magnetic release for short circuit protection on each pole.
- 4.07.02 MCCBs / MPCBs shall be suitable for manual closing and opening and also automatic trip on overload and short circuit. MCCB shall have intermediate position to indicate trip condition.

- 4.07.03 The MCCBs shall be provided with mechanical ON-OFF indicator at the front panel. The MCCB handles, after the breaker tripped due to faults, shall occupy a mean position indicating trip condition.
- 4.07.04 The compartment door shall be interlocked mechanically with the MCCB such that the door cannot be opened unless the MCCB is in OFF position. Means shall be provided for releasing this interlock at any time.
- 4.07.05 All feeders of PMCC / MCC rated up to & including 400 Amp shall be provided with MCCB. Air circuit breaker shall be provided for feeders rated above 400 Amp.
- 4.07.06 Motors rating above 110 KW will be operated by Air circuit breaker and protected by consolidated numerical motor protection relay.
- 4.08.00 **A.C. Starter**
- 4.08.01 Contactors
- a. The contactors shall be three pole, air break type designed for duty class III - Category AC3 (for unidirectional motor) with non-bouncing silver/ silver alloy contacts. Contacts for reversible motors will be of AC4 duty.
 - b. Each contactor shall be provided with minimum two (2) normally open and two (2) normally closed auxiliary contacts rated 10 A at 240V A.C. The exact requirement of contacts shall be decided by the tenderer taking into account the scheme requirements & spares.
 - c. Reversing contacts shall be electrically and mechanically interlocked.
 - d. Contactors with delayed dropout feature shall be provided for some essential auxiliaries. These contactors shall not dropout on power failure if the voltage is restored within 3 seconds.
- 4.08.02 Thermal Overload
- a. Thermal overload relays shall be three element, positive acting, ambient temperature compensated with adjustable settings.
 - b. Single phase preventor relay shall be provided, as an inbuilt feature of thermal overload relay.
 - c. Relays shall be manual reset type with two changeover potential-free contacts. Resetting of relays shall be possible with compartment door closed. Colour of the resetting button shall be BLACK.
 - d. Relays may be direct acting or C.T. operated, depending on current rating. C.T.s shall be included in the scope of supply.
 - e. Motor starters shall have type '2' co-ordination according to IEC 947-4.

4.09.00 **D.C. Starters**

4.09.01 DC starters shall be complete with switch-fuse units, contactors, resistors, relays, meters, push-buttons, lamps, etc.

4.09.02 Starters shall be furnished in totally enclosed floor-mounting, sheet steel cold rolled continuously annealed (CRCA) fabricated cubicles complete with a hinged front access door. Minimum thickness of sheet steel shall be 2 mm for load bearing members and 1.6mm for other non-load bearing members.

4.09.03 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.

4.09.04 Cubicle space heater shall be provided to maintain internal temperature above dew point. Heater shall be furnished with switch-fuse unit and thermostat control.

4.10.00 **Relays**

4.10.01 All incoming and bus-coupler circuits and circuit breaker operated outgoing feeders shall be provided with numerical relays. Breaker operated motor feeders shall be provided with numerical motor protection relay.

4.10.02 The numerical relays shall have provisions for interfacing with Plant DCS / PLC.

4.10.03 Relays shall be of drawout design with built-in testing facilities. Small auxiliary relays may be in non-drawout execution.

4.10.04 All protective relays, auxiliary relays, and timers shall be provided with hand reset operation indicator (flag).

4.10.05 Relays shall be rated for operation on 110V secondary voltage and 5 A or 1 A. Number and rating of relay contacts shall suit the job requirements.

4.10.06 Make of numerical relays for main protection shall be either Siemens / ABB / Areva.

4.11.00 **Control and Indication**

4.11.01 Circuit breakers shall be wired up for local and remote operation. Each breaker cubicle shall be equipped with the following :

i) One (1) TEST-NORMAL-TRIAL selector switch with pistol grip handle and key interlock for breakers with motor wound spring charging mechanism.

ii) Two (2) push buttons for TRIP and CLOSE

iii) Following indicating lamps on the front of the compartment :

Breaker open	-	GREEN
Breaker closed	-	RED
Breaker tripped	-	AMBER
Spring charged	-	WHITE
Trip Ckt. Healthy	-	BLUE

Motor Space heater 'ON' for motor circuit - YELLOW

- 4.11.02 Push button shall be heavy duty, oil tight, push to actuate type with integral escutcheon plate marked with its function.
- 4.11.03 Each push button shall have minimum two (2) nos. normally open and two (2) nos. normally closed contacts rated 10 A at 240 V.
- 4.11.04 Selectors switches shall be stay-put, rotary type with escutcheon plates marked to indicate the function and positions, and shall be lockable in each position. Selector switch contacts shall be rated for 10A at 240 V A.C.
- 4.11.05 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.
- 4.11.06 Lamps shall be clustered LED type with series resistor and coloured lens. Lens and lamps shall be replaceable from the front. Lamps shall be located just above the associated push button/control switch
- 4.11.07 The general scheme of connections for control, interlock and protection is shown in the enclosed drawings. Detailed requirements of individual circuits will be intimated later to the successful Bidder, who shall develop and furnish the schemes accordingly
- 4.11.07 For control supply, two (2) no. 415/240V control transformers (with $\pm 5\%$ taps @ 2.5%) with 100% standby arrangement and auto transfer scheme shall be provided for each PCC. Control supply healthy indication shall be provided.
- 4.12.00 **Meters**
- 4.12.01 All indicating instruments (96 x 96 mm) shall be Digital type, with LED display & flush mounted type and accuracy class of 0.5. Each meter shall have in-built transducer with 4-20 mA output for hooking-up with Plant DCS / PLC.
- 4.12.02 Motor ammeter shall be suitable to indicate starting current (6 to 8 times full load current) for DOL starting of motor.
- Motor ammeter shall be provided for motor rated 30 kW and above and for critical drives, to be finalized during detail engineering.

- 4.12.03 All incomers, tie feeders and circuit breaker operated motor feeders shall be provided with 3-phase multifunction, digital energy meter with pulse output and communication port for interfacing with Plant DCS / PLC.
- 4.12.04 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.
- 4.13.00 **Current Transformer**
- 4.13.01 Current transformers shall be cast-resin type. All secondary connections shall be brought out to terminal blocks where wye or delta connection will be made.
- 4.13.02 Accuracy class of the current transformers shall be:
- a) Class PS for differential.
 - b) Class 5P20 for other relaying.
 - c) Class 1.0 ISF < 5 for metering.
 - d) Class 0.5 ISF < 5 for metering (Incomer & Bus coupler of PMCC)
- Other CT particulars like ratio, burden, knee point, excitation current & secondary resistance shall be decided by the tenderers.
- 4.13.03 CT secondary shall be rated for 1A for metering & either 5A or 1A for protection.
- 4.14.00 **Voltage Transformer**
- 4.14.01 Voltage transformers shall be cast-resin, drawout type and shall have an accuracy class of 1.0. Voltage transformer mounted on breaker carriage is not acceptable. For Incomer and bus coupler of PMCC accuracy class of voltage transformer shall be 0.5.
- 4.14.02 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 draw out position.
- 4.14.03 Secondary winding MCBs, sized to prevent overload shall be installed in all ungrounded secondary leads. MCBs shall be suitably located to permit easy replacement while the switchgear/PMCC is energized.
- 4.14.04 Both primary side & secondary side fuse failure / voltage loss monitoring system of VT shall be provided.
- 4.15.00 **Transducers**
- 4.15.01 Transducer for conversion of AC electrical quantities such as voltage, current, KW etc. shall be supplied as required for remote connection to Plant DCS / PLC. All transducers shall be dual output type.

- 4.15.02 The transducers for indicating type instruments shall be of very low burden type having 4-20 mA DC linear, galvanically isolated output, compatible with secondary instruments and Plant DCS system.
- 4.16.00 **Secondary Wiring**
- 4.16.01 The PMCC/MCC/DB shall be fully wired at the factory to ensure proper functioning of control, protection and interlocking schemes.
- 4.16.02 Fuse and links shall be provided to permit individual circuit isolation from bus wires without disturbing other circuits. All spare contacts of relays, push buttons and other devices shall be wired upto terminal blocks.
- 4.16.03 Wiring shall be done with flexible, 1100V grade, fire resistance PVC insulated switchboard wires with stranded Copper conductors of 2.5 mm² for control, current and voltage circuits.
- 4.16.04 Each wire shall be identified, at both ends, with permanent markers bearing wire numbers as per Contractor's wiring diagrams.
- 4.16.05 Wire terminations shall be made with crimping type connector with insulating sleeves. Wires shall not be spliced between terminals. Separate colour code shall be used for AC & DC circuit wiring for easy identification.
- 4.17.00 **Terminal Blocks**
- 4.17.01 Terminal blocks shall be 660V grade box-clamp type with marking strips similar to ELMEX 10 mm² or equal. Terminals for C.T. secondary leads shall have provision for shorting.
- 4.17.02 Terminal blocks used for interface with DCS / PLC via termination cabinet shall be suitably sized to facilitate proper termination of interconnecting cables.
- 4.17.03 Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20% active terminals shall be furnished.
- 4.17.04 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.
- 4.18.00 **Cable Terminations**
- 4.18.01 PMCC shall be designed for cable entry from bottom. MCC/DB shall be designed for cable entry both from top and bottom. Actual configuration shall be intimated later Sufficient space shall be provided for ease of termination and connection.
- 4.18.02 All provisions and accessories shall be furnished for termination and connection of cables, including removable gland plates, cable supports, crimp type tinned Copper/Aluminium lugs, brass compression glands with tapered washer (Power Cables only) and Terminal blocks.

- 4.18.03 Gland plates shall be minimum 4 mm thick. The gland plate and supporting arrangement for 1/C power cables shall be of non-magnetic material to minimize flow of eddy current.
- 4.18.04 Sufficient space shall be provided between the lower most power cable termination and gland plate for easy cable connection.
- 4.19.00 **Bus Duct Connection**
- 4.19.01 Bus duct connections shall be furnished along with transition panel, if required. Unless mentioned otherwise bus duct connections shall generally be from the top.
- 4.19.02 All connecting bus work shall have the same continuous current rating as associated PMCC bus and shall be fully braced for the LT system short circuit current.
- 4.19.03 All provisions such as matching flange and other accessories shall be furnished for connection to bus duct.
- 4.20.00 **Ground Bus**
- 4.20.01 A ground bus rated to carry the maximum fault current, shall extend full length of the PMCC / MCC / DB. The ground bus shall be G.I. type of minimum size 50 x 6 mm.
- 4.20.02 The ground bus shall be provided with two-bolt drilling with G.I. bolts & nuts at each end to receive 50 x 6 mm G.I. flats.
- 4.20.03 All stationary structures shall be directly connected to the ground bus for effective grounding.
- 4.20.04 The frames of all circuit breakers & drawout VT units shall be grounded through heavy multiple contacts at all times except when the primary disconnecting drives are separated by a safe distance.
- 4.20.05 The frame of draw out module shall be grounded at all times except when the power disconnects are separated by a safe distance.
- 4.20.06 Where ever the schematic diagrams indicate a definite ground at the switchgear, a single wire for each circuit thus grounded shall be run independently to the ground bus & connected thereto.
- CT & VT secondary neutrals shall be earthed through removable links so that earth of one circuit may be removed without disturbing others.
- 4.20.07 All hinged doors shall be earthed through flexible copper braid wire.
- 4.21.00 **Nameplate**
- 4.21.01 Nameplate of approved design shall be provided for each control compartment and also at the top of each PMCC / MCC / DB.
- 4.21.02 The material of the name plate shall be anodized aluminium / lamicaid or approved equal, 3 mm thick, with white letter on black background. Name

plates shall be minimum 20 x 75 mm for instrument / devices and 40 x 150 mm for panels.

4.21.03 Caution notice on suitable metal plate shall be affixed at the back of each vertical panel.

4.22.00 **Space Heater**

4.22.01 Each vertical section of the PCC / MCC / DB shall be furnished with thermostat controlled space heater and 5A, 3 pin plug socket.

4.22.02 In addition, motor feeders 30 KW and above shall be wired up for feeding motor space heater through starter auxiliary NC contacts.

4.22.03 Cubicle heater, Motor heater and plug socket circuit shall be provided with individual MCB/switch fuse units.

4.23.00 **A.C./D.C. Power Supplies**

4.23.01 Necessary 415V AC and 220V DC power supplies as required for control and service shall be arranged by the contractor. Single feeder shall be arranged for A.C. supply and duplicate feeder shall be arranged for D.C. supply.

4.23.02 Isolating switch fuse units shall be provided at each switchgear for the incoming supplies, 4-pole, single throw for A.C. and 2-pole, double throw for D.C. Molded case circuit breaker (MCCB) shall also be accepted as an alternative.

4.23.03 Bus-wires of adequate capacity shall be provided to distribute the incoming supplies to different cubicles. Isolating switch fuse units / MCCB shall be provided at each cubicle for A.C/D.C. supplies.

4.23.04 A.C. load shall be so distributed as to present a balanced loading on three-phase supply system.

4.24.00 **Tropical Protection**

All equipment, accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects & corrosion.

Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent the entrance of insects.

4.25.00 **Painting**

4.25.01 All steel surfaces shall be sand blasted, grounded and pickled as required to produce a smooth, clean surface free of scale, grease & rust.

4.25.02 After cleaning, the surfaces shall be given a phosphate coating followed by two coats of high quality primer and stoved after each coat.

4.25.03 PCC / MCC / DB shall be finished in light grey (RAL 7032) with two coats of synthetic enamel paint.

4.25.04 Sufficient quantity of touch-up paint shall be furnished for application at site.

4.25.05 Caution notice plate shall be affixed at the back of each vertical panel.

5.00.00 **TESTS**

5.01.00 All equipment shall be completely assembled, wired, adjusted and tested at the factory as per the relevant standards.

5.02.00 **Routine Test**

The tests shall include but not necessarily be limited to the following :-

- a. Operation under simulated service condition to ensure accuracy of wiring, correctness of control scheme and proper functioning of the equipment.
- b. All wiring and current carrying part shall be given appropriate High Voltage Test.
- c. Primary current & voltages shall be applied to all instrument transformers.
- d. Routine test shall be carried out on all equipment such as circuit breakers, switch - fuse, contactors, relays, meters etc.

5.03.00 **Type Tests**

The type test certificates for the following tests carried out on an identical & similar type of switchgear shall be furnished. The date of tests shall be within the last five years.

- a. Temperature rise Test
- b. Short time current test on main circuit and earth circuit.
- c. Verification of making and breaking capacity.

Type test certificates of any equipment shall be furnished if so designed by the purchaser/ owner. Otherwise the equipment shall have to be type tested free of charge, to prove the design. Type test performed before five(5) years are not acceptable.

6.00.00 **DRAWINGS, DATA & MANUALS**

6.01.00 To be submitted with the bid :-

- a. General arrangement drawing showing constructional features, space required in front for withdrawals, power & control cable entry points etc.
- b. Typical foundation plan
- c. Typical control schematic
- d. Bill of materials

- e. Type test reports on circuit breaker
- f. Board wise single line diagram.
- g. Calculation of CT & VT rating.
- h. Busbar sizing calculation.
- i. Reports for all type tests of representative sections of panel assemblies.
- j. Technical leaflets on :-
 - i) Circuit breaker
 - ii) Contactors
 - iii) Relays, meters, push buttons, selector switches etc.
 - iv) Glands/terminals blocks
 - v) MCCB
 - vi) MCB
 - vii) Instrument Transformers

6.02.00 To be submitted for Approval & Distribution :

- a. Outline dimensional drawing showing general arrangement, space requirements and bus duct/cable entry points.
- b. Board wise Single Line Diagrams.
- c. Cross-section with parts list.
- d. Foundation plan & loading.
- e. Consolidated bill of materials
- f. Control schematics.
- g. Wiring Diagrams.
- h. Instruction manuals of PMCC/MCC/DB and individual equipment.
- i. All other relevant drawings, documents or data necessary for satisfactory installation, operation and maintenance.

The manuals shall clearly indicate that the installation method, check-up and tests to be carried out before commissioning of the equipment.

6.03.00 The Bidder may note that the drawings, data and manuals listed herein are minimum requirements only. The Bidder shall ensure that all other necessary write-ups, curves and information required to fully describe the equipment are submitted with his bid.

Other Feeder : AC22 DC22

5.0 A.C. / D.C. Power Supply

Control Voltage for : 220V DC +10% to -15%
Circuit breaker

Control voltage for : 240V AC \pm 10%, 1 Ph, 50 Hz \pm 5%
MCCB modules

Service voltage : 240V AC \pm 10%, 1 Ph, 50 Hz \pm 5%

ANNEXURE-B

PROTECTIONS

- 1.0 All Protective relays shall be microprocessor based numerical type having communication facility with Plant DCS system / PLC.
- 2.0 The minimum protections to be provided for different types of circuits are listed below:
 - a. Incoming Feeder & Bus-coupler with ACB:
 - 3 - inverse time O/C relays (51) for phase fault.
 - 1 - Inverse time O/C relay (51N) for Earth fault.
 - 3 - Under Voltage (27), Range : 40-80% with timer
 - b. Motor Feeder with ACB: (above 110 kW)
 - 1 - Composite Motor protection relay (99) for protection against
 - Thermal overload
 - Phase faults
 - Unbalance (negative sequence)
 - Locked rotor
 - Excessive Start-up time and Start-Stop.
 - Earth fault
 - c. Outgoing Feeder with ACB :
 - 3 - Inverse time O/C relays (51) for phase fault.
 - 1 - Inverse time O/C relay (51N) for Earth fault.
- 2.0 Apart from protection relays, each electrically operated breaker shall be provided with anti-pumping (94), trip annunciation (30), lockout (86) and trip circuit supervision (74) relays. Lockout relay shall be hand reset type.
- 3.0 Both primary side & secondary side fuse failure / voltage loss monitoring system of VT shall be provided..
- 4.0 For Auto-bus change-over as well as live bus change-over through synchronization refer enclosed Control Schematic drawings.
- 5.0 Each incomer shall be provided with three (3) nos. Bus Energised indicating lamps – Red/Yellow/Blue for each phase.

ANNEXURE-C

INDICATIVE LIST OF 415V PMCCs / MCCs / DBs

A.	PMCC/MCC	Quantities
1)	415 V Unit PMCC	: 1 no.
2)	415 V Station PMCC	: 2 nos.
3)	415 V Emer. PMCC	: 1 no.
4)	415 V ESP PMCC	: 6 nos.
5)	415 V Turbine Valve MCC	: 1 no.
6)	415 V Turbine Aux. MCC	: 1 no.
7)	415 V Coal Mill MCC	: 1 no.
8)	415 V Boiler Valve MCC	: 1 no.
9)	415 V Boiler Aux. MCC	: 1 no.
10)	415 V Soot Blower MCC	: 1 no.
11)	415 V CPU REGN. MCC	: 1 no.
12)	415 V STN Vent. MCC	: 1 no.
13)	415 V ESP Vent & A/C MCC	: 1 no.
14)	415 V Fuel Oil Unloading & Transfer P/H MCC	: 1 no.
15)	415 V Fire Water MCC	: 1 no.
16)	415 V Bunker Floor MCC	: 1 no.
17)	415 V Wagon Tripler PMCC	: 1 no.
18)	415 V CHP PMCC	: 1 no.
19)	415V ASH Silo PMCC	: 1 no.
20)	415V Raw Water PMCC	: 1 no.
21)	415 V Station AC MCC	: 1 no.
22)	415V CW Treatment PMCC	: 1 no.
23)	415V CW Chlorination MCC	: 1 no.
24)	415 V CWPH PMCC	: 1 no.

25)	415V Clarified Water MCC	:	1 no.
26)	415 V Water Treatment PMCC	:	1 no.
27)	415 V Switchyard PMCC	:	1 no.
28)	415V Fuel Oil Pressurizing MCC	:	1 no.
29)	415V Ash Water Recovery MCC	:	1 no.
30)	415V AHP PMCC	:	1 no.
31)	415V Ash Slurry MCC	:	1 no.
32)	415V AHP Water System MCC	:	1 no.
33)	415 V Ash Dyke MCC	:	1 no.
34)	415V DM PLANT MCC	:	1 no.
35)	415V Water Service PMCC	:	1 no.
36)	415V ETP PMCC	:	2 nos.
37)	415V Station AC MCC	:	1no.
B.	415V ACDBs		Quantities
1)	Station ACDB	:	To be decided by EPC contractor
2)	Boiler ACDB	:	To be decided by EPC contractor
3)	Turbine ACDB	:	To be decided by EPC contractor
4)	Lighting Distribution Board	:	To be decided by EPC contractor
5)	Welding Transformer Board	:	To be decided by EPC contractor
C.	240V ACDBs	:	AS Required (To be decided by EPC contractor)
D.	220V DCDBs	:	AS Required (To be decided by EPC contractor)

NOTE : Any other PMCCs / MCCs / DBs, if required, shall also be included under the Scope of EPC Contractor without any price implication.

ANNEXURE-D
MODULE SELECTION

MOTOR FEEDER

Type	Motor Rating	MCCB Rating	Contactor	Cable size
AU/AR	0 - 5.5 KW	32A	16A	3/c – 2.5 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 - 110 KW	400A	300A	2 x 3/c - 185 Sq.mm - Al

NOTE :

1. MCCB, thermal overload relay with SPP, Contactor are to be co-ordinated (Type-2) with motor rating by the Contractor.
2. “U” stands for Undirectional and “R” for Reversible drives.

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

DCDB FEEDER (SFU Unit)

Type	MCCB Rating	Fuse Rating	Cable Size
DAF	16A	16A	2/C-2.5 Sq.mm - Cu
DBF	32A	32A	2/C-16 Sq.mm - Al
DCF	63A	63A	2 x 2/C-16 Sq.mm - Al
DDF	100A	100A	4/C-35 Sq.mm - Al
DEF	200A	200A	2 x 4/C-35 Sq.mm - Al
DFF	400A	400A	2 x 1/C-630 Sq.mm - Al

NOTE : Cable size as shown above are indicative only. However actual sizes of each motor/ outgoing feeder to be decided by the EPC contractor with back up sizing calculation.

ANNEXURE-E

BUS TRANSFER SCHEME FOR PMCC

1.0 The manual bus transfer shall be arranged in such a way that any of the following modes of operation is possible.

1.1 Manual Bus Transfer

a) Without voltage interruption

This means by allowing momentary parallel operation of two sources.

b) With voltage interruption

i) Slow Transfer

ii) Fast Transfer

NOTE : For CHP system 'Manual bus transfer without voltage interruption' and 'dead bus transfer with voltage interruption' shall be provided.

Synchronisation of Incomer & Bus coupler for each of the 415V PMCC shall be implemented through PLC in CHP substation cum control room building (SS-2). Synchronization check relay, guard relay and auxiliary relay shall be provided in each PMCC. Synchroscope along with cut off switch, double voltmeter, double frequency meter shall be provided in the Main CHP substation building cum control room. Separate synchronization switch and trip selector switch for each of the PMCC shall also be provided in the CHP substation building cum control room (SS-2).

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SECTION-VIII

**TECHNICAL SPECIFICATION
FOR
LOCAL CONTROL BOARDS/PANELS,
LOCAL ISOLATING SWITCH UNITS
AND LOCAL PUSH BUTTON STATIONS**

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE OF SUPPLY
2.00.00	CODES AND STANDARDS
3.00.00	DESIGN CRITERIA
4.00.00	SPECIFIC REQUIREMENTS
5.00.00	TESTS
6.00.00	DRAWINGS, DATA AND MANUALS

ATTACHMENTS

ANNEXURE-A	RATINGS AND REQUIREMENTS
ANNEXURE-B	FUNCTIONAL REQUIREMENTS OF ANNUNCIATOR
ANNEXURE-C	AREA WISE INDICATIVE LIST OF LOCAL CONTROL BOARDS
ANNEXURE-D	LOCAL CONTROL PANEL / LOCAL STARTER PANEL FOR COAL HANDLING PLANT

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SECTION-VIII

**TECHNICAL SPECIFICATION
FOR
LOCAL CONTROL BOARDS/PANELS, LOCAL ISOLATING
SWITCH UNITS AND LOCAL PUSH BUTTON STATIONS**

1.00.00 SCOPE OF SUPPLY

1.01.00 The following equipment shall be furnished with all accessories:

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

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

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

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

2.00.00 CODES AND STANDARDS

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

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

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

3.00.00 DESIGN CRITERIA

3.01.00 The Local Control Boards/Panels will be used for controlling incomers/ bus-section/electrically operated radial breaker feeders of the associated PMCC/MCC. Necessary indications, meters, annunciations and mimic representation shall also be provided on these control boards/panels.

Local control of all drives shall be done from Process Control Boards/Panels, as described in respective sections of mechanical specification.

The Local Control Boards/Panels shall have to be duly matched with the Process Control Boards/Panels.

- 3.02.00 Local Push Button (L.P.B.) stations will be used for controlling drives from local as required.
- 3.03.00 Local Isolating Switch (L.I.S) Units will be used for local isolation of power supply to various machines as required.
- 3.04.00 All equipment except L.I.S. Units and L.P.B stations, will be located in a clean but hot, humid, and tropical atmosphere. The L.I.S. Units and L.P.B. stations will be generally installed in a hot, humid, and tropical atmosphere, heavily polluted at places with fly ash and/or coal dust, and shall be suitable for outdoor service with degree of protection specified elsewhere in this specification.
- 3.05.00 All Control Boards/Panels, L.I.S. Units, and L.P.B. stations shall be liberally sized so as to provide spacious layout of equipment and devices with sufficient working space in between.
- 3.06.00 Adequate space/terminals shall be kept in the boards/panels for installing additional equipment in future.
- 3.07.00 For continuous operation at specified ratings, temperature rise of the various components/equipment shall be limited to the permissible values stipulated in the relevant standards and/or this specification.
- 3.08.00 All equipment/components thereof shall be capable of withstanding the mechanical forces and thermal stresses of the system short circuit current without any damage or deterioration of material.
- 3.09.00 Design, material selection, and workmanship shall be such as to present a neat appearance outside and inside with no welds, rivets, screws, or bolt heads apparent from the exterior surface of the boards/panels. All instrument cut-outs, mounting studs, and support brackets shall be accurately located.

4.00.00 **SPECIFIC REQUIREMENTS**

4.01.00 **Construction**

4.01.01 Local Control Boards/Panels

- a) Local Control Boards may consist of a number of vertical panels mounted side-by-side, in which case, they shall be bolted together to form a compact unit. Where two panels meet, the joints shall be smooth, close-fitting, and unobtrusive.
- b) The control boards/panels shall be totally enclosed type, conforming to degree of protection IP-54 or better.
- c) Generally, the local control boards/panels shall be free-standing, floor-mounted, dead-front assemblies. In some cases, however, wall-mounted type control boards/panels may also be accepted.

- d) Floor-mounted control boards/panels shall be assembled on channel/ angle base plates with anti-vibration mountings and stainless steel kick-plates.
- e) Control boards/panels shall be of folded sheet steel CRCA construction, minimum 1.6 mm. thick for non-load bearing members and 2 mm for load bearing members, and free from all surface defects.

The boards/panels shall have sufficient structural reinforcement to ensure a plane surface, to limit vibration, and to provide rigidity during shipment and installation.
- f) All floor-mounted panels shall have rear door.
- g) Doors shall have concealed type hinges and padlocking arrangement. Doors shall be grounded by flexible copper braid.
- h) All doors and removable covers shall be provided with neoprene rubber gaskets all round and latches sufficiently strong to hold them in alignment when closed.
- i) Working height of the panels shall be limited between 550 mm and 1800 mm above floor level.

4.01.02 Local Push Button Stations

- a) L.P.B. Stations shall be furnished in sheet steel enclosure of dust and vermin-proof, weather-proof, gasketed construction, suitable for outdoor use with or without canopy according to outdoor / indoor installation, and conforming to degree of protection IP-55 or better.
- b) L.P.B. Stations shall be suitable for column/structure/wall mounting and shall be complete with push-buttons, terminal blocks, anodised aluminum inscription plate, two (2) nos. earthing terminals, removable gland plate along with crimp type tinned copper lugs and compression type glands for cable/conduit entry from top and bottom. The earthing terminals shall be suitable for connection to one (1) no. 8 SWG G.I. wire.
- c) L.P.B. Stations shall be of the following basic type and equipped with:
 - Type-A : One (1) START push-button and one (1) STOP push-button.
 - Type-B : One (1) OPEN push-button, one(1) CLOSE push-button, and one(1) STOP push-button.
 - Type-C : Flame proof type as per IS-2148. one (1) START push-button and one(1) STOP push-button.
 - Type-D : One (1) STOP Lock-out switch.

Type-E : One (1) STOP Emergency PB.

Belt sway bridging Push Button shall be provided in the Local Push Button Station for all conveyor Drives.

Any other type of L.P.B. Station, if required, shall be subject to approval of the Purchaser.

- d) OPEN, CLOSE, and START push-buttons shall be spring return to normal type. STOP push-buttons shall have mushroom head actuator with press-to-latch and key-to-release feature.
- e) OPEN/START push buttons shall be GREEN, STOP push buttons shall be RED, and CLOSE buttons may be YELLOW.
- f) All push-buttons shall have a minimum of two (2) Normally-Open and two (2) Normally-Closed electrically separate contacts, rated minimum 10 A at operating voltage.
- g) Wiring shall be done by 1/C - 2.5 sq.mm. 1100V grade, PVC insulated, stranded copper conductor, cable. Each wire shall be identified at both ends by ferrules with wire designation.
- h) Terminals shall have provision for connecting at least two (2) nos. 2.5 sq.mm. copper cable and shall be rated for carrying continuously minimum 10 A at 240V A.C. and 2 A at 220V D.C.

4.01.03 Local Isolating Switch Units

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

4.02.00 Equipment Mounting

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

- 4.02.02 All equipment mounted inside the panels shall be so located that their terminals and adjustments are readily accessible for inspection or maintenance.
- 4.02.03 For Local Control Boards/Panels control components such as push buttons, indicating lamps, selector switches, indicating meters etc. shall be flush mounted on the front face of the board/panel while switch fuses, supervision relays (AC/DC) etc. shall be mounted inside.
- 4.03.00 **Name Plate**
- 4.03.01 Nameplates shall be furnished for each panel and for each instrument or device mounted on the panel. Each LPB Station shall also be provided with a nameplate.
- 4.03.02 The material of the nameplate shall be lamicaid or approved equal, 3 mm thick, with white letters on black background.
- 4.03.03 The nameplates shall be held by self tapping screws. The size of nameplate shall be approx. 20 mm x 75 mm for equipment and 40 mm x 150 mm for the panels. The size of the nameplate shall suit the overall dimensions of LPB station/L.I.S Unit.
- 4.03.04 Nameplates for panels shall be provided both on the front and on the rear and shall be according to final device/designation list.
- 4.03.05 Control and meter selection switches shall have integral nameplates. Nameplates for all other devices shall be located below the respective devices.
- 4.03.06 Instruments and devices mounted on the face of the panels shall also be identified on the rear with the instrument or device number. The number may be painted on or adjacent to the instrument or device case.
- 4.04.00 **Mimic Diagram**
- 4.04.01 Mimic diagram of electrical connections shall be furnished on the front face of all electrical control panels.
- 4.04.02 Mimic buses shall be at least 3 mm thick and 10 mm in width, made of suitably treated metal strips or approved equivalent and colour coded to denote different voltages.
- 4.04.03 The mimic representation, colour and size of diagram are subject to the approval of the Purchaser.
- 4.05.00 **Illumination, Space Heating and Receptacles**
- 4.05.01 Each panel shall be provided with interior fluorescent tube with door switch, space heater with thermostat and 5A, 3-pin receptacle with plug. Third pin of the socket shall be effectively grounded through the metallic structure.
- 4.05.02 Tube, heater and receptacle circuits shall be suitable for available A.C. supply and furnished with individual ON-OFF switch.

- 4.05.03 The lamp shall be located at the ceiling and guarded with protective cage. Space heater shall be located near the floor so as not to pose any hazard to service personnel.
- 4.06.00 **AC/DC Power Supply**
- 4.06.01 Necessary A.C. and D.C. supplies as required for control and service shall be arranged by the contractor. Single feeder shall be arranged for A.C supply and duplicate feeders shall be arranged for D.C supply.
- 4.06.02 Isolating switch fuse units shall be provided for the incoming AC/DC power supplies and bus wires shall be run for power distribution to different panels. D.C. supply isolating switches shall be double pole, double throw with off and A.C. supply isolating switches shall be 4-pole, double throw type.
- 4.06.03 Fuse and link shall be provided for individual circuits for protection and also for isolation from bus wire without disturbing other circuits.
- 4.06.04 The fuse requirements in each panel shall be grouped in easily accessible fuse blocks or distribution panel. The grouping shall be done in a neat and orderly fashion.
- 4.06.05 Alarm relays with reverse flag shall be provided to annunciate failure of main incoming A.C. and D.C. power supplies and annunciation D.C. supply in each panel. Lamp indications shall be provided individually for main D.C. supply-1 fail, main D.C. supply-2 fail, and panel annunciation D.C. supply fail. A common A.C. electric bell shall be provided to give an audible alarm in case of failure of D.C. supply-1/D.C. supply-2/annunciation D.C. supply in any panel. A common push-button shall also be provided for cancellation of lamp indications and audible alarm.
- 4.06.06 Separate circuits shall be provided for (a) indication and alarm (b) tripping, and (c) control.
- 4.06.07 For lighting, auxiliary supply and space heating A.C. supply shall be used. D.C. supply shall be used for providing control supply to annunciator.
- 4.06.08 Bus wires of adequate capacity shall be provided to distribute the incoming supplies to different cubicles of a VDB. Isolating switch fuse units shall be provided at each cubicle for A.C/D.C supplies.
- 4.07.00 **Wiring**
- 4.07.01 The panels shall be fully wired up at the factory to ensure proper functioning of control, protection and metering schemes.
- 4.07.02 All spare contacts of relays and switches shall be wired up to terminal blocks.
- 4.07.03 Wiring shall be done with flexible, heat resistant, 1100V grade, fire resistance PVC insulated, switchboard wires with stranded copper conductor, 2.5 Sq.mm for current, control circuits and voltage circuits.
- 4.07.04 Each wire shall be ferruled by plastic tube with indelible ink print at both end having terminal Block No., terminal numbers, destination number as per approved wiring drawing.

- 4.07.05 All wire termination shall be made with insulated sleeve solderless crimping type tinned copper lugs. Wires shall not be tapped or spliced between terminals.
- 4.07.06 Wiring shall be neatly bunched in groups by non-metallic cleats or bands. Each group shall be adequately supported along its run to prevent sagging or strain on the termination.
- 4.07.07 Colour codes shall be used for wiring as per latest revision of IS: 375.
- 4.08.00 **Terminal Block**
- 4.08.01 Multi-way terminal blocks complete with necessary binding screws and washers for wire connections and marking strip for circuit identification shall be furnished for terminating the panel wiring and outgoing cables. Terminals shall be box-clamp type, 10 sq.mm. minimum. Terminals for C.T. secondary leads shall have provision of shorting and grounding.
- 4.08.02 Not more than two wires shall be connected to one terminal. If necessary, a number of terminals shall be jumpered together to provide wiring points.
- 4.08.03 Each terminal shall be identified with designation as per approved schematic. At least 20% of the total number of active terminals shall be furnished as spare in each panel.
- 4.08.04 The wiring and terminals shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.
- 4.08.05 The terminal blocks shall be located to allow easy access and also to suit floor openings for cable entry.
- 4.08.06 The terminal blocks within the panels shall be mounted on vertical support brackets. The support brackets shall be tack welded to the interior sheet steel mounting plates of the cabinet. Support brackets shall not be welded directly to the walls of the enclosure. The terminal blocks shall be attached to the support brackets with round head machine screws.
- 4.08.07 Terminal blocks shall generally be mounted vertically with adequate spacing (not less than 100 mm) between adjacent rows.
- 4.08.08 The bottom of the terminal block shall be at least 200 mm above the incoming cable gland plate.
- 4.09.00 **Cable Entry**
- 4.09.01 The Control Boards/Panels shall have provisions of cable entry from the bottom. Bottom plate shall be provided to make entry dust-tight. L.P.B. stations and Local Isolating Switch Units shall have provision for cable/conduit entry from both top and bottom. Suitable cable gland-plates shall be provided.
- 4.10.00 **Grounding**
- 4.10.01 50 x 6 mm TINNED COPPER ground bus shall be provided in each control panel extending along the entire length of the assembly.

- 4.10.02 The ground bus shall have two-bolt drilling with GI bolts and nuts at each end and shall be suitable for connection to 50 x 6 mm G.S. flat.
- 4.10.03 The ground bus shall be bolted to the panel structures and shall effectively ground the entire assembly. The cases of meters, relays and switching devices shall be grounded through the steel structure.
- 4.10.04 Whenever a circuit is grounded, a single wire from the circuit shall be run independently to the ground bus and connected to it.

4.11.00 Painting

- 4.11.01 Panels and Push-button Stations shall be finished with two coats of synthetic enamel paint white inside and gray (shade 631 of IS-5) outside. Panels and push-button stations shall be stoved after each spraying of finish paint. Painting process shall be of powder coating.
- 4.11.02 Caution Notice plate shall be affixed at the back of each vertical panel.

4.12.00 Switches

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

Sl. No.	Application	Switch description
a)	Synchronising Selector switch	180°, 4-position (INCOMER-1/BUS-SECTION / INCOMER-2/OFF), stay put type, pistol grip handle. OR 120°, 3-position (INCOMER/TIE/OFF) stayput type, pistol grip handle.
b)	Trip Selector Switch	120°, 3-position (INCOMER-1/BUS-SECTION OR TIE/INCOMER-2), stayput type, pistol grip handle.
Sl. No.	Application	Switch description
c)	Meter Selector Switch	4-position (OFF/R/Y/B for ammeter selector switch and OFF/R/Y/YB/RB for voltmeter selector switch), maintained

- contact, stay-put type, knob handle. Ammeter selector switches shall have make-before-break contacts.
- d) Auto-Manual Selector switch 120°, 2-position (AUTO/MANUAL), stayput type, non-lockable, spade handle.
- e) On-off Switch/Local-Remote Selector Switch 90°, 2-position (ON/OFF OR LOCAL/ REMOTE), stayput type, non-lockable, spade handle
- 4.12.04 Any other type of switch, if required, shall be subjected to approval of purchaser.
- 4.12.05 Tenderer shall decide the number of switch contacts taking into account the scheme requirements and spares.
- 4.13.00 **Fuses**
- 4.13.01 Fuses shall be HRC, preferably link type, with a minimum interrupting capacity equal to the system short circuit current.
- 4.13.02 Fuses shall be furnished complete with fuse boxes and fittings of such design as to permit easy and safe replacement of fuse element. Visible indication shall be provided on blowing of the fuse.
- 4.13.03 Motor fuse characteristics and ratings shall be chosen to ride over motor starting period without blowing. The fuse on incoming feeder, wherever provided, shall be chosen to provide discrimination with motor/feeder fuses.
- 4.14.00 **Contactors**
- 4.14.01 Contactors shall be three pole, air break type, with non-bouncing silver/silver alloy contacts. Contactor duty shall be class III - category AC3 for unidirectional drives and AC4 for bi-directional and inching drives/class I - category DC2.
- 4.14.02 Each contactor shall be provided with minimum two (2) N/O and two (2) N/C auxiliary contacts rated 10 A at operating voltage. The exact requirement of contacts shall be decided by the Tenderers taking into account the scheme requirements and spares.
- 4.14.03 Contactor starters shall comply with the requirements of IS-8544 (Part - 1) in respect of co-ordination of the characteristics of contactor, overload relay, and fuse. The type of co-ordination shall be Type-C as per IS-8544.
- 4.15.00 **Thermal Overload**
- 4.15.01 Thermal overload relays shall be three elements, positive acting, ambient temperature compensated with adjustable settings.

- 4.15.02 Single phasing preventor shall be provided as an inbuilt feature of the thermal overload relay.
- 4.15.03 Overload relays shall be manual reset type with change over contacts. Resetting of relays shall be possible with compartment door closed. Colour of resetting button shall be BLACK.
- 4.15.04 Relays for fan motors having long starting time shall be saturable core C.T. operated.
- 4.16.00 **Current Transformers**
- 4.16.01 Current transformers shall be cast-resin type. All secondary connections shall be bought out to terminal blocks where wye or delta connection will be made.
- 4.16.02 Accuracy class of the current transformers shall be:
- a) Class PS for differential.
 - b) Class 5P20 for other relaying.
 - c) Class 1.0 ISF < 5 for metering.
- Other CT particulars like ratio, burden, knee point, excitation current & secondary resistance shall be decided by the tenderers.
- 4.16.03 Drives requiring current monitoring shall be provided with current transducers with calibration for full-scale reading. The output shall be 4-20 mA D.C; 4-18mA of which shall correspond to the normal range and 18-20 mA shall correspond to the suppressed range.
- 4.17.00 **Voltage Transformers**
- 4.17.01 Voltage transformers shall be cast-resin, drawout type and shall have an accuracy class of 1.0.
- 4.17.02 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 draw out position.
- 4.17.03 Secondary winding MCBs, sized to prevent overload shall be installed in all ungrounded secondary leads. MCBs shall be suitably located to permit easy replacement while the switchgear/PMCC is energized.
- 4.17.04 Both primary side & secondary side fuse failure / voltage loss monitoring system of VT shall be provided.
- 4.18.00 **Push Button**
- 4.18.01 All push buttons shall be oil tight, heavy duty, push to actuate type, with coloured button and inscription plate marked with its function. The colour of "ON" and "OFF" push buttons shall be GREEN and RED respectively. RESET push buttons shall be coloured black.

- 4.18.02 Each push button shall have minimum 2 NO. + 2 NO. contacts, rated 10A at 240V AC and 2A at 220V DC.
- 4.18.03 Push buttons shall be shrouded type except for emergency trip/stop button, which shall be mushroom type with lockable arrangement for easy identification.
- 4.19.00 **Lamps**
- 4.19.01 All indicating Lamps shall be LED type.
- 4.19.02 LED lamp shall be made in accordance with InP Technology (Aluminium Indium Gallium Phosphide Technology). The body shall be made of Poly Carbonate Unbreakable Lens. LED shall be protected by inbuilt fuse with surge suppressor or leakage voltage glow protection. LED circuit shall be PCB mounted. Intensity shall be greater than 200 mcd. All Push Button lamp shall be as per LED indicating lamp.
- 4.20.00 **Operating Range**
- All instruments shall be generally suitable for operation on 1A or 5A C.T. secondary circuit and/or 110V V.T. secondary circuit.
- 4.21.00 **Meters**
- 4.21.01 All indicating instruments shall be switchboard type, back connected, suitable for flush mounting, 96 x 96 mm with 240 Deg. scale, antiglare glass and accuracy class of 0.5. The dials shall be made of such material as to ensure freedom from warping, fading, and discolouring during the lifetime of the instruments.
- 4.21.02 All indicating instruments shall be enclosed in dust-tight cases suitable for tropical use.
- 4.21.03 Meters shall have provision for zero-adjustment from front of the panel.
- 4.21.04 Meters shall be compensated for temperature errors and factory calibrated to read the primary quantities directly without using a multiplying factor.
- 4.21.05 D.C. ammeters, wherever required, shall be provided with external shunt if the current exceeds 5A. The rated voltage drop for the shunts shall be 75mV.
- 4.22.00 **Annunciator System**
- 4.22.01 Each control panel shall be provided with an annunciator window board. The annunciator boards shall be back-connected and suitable for semi-flush mounting.
- 4.22.02 The annunciator system shall be solid state type with optical isolation for input signals. The functional requirements shall be as per Annexure-C.
- 4.22.03 Each annunciator group shall be independent, complete with its own power supply, acknowledge-reset-test buttons and other necessary accessories. Hooter for audible alarm shall be common for each control panel assembly.

- 4.22.04 Each annunciator group shall be provided with a common alarm relay for group alarm annunciation in remote control room. The common alarm relay will operate on actuation of any alarm point of the group.
- 4.22.05 The annunciator shall be non-integral type with hardware box mounted separately for easy access and maintenance.
- 4.22.06 Audible alarms with different tones shall be used for trip, non-trip and ring back functions.
- 4.22.07 The window size shall be such as to accommodate minimum three (3) lines of twelve (12) characters each. Each character shall be minimum 4.75 mm high.
- 4.22.08 The annunciator system shall be suitable for operation from both NO and NC type initiating contacts.
- 4.22.09 At least 10% spare channels and window facia shall be provided in each annunciator group.
- 4.23.00 **Relays**
- 4.23.01 Auxiliary relays shall be furnished in fixed, dust-tight, casings and mounted inside the panel.
- 4.23.02 The relays shall have adequate numbers of contacts to suit scheme requirements. Besides, each relay shall have spare contacts for future use.
- 4.23.03 Contacts shall be silver-surfaced, bounce-free, and capable of repeated operation without deterioration.
- 4.24.00 **Auxiliary Devices**
- 4.24.01 The Contractor shall furnish, install, and wire-up all auxiliary devices such as timing / switching / lockout / auxiliary relays/auxiliary contactors, etc. as required for the proper functioning of the approved schemes.
- 4.24.02 The Contractor shall number the various types of relays and contactors as per the numbers appearing in the approved Schematic/Wiring appearing in the approved Schematic/Wiring diagrams.
- 5.00.00 **TESTS**
- 5.01.00 All Control Boards/Panels, L.I.S. Units and L.P.B. Stations shall be completely assembled, wired, adjusted and tested at the factory prior to shipment to ensure accuracy of wiring, correctness of control scheme and proper functioning of all components.
- 5.02.00 **Routine Tests**
- 5.02.01 The tests shall include wiring continuity tests, high voltage tests, insulation measurement test both before and after high voltage test, and functional tests to ensure accuracy of wiring operation of the control/ protection/metering schemes and individual equipment. Detailed test report including procedure and drawing shall be furnished.

- 5.02.02 All switches, meters, relays and other devices shall be tested and calibrated in accordance with relevant IS standards.
- 5.03.00 Type test certificate on any equipment, if so desired shall be furnished. Otherwise the equipment shall have to be type tested, free of charge, to prove the design.
- 6.00.00 **DRAWINGS, DATA & MANUALS**
- 6.01.00 **To be submitted with the Bid**
- 6.01.01 General Arrangement drawings and cross-section of each equipment showing constructional features, cable entry points etc.
- 6.01.02 Typical foundation plan.
- 6.01.03 Bill of Materials.
- 6.01.04 Technical leaflet and Catalogues of:
- a) Local Control Boards and Local Starter-cum-Control panels
 - b) Local Isolating switch units
 - c) Local Push Button Stations
 - d) Switches and Lamps
 - e) Meters, relays, push buttons
 - f) Switch fuse units
 - g) Annunciator System
 - h) Auxiliary Devices
 - i) Terminal Blocks/glands.
 - j) Temperature Scanner
- 6.02.00 **To be submitted after award of Contract**
- 6.02.01 Dimensional general arrangement of all Local Control Boards, Local Starter-cum-control panels, Local Push Button Stations, and Local Isolating switch units showing equipment disposition and identification along with space requirements and cable entry points.
- 6.02.02 Foundation plan and loading diagram, clearly showing panel fixing arrangement, floor opening for cable entry etc
- 6.02.03 Cross section with parts list
- 6.02.04 Schedule of materials and label inscriptions.
- 6.02.05 Detailed Control Schematics clearly showing terminal and wire numbering

- 6.02.06 Wiring diagram showing all equipment and devices in their relative physical positions and all wiring upto the terminal blocks.
- Equipment/Device and terminals shall be identified with designations/numbers as per approved schematic and connection diagrams.
- 6.02.07 Data Sheets and Instruction Manual for each piece of equipment
- 6.03.00 Tenderers may note that the drawings, data and manuals listed are minimum requirements only. The Bidder shall ensure that all other necessary write-ups, curves and information required to fully describe the equipment offered are submitted with his bid.

ANNEXURE-A

RATINGS & REQUIREMENTS

1.0	Local Control Board		
1.1	General		
	Type	:	Fixed type
	Service	:	Indoor
	Enclosure	:	IP-54
1.2	System		
	Voltage	:	415 Volt \pm 10%
	Phase	:	3
	Frequency	:	50 Hz \pm 5%
	System	:	Solidly grounded
1.3	Rated Current at 50°C		
	Bus bar	:	To be decided by the Tenderers
	Switches	:	To be decided by the Tenderers
1.4	Short Circuit Rating		
	Interrupting	:	50 KA
	Short time for 1 Second	:	50 KA
1.5	Insulation Level	:	2.5 KV for 1 min.

ANNEXURE-B

FUNCTIONAL REQUIREMENTS OF ANNUNCIATOR

TYPE

The annunciation system shall be manually reset type with ring back facility, suitable for operation from 220V DC ungrounded supply.

FUNCTION

The sequence of operation shall be similar to ISA-2A with fast/slow blinking as detailed below:

Field Condition	Visual Display	Audible Alarm	Ringback Alarm
Normal	Off	Silent	Silent
Abnormal	Fast blinking	On	Silent
Acknowledge	Steady On	Silent	Silent
Return to normal	Slow blinking	Silent	On
Reset	Off	Silent	Silent
Normal Before Acknowledge	Slow blinking	On	On
Acknowledge	Steady On	Silent	On
Reset	Off	Silent	Silent
Test	Fast blinking	On	On

ANNEXURE-C

AREA WISE INDICATIVE LIST OF LOCAL CONTROL BOARDS

Sl. No.	Description
1.	C.W. System Electrical Control Board
2.	Electrical Control Board for MCC/PMCC located in Ash-Slurry and Ash-Water Building.
3.	Electrical Control Boards for ESP PCC/PMCC
4.	Electrical Control Board for Fuel Oil Pressurising system
5.	Electrical Control Board for Fuel Oil Unloading and Forwarding MCC
6.	Electrical Control Boards for Raw water MCC

Note : The above list is indicative only. In addition to the above Electrical Control Boards, necessary local panels/remote panel shall be provided for respective system/equipment/drive, e.g., BFP, Hydrogen-seal Oil system for Generator, ESP, etc. as described in respective sections of mechanical specification.

ANNEXURE-D

**LOCAL CONTROL PANEL / LOCAL STARTER PANEL
FOR COAL HANDLING PLANT**

1.00.00 DESIGN CRITERIA

1.01.00 Stacker/Reclaimer MCC & Control Desk

The power supply from 6.6 KV CHP switchgear shall be achieved through one (1) number land mounted load break isolator, one (1) number fuse cum junction box located near centre or travel, one (1) number machine mounted load break isolator, line P.T with voltmeter on 6.6 KV side, L.T Air Circuit Breaker, Ammeter with selector switch, Voltmeter with selector switch etc.

Power CRD shall be connected to isolator panel mounted on the machine. H.T. fuses for the primary side of the transformer shall be housed inside the isolator panel on machine. Fuses shall be provided with the striker pin mechanism. Specification of Load break isolator is governed by HT Switchgear Specification

- 1.01.01
- a) One number Stacker-Reclaimer MCC shall be provided on the mobile Stacker-Reclaimer. This MCC shall receive power at 433V, 50 Hz, from the output of a 6.6 KV/433V, dry type cast resin power transformer located on the mobile machine, through suitable cables.
 - b) Power shall be received at the panel by means of ACB unit. The ACB shall be series trip type with short circuit and ground fault releases having adjustable settings. Necessary CT ammeter, ammeter selector switch; voltmeter; voltmeter selector switch; R/Y/B indication lamps shall be available on the MCC. Power supply for indication of breaker including load break isolator shall be derived from the UPS of PLC. The specification requirement of MCC is guided by respective 415V PMCC/MCC specification.
 - c) Stacker/Reclaimer is PLC controlled. Under manual local operation it shall only be possible to run individual equipment by passing all process interlock. Under manual remote operation it shall be possible to run the entire system through PLC with process and safety interlock in place. The selector switch, remote/local shall be housed in control desk.
 - d) Specification requirement of PLC has been detailed under main PLC specification with the exception of 100% hot standby mode and redundancy.
 - e) Control desk shall accommodate annunciation windows, selector switches, ammeter, voltmeter and indicating lamps for incomer, ammeter for outgoing motor feeder rated 30 KW and above.
 - f) Panel door shall be interlocked with the incoming switch such that the panel door can not be opened when the switch is 'ON'. However, necessary door interlock defeat feature shall also be provided for

testing purpose. Rating of components shall conform to the rating indicated in the enclosed component selection chart.

- g) Audio visual annunciation system shall have at least but not limited to the following annunciation points complete with Accept/Test Preset P.B.:
- i) Transformer winding temperature high.
 - ii) 415 V Incomer breaker tripped
 - iii) Boom Conveyor zero speed switch operated
 - iv) Boom Conveyor belt sway operated
 - v) Boom Conveyor pull cord switch operated
 - vi) Boom Conveyor brake not released.
 - vii) Boom Conveyor Motor overload/SPPR fault
 - viii) Back up limit switch operated.
 - ix) Wind velocity high.
 - x) Wind velocity very high.
 - xi) Slew limit switch operated.
 - xii) Slew drive fault.
 - xiii) Slew motor overload.
 - xiv) Slew drive lubrication system fault.
 - xv) Hydraulic oil temperature high.
 - xvi) Oil level low in hydraulic tank.
 - xvii) Hydraulic system filter clogged.
 - xviii) Bucket wheel brake not released.
 - xix) Bucket wheel zero speed switch fault.
 - xx) Bucket wheel motor overload/SPPR fault.
 - xxi) Power CRD motor overload.
 - xxii) Power CRD over tension switch operated.
 - xxiii) Control CRD motor overload.
 - xxiv) Control CRD over tension switch operated.
 - xxv) Travel drive brake not released.
 - xxvi) Travel drive motor overload/SPPR fault.
 - xxvii) Travel limit switch operated.
 - xxviii) Rail clamp not released.
 - xxix) DS motor overload/SPPR fault (to be provided for each motor).
 - xxx) HT load brake switch operated.

Annunciation system shall be similar to that of main Control Panel with 20% spare windows.

- h) Separate cable reeling drum shall be provided for power & control cable. Combined trailing cable shall have 24C X 2.5 mm² (cu) control cable and 8 pair 1.5 mm² (cu) screened cable for signal and communication.

1.02.00 ON/OFF operation of Wagon tippers shall be achieved from the respective Wagon tippler Control desk through PLC based logic. Control desk shall be provided in each Wagon tippler Control room for Control, Operation, Indication & Annunciation of Wagon Tippler equipment. Control desk shall interface with PLC for the entire operation and shall accommodate annunciation windows, ammeter, voltmeter, selector switches and indicating lamps for incomer, ammeter for outgoing motor feeder rated 30 KW and above. Other features as described above for the control desk of Stacker Reclaimer shall also be considered for Wagon Tippler.

1.03.00 MCC/DB/Local Starter Panel for Dust Suppression, Dust Extraction, Sump Pump, Coal Sampler, Bunker Level and other Panels

1.03.01 The Local Starter Panel shall be fixed type with compartmentalized execution. One (1) number 415 V \pm 10% 3 phase 4 wire 50 Hz \pm 5% power supply feeder shall be provided for each panel. Power shall be received through an incoming SFU having R/Y/B indication lamps, voltmeter with selector switch, ammeter with selector switch. Individual motor feeder shall have their switch fuse, power contactor, overload relay-cum-single phasing preventor (hand reset type), stop/ start push button, auto/manual selector switch, Red/Green/Trip indication lamp, auxiliary relays, timers, etc. The stop push button shall be lockable type. Necessary interlock, annunciation, 415/240 V Transformers for control supply, space heating as applicable to meet system requirement shall also be provided and in no case derive any power supply from its main feeder. Separate feeders shall also be provided for brakes and rail clamp as applicable. Facility shall be provided for resetting the motor overload relay from outside without opening the panel door. Panel door shall be interlocked with the incoming Switch such that the door can not be opened when Switch is ON.

Specification requirement of the above including module selection chart will be governed by 415 V MCC/PMCC Specification.

1.03.02 Interlock, control, indication, annunciation etc. shall be achieved by relay logic

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

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

1.03.05 Thermostatically control space heater shall be provided.

1.03.06 Necessary door interlock defeat feature shall also be provided for testing purpose. Wherever necessary, the panels shall be designed for outdoor and of weather proof/rain protection type. Ratings of components shall be as per module selection chart indicated under 415 V PCC/PMCC/MCC Specification.

1.03.07 Travelling Tripper DB cum Control Panel

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

- i) Brakes applied
- ii) Rail clamps applied
- iii) Flap Gate position
- iv) Travel driver over speed
- v) Travelling tripper – Forward/Reverse
- vi) Cable Reeling Drum on

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

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

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

- i) 4 pair core (Sheilded) for communication.
- ii) 4 Core for control.

1.03.08 Sump Pump Control Panel

Sump Pump Control Panel shall be provided with level controller, necessary contacts to start pumps in auto mode when level reaches high. Further, very high level shall cause hooter to blare and the same shall stop after sometime delay. In manual mode it shall be possible to start individual pump. However, in manual mode and auto mode of operation, pump shall be tripped when level in the sump pit reaches low.

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

1.03.09 Miscellaneous Control Panels

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

The requirement of 4-20 mA signals for Belt Weigher and bunker level indicator have been spell out in Mechanical Specification and accordingly the same shall be provided.

2.00.00 SPECIFIC DESIGN REQUIREMENT

2.01.00 Construction

a) **Stacker/Reclaimer/ Wagon Tippler Control Desk**

Ammeters and annunciation facia shall be mounted on the vertical portion of the panel and all push button; selector switches; indication lamps etc. shall be mounted on the desk portion. The front desk shall be with top inclined downward towards front. A removable type front door shall be provided on the desk portion along with a lockable and lift-off rear door for the panel portion of the desk-cum-panel.

Travelling Tripper/Magnetic Separator/Metal Detector/Dust Extraction/Dust Suppression/Ventilation/Coal Sampler/Bunker Level indication, Hoist/MCC/DB/Starter-Cum-Control Panel, Misc. Control Stations, Push Button Stations & Local Information Boards.

These panels/stations shall be furnished in sheet steel enclosures suitable for wall/column/floor mounting.

2.02.00 General

- a) Design, material selection and workmanship shall be such as to present a neat appearance outside and inside with no marks of welds, rivets, screws or bolt heads apparent from the exterior surface of the frames.
- b) Panels shall be of folded sheet steel construction, assembled on channel/angle base plates. Anti-vibration mountings shall be provided for moving equipment.
- c) The panels shall be fabricated of not less than 14 SWG sheet steel free from all surface defects. The panels shall have sufficient structural reinforcement to ensure a plain surface, limit vibration and provide rigidity during despatch and installation. Vertical panels shall be freestanding type.
- d) Sufficient inter-component spacing shall be available for easy maintenance, replacement, ventilation etc. of the components. A minimum spacing of 50mm is recommended for the same.
- e) All doors, covers etc. shall be properly gasketed to make the panel effectively vermin and dust proof. Door hinges shall be concealed type. Special dust protection measures shall be taken for panels located in dusty area.
- f) All hardware for the complete installation of the equipment including foundation and fixing bolts, nuts, washers etc. shall be supplied to suit

the requirement. All bolts, nuts etc. exposed to external atmosphere shall be cadmium plated or zinc passivated.

- g) The panels shall be liberally sized so as to provide spacious layout of equipment and devices with sufficient working space in between.
- h) Shock absorbers shall be provided for panels mounted on mobile machines.
- i) Maximum and minimum height of the operating devices on all panels except Local Control Stations shall be restricted to 1800 mm and 750 mm respectively from the floor level.

VOLUME : IIF/2

SECTION-IX

**TECHNICAL SPECIFICATION
FOR
ERECTION - CABLING, GROUNDING AND
LIGHTNING PROTECTION SYSTEM**

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE OF WORK
2.00.00	SCOPE OF SUPPLY
3.00.00	GENERAL REQUIREMENTS
4.00.00	DESIGN CRITERIA
5.00.00	SPECIFIC REQUIREMENTS - SUPPLY
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ATTACHMENTS

ANNEXURE-A	NOTES AND DETAILS FOR CABLING SYSTEM
ANNEXURE-B	NOTES AND DETAILS FOR GROUNDING AND LIGHTING PROTECTION SYSTEM

SECTION-IX

TECHNICAL SPECIFICATION FOR 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 Plant lightning protection system, all cabling and electrical grounding works. The scope shall broadly cover, but not be limited to :

1. Main Power House Building
2. Boiler area, ESP stack
3. Transformer yard
4. All auxiliary buildings (including electrical rooms of respective buildings) and structures as details in the Lead Specification.
5. Overhead interplant cable trestle and pipe cum cable trestle.
6. All electrical equipment as described in Volumes II-F/1 & II-F/2.

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

2.00.00 SCOPE OF SUPPLY

2.01.00 The scope of supply shall include but not be limited to the followings

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

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

- a) Galvanised steel pre-fabricated cable trays, coupler plates, nuts, bolts & washers, reducers, covers, wall brackets, hanger clamps, straight run, elbows, bends, etc.
- b) Galvanised steel rigid/flexible conduits and accessories, ferrules, lugs, glands, terminal blocks, galvanised sheet steel junction boxes, cable fixing clamps, nuts & bolts, etc. as required.
- 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, galvanised steel flats, galvanised steel rods, lead coated copper tube suitably brazed with galvanised steel Bend ring galvanised steel wires, etc. required for grounding and lightning protection system shall be supplied in standard lengths.
- f) Fire Stop mortal seal, fire retardant cable coating system .
- g) Any item of works or erection materials which have not been specifically mentioned but are necessary to complete the work involved shall be deemed to be included in the scope of this specification and shall be furnished by the contractor without any extra charge to the Purchaser.

2.01.02

- a) Main Ground Mat

Laying underground conductors and arc welding the conductors at each crossing and straight run (lap joint). The conductors at the periphery of the mat shall be 1 no. 40 mm diameter M.S. rod and the internal cross conductors of the mat shall be 1 No. 40 mm diameter M.S. rod. Suitable pigtailed shall be provided .Diameter of the ground grid conductors as indicated above is minimum . However bidder shall select the actual diameter of conductor with supporting calculation.

- b) Grounding Electrode

Fabrication and driving into ground 40 mm. diameter 3000 mm long M.S. rod and connecting them to the grounding mat by arc welding.

- c) Column Grounding

- i) Concrete Columns

Erection of 1 no. 40 mm. dia. M.S. rod from grounding mat to all concrete columns including necessary fixing, welding of one end of the rod with ground mat and the other end with the column above ground by welding with a short GS flat to edge angles.

- ii) Steel Columns

Erection and connection of 1 No. 40 mm diameter M.S. rod from grounding mat to all steel columns including necessary fixing, welding of one end with ground mat and the other end with the column above ground with a short GS flat.

Diameter of the Earth Electrode as indicated above is minimum. However bidder shall select the actual diameter of conductor with supporting calculation

d) Risers

Erection and connection of all risers from underground mat to above ground levels where the ends will be left free for connecting to the equipment. Each riser will be 1 No. 40 mm dia. M.S. rod and Minimum 300 mm above grade level/concrete floor level.

Diameter of the Earth Riser as indicated above is minimum. However bidder shall select the actual diameter of conductor with supporting calculation

e) 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 (400x100x10mm) of all electronic panels shall be connected by insulated wire to an insulated common electronic ground bar as shown in the Grounding Notes and details drawing.

All connection made above shall be in the form of a radial distribution system without any parallel ground paths.

Electronic equipments 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 of 3M X 3M min 40 mm dia ground rod.

f) All other ancillary works in connection with the items of work described above which are not specifically mentioned but are necessary to complete the work, shall be under the scope of this specification.

2.01.03

a) Air Terminal

Installation of vertical 20mm dia galvanised steel rod (except for chimney). The projected length of the rod shall be as required to protect the object. (on which the rod is fixed from lightning stroke).

Installation of air terminal at top the stack/chimney for lightning protection shall be 20mm dia coated solid copper rod.

b) Horizontal Air Terminal

Erection of horizontal air terminal of 75X 10 mm GS flat conductor in such a way that no part of of the roof will be more than nine meters from the nearest roof conductor.

c) Down conductor

Erection of down conductor 75 X 10 mm GS Flat and 25 X 3 mm GS flat (Conveyor Gallery) conductor. one end of this down conductor connected with air terminal rod/ horizontal conductor at the top of roof/structure and other end connected to the nearest 40mm dia MS

rod riser through test link located at approximately 1500mm above ground level.

d) Electrode (for Lightning protection)

Fabrication and driving into ground 40 mm. diameter 3000 mm long M.S. rod and connecting them to the grounding mat by arc welding.

e) Risers (for Lightning protection)

Erection and connection of all risers from underground mat to above ground levels where the ends will be left free for connecting to the equipment. Each riser will be 1 No. 40 mm dia. M.S. rod and Minimum 300 mm above grade level/concrete floor level.

Diameter of the Earth Riser as indicated above is minimum. However bidder shall select the actual diameter of conductor with supporting calculation

f) Shielding Mast

Erection of shielding mast at the top of steel columns cap plates of power house building.

g) All other ancillary works in connection with the items of work described above which are not specifically mentioned but are necessary to complete the work, shall be under the scope of this specification.

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

2.03.00 Necessary drawings, data sheets and Technical leaflets on each piece of material.

2.04.00 **Scope of Services**

The scope includes but is not limited to the followings;

2.04.01 Furnishing of all erection tools and tackles, testing equipment, implements, supplies, hardware and transport for timely and efficient execution of the erection work.

2.04.02 The items of erection work shall be performed with respect to the following equipment/materials :

a) Power Cables

b) Cables laid directly buried in ground

c) Control, instrument and special cables

d) Supply and erection of entire cable tray and cable shaft arrangements indoor as well as outdoor area and all associated civil and structural works including foundation and cable trenches for complete plant.

- e) Supply and Erection of Grounding system.
- f) Supply and Erection of Lightning Protection system.

3.00.00 GENERAL REQUIREMENTS

3.01.00 Codes and Standards

- 3.01.01 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.
- 3.01.02 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.
- 3.01.03 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 entire erection work shall be carried out in a phased manner. A schedule of the work showing the sequence of erection shall be submitted by the tenderer for this purpose.
- 3.02.02 The erection schedule, as approved by the Owner's Engineer shall be strictly followed by the contractor. If, for any reason beyond the control of the Contractor, the work is held-up then the Contractor shall bring it to the notice of the Owner's Engineer without any delay.

4.00.00 DESIGN CRITERIA

4.01.00 Grounding System

4.01.01 Grounding shall follow the relevant standards/codes amended till date as below:

- a) Indian Electricity rules
- b) National Electrical Code
- c) Code of Practice of Earthing IS 3043
- d) Protection of building and allied structures against lightning IS 2309
- e) IS- 732, IS 226, IS 2629, IS 2633 & IS 4759
- f) IEEE -80 ,IEEE-665

The station grounding system shall be an interconnected network of MS conductor and MS ground rods. The system shall be provided to protect plant personnel and equipment from the hazards, which can occur during power system faults and lightning strikes

4.01.02 The main objectives of grounding system are to :

- a) Provide safety to personnel from contact of dangerous potential caused by ground fault.
- b) Ensure sufficient grounding current for effective relaying.
- c) Stabilize circuit potential with respect to ground.

Design Basis

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 owner.

Actual soil resistivity measurement shall be carried out at proposed site for new units during dry season.

The surface Resistivity shall be considered as 3000-ohm meter for Gravel and 1000 ohm-meter for concrete.

- a) 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 under ground grid.
- b) 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.
- c) Instrumentation cable screens shall be single point bonded to the instrument earth network to minimize the effects of electrical interference.
- d) 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.
- e) A grounding conductor (steel wire armor) shall be routed parallel to all power conductors operating above 240 volts.
- f) All ground wires installed in conduits shall be uninsulated.
- g) Embedded grounding grid of 75x10mm GI flat at basement/grade slab as well as upper floor/suspended slabs shall be provided.
- h) 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 75x10mm GI flats.

- i) 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.
- j) Dedicated treated earth pit shall be provided for lightning protection system.
- k) 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.
- l) 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.

4.01.03 In order to meet the above objectives, 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.

The major aspects to be considered for grounding system design are given below :

4.01.04 Ground Grid Conductor

- a) Ground grid conductor of mild steel rod shall be used.
- b) 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 one (1) no. 40 mm dia mild steel conductor.

4.01.05 Underground Grid

- a) The ground grid mesh is designed to keep the touch and step voltages within safe limits as per recommendation of IEEE 80 & IEEE665.
- b) 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.
- c) The ground grid conductor will be so laid as to provide short and direct connection to building steel and major electrical equipment.
- d) Ground rods shall be provided at the points where system neutrals/lightning protections are connected to the ground grid.

- e) All ground grid conductor connections will be welded type.
- f) Main Plant ground grid shall be connected with the other auxiliary building /area ground grid at least at two (2) points.
- g) 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

4.01.06 Above Ground Connections

- a) Galvanised steel flats shall be used for all connections above earth.
- b) 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.
- c) Two separate and distinct ground connections will be provided for each electrical equipment in compliance with I.E. Rules.
- d) All connections above ground will be welded type except connection to equipment/structures which shall be bolted type.

4.01.07 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.

4.01.08 Electronic Equipment Grounding

Internal ground connection of electronic panels shall be insulated from the enclosure, frame, chassis and to be terminated to an insulated ground bus.

Insulated ground bus of all electronic panels shall be connected by insulated wire to an insulated common electronic ground bar.

All connection made above shall be in the form of a radial distribution system without any parallel ground paths.

Electronic equipments 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.

4.01.09 The minimum ground conductor sizes for various equipment and structures are given in Annexure-B.

4.01.10 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**

Lighting protection system design shall be as per IS:2309

4.02.01 The main purposes of lightning protection system are to :

- a) Provide protection to structures from lightning strokes.
- b) Provide a low resistance-conducting path to lightning discharge.

4.02.02 Lightning protection shall be provided for Power House building, auxiliary building , chimney, cooling tower and other structures.

4.02.03 Lightning protection will also be provided for building/ structures where the overall rise factor exceeds 10^{-6} as per IS:2309.

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

4.02.05 **System Design**

- a) Air termination network with down conductors and earthing electrodes will be provided on the basis of IS Code of Practice.
- b) Horizontal air termination shall be so laid out that no part of the roof will be more than 9 meters from the nearest conductor.
- c) 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.
- d) Down conductors will run along the outer surfaces of the building and shall have a test joint about 1500 mm above ground.
- e) An earth electrode will be provided at the connection point of the down conductor with the station ground.
- f) Galvanised steel rods and flats will be generally used for air termination and connections. All connections will be welded type.
- g) For air terminals of chimney, lead coated copper tube suitably brazed with G.S. Band ring shall be provided.

4.03.00 **Cabling System**

4.03.01 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.

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

4.03.03 Cables will generally be laid on cable trays, cable trench, cable rack, overhead supported from building steel/structures or cable bridge/cable trestle. Cables shall be run in concrete trenches in transformer yard and in those electrical rooms at ground level, which are without any spreader room below. However cable trench shall be avoided as far as possible in outdoor areas. Cables buried directly in ground are not acceptable.

- In indoor pumps, mechanical equipment areas overhead cable trays shall generally be used.
- 4.03.04 For outdoor area cable shall be laid both in cable trench and cable trays within overhead pipe bridge. However cable trench shall be avoided as far as possible in outdoor areas and cable rack shall be used in Pipe Bridge for outdoor area cable interconnection
- 4.03.05 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).
- 4.03.06 A.C. and D.C. circuit will not be run in same cable. Further, separately fused circuit will run in separate cables.
- 4.03.07 Cables for redundant equipment system shall be run in separate trays, as far as possible.
- 4.03.08 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.
- 4.03.09 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 horizontal/vertical accelerations due to seismic forces for indoor trays and also wind load for outdoor trays such as on Boiler platforms in addition to normal tray cable loadings.
- 4.04.00 All erection work to be carried out under this specification shall conform to the notes and details given in Annexure-A & drawing 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 Equipment and materials furnished shall be complete and operative in all details.
- 5.01.03 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.
- 5.01.04 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 **Pre-fabricated Cable Trays**
- 5.02.01 Cable trays shall be pre-fabricated ladder type sheet steel with hot dip galvanising furnished in standard length of 2.5 metres.

- 5.02.02 Cable trays shall be of standard width specified in Annexure-A and drawings.
- 5.02.03 Cable trays shall be complete with all necessary hot dip galvanised sheet steel accessories such as coupler plates, ground continuity connections, nuts, bolts, washers, hangers, clamps, etc. Also horizontal/ vertical bends, horizontal/ vertical Tee, Reducers, Horizontal cross-pieces, protective covers shall be supplied along with straight runs in order to take care of cable tray alignments in different routes.
- 5.02.04 All fittings like horizontal/ vertical elbow, horizontal crosspiece, reducer, horizontal tee, etc. should be prefabricated.
- 5.02.05 Cable trays, fittings & accessories as well as elbows, reducers, tees, crosses, etc. shall be fabricated out of 14 gauge (2 mm thick) hot rolled mild steel sheets.
- 5.02.06 Contractor shall supply 16 gauge (1.6 mm thick) perforated type hot rolled mild steel sheet covers for vertical cable shafts up to a height of 2.5 metres from floor level. The perforated covers used for the vertical raceways may be of one or more pieces along the width of the raceway, depending on the width of the raceway and shall be bolted to the structural framework of the raceway.
- 5.02.07 The cable trays, fittings and accessories including all bolts, nuts, screws, washers, etc. shall be hot dip galvanised after fabrication as per IS:2629. Galvanising shall be uniform, clear, smooth and free from acid spots. Should the galvanising of the samples be found defective, the entire batch of steel will have to be regalvanised at Contractor's cost.
- 5.02.08 Each 2.5M long section of all types of cable trays & each fittings like elbow, tees, crosses, etc. shall be provided with two nos. hot dip galvanised side coupler plates & associated bolts, nuts and washers on each side.
- 5.02.09 The Contractor shall perform all tests necessary to ensure that the material and workmanship conform to the relevant standards and that such tests are adequate to demonstrate that the equipment will comply with the requirement of this specification.

The amount of zinc deposited shall not be less than 610 gms per square metre of surface area and in addition the thickness of the zinc deposit at any spot whatsoever, shall not be less than 75 microns. The Owner reserves the right to measure the thickness of zinc deposit by Elcometer or any other instrument and reject any component, which shows thickness of zinc at any location to be less than 75 microns.

The tolerance on dimensions shall be in accordance with appropriate Indian Standards. The extent of the tests to be performed by the contractor shall include but not be limited to the following:

Deflection Test

A 2.5 metre straight section of each type of cable trays shall be simply supported at the two ends. A uniformly distributed load of 100 Kg per metre will be applied along the length of the tray. The maximum deflection at mid span shall not exceed 7 mm.

- 5.02.10 For other details refer CABLING NOTES AND DETAILS annexed to this specification.
- 5.03.00 **Conduits and Accessories**
- 5.03.01 Conduits shall be of rigid steel, hot-dip galvanised, furnished in standard length of 5 metres, threaded at both ends.
- 5.03.02 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.
- 5.03.03 Each piece of conduit shall be straight, free from blister and other defects, internal surface shall be of smooth finish and covered with capped bushings at both ends.
- 5.03.04 The contractor shall provide and install all rigid steel conduits, mild steel pipes, flexible conduits rigid PVC pipes, etc. complete with accessories such as tees, bends, adapters, locknuts, pull boxes, conduit plugs, caps, etc as required for the cabling work.
- 5.03.05 Steel conduits with interior coating of silicon epoxy ester for ease of wire/cable pulling shall be seamed by welding and flo-coat metal conduit/hot-dip galvanised. These shall be supplied in standard length of 5M with minimum wall thickness as specified in IS:9537. 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.
- 5.03.06 For sizes above 63 mm mild steel pipes with necessary fittings & accessories shall be provided and installed by the contractor. Pipes shall be manufactured by electric welding process. These pipes shall be of heavy duty class as per IS:1239 and shall have ISI mark. Pipes shall be supplied in lengths of approximately 5 metres. Pipes, fittings & accessories shall be hot dip galvanised both on inside and outside.
- 5.03.07 Flexible conduits shall comply with IS:3480. They shall be made with bright, cold-rolled, annealed and electro-galvanised mild steel strips. Flexible conduits shall be used between embedded conduits/pipes and the motor terminals. Flexible conduits shall also be used between fixed conduit and any equipment terminal boxes where vibration is anticipated or equipment that require regular removal.
- 5.03.08 Rigid PVC conduits conforming to IS:4985 shall generally be used for control & instrumentation cables in some areas where cable trays do not exist and where the runs are straight ones generally the PVC pipes with special Bell Mouthing shall be of 110 mm,160 mm & 200 mm outside diameter and shall be suitable for working pressure of 6 kg/sq. cm. The length of each pipe shall be 5 to 6 metres. Necessary fittings & accessories as may be required for the installation shall also be provided.
- 5.04.00 **Junction Boxes**
- 5.04.01 Glass Fibre Reinforced Junction Boxes

1. No. of Ways:12 / 24 / 36 / 48 with 20% spare terminals.
2. Design:

Junction boxes shall be Glass Fibre Reinforced with saturated polyester informing to standards like DIN 16911 type 803 / 16913 type 834, 5 self extinguishing in accordance with ASTM D 635 / UL 94 VO.

Junction boxes for use in outdoor or damp locations shall be sturdy construction. Temperature resistance between – 10 to 100 deg C. Impact resistance shall be greater than 7 Nm, (EN 50 014). Protective insulation shall be in line with VDE 0100, dielectric strength shall be greater than 10 KV/mm, halogen free toxicity, the enclosure and door cover shall be painted and electrostatically powder coated (preferably in RAL 7032). Earth connection (studs size shall be M 6) shall be provided on the cover as well as door.

Doors:

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

- a) Protection Class :

Protection Category shall be IP 66 to EN60 529. There shall be guaranteed perfect seal to meet Protection class IP 66 providing sealing arrangement like highly elastic foamed in special type seal like polyurethane / chloroprene. The sealing rubber shall not have aging effect and shall retain its sealing characteristics for more than 20 yrs. Bidder shall indicate this in data sheet. The rubber seal should be pasted at its place with pasting technology for like more than 20 yrs (double sealing arrangement is preferred).

- b) Mounting clamps and accessories :

Suitable for mounting on walls, columns and structure. Brackets, bolts, nuts, screws, glands and lugs required for erection shall be of brass. The accessories like mounting plants etc. of steel shall be powdered coated. The support rails for terminal box shall be zink coated.

- c) General :

- i) JBs shall have small canopy at the top.
- ii) There shall be rainwater collection arrangement from top and side of the outer ages to ensure that any leakage in to the junction box shall be avoided and it shall fall outside.
- iii) Cable entry shall be from bottom side only.
- iv) Ensure gland plate sealing perfect. It shall be of the same quality and arrangement as that of door to cover arrangement.

5.04.02 Steel Junction Boxes :

- a) No. of Ways:12 / 24 / 36 / 48 with 20% spare terminals.
- b) Design :
- Junction boxes shall be designed in accordance with NEC, article 370, paragraph 18, 20 or equivalent standards.
- c) Enclosure :
- Junction boxes for use in outdoor or damp locations shall be sturdy steel construction. The enclosure and door cover shall be surface finished clean, degreased, phosphated, deep coated primed (preferably in RAL 7044) and electrostatically powder coated (preferably in RAL 7032). Earth connection (studs size shall be M 6) shall be provided on the cover as well as door. The sheath steel thickness shall be minimum 2 mm.
- d) Doors :
- The doors shall be hinged and lockable. The doors shall have industrial heavy – duty hinges. The doors shall be easily but firmly lockable with quick release fastener.
- e) Protection Class :
- Protection Category shall be IP 66 to EN60 529 / 10.91 complies with NEMA 4. There shall be guaranteed perfect seal to meet Protection class IP 66 providing sealing arrangement like highly elastic foamed in special type seal like polyurethane. There shall be an arrangement like multifold protection channel for additional stability and prevention of ingress of dust and water when the enclosure is open.
- The sealing rubber shall not have aging effect and shall retain its sealing characteristics for more than 20 yrs. Bidder shall indicate this in data sheet. The rubber seal should be pasted at its place with pasting technology for like more than 20 yrs (double sealing arrangement is preferred).
- f) Mounting clamps and accessories:
- Suitable for mounting on walls, columns and structure. Brackets, bolts, nuts, screws, glands and lugs required

- 5.04.03 The junction boxes shall have the following indelible marking
- Circuit nos. on top by white-stenciled paint at site.
 - Circuit nos. with ferrules (inside) as per approved drawing.
 - Danger sign in case of 415V circuit.

5.05.00 **Terminals**

- 5.05.01 Multiway terminal blocks of approved type, complete with screws, nuts; washers and marking strips shall be furnished for connection of incoming/outgoing wires.

5.05.02 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.

5.06.00 Cable Termination & Jointing Kits

5.06.01 The 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. All the materials and components of the termination/joints shall be suitable and compatible with the type of cables for which the terminals/ joints are intended.

5.06.02 The straight through joints of H.T. and L.T. cables shall be of Tapex/ Paracast/Parawrap type. The end termination kits for H.T. cables shall be of Raychem/3M/Elastimold type. Cable joint or end terminations on Electrical equipment shall be suitable for Indoor & Outdoor use, as the case may be.

5.06.03 Glands and lugs required for termination of H.T., L.T. and instrumentation cables shall be supplied by the Contractor in required quantity.

5.07.00 Cable Glands

Cable glands shall be tinned brass gland, double compression type complete with necessary armour clamp and tapered washer, etc. Cable glands shall match with the sizes of different HT/LT/Control cables.

5.08.00 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 Consumables and Hardware

5.09.01 The Contractor shall furnish all erection materials, hardware and consumables required to complete the installation.

5.09.02 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.
5.09.03 Supply of cement, sand, stone, etc. required for the execution of the contract shall be the responsibility of the Contractor.

5.10.00 **Testing Equipment**

5.10.01 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.

5.10.02 The list of equipment is indicative only. Any other test equipments 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**

7.01.01 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.
- 7.05.03 In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cable.
- 7.05.04 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.
- 7.05.05 The drum shall be rolled on the spindle slowly so that the cable should come out over the drum and not below the drum.
- 7.05.06 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.
- 7.05.07 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.
- 7.05.08 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 All 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 All H.T. multicore power cables and L.T. multicore power cables with cross-sectional area including & above 95 sq.mm 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.
- 7.06.09 After completion of installation and prior to connection, all power cables shall be subjected to a high potential test.

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 The location of cable joints, if any, shall be clearly indicated with cable marker with an additional inscription 'cable-joint'.
- 7.07.04 The 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 The 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 The 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.
- 7.08.03 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.
- 7.09.00 **Termi-point Connection**
- a) The conductor (solid or stranded) is forced against the contact area of the 2.4 x 0.8 mm or 1.6 x 0.8 mm connection pin by means of a

tin-coated bronze clip, which maintains a constant pressure. In the Maxitermi-point method, 2.4 x 0.8 mm pins is used without exception.

- b) The conductor is "shot" onto the pin together with the clip. The resulting friction causes both the wire and the contact area of the pin to be cleaned and any oxide layers to be penetrated.
- c) Apart from this the wire and the clip are deformed in such a way that a gas-tight connection with very good electrical and mechanical properties is established.
- d) A special manually or pneumatically driven gun is required. Up to 3 adjacent connections can be "shot" onto one pin. In most cases only one clip at the base of the pin is attached. The sections above usually remain vacant. Any part of a connection pin may be reused several times after removal of the existing clip connection. Contact areas below existing connections that have become vacant can be reused by pushing the connections above the vacant space downwards, so that the new connection can be "shot" on above the top connection. The single jumper wires need not be specially prepared as the end insulation is stripped within the tool.
- e) This connection method requires special insulation of the wires. The diameter of solid conductors is 0.8 mm the cross-section of stranded conductors 0.5 Sq.mm.
- f) The conductor is deformed greatly when attached and is to be shortened by 3 mm when disconnected and reused.
- g) Strips and special tools for termi-point connection shall be supplied by the Contractor.

7.10.00 Cable Joints

7.10.01 Cable shall be installed without joints as far as practicable.

7.10.02 If however jointing becomes necessary, it shall be made only by qualified cable jointer and strictly in accordance with manufacturer's recommendation.

7.11.00 Grounding

7.11.01 The 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 enclosed grounding and lightning protection notes and details.

7.11.02 The grounding shall be done by conductors of adequate sizes (size shall be selected by the bidder with supporting calculation) and the same shall be connected to the risers of main ground mat.

7.11.03 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.

- 7.11.04 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.
- 7.11.05 All ground conductors shall be painted black for easy identification.
- 7.11.06 Equipment ground connections, after being checked and tested by the Engineer, shall be coated with anti-corrosive paint.
- 7.11.07 Whether specifically shown or not, 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.
- 7.11.08 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.
- 7.11.09 The 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.
- The Contractor will plan and organise works to lay the grounding mat in the same sequence in which the building and equipment foundation is being done.
- 7.11.10 Ground Electrode
- Ground electrodes will be 40 mm dia (minimum) and 3 metre long M.S. rod. These are to be fabricated and driven into the ground by the side of mat conductor. All connections to the conductors shall be done by arc welding process.
- 7.11.11 Risers
- Risers are required for connecting the equipment and structures with the ground mat. These will be 1 No. 40 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.
- 7.11.12 Column Grounding
- All columns are required to be grounded by 1 no. 40 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.

7.11.13 Electronic Equipment Grounding

Internal ground connection of electronic panels shall be insulated from the enclosure, frame, chassis and to be terminated to an insulated ground bus.

Insulated ground bus of all electronic panels shall be connected by insulated wire to an insulated common electronic ground bar.

All connection made above shall be in the form of a radial distribution system without any parallel ground paths.

Electronic equipments 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.

7.12.00 Painting

7.12.01 The 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.

7.13.00 Galvanising

7.13.01 The galvanising shall be uniform, clean, smooth, continuous and free from acid spots. Should the galvanising of the samples be found defective, the entire batch of steel has to be regalvanised, at Contractor's cost. The amount of zinc deposit shall not be less than 610 grams per square metre of surface area and in addition, the thickness of the zinc deposit at any spot whatsoever shall not be less than 75 microns. The Owner reserves the right to measure the thickness of zinc deposit by Elkometer or any other instrument and reject any component which shows thickness of zinc at any location less than 75 microns.

7.14.00 Excavation and Back Filling

7.14.01 The Contractor shall perform all excavation and backfilling as required for buried cable and ground connections.

7.14.02 Excavation shall be performed up to the required depth. Such sheeting and shoring shall be done as may be necessary for protection of the work.

7.14.03 The Contractor shall make use of his own arrangements for pumping out any water that may be accumulated in the excavation.

7.14.04 All excavation shall be backfilled to the original level with good consolidation.

7.15.00 Steel Fabrication

7.15.01 All racks, trays, supports, hangers & brackets wherever necessary shall be fabricated by the Contractor.

7.15.02 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.

7.16.00 **Cleaning up of Work Site**

7.16.01 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.

7.16.02 Upon completion of work, the Contractor shall remove all rubbish, tools, scaffoldings, temporary structures and surplus materials etc. to leave the premises clean and fit for use.

8.00.00 **TESTS**

8.01.00 Shop Tests

8.01.01 All equipment shall be completely assembled, wired, adjusted and routine tested as per relevant Indian Standards at manufacturer's works.

8.01.02 Tests on panels/junction boxes shall include :

- a) Wiring continuity tests.
- b) High voltage and insulation tests.
- c) Operational tests.

8.02.00 **Site Tests**

8.02.01 Contractor shall thoroughly test and meggar all cables, wires and equipment to prove the same are free from ground and short circuit.

8.02.02 If any ground or short circuit is found, the fault shall be rectified or the cable and/or equipment replaced.

8.02.03 All power cables after installation and prior to connections shall be subjected to High Potential tests. Also the insulation resistance values shall be measured both before and after Hipot test for comparison. The leakage current shall also be measured during the Hipot test at site.

Cable cores shall be tested for :

- a) Physical damage
- b) Continuity
- c) Correctness of connections as per relevant wiring diagram
- d) Insulation resistance to earth
- e) Insulation resistance between conductors
- f) Proper earth connections of cable glands, cable boxes, cable armour, screens etc.

- 8.02.04 All equipment shall be demonstrated to operate in accordance with the requirements of this specification.
- 8.03.00 **Test Certificates**
- 8.03.01 Type test certificate on any equipment, if so desired by the Owner, shall be furnished. Otherwise the equipment shall have to be type tested, free of charge, to prove the design.
- 9.00.00 **DRAWINGS, DATA & MANUALS**
- 9.01.00 To be submitted with the Bid
- 9.01.01 Make, type and catalogue number of different electrical items and accessories along with technical leaflets, data sheets etc.
- 9.01.02 Typical General arrangement drawings showing constructional features, fixing arrangement of pre-fabricated cable trays.
- 9.01.03 Bill of Materials for cable trays and accessories, conduits & accessories.
- 9.01.04 Layout of Grounding system & lightning protection system showing connection and other details along with backup design calculations and detailed write up.
- 9.01.05 Bill of materials for grounding and lightning protection system.
- 9.01.06 Drawing showing details of equipment grounding.
- 9.02.00 **To be submitted after Award of Contract**
- 9.02.01 Make, type & catalogue number of cable termination kits, joints & accessories.
- 9.02.02 Detail dimensional drawings showing constructional features, grounding, fixing arrangement etc.
- 9.02.03 Bill of Materials for Pre-fabricated cable tray and accessories, Conduits & accessories.
- 9.02.04 Dimensional G.A. drawings and data sheets for different equipment and items supplied under this specification.
- 9.02.05 Layout drawing of Grounding system and Lightning protection system showing connection details along with backup design calculation and detailed write up.
- 9.02.06 Bill of material for grounding system and lightning protection system.
- 9.02.07 Drawing showing details of equipment grounding system.

ANNEXURE-A

**NOTES AND DETAILS
FOR
CABLING SYSTEM**

1.00.00 GENERAL

1.01.00 These notes and details shall be read and construed in conjunction with Specification and the drawings meant for cable tray details and supporting arrangements in Trench, Racks etc., enclosed elsewhere. In case of conflict between these notes and drawings, the latter shall prevail.

1.02.00 The Cabling System installation work shall conform to the requirements of the latest revisions of the following standards/codes

- a) Indian Electricity Rules, 1956, with up to date amendment.
- b) I.S. Code of Practice.

2.00.00 CABLE ROUTING/LAYING

2.01.01 Cables shall generally be laid on ladder type cable trays either in trenches or overhead supported from building steel/structures except in some cases cables may have to be laid underground and for short runs in conduits for protection or crossing.

2.01.02 For interplant connections, the cables may be directly buried or routed through an overhead cable bridge or cable trenches/tunnels selection being dependent on site constraints.

2.01.03 For underground crossing of railways, roads etc. hume pipes shall be used and shall be laid at a depth of minimum 1000 mm such that cables shall not be damaged.

2.01.04 In boiler area, trench will be avoided as far as practicable. The cable racks shall be supported from Boiler structure in vertical configuration with suitable cover to avoid deposition of coal dust as far as practicable.

2.01.05 Different voltage grade cables shall be laid in separate trays when trays are arranged in tiers. Power cables shall be on top trays and Control/Instrumentation cables on bottom trays, and it is recommended that trays for cables of different voltage levels be stacked in descending order with higher voltage level above.

2.01.06 Cables for redundant equipment/system shall be run in separate trays in separate route.

2.01.07 Cables from two different services viz. supply from station board and supply from unit board shall be fully segregated to prevent simultaneous damage due to fire in one of the services.

- 2.01.08 Low level signal cables and other special Instrumentation and Control cables shall run in separate trays. In general, a minimum of 1500 mm clearance shall be maintained between these cables and noise generating equipment (large motors, generators, transformers etc.).
- 2.01.09 The cable spreaders of each unit shall be compartmentalized by provision of fire proof partition wall.
- 2.01.10 The floor of the cable spreader rooms will have to be made water proof so that water does not percolate to lower levels in the event of fire fighting operations. Adequate arrangement for efficient drainage of water shall be provided. The cable raceways should also be suitably curved to avoid water entry through this place.
- 2.01.11 Cabling System for CHP
- a) Cable in CHP area shall be generally routed through the conveyor gallery / tunnel, TP / Buildings by separate supporting structures, Pipe cum cable bridge. The cables shall be laid in vertical trays.
 - b) In substation & Switchgear room cable shall be laid in horizontal cable trays installed in cable vault room.
 - c) Cables may also be routed through hume pipes to enter into various buildings from the nearest overhead cable trestle/substation building..
 - d) Overhead cable trestle/cable bridge shall be provided for routing of cables between the following Sub-Stations/buildings:
 - i) Main CHP Substation Building and Crusher House.
 - ii) Main CHP Substation Building and Pump House.
 - iii) Wagon Tippler Substation Building and TP.

The bottom of the steel supporting structure shall be generally at 2.5m above the grade level except for road crossing and rail crossing where the same shall be 6.5 m and 9.0m respectively above grade level.
 - e) Cable trays shall be laid out horizontally in sub-station buildings and pump-house whereas the same shall be installed vertically inside transfer points, crusher house, conveyor gallery/tunnel etc. The cable trestle shall have a minimum 600mm clear walk way all along its routes and shall have maintenance platforms as required.
 - f) Separate trays shall be provided for H.T., L.T., control and instrumentation cables. LT multicore Power cables shall be laid touching each other in single layer & touching formation and single core cable in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil centre lines and clamped at every two meter while control and instrumentation cables shall be laid in maximum of two layers formation. Single core HT power cables shall be laid on trefoil formation with a distance of four times the diameter of cable between trefoil centre lines and clamped at every two meter and Multi core power cables shall be laid in single layer & touching formation. Normally cable trays shall be designed with 70%

fill-in criteria and conduit 40% fill-in criteria. Same cable laying philosophy shall be considered in other areas of the plant, if not specifically mentioned.

2.02.00 Cable Trays/Supports

2.02.01 Cable trays and covers shall be pre-fabricated type, constructed from minimum 14 SWG sheet steel for trays and 16 SWG for covers and hot-dip galvanized after fabrication.

2.02.02 Cable tray supports shall be cantilever type for each installation. All supports and hardware shall be hot-dip galvanized.

2.02.03 Standard cable tray width shall be 600 mm. However, trays with 450, and 300, 150 mm width may be used in some places considering the requirement and space restrictions. For instrumentation and control purpose, some perforated type cable trays of width 150 and/or 100mm may be used particularly in Boiler Platform area, and 600, 450, 300 mm perforated trays may be used depending on site requirement.

2.02.04 Cable trays shall be ladder type with 250 mm rung spacing, 100 mm depth and rung width not less than 50 mm.

2.02.05 All weld for cable tray supports shall have a min. throat thickness of 6 mm.

2.02.06 Cable trays in areas subjected to excessive coal dust, or mechanical damage will have hot-dip galvanized sheet metal tray cover installed on front tray in vertical run and inverted 'V' type on upper tray in horizontal run.

Where covers are used on trays containing power cables, consideration should be given to ventilation requirements. Areas where corrosive chemicals are likely to be handled, cable tray and covers shall be epoxy painted.

2.03.00 Conduits

2.03.01 Conduits shall be rigid steel coated type; minimum size of conduit shall be limited to 19mm.

2.03.02 Steel conduits with interior coating of silicon epoxy ester for ease of wire pulling shall be seamed by welding and flo-coat metal conduit/hot-dip galvanized. These shall be supplied in standard length of 5M with minimum wall thickness as specified in IS:9537 Part-II. In chemical handling areas, Battery room etc., the exterior surface shall be further coated with chromate and polymer for better resistance to corrosion.

2.03.03 Conduit runs shall be supported at an interval of 750 mm for vertical run and 1000 mm for horizontal run.

2.03.04 Conduits shall be sized so that conduit fill (ratio of total cable area to conduit area) shall not exceed the following :

One Cable	:	53%
Two Cable	:	31%
Three Cables & Up	:	40%

- 2.03.05 Conduit runs shall be provided with necessary bends as required.
- 2.04.00 **Installation**
- 2.04.01 The Contractor shall install terminate and connect up all cables and conduits with supporting arrangements as per drawings, cable schedules and interconnection chart/drawings.
- 2.04.02 The HV power cables of 11 KV/6.6/3.3 KV shall be laid in trays or racks as follows :
- a) In single layer only.
 - b) Multi core cables to be laid in touching with each other.
 - c) Single core cables to be laid in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil centerlines and clamp every two meter.
- 2.04.03 1100V grade power cables shall be laid in single layer in trays.
- 2.04.04 1100V grade mutlicore power cable shall be laid in touching formation to each other.
- 2.04.05 1100V grade Single core cables to be laid in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil centerlines and clamp every two meter.
- Control and Instrumentation cables can be laid up to a maximum of two layers in each tray.
- 2.04.06 Normally cable trays shall be designed with 70% fill-in criteria and conduit 40% fill-in criteria. Same cable laying philosophy shall be considered in other areas of the plant, if not specifically mentioned.
- 2.04.07 The trays shall be run with a vertical spacing of 300 mm for overhead cable trays as well as inside cable trenches. A minimum of 225 mm clearance shall be provided between the top of tray and beams, cold piping, 500 mm clearance for hot piping/object to facilitate installation of cables in tray.
- 2.04.08 Adequate pull boxes shall be provided in conduit run to facilitate cable pulling in long runs and also to ensure that there will be no more than 270 Deg. bends between pull points.
- 2.04.09 Cable tray/conduit system shall be installed to accommodate cable manufacturer's recommended maximum pulling tension and minimum bending radius.
- 2.04.10 All openings in the floor and wall for cable access shall be sealed after installation of the cable system with non-inflammable materials, as follows :
- i) Fire stop/Penetration seal shall be installed in the cable spreaders and cable raceways.
 - ii) Similarly in the trenches fire stop/penetration seals shall be provided at suitable interval to avoid spread of fire.

- iii) For all H.T., L.T., Relay and Control panels, Control desk, instrumentation panels, battery charger, D.C. Dist. boards and other miscellaneous panels, fire-stops should be provided below base plate.

2.04.11 All floor/wall openings for cable entry to the electrical equipment and accessories shall be sealed with non-inflammable materials, after completion of cable installation. Thickness of such materials shall be equal to the thickness of floor/wall unless specified otherwise.

2.04.12 The portion of galvanised steel, which, if required, undergoes any welding at site shall be coated with two (2) coats of cold galvanising anti-corrosive paint after welding.

2.04.13 Refer Clause No. 3.00.00 below for details of fire-proof sealing and fire protection coating.

2.05.00 **Identification**

2.05.01 The complete cabling system shall be properly identified. Methods for identification of cabling system shall be furnished to the successful EPC Contractor shall strictly adhere to the said methods.

2.05.02 Each cable and conduit run shall be tagged with numbers that appear in the cable and conduit schedule.

2.05.03 Location of cables laid directly underground shall be clearly indicated with cable marker made of galvanised iron plate, projected above ground level.

2.05.04 Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry, at each bend and at every thirty (30) metres in cable tray/trench runs. Cable tags shall also be provided inside the switchgear, MCC, control & relay panels etc. wherever required for cable identification, such as where a number of cables enter together through a gland plate.

3.00.00 **FIRE-PROOF SEALING / FIRE PROTECTION COATING SYSTEM**

3.01.00 The Fire proof sealing / fire stop system / fire protection coating system is 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 / Distribution boards / Cabinets / Panels, etc.

3.02.00 **Scope of Work**

3.02.01 The scope of work includes but is not limited to the following supply and services:

- i) Fire Stops in wall / floors.
- ii) Fire stops below switchgear / MCC / Switchboards, junction boxes / panels / cabinets, etc. which are floor mounted type.
- iii) Fire retardant coating to be applied for installed cables.

- iv) Minor civil / structural works for installation of the entire work.
- v) All necessary erection materials, consumables and sundry items to complete the entire work for satisfactory and trouble free operation.
- vi) Any special tools & tackles.
- vii) Conducting the type test of fire proof sealing system in presence of Owner's engineers.
- viii) All relevant Drawings, Data sheets and instruction manuals.
- ix) Fire proof barrier walls.
- x) Fire proof doors.

3.03.00 Design Criteria

3.03.01 Fire Proof Sealing System

The material / components used for fire-proof sealing system shall be provided to meet the following requirements:

- i) Life expectancy should not be less than 30 years from the date of installation.
- ii) Free from shrinkage or cracking or asbestos in composition and should achieve smoke and gas tightness during fire and should be modifiable.
- iii) Not to generate toxic gas and harms to the personnel handling the system.
- iv) Prohibition of production of acid or alkali during gas generation.
- v) Will not produce suffocating / corrosive gas.
- vi) Repellant to paste / rodent / termite.
- vii) Expansion co-efficient - very low which is to be comparable with masonry concrete.
- viii) Not soluble / reactive to acid, water, alkali.
- ix) Thermal conductivity - low.
- x) The material in contact with the cables in the fire-proof sealing system shall be compatible with the material used for outer sheath of cables.
- xi) It should not have any adverse effect on the cables and should not alter the current carrying capacity of the cables.

- xii) Retrofit in design to accommodate not less than 15% more addition of cables depending upon the size of cables, physically and chemically stable.
- xiii) Capable of withstanding vibrations, drop-loads, foot traffics, mechanical loads, etc.
- xiv) The F.P.S. system shall maintain its integrity and perform satisfactory even after
 - a. Remaining in water for a long time.
 - b. Accelerated thermal aging.
 - c. Sustaining vibrations.
- xv) The design and construction of F.P.S. 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 F.P.S. system or the material constituting the FPS System.
- xvi) 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.
- xvii) The fire rating shall not be less than two (2) hours and the system shall be stable after applicable of water jet in the exposed side in order to extinguish fire.

3.03.02 Fire Protection coating to be applied on installed Cables:

The cables shall be coated with fire protection material of 2 mm dry thickness at the strategic locations as follows so as to limit the spread of fire:

- i) At fire stops in walls and floors on either side upto 500 mm length.
- ii) At fire stop below Electrical Switchgears/ MCCs/ Panels/ Cabins, etc. on one side coating of 500 mm length, i.e., on the cable vault side / cable trench side.
- iii) Length of 500 mm on all sides of the junction/crossing of cabling work in open cable routes/ cable trench.
- iv) In fire risk areas and where specified at suitable intervals as decided upon site conditions in open cable routes.
- v) Where necessary and specified at site intervals along cable routes in cable trenches.
- vi) The coating shall be applied evenly on the cables only.

3.03.03 The fire protection coating shall have the following properties/composition:

- i) Asbestos free, non-volatile, not eatable by vermin, harmless and non-irritant to skin of human.
- 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 IEEE - 383.
- iv) Coating material shall show no signs of cracking and peeling when the coated cable is bent to the radius of minimum 12 times the diameter of the maximum size cable at 180°C.
- v) The limiting oxygen index of the material shall not be less than 60% as per ASTM D - 2863.
- vi) Life expectancy equivalent to the cable installations.

3.03.04 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.

3.05.00 **Type Test On Penetration Seals**

3.05.01 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.

3.05.02 Fire Rating Test

This test shall be carried out to prove the guaranteed power rating duration of the system in respect of stability, integrity and insulation characteristics of the complete system. The penetration seal system as a whole conforming to ASTM 814 and as per BS:476 Part-8 shall be built with the necessary component. The fire test shall be built with the necessary component.

The test specimen of the penetration seal built with 9-10 nos. armoured cables of various sizes passing through the seal shall be fitted to the gas fired furnace and shall form the upper most face of the furnace. The gas fired furnace shall have provision to achieve standard time temperature characteristics for fire tests as mentioned in BS-476 Part-8, according to which the temperature required to be maintained are as under:

<u>Heating time in minutes</u>	<u>Temperature in the furnace</u>
30 minutes	821°C
90 minutes	886°C
120 minutes	1029°C
150 minutes	1062°C
180 minutes	1090°C
210 minutes	1113°C
240 minutes	1133°C

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, the temperature 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.

3.05.03 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 sealing system through which the flame / or gas can pass,

the system is deemed to have failed to maintain integrity. The development of crack is characterized by ignition cotton wool held near the seal on the unexposed surface at a distance of about 30 mm from the aperture.

- iii) In case the mean temperature rise of unexposed surface of seal exceeds 140°C above the initial temperature or temperature of unexposed surface exceeds 180°C, the system shall be deemed to have failed in respect of insulation characteristics.
- iv) Temperature measurement on the unexposed side of the penetration seal specimen shall be measured by the thermocouple on the surface of penetrating items and on fire stop material in accordance with ATME-814/UL 1479 at a distance of 25 mm from fire stop material and penetration items respectively.

3.05.04 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 through out 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.'

3.05.05 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 degree centigrade. However, for system components 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. This 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.

3.05.06 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 deg.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 at (1) - (c) above.

3.05.07 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 degree centigrade, 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.

3.05.08 Water Absorption Test:

The test specimen shall be immersed in fresh clean water at a temp. of 20°C. The test specimen must be separated from the bottom and sides of the soak tank by at least 10 mm and it shall be covered by approximately 25 mm of water. At the end of the 24 hours soak period, the specimen shall be removed from the water and mopped up with a damp cloth.

Fire rating test after water absorption is to ascertain whether the penetration seal subjected to water absorption still passes the fire rating test for guaranteed fire rating duration.

The test apparatus for this test shall be similar to the one used for fire rating test at Sr. No.1. 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 temp. 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.

3.05.09 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".

3.05.10 Anti-Rodent Test:

Physical tests:

- a) This test shall be carried out to ascertain the anti-rodent properties of the components of the Fire proof sealing system.
- b) This test shall be carried out at approved test station performing sealing system tests on pharmaceutical products. The complete Fire Proof sealing system shall be subjected to attack of insect / vermin such as rat for about 20 days.
- c) At the end of the test condition of the surface of Fire Proof sealing system the test material shall be compared with the surface condition before commencement of the test. The fire stop shall be deemed to have passed this test in case no marks of growth are seen on the surface.

3.05.11 Test Certificates

Certified copies of all tests carried out at works and at site shall be furnished in requisite number of copies.

Test reports shall be complete with all details and shall also contain limit values specified in the relevant standards, wherever applicable, to facilitate review of Test Report/ Certificates.

The fire proof sealing system shall be installed only after receipt of approval of the test reports.

3.05.12 Testing Charges

The bidder has to indicate that unit rates for conducting the type test successfully alongwith the offer, which will be considered for evaluation of tender.

ANNEXURE-B

**NOTES & DETAILS
FOR
GROUNDING & LIGHTNING PROTECTION SYSTEM**

1.00.00 **GENERAL**

1.01.00 These notes and details shall be read and construed in conjunction with grounding and lightning protection drawings and specification. In case of conflict between these notes and drawings, the latter shall prevail.

1.02.00 The grounding and lightning protection system installation work shall conform to the requirements of the latest editions of the following standards/codes :

- a) Indian Electricity Rules, 1956.
- b) National Electrical Code, 1985.
- c) Code of Practice for Earthing (IS: 3043)
- d) Protection of Buildings and Allied Structures Against Lightning (IS: 2309)
- e) IEEE 80

2.00.00 **GROUNDING SYSTEM**

2.01.00 **Main Grounding Mat/Grid**

2.01.01 The main ground grid shall be buried in earth at a minimum depth of 1000 mm below finished grade level unless stated otherwise. The size of ground grid conductor shall be bare 40 mm dia. mild steel rod (minimum). The actual diameter of ground grid conductor shall be selected by EPC contractor with back up calculation.

2.01.02 A minimum earth coverage of 300 mm shall be provided between the ground grid conductor and the bottom of trenches, tunnels, underground pipes, foundations, railway tracks etc. The ground grid conductor shall be re-routed in case it fouls with equipment foundations.

2.01.03 In some cases, it may happen that the construction work of cable trench, foundation and laying of underground pipes are being taken up after the grounding mat has been laid. It may be required to cut a portion of grounding conductor to avoid fouling with cable trench, equipment foundations, underground pipes etc. In this case, the ground conductor shall be properly rerouted and rejoined/reconnected with the main grounding mat during the construction/laying of above underground objects and good electrical continuity of grounding conductor shall be ensured.

2.01.04 Grounding conductors crossing the road may have to be laid at greater depth to suit the site conditions.

- 2.01.05 Grounding conductor around the building shall be buried in earth at a minimum distance of 1200 mm from the outer boundary of the building.
- 2.02.00 **Grounding Electrodes**
- 2.02.01 The ground electrodes shall be 40 mm dia, 3000 mm long mild steel rod. These shall be fabricated and driven into the ground by the side of grounding mat conductors and connected to the ground mat conductors.
- 2.03.00 **Risers**
- 2.03.01 All risers/pigtail from the ground grid shall be 40 mm dia mild steel rod and shall be projected 300 mm above grade level/concrete floor level unless otherwise shown.
- 2.04.00 **Earthing Conductor**
- 2.04.01 75x 10 mm galvanised steel flats shall be run as main earthing conductors above ground along building columns, walls, steel structure, etc. for equipment and other structures earthing.
- 2.04.02 These earthing conductors shall be interconnected between them and to the main ground grid through risers/pigtail. The connection between earthing conductor and riser shall be made above ground.
- 2.04.03 Earthing conductors along their run on column, wall etc. will be supported by suitable welding/clamping at intervals set exceeding 750 mm.
- 2.04.04 Earthing conductors shall be embedded in concrete floor of the building without having direct contact with the reinforcement rods.
- 2.04.05 At the crossing of building walls, floors etc. the earthing conductor shall be passed through galvanised conduit sleeves. Both ends of the sleeve shall be sealed to prevent the passage of water through the sleeves.
- 2.05.00 **Grounding of Equipment And Structures**
- 2.05.01 All indoor and outdoor electrical equipment and associated non-current carrying metal works, supporting structures, building/ boiler columns, fence, system neutrals, lightning masts/arresters shall be connected to the plant ground system.
- 2.05.02 Two separate and distinct ground connections shall be provided for grounding electrical equipment frameworks in compliance with I.E. rules.
- 2.05.03 All Electrical equipment will be furnished with two (2) separate ground pads with tapped holes, bolts and spring washers. The connection between these ground pads and the grounding grid shall be made by short and direct earthing conductors free from kinks and splices.
- 2.05.04 Miscellaneous devices such as junction boxes, pull boxes, pushbutton stations, lockout switches, cable end boxes, lighting fixtures, receptacles, switches etc. shall be effectively grounded whether specifically shown or not.

- 2.05.05 The generator neutrals, transformer neutrals, earthing terminals of lightning arresters, coupling capacitor shall be directly connected to rod electrodes through riser which in turn, shall be connected to station grounding mat.
- 2.05.06 Grounding mat comprising closely spaced conductors shall be provided below the operating handles of isolator and circuit breaker operating box located in outdoor high voltage substation. The operating handles shall be properly bonded with flexible conductors.
- 2.05.07 Metallic conduits and pipes shall not be used as earth continuity conductor. These shall be grounded at both ends.
- 2.05.08
- a) The cable trays inside the cable trenches shall be grounded thru' one (1) no. 40 mm dia M.S. Rod at an interval of ten (10) metres. One end of this rod is connected with riser from grounding mat and the other end which is projected inside the cable trench shall be connected with one (1) 50 x 6 mm G.S. flat which runs horizontally along the cable trench. This earthing conductor shall be securely attached to each tray section of cable tray/trays forming a solidly grounded tray system through 50 x 6 mm G.S. flats.
 - b) A continuous 50 x 6 mm G.S. flat earthing conductor shall run along the supporting structure of overhead cable trays/cable shafts. This earthing conductor shall be attached to each section of cable tray/trays through 50 x 6 mm G.S. flats.
- 2.05.09 Fence within the ground grid shall be bonded to the plant ground system at regular interval not exceeding ten (10) metres. Fence gate shall be separately grounded with flexible connection to permit movement.
- 2.05.10 The street lighting poles, junction boxes mounted on the poles, flood light supporting structures etc. shall be connected to ground grid at minimum two points.
- 2.05.11 The steel columns, metallic stairs, hand-rail etc. of the building where electrical equipment are located shall be connected to the nearby ground mat by earthing conductor. Electrical continuity shall be ensured by bonding the different sections of handrails and metallic stairs.
- 2.05.12 The railway tracks within plant area shall be bonded across fish plates and the rail tracks shall be connected to grounding grid at different locations. The rail tracks leaving the plant boundary shall be made electrically discontinuous from the rail tracks inside the plant area by providing suitable arrangements at fish plate joints.
- 2.05.13 The overhead crane rails shall be grounded at both ends. In addition all joints shall be bonded to provide electrical continuity.
- 2.05.14 The flexible earthing connection of jumpering wire shall be provided where flexible conduits are connected to rigid conduits to ensure continuity.

2.06.00 Earthing of Cable

2.06.01 The metallic sheaths, screens and armour of cables shall be earthed at both switchgear/MCC/DB and equipment ends.

2.07.00 Jointing And Connection

2.07.01 All ground conductor connections below ground level shall be done by electric arc welding with low hydrogen content electrode. The contact surfaces shall be thoroughly cleaned to provide good electrical continuity.

2.07.02 The bending of the large diameter ground conductor where necessary shall be done by gas heating.

2.07.03 The projected portion of riser/pigtail above ground shall be coated with two coats of bitumen paints (anti-corrosive paints) with a minimum thickness of 1 mm after connection.

2.07.04 The connections between the riser/pigtail and earthing conductors (galvanised steel flats) and between the earthing conductors above ground level shall be made by electric arc welding.

2.07.05 The portion of galvanised steel flats, which undergoes welding at site, shall be coated with two (2) coats of cold galvanising anti-corrosive paint after welding.

2.07.06 The earthing connections to equipment grounding pads/terminals and some removable structures shall be bolted type with GI bolts and nuts. The contact surfaces shall be thoroughly cleaned (to free from scale, paint, enamel, grease, rust) before connection to ensure good electrical contact.

2.07.07 Equipment/structures ground connections after properly checked and tested shall be coated with weather resistant paints/cold galvanising paints.

2.08.00 The sizes and materials of ground conductors used in grounding system are listed below :

Description	Size	Material
a) Main Grounding Grid Conductor	40 mm dia Rod (Min)	Mild Steel
b) Riser/Pigtail From Grounding Grid/Mat	40 mm dia Rod (Min)	- Do -
c) Electrode	40 mm dia Rod (Min) - Do - 3000 mm long.	

Description	Size	Material
d) Conductor used for connection of various equipment/structures as listed below		
i) E.H.V. Substation quipment	Flats 75x 10 mm	Galvanised Steel
Generator Frame & Gen Neutral	75 x 10 mm Flat	- Do -
Generator Exciter Frame	75 x 10 mm Flat	- Do -
GT, ST, UT Frame	75 x 10 mm Flat	- Do -
GT, ST, UT Neutral	75 x 10 mm Flat	- Do -
Aux. Power Transformer Frame	75 x 10 mm Flat	- Do -
ii) 11 kV/3.3kV Equipment	75 x 10 mm Flat	- Do -
iii) 11 kV/3.3kV Switchgear	75 x 10 mm Flat	- Do -
iv) 415 V PMCC	75 x 10 mm Flat	- Do -
v) Structures, Bus Duct Control Panels, Cable Trays etc.	75 x 10 mm Flat	- Do -
vi) 415V Motor Control Centres, Distribution Boards etc.	75 x 10 mm Flat	- Do -
vii) Local Panels, Lighting Panels	50 x 6 mm Flat	- Do -
viii) Motors :		
All HT Motors	75 x 10 mm Flat	- Do -
LT Motor Above 90 kW	50 x 6 mm Flat	- Do -
LT Motors Above 30 kW Upto 90 kW	35 x 6 mm Flat	- Do -
Above 5 kW Upto 30 kW	25 x 3 mm Flat	- Do -
Upto 5 kW	8 SWG Wire	Galvanised Iron
ix) Miscellaneous Items, viz. Push Button Station, Junction Boxes etc.	8 SWG Wire	- Do -

Note: Sizes of GS Flat as indicated above are minimum. However Bidder shall calculate each of them and submit for approval.

3.00.00 LIGHTNING PROTECTION SYSTEM

3.01.00 Air Terminations

3.01.01 The vertical air terminal rods shall be installed at the roof of buildings (including power house main building), at the top of chimney and cooling towers to protect these objects from lightning strokes.

3.01.02 The vertical air terminal except for chimney shall be made of 20 mm dia galvanised steel rod. The projected length of the rod shall be as required to protect the object (on which the rod is fixed) from lightning stroke.

3.01.03 The air terminal rods provided at the top of chimney/stack for lightning protection shall be 20 mm dia lead coated solid copper rod.

3.01.04 The air terminal rod shall be properly fixed on the top of the building/structure to withstand very high wind pressure. In case the air terminal rod is embedded at the top of roof of building: the portion embedded inside the concrete shall not touch the reinforcement bars and shall be duly insulated from them.

3.01.05 All the vertical air terminal rods shall be electrically connected together by means of horizontal conductors of size 75 x 10 mm galvanised steel flats.

3.01.06 The 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.

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

3.02.00 Shielding Masts

3.02.01 The shielding mast for lightning protection shall be installed at the top of steel columns cap plates of power house main building.

3.02.02 The shielding mast shall be made of galvanised steel pipe and the height of the same shall be decided considering the zones to be protected.

3.02.03 Each shielding mast shall be connected to grounding grid by a down conductor 75 x 10 mm. Galvanised steel flat run along the building column. In addition all power house building columns joints shall be electrically bonded.

3.03.00 Down Conductors

3.03.01 The down conductors shall be 75 x 10 mm galvanised steel flats. The sizes of down conductors and horizontal conductor provided for lightning protection of conveyer gallery shall be 25 x 3 mm galvanised steel flats. One end of this shall be connected with air terminal rod/horizontal conductor at the top of roof/structure and other end connected to the nearest 40 mm dia. mild steel rod riser from ground electrode.

3.03.02 Each down conductor shall have an independent earth termination. In no case conductors of the lightning protection system shall be connected with the conductor of grounding system above ground level.

3.03.03 The connection between each down conductor and rod electrode (by means of 40 mm mild steel rod riser) shall be made via test link located at approximately 1500 mm above ground level.

3.03.04 The down conductor shall be laid straight and sharp bends shall be avoided as far as practicable. These shall be cleated on outside of the building wall and column/structure at about 750 mm intervals unless stated otherwise in the drawing.

3.03.05 At all supports for down conductor along the column/wall of the buildings; chimney etc. the portion embedded inside the building concrete should not touch the reinforcement bars.

3.03.06 All exposed metallic parts of the buildings shall be bonded to the down conductors. Such parts shall include ladders, balconies, conduits etc.

3.03.07 The down conductors shall be protected at the ground level against mechanical injury by means of non-metallic pipes, viz. PVC pipes filled with bituminous compound.

3.04.00 Electrodes (for Lightning Protection)

3.04.01 The electrodes shall be 40 mm diameter 3000 mm long mild steel rod. These shall be driven into the ground.

3.04.02 All the electrodes shall be interconnected by means of one (1) 40 mm dia mild steel rod which will be laid under ground at a minimum depth of 1000 mm below finished grade level unless stated otherwise. This ground mats/electrode in turn shall be connected to main grounding grid.

3.05.00 Riser (for Lightning Protection)

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

3.06.00 Jointing & Connection

3.06.01 All ground conductor connections below ground level shall be done by electric arc welding with low hydrogen content electrode.

- 3.06.02 The projected portion of riser above ground shall be coated with two (2) coats of bitumen paints (anti-corrosive paints) with a minimum thickness of 1 mm after connection.
- 3.06.03 The joints in the lightning conductors shall be kept to a minimum and there shall be no joint in the underground portions of conductors.
- 3.06.04 All the joints shall be done by arc welding process overlapping of the conductors at straight joints shall not be less than 150 mm. The contact surfaces shall be cleaned properly before jointing.
- 3.06.05 The portion of galvanised steel flats, which undergoes welding at site, shall be coated with two (2) coats of cold galvanising anti-corrosive paint after welding.
- 3.06.06 The bolted joint of the test link shall be covered with thick coating of bitumen paint after successful testing.
- 3.06.07 The air terminal rods and shielding mast shall be coated with weather resistant anti-corrosive paint (zinc chromate followed by two coats of aluminium paint).
- 3.06.08 The steel to copper connection shall be brazed type.
- 3.07.00 **Lightning Protection of 400kV GIS & Other areas**
- 3.07.01 The lightning protection of outdoor switchyards/substation shall be done by lightning masts on the top of steel towers. In addition, shield wires shall be used where required. The shield wire shall be strung across the top of the steel tower and/or powerhouse structure.
- 3.07.02 The shield wire which shall be brought down up to bottom of steel tower shall be connected to the earthing conductor (50 x 6 mm galvanised steel flat) which in turn connected to the riser (from the main grounding mat/grid).
- 3.07.03 The lightning protection of inflammable liquid storage tanks wherever required, shall be provided with horizontal conductors strung between tall poles covering the entire zones or with air terminal rods mounted on top of poles/structure. These horizontal conductors/vertical air terminal rods shall be connected to rod electrodes, which in turn shall be connected to station ground mat.
- 3.07.04 The lightning protection of conveyor gallery shall be provided with horizontal conductors (25 x 3 mm G.S. Flat) run along the length of the conveyor gallery at the top of gallery roof. This conductor shall be connected to riser and grounding electrode (40 mm dia G.S. Rods) at an approximate interval of 30 mm through two down conduction (each 25 x 3 mm G.S. Flats).

3.08.00 The sizes and materials of earthing conductors to be used in lightning protection system are listed below :

Description	Size	Material
a) Vertical Air Termination	20 mm dia Rod (Chimney)	Lead Coated Copper rod.
b) Vertical Air Termination (Except Chimney)	20 mm dia Rod	Galvanised steel
c) Horizontal Conductor	i) 75 x 10 mm Flat ii) 25 x 3 mm Flat	- Do - - Do -
d) Down Conductors	i) 75 x 10 mm Flat ii) 25 x 3 mm Flat	- Do - - Do -
e) Riser From Electrode/ Grounding Mat	40 mm dia Rod	Mild Steel
f) Electrode for Lightning Protection	40 mm dia Rod 3000 mm long	- Do -

Note :

In addition to above, all materials as required such as G.I. pipes of appropriate length, diameter and thickness will be provided for lightning masts of Power House building and Switchyard.



**TITLE : TECHNICAL SPECIFICATION
FOR
CONDENSER ON LOAD TUBE CLEANING
SYSTEMS (COLTCS)**

SPEC. NO. PE-TS- 408 165-N002

VOLUME : IIB

SECTION : D

REV. NO. 0

DATE : 27-11-15

SHEET 1 of 1

**SECTION C3
CONDENSER ONLOAD TUBE CLEANING SYSTEMS
C&I DETAILS**

**CONDENSER ON LOAD TUBE CLEANING SYSTEM & SELF CLEANING STRAINER -
C&I REQUIREMENTS**

S.NO.	PROJECT	1X800MW WANAKBORI
1.00	SYSTEM	COLTCS
2.00	COMMON / PER UNIT	REFER NOTE -9,14
3.00	CONTROL SYSTEM	DCS with Local Control Panel
3.10	PROCESSOR CONFIGURATION FOR PLC SYSTEM	NA
4.00	LOCATION OF CONTROL SYSTEM	EER
4.10	CONTROL SYSTEM SCOPE (BIDDER/ BHEL/ CUSTOMER)	DCS:-BHEL LCP:-Bidder
5.00	HARDWIRED INTERFACE WITH DCS (Y/N)	NA
5.10	PURPOSE OF HARDWIRED INTERFACE WITH DCS	CONTROL & MONITORING
5.11	a) COMMAND FROM LCP(Y/N)	Y
5.12	b) STATUS FEEDBACK TO LCP(Y/N)	Y
5.13	c) GROUP FAULT ALARM TO DCS (Y/N)	Y
6.00	SOFTLINK TO DCS (Y/N)	NA
6.10	PURPOSE OF SOFTLINK TO DCS	NA
6.11	a) COMMAND INTERFACE WITH DCS (Y/N)	NA
6.12	b) STATUS MONITORING IN DCS (Y/N)	NA
7.00	PROTECTION CLASS FOR PLC / RIO PANEL	NA
8.00	CONTROL FROM PB's ON LCP/OWS	PB's ON LCP
9.00	ANNUNCIATION ON LCP (Y/N) -- IF Y, MIN NO. OF HARDWIRED ALARMS / INDICATIONS	YES- BIDDER TO PROPOSE MIN. NO. OF ALARMS/INDICATIONS
9.10	MIMIC ON LCP (Y/N)	Y
10.00	CONTROL FROM DCS IN CCR (Y/N)	Y

**CONDENSER ON LOAD TUBE CLEANING SYSTEM & SELF CLEANING STRAINER -
C&I REQUIREMENTS**

S.NO.	PROJECT	1X800MW WANAKBORI
11.00	TYPE OF SOFTLINK (TP/OFC)	NA
11.10	COMMUNICATION CABLE SCOPE (BIDDER/ BHEL)	NA
11.20	REDUNDANT CABLE (Y/N)	NA
11.30	PROTOCOL	NA
12.00	RIO / RPU (Y/N)	NA
13.00	## NO. OF OWS / LAPTOP/LCD	NA
13.10	SIZE OF OWS/ CRT OR LCD	NA
14.00	NO. OF PRINTER	NA
14.10	PRINTER SIZE AND TYPE	NA
15.00	POWER SUPPLY AVAILABLE FOR BALL MONITOR (24V DC / 110 V AC UPS / 230 V AC UPS)	230 V AC UPS
15.10	&& POWER SUPPLY AVAILABLE FOR PLC PANEL (3PHASE, 415 V AC/ 1PHASE, 110 V UPS/ 1PHASE, 230 V UPS)	NA
15.20	REDUNDANT FEEDERS (R) / NON-REDUNDANT (NR) FEEDERS FOR POWER SUPPLY	NA
15.30	**UPS BATTERY CONFIGURATION (1X100% / 2X100%)	NA
15.40	BATTERY TYPE (LEAD ACID/ Ni-Cd)	NA
15.50	BATTERY BACK-UP TIME (in minutes)	NA
16.00	ACTUATOR WITH INTEGRAL STARTER (Y/N)	N
17.00	PG/ DPG/ PS/ DPS/ PT/ DPT per Balls Collecting Strainer/DF/SCS	DPT = 2 nos. DPI = 1 no.(ACROSS EACH BALL SEPARATOR)
19.00	PROJECT SPECIFIC INFO	Y

CONDENSER ON LOAD TUBE CLEANING SYSTEM & SELF CLEANING STRAINER - C&I REQUIREMENTS		
S.NO.	PROJECT	1X800MW WANAKBORI
20.00	REMARKS	
21.00	NOTES:	
	1. \$\$ THIS IS APPLICABLE FOR DCS CONTROLLED SYSTEMS ONLY.	
	2. 4& THIS IS APPLICABLE FOR PLC CONTROLLED SYSTEMS. ALL POWER SUPPLY REQUIREMENTS FOR INDIVIDUAL SUB-SYSTEMS/ COMPONENTS EG. BALL MONITOR, SOL VALVES ETC SHALL BE DERIVED BY THE VENDOR FROM THIS POWER SUPPLY.	
	3. ** THE UPS FOR PLC & OWS SHALL BE IN BIDDER'S SCOPE. ITS CONFIGURATION SHALL BE 2X100% CHARGERS / INVERTERS.	
	4. IN CASE OF DCS CONTROLLED SYSTEMS, BIDDER TO TERMINATE ALL INSTRUMENTATION AND CONTROL ELEMENTS IN JUNCTION BOXES FOR FURTHER CABLING TO DCS BY BHEL/CUSTOMER. BIDDER TO PROVIDE INPUT/OUTPUT LIST, DRIVES LIST, JUNCTION BOX SCHEDULE AND TERMINATION DETAILS, RECOMMENDED CONTROL LOGICS / WRITE-UP ETC. DURING DETAILED ENGINEERING	
	5. IN CASE OF PLC CONTROLLED SYSTEMS, ALL CABLES & CABLE ENGINEERING SHALL BE IN BIDDER'S SCOPE.	
	6. ## FOR PLC BASED CONTROL SYSTEM WHERE OWS IS PROVIDED, THE OWS SHALL HAVE PROGRAMMING & CONFIGURATION FACILITY. LAPTOPS SHALL BE OF LATEST CONFIGURATION WITH PROGRAMMING SOFTWARE & COMMUNICATION CABLE.	
	7. FOR THE PROJECTS IN WHICH CONTROL ARE ENVISAGED WITH DCS CONTROL SYSTEM FOR COLTCS/SCS/DEBRIS FILTER - 2 SETS OF COLTCS/SCS/DEBRIS FILTER SHALL HAVE ONE COMMON STARTER PANEL (SWITCH GEAR PANEL).	
	8. FOR THE PROJECTS IN WHICH CONTROL ARE ENVISAGED WITH PLC BASED CONTROL SYSTEM FOR COLTCS/SCS - 2 SETS OF COLTCS/SCS SHALL HAVE ONE COMMON STARTER PANEL (SWITCH GEAR PANEL) CUM PLC PANEL.	
	9. FOR THE PROJECTS IN WHICH CONTROLS ARE ENVISAGED WITH PLC BASED CONTROL SYSTEM, 2 SETS OF COLTCS SHALL HAVE ONE COMMON PLC CONTROL SYSTEM WITH SEPARATE LCP PROVIDED FOR EACH SET OF COLTCS.	
	10. COLOUR OF STARTER PANEL SHALL BE RAL 7035 FOR EXTERIOR & BRILLIANT WHITE FOR INTERNAL.THIS SHALL BE DECIDED DURING DETAIL ENGINEERING	
	11. INSTRUMENT RACK AND JUNCTION BOXES SHALL BE IN BIDDER'S SCOPE OF SUPPLY. FURNITURE FOR PLACING OWS & PRINTER SHALL BE IN BIDDER'S SCOPE.	
	12. BIDDER TO FURNISH ELECTRICAL LOAD DATA DURING DETAILED ENGINEERING.	
	13. ALARM FACIA SHALL BE UNDER BIDDER'S SCOPE. NO. OF FACIA SHALL BE DECIDED DURING DETAILED ENGINEERING.	
	14. FOR PROJECTS WHERE PLC BASED CONTROL SYSTEM IS ENVISAGED FOR COLTCS & SCS , SEPARATE PLC'S SHALL BE PROVIDED FOR COLTCS & SCS. PLC SYSTEM SHALL BE PROVIDED UNIT WISE.	
	LEGEND:	
	DCS- DISTRIBUTED CONTROL SYSTEM	
	PLC- PROGRAMMABLE LOGIC CONTROLLER	
	RPU - REMOTE PROCESSING UNIT	

**GENERAL & SPECIFIC TECHNICAL
REQUIREMENT**

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 implication.

3.0 Measuring instruments/equipment and subsystems offered by the bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further all the instruments shall be of proven reliability, accuracy, and acceptable international standards and shall be subject to employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specification, ranges, makes/ numbers as approved by 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 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.

Specific Technical Requirements (C&I):

1) The control of COLTCS shall be DCS based. The operation and control philosophy of COLTCS shall be as per design memorandum given elsewhere in the specification. Bidder to provide Local Control Panel for COLTCS. The motorized valves, ball separator, ball recirculation pump etc. shall be operated from Lamp /Pushbuttons, selector switches etc. located on the Local Control panel.

2) All electrical actuators shall be non-integral type.

3) The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.

4) Power supply shall be provided by BHEL at a single point. Further distribution to various instruments shall be in Bidder's scope. Bidder to include necessary power distribution board (ACDB)(as per details attached elsewhere in this specification) in his scope. Any power supply other than the above, if required by any instrument/device, has to be derived by the Bidder from the above supply and all necessary hardware for the same shall be in bidder's scope. Bidder to furnish UPS power requirement along with the bid.

5) The solenoid valves shall have limit switches for open/close feedback.

6) All the instruments/drives shall be terminated on JB's/Panels in field. JB's/Panels shall be in Bidder's scope. RTD's shall be of duplex type.

7) 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.

8) At least 10% spare channels and window facia shall be provided in each annunciator group in the local control panel.

9) Bidder to comply with codes and standards as mentioned in the specification.

1X800 MW Wanakbori STPP

SECTION: C
SUB SECTION :
C&I

10) All local gauges, transmitters and switches shall be mounted on suitable enclosures, racks subject to owner's approval. All transmitters shall be HART compatible.

11) Bidder to delegate /depute their persons/experts as per owner/consultants' requirement.

12) Bidder must offer general tools and tackles and special calibration instruments required during start-up, trial run, operation and maintenance of the system.

13) 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.


	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I SHEET 8 of 18
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

C&I DELIVERABLES LIST

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT						
1X800 MW WANAKBORI TPP						
DOCUMENT NUMBER PE-GL-408-145-I100						
Sl.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CUSTOMER	FROM	USER	REMARKS
INSTRUMENTATION						
1	PE-V9-408-XXX-1901	INSTRUMENT DATA SHEETS	-	VENDOR	C&I	
2	PE-V9-408-XXX-1902	INSTRUMENT SCHEDULE	-	VENDOR	C&I	
3	PE-V9-408-XXX-1903	INSTRUMENT INSTALLATION/ HOOK UP DIAGRAMS	-	VENDOR	C&I	
5	PE-V9-408-XXX-1905	INSTRUMENT QP/CHECK LIST	-	VENDOR	C&I	
LOCAL CONTROL PANEL						
1	PE-V9-408-XXX-1950	LOCAL CONTROL PANEL DATASHEET	A	VENDOR	C&I	
2	PE-V9-408-XXX-1951	WIRING DIAGRAM	-	VENDOR	C&I	
3	PE-V9-408-XXX-1952	PANEL GA DRAWINGS	-	VENDOR	C&I	
8	PE-V9-408-XXX-1956	BILL OF MATERIAL	-	VENDOR	C&I	
13	PE-V9-408-XXX-1957	LOCAL CONTROL PANEL QUALITY PLAN	`	VENDOR	C&I	
14	PE-V9-408-XXX-1958	LOCAL CONTROL PANEL O&M MANUAL	-	VENDOR	C&I	
19	PE-V9-408-XXX-1925	MANDATORY SPARES BILL OF MATERIAL	A	VENDOR	C&I	
	Notes:	408 - Project No.				
		XXX -MAX Package Code				
		\$\$ -Approval by BHEL if Vendor BBU Item. Approval by Customer if Customer BBU Item				

SPECIFIC TECHNICAL REQUIREMENTS (C&I)

**SPECIFICATION FOR MOTORISED VALVE
ACTUATOR**

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR	SPECIFICATION NO.: PE-ID-408-145-I902		
		VOLUME	II B	
		SECTION	D	
		REV. NO.	00	DATE: 04.04.15
		SHEET	1	OF 3
Data Sheet A & B				
DATA SHEET-A (TO BE FILLED BY PURCHASER)		DATA SHEET-B (TO BE FILLED-UP BY BIDDER)		

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GENERAL*	* PROJECT		
	OFFER REFERENCE		
	* TAG NO. SERVICE		
	* DUTY	<input type="checkbox"/> ON / OFF <input type="checkbox"/> INCHING	
	* LINE SIZE (inlet/outlet): MATERIAL		
	* VALVE TYPE	<input type="checkbox"/> GLOBE <input type="checkbox"/> GATE <input type="checkbox"/> REG. GLOBE <input type="checkbox"/> BUTTERFLY	
	* OPENING / CLOSING TIME		
	* WORKING PRESSURE		
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%	
	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, IPW:55	
	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.	
HANDWHEEL	* REQUIRED	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	
	* ORIENTATION	<input type="checkbox"/> TOP MOUNTED <input type="checkbox"/> SIDE MOUNTED	
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.		
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY	
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY	
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT- INCLUSIVE OF I.S. TOLERANCE	
	ACTUATOR APPLICABLE WIRING DIAGRAM	<input checked="" type="checkbox"/> ENCLOSED (BIDDER TO CONFIRM) A: <input type="checkbox"/> DRG. NO. 3-V-MISC-24227 R00 B: <input type="checkbox"/> DRG. NO. 3-V-MISC-24550 R00 C: <input type="checkbox"/> DRG. NO. 3-V-MISC-24283 R00 D: <input checked="" type="checkbox"/> DRG. NO. 4-V-MISC-90271 R11 E: <input type="checkbox"/> For Thyristor based Integral starter, Bidder/Vendor to furnish wiring diagram	
	COLOUR SHADE	<input type="checkbox"/> BLUE (RAL 5012) <input type="checkbox"/> (TO BE DECIDED BY BHEL DURING DETAIL ENGG.)	
	PAINT TYPE (## Refer Notes)	<input type="checkbox"/> ENAMEL <input type="checkbox"/> EPOXY <input type="checkbox"/> (TO BE DECIDED BY BHEL DURING DETAIL ENGG.)	
	SHAFT RPM	BIDDER TO SPECIFY	
	OLR SET VALUE	BIDDER TO SPECIFY	
	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY	
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY	



**SPECIFICATION
FOR
MOTORISED VALVE ACTUATOR**

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(TO BE FILLED-UP BY BIDDER)

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	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC	
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER <input type="checkbox"/> 230 V <input checked="" type="checkbox"/> 110 V	
	@ ENCLOSURE CLASS OF MOTOR	<input checked="" type="checkbox"/> IP 65 <input type="checkbox"/> FLAME PROOF	
	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B	
	@ WINDING TEMP PROTECTION	<input checked="" type="checkbox"/> THERMOSTAT (3 Nos.,1 IN EACH PHASE) <input checked="" type="checkbox"/> ---THERMOSTAT- 1 NO+1 NC CONTACT -----	
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED	
INTEGRAL STARTER	INTEGRAL STARTER	<input type="checkbox"/> REQUIRED <input checked="" type="checkbox"/> NOT REQUIRED	
	TYPE OF SWITCHING DEVICE	<input type="checkbox"/> CONTACTORS <input type="checkbox"/> THYRISTORS	
	TYPE	<input type="checkbox"/> CONVENTIONAL <input type="checkbox"/> SMART (NON-INTRUSIVE)	
	IF SMART		
	a) SERIAL LINK INTERFACE	<input type="checkbox"/> INTEGRAL <input type="checkbox"/> FIELD MOUNTED	
	b) SERIAL LINK PROTOCOL	<input type="checkbox"/> FOUNDATION FIELD-BUS <input type="checkbox"/> PROFI-BUS <input type="checkbox"/> DEVICE NET <input type="checkbox"/>	
	c) SERIAL LINK MEDIA	<input type="checkbox"/> TWISTED PAIR Cu-CBL <input type="checkbox"/> CO-AXIAL Cu-CBL <input type="checkbox"/> OFC	
	d) HAND HELD PROGRAMMER	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	e) TYPE OF HAND HELD PROGRAMMER	<input type="checkbox"/> BLUETOOTH <input type="checkbox"/> INFRARED <input type="checkbox"/>	
	f) MASTER STATION	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	g) MASTER STN INTRFACE WITH DCS	<input type="checkbox"/> MODBUS <input type="checkbox"/> TCP/IP	
	h) DETAILS OF SPECIAL CABLE	<input type="checkbox"/> ENCLOSED <input type="checkbox"/> NOT REQUIRED	
	STEP DOWN CONT. TRANSFORMER	<input type="checkbox"/> REQUIRED	
	OPEN / CLOSE PB	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	STOP PB	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	INDICATING LAMPS	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
LOCAL REMOTE S/S	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
STATUS CONTACTS FOR MONITORING	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, S/S IN LOCAL, TORQUE SWITCH OPTD. MID WAY)		
INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter)	TYPE OF ISOLATING DEVICE	<input type="checkbox"/> INTERPOSING RELAY <input type="checkbox"/> OPTO COUPLER <input type="checkbox"/> EITHER	
	QUANTITY	<input type="checkbox"/> 2 NOs. <input type="checkbox"/> 3 NOs.	
	DRIVING VOLTAGE	<input checked="" type="checkbox"/> 20.5 – 24V DC <input type="checkbox"/> _____ V DC	
	DRIVING CURRENT	<input checked="" type="checkbox"/> 125mA MAX <input type="checkbox"/> _____ mA MAX	
	LOAD RESISTANCE	<input checked="" type="checkbox"/> > 192 ohms - <25 k ohms <input type="checkbox"/> > _____ ohms - < _____ ohms	
TORQUE SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN / CLOSE	<input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos. / <input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos	
	CONTACT TYPE	2 NO + 2 NC	
	RATING	5A 240V AC AND 0.5A 220V DC	
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE	
	ACCURACY	+3% OF SET VALUE	

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Data Sheet A & B				
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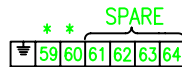
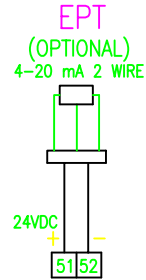
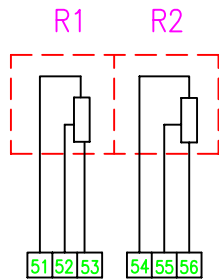
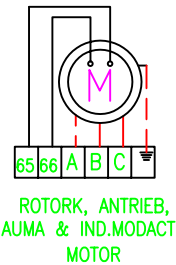
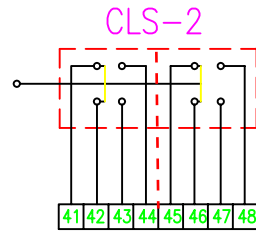
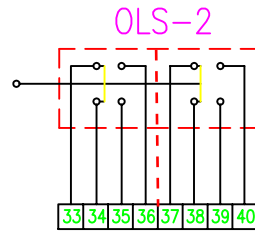
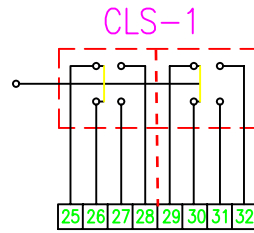
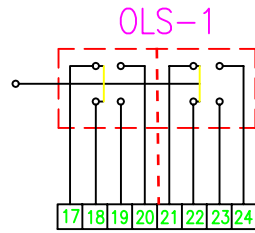
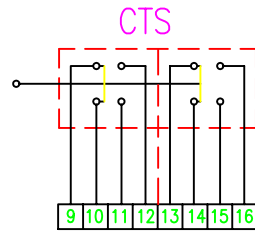
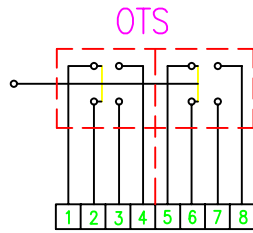
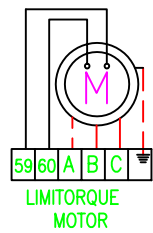
LIMIT SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY		
	OPEN : INT : CLOSE	<input type="checkbox"/> 1 No. <input checked="" type="checkbox"/> 2 Nos.	2 Nos. (ADJ.)	<input type="checkbox"/> 1 No. <input checked="" type="checkbox"/> 2Nos.
	CONTACT TYPE	2 NO + 2 NC		
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC		

POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty & other specific applications)	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED
	MFR & MODEL NO.	BIDDER TO SPECIFY
	TYPE	<input checked="" type="checkbox"/> ELECTRONIC (2 WIRE) R/I CONVERTER <input type="checkbox"/> ELECTRONIC (2 WIRE) CONTACTLESS
	SUPPLY	<input checked="" type="checkbox"/> 24V DC <input type="checkbox"/>
	OUTPUT	<input checked="" type="checkbox"/> 4-20mA
	ACCURACY	± 1% FS
SPACE HEATER	@SPACE HEATER	REQUIRED
	@ POWER SUPPLY (NON INTEGRAL)	230V AC, 1 PH., 50 Hz
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY
	@ RATING	decided as per load data received tender stage
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED
	ENCL CLASS ACTUATOR/MOTOR T.B.	@ <input type="checkbox"/> IP 68 @ <input type="checkbox"/>
	@ EARTHING TERMINAL	REQUIRED
	PLUG & SOCKET (9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT)	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED <input type="checkbox"/> 2 NOS. <input type="checkbox"/>
CABLE GLANDS	@ POWER CABLE GLAND	SIZE: decided as per load data received tender stage
	@ SPACE HEATER CABLE GLAND	SIZE: decided as per load data received tender stage
	OTHER CONTROL CABLE GLANDS-1	<input type="checkbox"/> 1No. for BFV of CW PUMP (Cable size 2Px1.5mm ²)
	OTHER CONTROL CABLE GLANDS-2	QUANTITY & SIZE :-

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WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY	_____ Kg.
NOTES: 1. SCOPE: DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY. 2. CODES & STANDARDS: DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATIONAL STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH: IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722 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 OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%. 7. THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING. 8. CANOPY FOR OUTDOOR SERVICES SHALL BE PROVIDED. \$\$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE. ## EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.			
NAME SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY
	VENDOR COMPANY SEAL		
	NAME		
	SIGNATURE		
	DATE		
NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @ = TO BE FILLED BY ES			



* - SPARE FOR ROTORK, AUMA, ANTRIEB & IND.MODACT

SWITCHES - ALL ARE POTENTIAL FREE AND TWO PAIR OF CONTACTS CAN BE USED FOR DIFFERENT SUPPLY
THERMOSTAT - 65-66 (ROTORK, AUMA, ANTRIEB & IND.MODACT), 59-60 (LIMITORQUE).

EPT - ELECTRONIC POSITION TRANSMITTER (POTENTIOMETRIC TYPE, FOR INCHING DUTY)

THERMOSTAT TERMINALS - TERMINATED IN MOTOR TB IN ANTRIEB & IND.MODACT AND IN MAIN TB IN OTHER MAKES

CTS - TORQUE SWITCHES FOR CW ROTATION (CLOSE) - 2 NO+2 NC

OTS - TORQUE SWITCHES FOR CCW ROTATION (OPEN) - 2 NO+2 NC

OLS-1, OLS-2 - LIMITSWITCHES FOR POSITION OPEN - 2 NO+2 NC

CLS-1, CLS-2 - LIMITSWITCHES FOR POSITION CLOSE - 2 NO+2 NC

OTS, CTS - TWO INDEPENDENT SWITCHES IN ANTRIEB & LIMITORQUE

OLS-2 & CLS-2 - CAM DISC IN ROTORK & ANTRIEB

R1-R2- POTENTIOMETER 2 x 100 OHMS

H - SPACE HEATER 1ϕ 240V AC SUPPLY

M - MOTOR 3ϕ 415V 50 Hz AC SUPPLY

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

NOTE:

1. BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)
2. CONNECT THERMOSTAT WITHOUT FAIL IN THE STARTER CIRCUIT

CONTACT DEVELOPMENT DIAGRAM				
OTS	1-2	OFF AT OVER TORQUE DURING OPENING TRAVEL		
	3-4	ON AT OVER TORQUE DURING OPENING TRAVEL		
	5-6	ON AT OVER TORQUE DURING OPENING TRAVEL		
CTS	7-8	ON AT OVER TORQUE DURING CLOSING TRAVEL		
	9-10	OFF AT OVER TORQUE DURING CLOSING TRAVEL		
	11-12	ON AT OVER TORQUE DURING CLOSING TRAVEL		
OLS-1	13-14			
	15-16			
	17-18			
CLS-1	19-20			
	21-22			
	23-24			
OLS-2	25-26			
	27-28			
	29-30			
CLS-2	31-32			
	33-34			
	35-36			
SWITCH	37-38			
	39-40			
	41-42			
TERMINAL NO.	43-44			
	45-46			
	47-48			
	FULL OPEN	a	INTERMEDIATE	b
		VALVE POSITION		
		INDICATES CONTACT CLOSED		
		INDICATES CONTACT OPEN		

CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC

					BHARAT HEAVY ELECTRICALS LTD. UNIT: HIGH PRESSURE BOILER PLANT. TIRUCHIRAPALLI 620014.	
					365-139	
					DRAWN	N.P.ESWAR
					CHECKED	K.ARUNACHALAM
					APPROVED	P.LOGANATHAN
11	09.09.2000			CONTACT DEV. FIG.ADDED.	DATE	09.09.2000
REV	DATE	CHD	APPD	DESCRIPTION	DRAWING No.	4-V-MISC-90271
					REV	11

RETRACED WITH REVISION 11

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	STANDARDS
3.00.00	SERVICE CONDITIONS
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VOLUME : IIF/1

SECTION-III

**TECHNICAL SPECIFICATION
FOR
ELECTRIC MOTOR ACTUATORS**

1.00.00 SCOPE

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

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

2.00.00 STANDARDS

2.01.00 All electrical equipment shall conform to the latest applicable IS, ANSI and NEMA Standards, except when stated otherwise herein or in driven equipment specification.

2.02.00 Major standards, which shall be followed, are listed below. Other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed

i) IS-9334

ii) IS-325

3.00.00 SERVICE CONDITIONS

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

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

3.03.00 For actuator motor installed outdoor and exposed to direct sun rays , the effect of solar heat [manufacturer to decide] shall be considered or overhead shed shall be provided locally to avoid direct sun rays.

4.00.00 RATING

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

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

5.00.00 **PERFORMANCE**

The actuator shall meet the following performance requirements:

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

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

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

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

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

6.00.00 **SPECIFIC REQUIREMENT**

6.01.00 **Construction**

6.01.01 The actuator shall essentially comprise the drive motor, torque/ limit switches, gear train, clutch, hand wheel, position indicator/ transmitter, in-built thermostat for over load protection, space heater and internal wiring. Actuator shall be non integral type.

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

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

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

6.02.00 **Motor**

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

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

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

- 6.02.04 Motor leads shall be terminated in the limit switch compartment.
- 6.02.05 Motor actuators for valves/dampers shall be non-integral type with separate starter units and operable from remote.
- 6.02.06 Earthing terminals shall be provided on either side of the motor.
- 6.03.00 **Limit Switches**
- Each actuator shall be provided with following limit switches: -
- 6.03.01 2 torque limit switches, one for each direction of travel, self-locking, adjustable torque type.
- 6.03.02 4 end-of-travel limit switches, two for each direction of travel.
- 6.03.03 2 position limit switches, one for each direction of travel, each adjustable at any position from fully open to fully closed positions of the valve/damper.
- 6.03.04 Each limit switch shall have 2 NO + 2 NC potential free contacts. Contact rating shall be 5A at 240V A.C. or 0.5A at 220V D.C.
- 6.04.00 **Hand Wheel**
- Each actuator shall be provided with a hand wheel for emergency manual operation. The hand wheel shall declutch automatically when the motor is energized.
- 6.05.00 Position Indicator/Transmitter
- The actuator shall have:
- 6.05.01 One (1) built-in local position indicator for 0-100% travel.
- 6.05.02 One (1) position transmitter, potentiometer type, for remote indicator.
- 6.06.00 **Space Heater**
- A space heater shall be included in the limit switch compartment suitable for 240V, 1 phase, 50 Hz supply.
- 6.07.00 **Wiring**
- All electrical devices shall be wired up to and terminated in a terminal box. The internal wiring shall be of sufficient size for the power rating involved but in no case less than 1.5 Sq.mm copper. All wiring shall be identified at both ends with ferrules. All wires shall be fire resistance type.
- 6.08.00 **Terminal Box**
- The terminal box shall be weather proof, with removable front cover and cable glands for cable connection. The terminal shall be suitable for connection of 2.5 Sq.mm copper conductor.

7.00.00 ACCESSORIES

As required for the driven equipment, the actuator shall be furnished with starting equipment mounted on the actuator. This shall include:

- 7.01.00 One (1) triple pole MCCB for local isolation near the actuator
- 7.02.00 One (1) reversing starter with mechanically interlocked contactors, 3 thermal overload relays, 2 NO + 2 NC auxiliary contacts for each contactor.
- 7.03.00 One (1) remote-local selector switch.
- 7.04.00 CLOSE-STOP-OPEN oil tight push buttons with indication lights.
- 7.05.00 415/240 V or 415/110V control transformer with primary protected by fuse & secondary protected by Miniature Circuit Breaker (MCB).

8.00.00 TEST

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

9.00.00 DRAWINGS, DATA & MANUALS

9.01.01 To be Submitted with Bid

Data sheet for each type of actuator shall be furnished along with internal wiring diagram, suggested control schematic and torque limit switch contact development and manufacturer's catalogues.

9.01.02 To be Submitted after Award of Contract

- a) Actuator Data Sheet
- b) Internal wiring diagram and suggested control schematic
- c) Torque switch and limit switch contact development
- d) Manufacturer's Catalogue
- e) Instruction manual indicating clearly the installation methods, check ups and tests to be carried out before commissioning of the equipment.
- f) Any other relevant drawings, documents or data necessary for satisfactory installation , operation and manufacturing.

9.02.00 The Bidder may note that the drawings, data and manuals listed herein are minimum requirements only. The Bidder shall ensure that all other necessary write-ups, curves and information required to fully describe the equipment are submitted with his bid.

SPECIFIC TECHNICAL REQUIREMENTS (C&I)

SPECIFICATION FOR FIELD INSTRUMENTS

- f) ½" NPT cable gland
- 1.02.00 Differential Pressure Transmitter / Flow transmitter
01. Working Principle : Smart (HART compatible)
 02. Type : 2-Wire
 03. Output signal : 4-20 mA DC.
 04. Signal Processing Unit : Silicon solid-state electronic circuitry
 05. Measuring element : 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 : 60 : 1 minimum
 09. Span and Zero : Locally adjustable, non-interacting
 10. Enclosure class : IP-65
 11. Zero suppression /
elevation : At least 100% of Span
 12. Output Indicator : LCD type
 13. Nameplate : Tag number and Service engraved in SS tag plate
 14. Body : Forged Carbon Steel for air and flue gas application and SS for other application
 15. Ambient temperature : 0 - 50 °C
 16. Operating Voltage : 16 - 48 Volts DC
 17. Load : 600 Ohms (min.) at 24 Volts DC
 18. Performance:-
 - i) Accuracy : ±0.1 % of span or better
 - ii) Repeatability : ± 0.05 % of span or better
 - iii) Response time : 100 msec or better
 19. Sealing / Isolation : Extended diaphragm with 5 meters SS armoured capillary for viscous fluid applications.
 20. Accessories :
 - a) Universal mounting bracket suitable for 2" pipe mounting.
 - b) High tensile carbon steel U-bolts.
 - c) Siphon for steam and hot water services.
 - d) Companion flange with nuts, bolts and gaskets.
 - e) ½" NPT cable gland

- f) ½" NPT generally 5-valve stainless steel manifold, constructed from SS316 bar stock. 3 valve manifold for DP application in flue gas and air.

1.03.00 Displacer Type Level Transmitters

01. Type : Smart (HART compatible)
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 : CS or SS as per process application
 - vi) Transmitter Housing : Die cast aluminium or better
04. Operating Voltage : 16-48 Volts D.C.
05. Transmission : 2-wire
06. Output Signal : 4-20 mA DC.
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
12. Output Indicator : LCD type
13. Nameplate : Tag number and Service engraved in stainless steel tag plate
14. Ambient Temperature : 0 - 50 °C
15. Load Impedance : 600 Ohms at 24 Volts (minimum)
16. Process Connection : 2" Companion flange with nuts, bolts and gaskets
17. Performance -
- Accuracy : ± 0.5 % 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.
 - e) ½"NPT cable gland

19. Preferred Features : a) Test plug connection and cutout terminals physically separated from other electronics.
b) Electronic Damping facility (adjustable).
- 1.04.00 Mass Flow meter
- 1.04.01 Sensor
01. Measuring Principle : Coriolis Mass flow.
02. Primary Element : Flow Tube of 316SS or better
03. Heating Arrangement : Integral.
04. Temperature Control : For heavy fuel oil application.
05. Process Connection : Flanged of rating as per process requirement.
06. Drain : Self-draining facility
07. Enclosure : Stainless steel
08. Accessories : Counter flanges, Mounting nuts, bolts, gaskets etc.
- 1.04.02 Transmitter
01. Measured quantities : Mass Flow rate, Total Mass Flow, Density.
02. Input Signal Processing : Digital Processing.
03. Display : Digital Display (LCD).
04. Output : 2 off. isolated 4-20mA DC output.
05. Load : < 750 ohms.
06. Power supply : 240V AC, 50 Hz.
07. Turn Down : 100:1
08. Accuracy : ± 0.2 % of measured value
09. Housing : IP 65
10. Nameplate : Tag number, service engraved in stainless steel tag plate
11. Accessories : a) Handheld configurator
b) Mounting U-bolts, nuts, bolts, prefab cable etc.
c) $\frac{1}{2}$ "NPT cable gland
- 1.05.00 Pressure Gauge and Differential Pressure Gauge
01. Type : Bourdon/Bellows/Diaphragm
02. Sensing & Socket : AISI-316 SS
03. Movement Material : AISI-304 SS
04. Case Material : Stainless steel. IP-65.
05. Dial Size : Generally 150 mm
06. Scale : Black lettering on white in 270° arc.

- 07. Window : Shatterproof glass
- 08. Range Selection : Normal process pressure: 50~70 % of range
- 09. Over-range Protection : 125% of maximum range by internal stop. External stop at zero.
- 10. Adjustment : Micrometer screw for zero. Internal micrometer screw for range.
- 11. Element Connection : Argon welding
- 12. Process Connection : 1/2" NPT (M) Bottom for local, back for panel mounting.
- 13. Performance : Accuracy of ± 1.0 % of span or better.
- 14. Operating ambient : 0 - 50 °C
- 15. Safety Feature : Blow out disc /diaphragm at the back
- 16. Accessories :
 - a) Snubbers and Glycerin filled for pulsating fluid applications and at pump discharge.
 - b) Stainless steel Diaphragm seals for viscous fluids.
 - c) 3-Way SS316 Gauge cock for pressure gauges.
 - d) 5-valve SS316 manifold from barstock for differential pressure gauge.
 - e) Siphons for steam and hot water services.
- 17. Applicable standard : IS-3624 / 1996
- 18. Nameplate : Tag number, service engraved in stainless steel tag plate

1.06.00 Temperature Gauge

- 01. Type : Bimetallic or gas filled.
- 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. Connection to well : 1/2" NPT
- 09. Case Material : Stainless steel
- 10. Dial Size : 150 mm in general
- 11. Scale : Black lettering on white in 270 ° arc.
- 12. Mounting : Surface/Panel
- 13. Over range Protection : 125 % of range or more

CCTV network configuration shall be built on the Stackable Managed Ethernet switches for better control of data traffic & performance and future expansion. Switch configuration shall be redundant with seamless changeover without any upset in the CCTV operation. MTBF of the switch shall be more than 20 Years. Configuration shall be automatic.

3.00.00 CONTROL PANEL/DESK MOUNTED INSTRUMENTS AND ELECTRICAL SYSTEM ACCESSORIES

3.01.00 Coupling Relay

01. Type : Octal base plug-in type/ DIN rail Mounting
02. Coil voltage : 24 V D.C. in general / other as required
03. Contact : 2 NO & 2 NC (Minimum)
04. Contact rating : 250 V/5A (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

3.02.00 Bar graph Indicator

01. Type : Bar graph
02. Number of channels : One / Two (as required)
03. Input : 4-20 mA/1-5 V/Thermocouple/RTD
04. Indication : Green LED / LCD
05. Scale : 100 mm vertical one for each channel graduated in engineering unit (linear scale)
06. Readable Distance : 3 meters (minimum)
07. Mounting : Flush panel
08. Face Dimension : 36(W) x 144(H) mm (approx) / 72 x 144 (H) mm
09. Resolution : 1% of scale or better
10. Power Supply : 240V, 1 Phase, 50 Hz AC
11. Operating Conditions :-
 - a) Temperature : 0-50 ° C
 - b) Relative Humidity : 5%-95%
 - c) Supply Voltage : -15% to +10%
12. Connection between

- | | | | |
|---------|---------------------------------|---|--|
| | Indicator and Tray | : | Prefab Cable |
| 13. | Accessories | : | i) Mounting Tray
ii) Engraved phenolic nameplate affixed to front flange to identify each indicator by tag number and each point by measured variables. |
| 14. | Alarm Facility | : | 1 HI and 1 LO for each channel independently adjustable over span. Voltage free outputs |
| 15. | Reference Junction Compensation | : | Built-in cold junction compensation for thermocouple inputs |
| 16. | Feature | : | i) Alarm level indication by flashing cursor
ii) Green Digital display of parameter value in front panel with a 3.1/2 digit display. |
| 3.03.00 | Valve Position Indicator | | |
| 01. | Input | : | 4-20 mA DC/1-5 Volts DC |
| 02. | Indication | : | Pointer and Scale. Moving Coil Meter |
| 03. | Readable Distance | : | 3 meters (minimum) |
| 04. | Pointer Deflection | : | 90 Deg Sector or linear |
| 05. | Mounting | : | Flush Panel (Horizontal/vertical) |
| 06. | Accuracy | : | ±1% or better |
| 07. | Protection Class | : | IP-42 |
| 08. | Operating Ambient Temp. | : | 0-50 °C |
| 09. | Scale | : | 0-100% |
| 10. | Bezel Size | : | DIN Standard |
| 3.04.00 | Digital Indicator | | |
| 01. | Type | : | Four and half digit LED seven-segment display with sign. |
| 02. | Face Dimension | : | 72 x 144 mm / 48 x 96 mm (as applicable) |
| 03. | Display Character | : | 13.8 mm, Green (LED) |
| 04. | Accuracy | : | 0.1% of reading, ±2 digit |
| 05. | Input | : | 4-20mA DC/1-5 V DC/RTD/Thermocouple |
| 06. | Mounting | : | Flush Panel |
| 07. | Power Supply | : | 240V ±10%, 50 ±2.5 Hz |
| 08. | Output Contact | : | 2 nos SPDT, contact rating 5A at 240V AC/
0.25A at 220V DC |
| 09. | Power/Signal Connection | : | Screwed |
- Large Display (150x300 mm) indicators shall be provided for MW, MVAR and frequency indications.