TANGEDCO
2x800 MW UPPUR STPP (STAGE -I, Unit 1 & 2) - BTG

TECHNICAL SPECIFICATION
FOR
DEBRIS FILTER (DF).

Specification No. : PE-TS- 425-165-N003 Rev 00

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

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SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)

1.0 GENERAL

The Debris Filter (DF) complete with all accessories shall conform to the standard technical specifications (Section-II) and Data Sheet-A enclosed herewith. In addition the requirements of this section I including customer specification attached (as applicable) shall also be complied with. However, wherever the details given in Section-II and Data Sheet-A are different, the requirements of Data Sheet-A shall prevail. Similarly in the event of contradictions between Section-I/ customer specification / Section-II/ Data Sheet-A, the same shall prevail in the order as: customer specification, Section-I, Datasheet-A, Section-II.

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

2.0 DESCRIPTION OF EQUIPMENTS :

2.1 Debris Filter (DF) :

The debris filter (DF) is intended to prevent accumulation of debris in CW Pipe before entering into the condenser. The cooling water system is of closed circuit type with cooling towers or open circuit type as specified. The water analysis is indicated with Datasheet-A.

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

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

3.2 SCOPE OF SUPPLY IN THE BIDDER'S SCOPE FOR DEBRIS FILTER:

3.2.1 Each set of Debris Filter shall comprise as following:

a) Flushing pump with drive Motor (if required) - 1 No.

b) Complete Interconnecting (As Applicable) & Debris disposal Pipe work, including flanges/counter flanges for pipes, bends, fittings, distributors, nozzles and support installation materials shall be in Purchaser's scope. **However, valves along with its Flanges/Counter Flanges/Gaskets/Nuts & Bolts shall be in Bidder's Scope**. Isometric Drawing along with BOM for interconnection piping, flanges/counter flanges for pipes, bends, fittings, distributors, nozzles and support installation materials in line with approved Installation Drawing to be submitted by the Bidder within 4 weeks after approval of the Installation Plan. Minimum Pipe Size to be considered by the Bidder for all interconnecting (as applicable) & Debris disposal piping shall be 200 Nb.

c) Filter body/ housing Vent and drain connections along with their isolating valves.

d) Length of Debris Filter, complete with scope of bolts, nuts and gaskets shall be as per Datasheet-A. Thickness of body flange shall be as per Drg no PE-DG-999-141-

MO17 enclosed at enclosures at Annexure-II of Datasheet-A.:

e) Differential pressure measuring system for debris filter. DP measuring system shall comprise of 2 Nos. DPT + 1 No. DPG for each DF and shall be with Remote seal arrangement. Stubs for DPT and DPG shall be independent.

f) The Electrical & C&I items/ accessories as specified in succeeding clause/ respective sections herein.

g) Power and Control cables between starter Panel (Switch Gear) and various drives in bidder's scope of supply.

h) Starter Panel (Switch Gear Panel) shall be as follows:

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

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

i) Control cables between field instruments and Switch gear panel.

j) All the field instruments stipulated in this specification shall be in Bidder's scope.

k) Set of commissioning spares, on "As required basis".

l) Set of mandatory spares as indicated in Data Sheet A.

m) 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

n) Finish paints for touch up painting of equipment after erection at site, in sealed containers.

o) Set of special tools and tackles if required for maintenance and erection of the equipment supplied.

p) 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.

q) Panels & Instruments: Scope and Type as specified in C&I section wherever required.

Any item not specified but required to make DF 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 Debris Filter:

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

The trial run & PG Test of equipment shall be generally conducted immediately after commissioning. These activities for different units shall be timed separately.

- **For drawings/documents approval**
  In the event of order all drawings / documents in soft as well as hard copy shall be submitted as per Cl. No. 10.0.

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

- **Site Visits for installation check / commissioning/ trail run/PG Test:**

  Bidder to include cost of two site visits for four days each for installation check, commissioning, trial run and PG testing for one unit i.e 2 nos of DF .

  In case of non-completion of above activities in site visits stipulated above, for any reasons not attributable to vendor, vendor shall complete above activities in subsequent site visits for which cost shall be borne by BHEL on pro-rata basis on price of site visit quoted by bidder in price schedule.

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.

6.1 The typical flow diagram applicable for the project specified herein for Debris Filter is enclosed (Annexure-I-A of Datasheet-A) with scope demarcation for bidder's compliance.

6.2 Location of Debris Filter shall be Approx. 15M Outside TG Hall 'A' Row in Transformer Yard. Final Layout drawing shall be provided during Detailed Engineering.

6.3 Thickness of body flange and counter flange of Debris Filter shall be as per Drg no PE-DG-999-141-MO17 enclosed at enclosures at Annexure-II of Datasheet-A.

6.4 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.

6.5 Housing/ body of Debris Filter 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 Debris Filter.

6.6 Cathodic Protection for DF along with Sacrificial Anode shall be provided by the bidder in the equipment.

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.

7.0 Performance Guarantee for Debris Filters.

Performance Guarantee Parameters shall be as under:

- Max. Pressure drop in Debris Filter in clean condition (Test to be conducted along with commissioning) – not exceeding 0.6 MWC. The Bids shall be technically rejected for pressure drop quoted higher than 0.6 MWC.

Any deviation to above pressure drop will not be accepted.

In case the successful bidder fails to demonstrate above parameter, he shall carry out modifications at his own cost, to purchaser's approval.
In case bidder fails to demonstrate above parameter to purchaser's satisfaction even after modification carried by him at site, the purchaser has the right to reject the equipment out rightly and bidder is liable to resupply the equipment meeting the contractual performance parameters within time period mutually agreed upon without any cost implication to BHEL/Customer.

8.0 SPARES :

8.1 Mandatory Spares

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

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

10.0 DELIVERY & DRAWINGS/ DOCUMENTS DISTRIBUTION SCHEDULE :

a. Delivery of Equipment shall be as per NIT.

b. The drawings to be submitted by bidder in event of award of contract:

- Technical Data Sheets, P&ID, Installation Plan.

- GA drawings, Details of Flushing Skid (if any) and C& I Document (Part-I & II) of DF as applicable.
- Quality Plan.
- O & M Manual.

c. Drawings submission schedule after the award of contract shall be as below:

PACKAGE	BHEL DRG NO	DRG TITLE	Drg Sch for Vendors
DEBRIS FILTER	Primary Documents -		
	PE-V3-425-165-N001	P&ID - OF DF SYSTEM	R-0 within 20 days (for all except Installation plan, for Installation Plan 30 Days) from LOI/PO & subsequent revisions within 10 days of comments received from BHEL.
	PE-V3-425-165-N002	TECHNICAL DATA SHEET-DF	
	PE-V3-425-165-N003	INSTALLATION PLAN- DF	
	PE-V3-425-165-N004	GENERAL ARRANGEMENT OF DF	
	PE-V3-425-165-N006	C&I Part-I, PANEL-TDS, I/O LIST, CABLE SCH AND CONTROL PHILOSPHY FOR DF	
	PE-V3-425-165-N008	QP-DF	
	PE-V3-425-165-N005	GA OF FLUSHING PUMP & FOUNDATION DETAILS OF FLUSHING PUMP AND SADDLE SUPPORT (If Applicable)	R-0 within 20 days from Cat-I(or)II approval of TDS & subsequent revisions within 10 days of comments received from BHEL
	PE-V3-425-165-N007	GA & WIRING DIAGRAM OF PANEL-DF	R-0 within 30 days from Cat-I(or)II approval of C&I Part-I document & subsequent revisions within 10 days of comments received from BHEL.
	Secondary Documents -		
	PE-V3-425-165-N009	O&M MANUAL-DF	Within 30 days from MDCC

11.0 The makes of various bought out items shall be subjected to purchaser's (BHEL & Customer) 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 Section III).
- Guarantee schedule duly signed and stamped (Enclosed at Section III).

- GA drawings of following with empty/ filled-ups.
  - Debris Filter body/ housing (as applicable).
  - Flushing Skid (if any).
  - Other equipment considered necessary for Layout/ Civil.

- Electrical Load Data.
- Schedule of Deviation.

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

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

14.0 Debris Filter packing procedure before dispatch

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

14.1 Preparation for Packing:

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

14.2 Protection of parts:

- DF Shell shall be packed in properly in high grade bubble plastic wrap for transportation, and long storage at site.
- Actuators shall be packed in separate wooden box of proper sizes.
- DF items (EXCEPT DF Shell) shall be packed in proper sizes of wooden cases. High grade woods like Rubber woods, jungle wood, hard wood, mango wood, pine wood, etc. is used for packing.
- Loose material, & Electrical & Electronics items shall be packed in corrugated box and plastic bags with proper tagging and marking of handle with care in proper sizes of wooden cases

- All finished (or) machined (External C.S. Surfaces shall be protected against corrosion with corrosion resisting coating, which is easily removable (Compound shall be such that it will remain on the surface at temperature normally encountered during shipping & storage).
- All machined surfaces shall be protected from mechanical damage. All external unfinished carbon steel surfaces shall be sand blasted & shall be coated with rust preventive primer.
- Flanged opening if any shall be covered with blank flanges sealed with blank gasket of natural rubber or equivalent. Butt welded opening shall be closed with temporary closing covers. Internal threads shall be protected with metal plug sealed with Teflon tape (if applicable). External thread shall be protected with PVC sleeve.
- Wooden cases shall be covered with HDPE cloth from inside wooden box and the top. All the opening in Debris Filter shall be closed properly by suitably covering to prevent foreign material entering in Debris Filter.
- All fabricated wooden cases & crates conform to the requirement as per table given below:

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

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

14.3 Preservation

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

14.4 Photographs

Bidder to take photographs of all parts like Debris Filter Shell, Screen, pumps (if any), piping, valves, instruments, actuators, panel (inside & outside) and sent to engineering deptt along with all inspection reports before final dispatch.

SUB-SECTION – IB

SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)

SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

a) Services and equipment as per "Electrical Scope between BHEL and Vendor".
b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.
c) Supply of mandatory spares as specified in the specifications of mechanical equipments.
d) Electrical load requirement for DEBRIS FILTER (DF).
e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer/BHEL approval without any commercial and delivery implications to BHEL
g) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.
h) Motor shall meet minimum requirement of motor specification.
i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
j) Cable BOQ worked out based on routing of cable listing provided by the vendor for "both end equipment in vendor's scope" shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

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

Refer "Electrical Scope between BHEL and Vendor".

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

3.1 The electrical specification without any deviation from the technical & quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of confirmation cum compliance sheet & cost of withdrawal sheet as in price schedule.

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

4.0 List of enclosures :

a) Electrical scope between BHEL & vendor (Annexure –I)
b) Electrical Load data format (Annexure –II)
c) BHEL cable listing format (Annexure –III)
d) Technical data sheet of motors.
e) Datasheets & quality plan for motors.
f) Customer Specification for motors
g) Customer Specification for Cables
h) Customer Specification for LT Switchgear
i) Electrical mandatory spares (As per spec.)
j) Sub vendor list for motors (Annexure-IV)

ANNEXURE-I REV-0, DATE: 11.10.17

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGES: DF

SCOPE OF VENDOR: SUPPLY

PROJECT: 2X800 MW SUPERCRITICAL COAL BASED UPPUR TPP

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/ microprocessor & 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	

ANNEXURE-I REV-0, DATE: 11.10.17

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGES: DF

SCOPE OF VENDOR: SUPPLY

PROJECT: 2X800 MW SUPERCRITICAL COAL BASED UPPUR TPP

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.

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.	VERIFICATION FROM MOTOR DATASHEET (Y/N)	KKS NO
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOs						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
ANNEXURE-II																				

NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)/ CUSTOMER

2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V

: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)

LOAD DATA (ELECTRICAL)	JOB NO.	425	ORIGINATING AGENCY		PEM (ELECTRICAL)	
	PROJECT TITLE	2X800 MW SUPERCRITICAL COAL BASED UPPUR TPP	NAME		DATA FILLED UP ON	
	SYSTEM	DF	SIGN.		DATA ENTERED ON	
	DEPTT. / SECTION	MSE	SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE	

CABLE SCHEDULE FORMAT

ANNEXURE III

UNITCABLENO	FROM	TO	PURPOSE	CABLE SCOPE (BHEL PEM/ VENDOR)	REMARKS	CABLESIZE	PATHCABLENO	TENTATIVE CABLE LENGTH

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

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

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

(A) SYSTEM VOLTAGE CODES:

(ac) A = 11KV, B = 6.6KV, C = 3.3KV, D = 415V, E = 240V, F = 110V

(dc) G = 220V, H = 110V, J = 48V, K = +24V, L = -24V

(B) CABLE VOLTAGE CODES:

A = 11KV (Power cables)

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

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

(C) CABLE CODES

PVC Copper

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

PVC Aluminium

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

XLPE Copper

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

XLPE Aluminium

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

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

DATASHEET

	Auxiliary power supply	
1.1	**HV supply**	
	11kV, 3Φ, 3W, 50 Hz non effectively earthed Earthed through resistance, limiting earth fault current to 400 Amps	Motors rated above 2000 kW
	Fault level	50 kA for 1 second
	HV Motors	shall be controlled through vacuum circuit breaker
	The cooling tubes of Motor	Shall be of Stainless Steel
1.2	**MV supply**	
	6.6kV, 3Φ, 3W, 50 Hz non effectively earthed. Earthed through resistance, limiting earth fault current to 400 Amps	Motors above 200kW upto and including 2000kW
	Fault level	40 kA for 1 second
	MV Motors	shall be controlled through vacuum circuit breaker
	The cooling tubes of Motor	Shall be of Stainless Steel
1.3	**LV supply**	
	415V, 3Φ, 3W, 50 Hz effectively earthed	Motors below and including 200kW
	Fault level	50kA for 1 second
	110V, 1Φ, 2W, 50 Hz effectively earthed	Lighting, space heating, AC control and protective devices
	LT motors rated up to 90 kW	shall be controlled through MPCB/ MCCB and contactor.
	LT motors rated more than 90 kW	Shall be controlled through air circuit breaker
1.4	**DC supply**	
	220V,2W, unearthed	DC alarm, control and protective devices.
	Fault level	25 kA for 1 second
2	Range of variation	As indicated in the specification
2.1	AC supply	

	voltage	------
	Frequency	------
	Combined voltage & frequency	--------
2.2	DC supply	198 to 240 V
Note: During starting of largest 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.		

SECTION – 14: AC & DC MOTORS

14.01.00 SCOPE

This specification is intended to cover design, manufacture, assembly and testing of AC Squirrel Cage Induction Motors for use in Thermal Power Plants and is supplement to the driven equipment specifications under which these motors are being procured for the project.

14.01.01 Site Conditions

Site conditions are covered in 'Project Data', contained in specification of the driven equipment.

14.01.02 Gases, Fumes & Dust Particles

General - Sulphur dioxide and/or trioxide fumes mildly present. Climate is tropical, conducive to fungus growth.

14.01.03 Dust Particles

i) Outdoor locations - Heavily dusty with abrasive dust and coal particles of size five (5) to hundred (100) microns present in atmosphere in large quantity.

ii) Indoor Locations.

iii) Coal conveyors - As for outdoor as per clause 14.01.3 (i) above.

iv) Other locations - Lightly dusty with abrasive dust and coal particles of size five (5) to twenty (20) microns present in atmosphere.

14.01.04 Special Fumes

i) Water treatment plant and acid cleaning room - Acid and alkali fuses present.

ii) Fuel oil pumping areas & Hydrogen generation plant - Explosive fuses (flameproof motors required).

iii) For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% (at 40 deg C) shall be considered. The equipment shall operate in a highly polluted environment.

14.02.00 LOCATION OF MOTOR - As required

14.03.00 CODES STANDARDS

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

Code	Name of standard
IS : 325	Specification for three phase induction motor.
IS : 900	Code of Practice for installation and maintenance of induction motors
IS : 996	Single phase AC motors
IS : 1231	Dimensions of three-phase foot-mounted induction motors
IS : 1271	Thermal evaluation and classification of electrical insulation.
IS : 2223	Dimensions of flange mounted ac induction motors.
IS : 2254	Dimensions of vertical shaft motors for pumps
IS : 3043	Code of practice for earthing.
IS : 3177	Crane duty motors
IS : 4029	Guide for testing three phase induction motors.
IS : 4691	Degree of protection for enclosures of rotating electrical machinery.
IS : 4722	Specification for rotating electrical machinery.
IS : 4728	Terminal marking and direction of rotation for rotating electrical machinery.
IS : 4889	Methods of determination of efficiency of rotating electrical machines.
IS : 5571	Guide for selection of electrical equipment for hazardous areas.
IS : 6362	Designation of Method of Cooling of Rotating electrical machines.
IS : 8223	Dimensions and output ratings for foot mounted rotating electrical machines with frame numbers 355 to 1000.
IS : 8789	Values of performance characteristics for three phase induction motors.
IS : 12065	Noise level of motors.
IS : 12075	Measurement and evaluation of vibration of rotating electrical machines.
IS : 12615	Induction motors - Energy efficient, three-phase, squirrel cage – Specification
IS : 12802	Temperature rise measurement of rotating electrical machines.
IS : 12824	Temperature rise measurement of rotating electrical machines

IS : 12824	Type of duty and classes of rating assigned.
IS : 14222	Requirements and method of Impulse withstand test
IEC: 60034-1	Rotating electrical machines.
ISO : 1940-1	Mechanical vibration – Determination of permissible residual unbalance
NEMA, MG-1	Motors and Generators
DIN/IEC/IS	RTD
BS 5308 part II	RTD triad Cable

Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be furnished during detail engineering.

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

14.04.00 TYPE

14.04.01 AC Motors:

i) Squirrel cage induction motor suitable for direct-on-line starting.

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

iii) Crane duty motors shall be squirrel cage Induction motor of S4 duty and 40% CDF.

14.04.02 DC Motors shunt wound.

14.05.00 VOLTAGE (NOMINAL)

14.05.01 LV Motors

For motors upto and including 200 KW - Four hundred fifteen (415) V.

14.05.02 MV Motors

For motors above 200 kW upto and including 2000kW. Six point six (6.) kV.

14.05.03 HV Motors

i) For motors above 2000kW - eleven (11) KV
ii) All motors are to be designed for system grounding described in "System Particulars" under site information of the Driven Equipment Specification.

14.06.00 FREQUENCY (NOMINAL) - fifty (50) Hertz

14.07.00 NUMBER OF PHASES - Three (3)

14.08.00 SPEED - As required by the driven equipment

14.09.00 TYPE OF STARTING - Direct on-line

14.10.00 DUTY

14.10.01 Continuous motor rating shall be arrived at considering 15% margin over the duty point input or 10% over the maximum demand of the driven equipment, whichever is higher, considering highest system frequency and voltage variation. Crane motors shall be rated for S4 duty, 40% cyclic duration factor. If however, a higher margin is stipulated in the accompanying driven equipment specification, the higher stipulated margin shall prevail.

14.10.02 Motor rating shall be such that it is not overloaded at any operating point of driven equipment from zero to full load.

14.10.03 The break-away torque, pull-up torque and pull-out torque of the motors shall be properly co-ordinated with the requirements of driven equipment to ensure smooth and rapid starting and steady operation. The torque-speed characteristic of motor super imposed thereon on driven equipment torque-speed characteristics at 100%, 90%, 80% shall be furnished.

14.10.04 Maximum torque shall not be less than 205% of full load torque.

14.10.05 All HV & MV motors shall be provided with vibration pads for mounting vibration detectors.

14.10.06 All motors shall be designed to withstand hundred twenty (120) percent of rated speed without any mechanical damage for two (2) minutes.

14.10.07 Motors shall be designed to keep torsional and rotational natural frequencies of vibration of the motor and driven equipment atleast twenty five (25) percent above or below, preferably above the motor operating speed (to avoid resonance in vibration over the operating speed) range.

14.10.08 All LV motors rated 0.37kW and higher upto and including 200kW (LV Motors) with S1 duty shall be compulsorily be of energy efficiency level IE 3 as per IS 12615:2011.

14.10.09 HV & MV motors shall have full load efficiency of 95% minimum and rated full load power factor of 0.8 minimum. The required power factor shall be achieved without using external capacitor.

14.11.00 SUPPLY VARIATIONS …… Motors shall be capable of running continuously at full load under following variations in power supply.

14.11.01 Voltage (percent of nominal voltage) ……. Plus minus (±) ten (10) for LT
Plus minus (±) Six (6) for MV & HT

14.11.02 Frequency (percent of minimal frequency)…….. Plus Three 3 & minus (-) five (5)

14.11.03 Combined voltage & frequency (percent) ……. Ten (10) (sum of absolute percentage value of voltage and frequency variation)

14.12.00 ABNORMAL CONDITIONS CAPABILITY

Motor shall have following capabilities as specified design ambient temperature:-

14.12.01 The motors shall also be capable of running up again after voltage collapse to about 40% for approximate duration of 0.5 sec. Subsequent rise in voltage to 70% and further to 80% and 100%, the total duration not exceeding 20 sec.

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

14.12.03 Low Voltage Running:-

Motor shall be capable of running satisfactorily at seventy five (75) percent nominal voltage for five (5) minutes.

14.12.04 Momentary Low Voltage Withstanding:

Motor, when running at full load, shall not stall when voltage drops down to seventy (70) percent nominal voltage for one (1) minute.

14.13.00 STARTING CAPABILITY

14.13.01 Low Voltage Starting

Motor shall be capable of starting and accelerating to full speed at full load (including loaded equipment e.g. mills and conveyors etc) at eighty (80) percent nominal voltage at motor terminals. Mill motors may be permitted to start with terminal voltage not below 90%.

14.13.02 Cold Motor Starting

Under specified voltage variations two (2) starts in quick succession and third start five (5) minutes thereafter, all with full load (including loaded equipment eg mills and conveyors etc) of driven equipment. No additional start shall be made till lapse of further thirty (30) minutes. (with initial temperature of the motor at ambient temperature)

14.13.03 Hot Motor Starting

Under specified voltage variations, one (1) immediate and two (2) fifteen (15) minutes interval starts all with full load (including loaded equipment e.g. mills and conveyors etc) of driven equipment. No additional start shall be made till lapse of further thirty (30) minutes. (with initial temperature of the motor at full load operating level)

14.13.04 Motor shall also be suitable for three (3) equally spread starts per hour when the motor is under normal service condition.

14.13.05 Break-away Starting Current

Breakaway starting current as percent of full load current for various motor ratings shall not exceed the values given below:-

i) Motors upto 1000 KW …… 600% subject to IS Tolerance of plus 20%

ii) Motors (above 1000 KW upto 3000 KW) …… 600%. Subject to 20% IS tolerance.

iii) Motors above 3000 KW……..…..450%. Not subject to any positive tolerance.For energy efficient

iv) LT motors, locked rotor current shall be as per IS: 12615.

v) Locked rotor current of the VFD controlled AC motors shall be limited to 300% of the full load current, and is subject to IS tolerance

14.14.06 Where variable voltage and variable frequency (VVFD) operation is envisaged through VVFD drives, motors shall be specially designed for such application.

14.14.00 STARTING VOLTAGE REQUIREMENT

14.14.01 All Motors (except Mill Motors)
i) 80% of rated voltage for Motors upto 4000 kW
ii) 75% of rated voltage for Motors above 4000 kW

14.14.02 For Mill Motors:

i) 85% of rated voltage for Motors above 1000 kW
ii) 90% of rated voltage for Motors below 1000 kW

14.15.00 TORQUE REQUIREMENTS

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

14.15.02 Full out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty Motors.

14.16.00 STARTING TIME

14.16.01 For motors with starting time up-to 20 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at-least 2.5 secs. more than starting time.

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

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

14.16.04 At no stage, speed switch shall be provided to achieve requirements mentioned in Clause No. 14.16.01 to 14.16.03.

14.17.00 CLASS OF INSULATION

14.17.01 LV Motors ..... Class F.

14.17.02 HV & MV Motors ..... Class F

14.17.03 However temperature rise shall be restricted to limits corresponding to Class 'B' insulation for both MV, HV & LT motors. The temperature under abnormal running conditions shall be limited to 5^{o}C above class 'B' limits.

14.17.04 The value of the polarization index for motors above 200kW should not be less than 2 when determined according to IS: 78114.0

14.17.05 For the VFD operated drives, insulation shall be designed to take care of stresses due to high DV/DT. Motors shall be wound with dual coated winding wires and impregnated with VPI process. Further for such application, insulated bearings shall be provided to avoid circulating current caused by shaft induced voltages,

14.17.06 HT motors shall withstand 1.2/50 micro sec impulse Voltage wave of 4U+5 kV (U=Line voltage in kV). The coil inter-turn insulation shall be as per IEC-60034 – Part 15 followed by 1 min power frequency high voltage test of appropriate voltage on inter turn insulation.

14.18.00 TEMPERATURE RISE UNDER NORMAL CONDITIONS

14.18.01 Temperature rise over specified design ambient temperature when motor is running with full load at nominal supply voltage & frequency shall not exceed the values given below:

S.No.	Specified Design Ambient Temperature	Thermometer Method	Resistance Method
i)	50^0C	60^0C	70^0C

14.18.02 For Water Cooled Motors, temperature rise of insulation should be limited to 80 deg. C over inlet cooling water temperature mentioned elsewhere, by resistance method.

14.19.00 BUS TRANSFER WITHSTAND CAPABILITY

Motors shall be connected to an automatic bus transfer system and hence may be subjected to one hundred and fifty (150) percent of the nominal voltage during changeover of buses due to the vector difference between the residual voltage and incoming supply voltage and the duration of this condition may be one second. Motors shall be capable of withstanding the voltage and torque stresses developed under such conditions without damage. The manufacturer/ vendor shall indicate the special precautions taken to meet the above requirements and confirm.

14.19.02 That motor shall be capable of withstanding heavy inrush transient current caused by such bus transfers without damage.

14.19.03 That the motor winding's shall be adequately braced to satisfactorily withstand mechanical stresses under these conditions.

14.19.04 The motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torques under these conditions.

14.20.00 TYPE OF ENCLOSURE

14.20.01 Outdoor Motors……IP 55 (Additional canopy to be provided by Bidder).

14.20.02 Indoor Motors ..... IP 55

14.20.03 IP-55 degree of protection shall be achieved without application of any compound, putty etc.

14.21.00 METHOD OF COOLING

14.21.01 Method of cooling shall be IC 411 (TEFC), IC 511 (TETV) or IC 611 (CACA). However, motors rated 3000kW or above can be closed air circuit water cooled (CACW).

14.21.02 Large capacity motors not available with above types of cooling may be accepted with IC 81 W for IC 91 W (CACW) cooling subject to the approval of the Owner.

14.22.00 TYPE OF MOUNTING ..... As required for the driven equipment.

14.23.00 MAXIMUM MECHANICAL VIBRATIONS

Vibration shall be limited within the limits prescribed in IS: 12075 / IEC 60034-14. Motors shall withstand vibrations produced by driven equipment. HV & MV motor bearing housings shall have flat surfaces, in both X and Y directions, suitable for mounting 80mmX80mm vibration pads.Vibration pads with screwed holes along with vibration probes shall be provided at both DE and NDE.

14.24.00 NOISE LEVEL

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

14.24.02 Motor body shall have two earthing points on opposite sides.

14.24.03 The spacing between gland plate & centre of terminal stud shall be as per Table-I.

TABLE – I

DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS

Motor MCR in KW	**Minimum distance between centre of stud and gland plate in mm**
UP to 3 KW	**As per manufacturer's practice.**
Above 3 KW - upto 7 KW	85
Above 7 KW - upto 13 KW	115
Above 13 KW - upto 24 KW	167
Above 24 KW - upto 37 KW	196
Above 37 KW - upto 55 KW	249
Above 55 KW - upto 90 KW	277
Above 90 KW - upto 125 KW	331
Above 125 KW-upto 200 KW	203

14.24.04 For HV & MV motors the distance between gland plate and the terminal studs shall not be less than 500 mm.

14.24.05 All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.

14.24.06 For motors rated 1000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.

14.25.00 WINDING & INSULATION

14.25.01	Type	:	Non-hygroscopic, oil resistant, flame resistant
14.25.02	11kV & 6.6 kV AC motors	:	Thermal class 155 (F) insulation and the temperature rise shall be limited to Class B. Winding material shall be of copper. The winding insulation process shall be total Vacuum Pressure Impregnated i.e resin poor method. The lightning Impulse & inter-turn insulation surge withstand level shall be as per IEC-60034 part-15
14.25.03	240VAC, 415V AC & 220V DC motors	:	Thermal Class(F)

14.26.00 DIRECTION OF ROTATION

14.26.01 As needed by driven equipment.

14.26.02 The 3 phase motor shall, however, be suitable for operation in both directions of rotation. A plate showing direction of rotation as determined by the phase sequence on the terminals marking shall be screwed at non-driving end of the body of the motor.

14.26.03 If, in the case of HV & MV motors, fan is suitable for only one direction of rotation, the fan shall be so designed that with the slight modification work, it can be made suitable for other direction of rotation also. No extra material shall be required for doing above modification work.

14.27.00 BEARINGS

14.27.01 Greased ball, roller and/or sleeve bearing shall be rated for minimum standard life of 40000 hours taking bearing and driven equipment loads into account. Loss of grease shall be scarce and it shall not creep along shaft into motor housing.

14.27.02 Bearing shall be effectively sealed against dust ingress and shall be pressure grease gun lubricated.

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

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

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

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

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

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

14.27.09 Bearings shall be of internationally reputed make subject to the approval of the Owner/Consulting Engineer.

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

14.28.00 **SHAFT EXTENSION** ..... Key slotted bare shaft extension of required length with key on driving end.

14.29.00 **DRAIN HOLES** ..... Two (2) drain holes with plugs, one (1) on either end of motor at the bottom most point.

14.30.00 **LIFTING DEVICES** ..... Motors shall be provided with eye-bolts, lugs or other means to facilitate safe lifting.

14.31.00 **DOWEL PINS**..... It shall be possible to drill holes vertically inclined through motor feet or mounting flange for installing dowel pins after assembling motor and driven equipment, before despatch (for completed driving + driven equipment assembly) or at site after erection (for separate supplies of above equipment).

14.32.00 **CENTERING SPIGOT**..... Flange mounted motor shall have centering spigot to match driven equipment socket.

14.33.00 **EASE OF MAINTENANCE**..... Motor shall be so constructed that it can be de-assembled and reassembled with ease.

14.34.00 **NAMEPLATES**..... Motor shall have nameplate(s) showing diagram of connections, all particulars as per IS: 325 and following additional information:-

14.34.01 In addition, an arrow block shall be screwed on to the body of motor on the non-driving end to indicate direction of rotation of motor.

14.34.02 Temperature rise under normal/abnormal conditions.

14.34.03 Type of bearing and recommended lubricants.

14.35.00 FINISH

14.35.01 Motor shall have synthetic enamel paint shade as mentioned in Chapter 1.

14.35.02 All sharp edges and scales shall be removed from the surface, which shall then be thoroughly degreased, de-rusted and given two (2) coats of primer and two (2) coats of finish paint. It is preferred that a phosphate coat is given to motor prior to application of primer coat. Motors for water treatment plant shall have Zinc Chromate base with acid resistant Epilex 4 paint.

14.36.00 TERMINAL BOXES

14.36.01 General

i) Motors shall be provided with separate terminal boxes for main, space heaters, embedded temperature detectors, bearing temperature indicators and moisture detectors terminals, Neutral CT terminals. When it is not possible to provide LT motors with separate terminal box for space heater terminals, space heater terminals shall be adequately segregated from the main terminals in the single box. Terminal boxes shall be weatherproof and water-tight confirming to minimum IP-55 degree of protection with removable front cover for making connections. IP-55 degree of protection shall be achieved without application of compound. Space between and around terminals shall be adequate for easily connecting aluminium conductor cables. Terminal box arrangement shall be to the approval of the Owner /Consulting Engineer. All terminal boxes shall be suitable for proper termination cable to be finalized during detailed engineering.

ii) The terminal boxes shall be complete with cable glands and termination accessories as required. Suitable non-magnetic material construction shall be adopted for terminal boxes where single core

cables are to be terminated. All HV & MV motors shall be provided with phase segregated terminal box.

iii) Terminal bushings and clamps shall be non-absorbent, non-inflammable, insulated material for connecting with cable.

14.36.02 Main Terminal Box

i) LV Motors ..... Main terminal box shall be capable of being turned through 360 degrees in steps of 90 degrees.

ii) MV & HV Motors shall be provided with two (2) terminal boxes for stator terminals. One (1) terminal box shall be for phase terminals while other one for forming star connection. For motors rated below 1000 KW should be interchangeable to facilitate cable routing.

iii) Neutral terminal box for HV motors rated 1000 KW and above shall be suitable for mounting of three (3) Nos. wound/bar primary/ring type cast resin insulated current transformers for differential protection. These CTs shall be mounted in the motor neutral terminal box. Stator phase terminal box shall be phase segregated terminal box suitable for both top or bottom entry of cables (i.e. they should be capable of being turned through 180 Degrees). The terminal box shall be designed for termination of XLPE cables using heat shrinkable terminating Kit. Terminal leading shall be stud type or leading wire type.

iv) Terminal Boxes shall be provided with cable end boxes having cable lugs and cable glands for cables.

v) The terminal boxes shall be capable of withstanding at the terminals the system fault level (as indicated below) without rupture for a duration of atleast 0.25 seconds.

vi) Phase to Phase/ Phase to Earth Air Clearance:-

a) Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows:-

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

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

14.37.00 **TYPE AND SIZE OF CABLES**

14.37.01 Space Heaters

i) For LV Motors: Two point five (2.5) mm^2, two (2) core copper conductor PVC insulated, armoured and FRLS PVC sheathed heavy duty 650/1100 V grade cable to IS: 1554 (Part-I).

ii) For MV & HV Motors: Six (6) mm^2 two core aluminium conductor XLPE insulated armoured and FRLS PVC sheathed heavy duty 650/1100V grade cable to IS: 1554 (Part-I).

iii) For Embedded Temperature Detectors two sets of six (6) Twisted triad 0.5 mm^2 ATC copper conductor armoured, shielded cable, 650/1100 V Grade IS: 1554 (Part-I). For bearing temperature, RTDS, two (2) sets of four (4) twisted triad 0.5 mm^2, ATC copper conductor armoured shielded 650/1100 V Grade, IS: 1554 (Part-I).

iv) Bearing Temperature Indicators - For each indicator, 0.5 mm^2 six (6) tarnished triad ATC copper conductor, PVC insulated, shielded armoured and FRLS PVC sheathed heavy duty 650/1100 V grade cable as per IS: 1554 Part-I. Two (2) cables one (1) for each bearing temperature indicator.

v) For Moisture Detectors.....As for space heaters as per Clause 14.041.1 (i) above.

14.37.02 For Main Terminals:-

i) LT Motors

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

b) Single core cables ……Stranded aluminium conductor, XLPE insulated, hard drawn aluminium wire/ strip armoured FRLS PVC type ST2 jacketed overall, 1100V grade, heavy duty cable as per IS: 1554 (Part-I).

ii) HV & MV Motors

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

14.38.00 GROUNDING

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

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

14.38.03 HV & MV Motors.....Non-corrodible metallic grounding pad shall be welded or brazed at each earthing point. The size of grounding pad shall be 75x65x25 mm. Grounding pad shall have 40 mm apart two (2) drilled and tapped holes with hexagonal head bolts, plain washers and spring washers for size of conductor specified. In addition, one suitable earthing terminal shall be provided inside the stator phase terminal box for earthing metallic shield of XLPE cables.

14.39.00 EMBEDDED TEMPERATURE DETECTORS

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

14.40.00 BEARINGS TEMPERATURE INDICATORS

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

14.41.00 SPACE HEATERS

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

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

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

14.42.00 HOT AIR TEMPERATURE DETECTOR

If the motor is of CACA or CACW enclosure, dial type temperature indicator shall be provided (one each for hot and cold air temperature monitoring for CACA and CACW and one each for inlet and outlet water temperature monitoring for CACW). In addition one (1) duplex type RTD shall be provided in each enclosure for alarm and if trip is required for cooling air temperature, temperature switch shall be provided.

14.43.00 WATER FLOW INDICATOR

If the motor is of CACW enclosure a provision shall be made for visual indication of water flow and flow switch shall also be provided with alarm contacts. Thermometers shall be provided in water inlet and outlet circuits. In addition one (1) duplex type RTD shall be provided in each water inlet and outlet circuit

14.44.00 MOISTURE DETECTORS

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

14.45.00 BED PLATE

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

14.46.00 OTHER ACCESSORIES

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

14.47.00 TESTS

14.47.01 HV & MV Motors

i) Routine Tests

All equipment shall be completely assembled, wired, adjusted and all acceptance and routine tests as per the specification and relevant standards shall be carried out. These tests shall be carried out in presence of the Owner's representative, for which a minimum 7 days notice shall be given by the Bidder. Charges for these shall be deemed to be included in the equipment price.

ii) Type Tests

a) For each type & rating of HV & MV motors the Bidder shall submit for Owner's approval the reports of all the type tests as per relevant standards. These reports should be for the tests conducted on the equipment similar to those proposed to be

supplied under this contract and the test(s) should have been conducted at an independent laboratory. Period - With in 5 Years from the zero date.

b) In case the Bidder is not able to submit report of the type test(s) conducted,, or in case the type test report(s) are not found to be meeting the specification requirements, the Bidder shall conduct all such tests under this contract free of cost to the Owner and submit the reports for approval, for which a minimum 7 days notice shall be given by the Bidder. Charges for these shall be deemed to be included in the equipment price

iii) List of minimum type tests to be conducted

The following Minimum type tests shall be conducted on each type and rating of HV & MV motor:-

a) No load saturation and loss curves upto approximately 115% of rated voltage.

b) Measurement of noise at no load.

c) Momentary excess torque test.

d) Full load test

e) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp., coolant flow and its temp. shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose. In case due to test bed limitations at the manufacturing works, mixed frequency method as per latest IEC 60034 is also acceptable.

f) Lightning Impulse withstand test on the sample coil shall be as per IEC-60034, part-15

g) Surge-withstand test on interturn insulation shall be as per clause no. 5.1.2 of IEC60034, part-15

h) Degree of protection test for the enclosure followed by IR, HV and no load run test.

i) Terminal box-fault level withstand test for each type of terminal box.

j) All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

14.47.02 LT Motors

i) Routine Test

All equipment shall be completely assembled, wired, adjusted and routine tested as per relevant IS/IEC Standards at manufacturer's works in the presence of Consultant /Owner or his representative.

ii) List of minimum tests for which reports have to be submitted

The following minimum type test reports shall be submitted for each type and rating of LT motor of above 30 KW only

a) Measurement of resistance of windings of stator and wound rotor.
b) No load test at rated voltage to determine input current power and speed.
c) Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors)
d) Full load test to determine efficiency power factor and slip.
e) Temperature rise test.
f) Momentary excess torque test.
g) High voltage test.
h) Test for vibration severity of motor.
i) Test for noise levels of motor(Shall be limited as per clause No. 14.24.00 of this section)
j) Test for degree of protection and
k) Over speed test.
l) Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1

iii) All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

14.48.00 INFORMATION WITH PROPOSAL

14.48.01 AC Motor Data Sheet.

14.48.02 Dimension Drawing/Foundation load details of motor and driven equipment.

14.48.03 Manufacturer's catalogue showing constructional details.

14.49.00 INFORMATION ON AWARD OF CONTRACT

14.49.01 Motor Data Sheet

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

14.49.02 Following characteristics curves:-

i) Torque-speed curves for motor at eighty (80), hundred (100) and hundred ten (110) percent rated voltage as well as torque-speed curve for driven equipment except for mill motor. For mill motor torque speed curve for motor at ninety (90) hundred (100) and hundred ten (110) percent rated voltage as well as torque-speed curve for driven equipment

ii) Current-speed curves at eight (80), hundred (100) and hundred ten (110) percent rated voltage except for mill motor. For mill motor current speed curve for motor at ninety (90) hundred (100) and hundred ten (110) percent rated voltage

iii) Current-time curves at eighty (80), hundred (100) and hundred ten (110) percent rated voltage except for mill motor. For mill motor current time curve for motor at ninety (90) hundred (100) and hundred ten (110) percent rated voltage.

iv) Thermal withstand curves for hot and cold at eighty (80), hundred (100) and hundred ten (110) percent rated voltage except for mill motor. For mill motor thermal withstand curve for motor at ninety (90) hundred (100) and hundred ten (110) percent rated voltage.

v) Efficiency, power factor, current and speed versus power output curves.

vi) Speed-time curves at eight (80), hundred (100) and hundred ten (110) percent rated voltage except for mill motor. For mill motor speed time curve for motor at ninety (90) hundred (100) and hundred ten (110) percent rated voltage.

vii) Negative phase sequence current withstand characteristics.

14.50.00 DC MOTOR

14.50.01 D.C. Motor provided for emergency service shall be shunt / compound would type. The starting current shall be as per manufacturer's standard.

14.50.02 Motor shall be sized for operation with fixed resistance starter for maximum reliability.

14.50.03 Starter panel complete with all accessories shall be included in the scope of supply.

14.51.00 **DRAWINGS, DATA & MANUALS**

14.51.01 Minimum Drawings, data & manuals for the motors to be submitted

i) Dimensional General Arrangement drawing
ii) Foundation Plan & Loading
iii) Cable end box details
iv) Space requirement for rotor removal
v) Thermal withstand curves hot & cold

vi) Starting and speed torque characteristics at 80% & 100% voltage except for mill motor. For mill motor Starting and speed torque characteristics at 90% & 100% voltage.
vii) Complete motor data
viii) Erection & Maintenance Manual
ix) Test reports
x) QAP

TECHNICAL DATA SHEET OF MOTORS

A) TO BE FURNISHED SEPRATELY FOR H.T. & L.T. MOTORS

Sr. No.	Description	
1.0	Type and frame size & design code no.	:
2.0	Nos. required	:
3.0	Application	:
4.0	Specification & Codes	:
5.0	Capacity for	
i)	for specified climatic conditions (50^0C)	:
	ii) At 40^0C ambient	:
8.0	Location for installation	:
9.0	Type of enclosure & ventilation	:
10.0	Degree of protection	:
11.0	Type of duty	:
12.0	No. of phases, frequency & voltage	:
13.0	Permissible variations in	
	a) Voltage	:
	b) Frequency	:
	c) Combined	:

14.0	At rated voltage & frequency		
	a) Full load current	:	
	b) Full load speed	:	
	c) No load current	:	
15.0	Minimum permissible voltage during starting	:	
16.0	Maximum permissible time at minimum permissible voltage during running at full load.	:	
17.0	Maximum permissible time at 75% of rated voltage during running at full load.	:	
18.0	Whether motor stalls at 70% of rated voltage.	:	
19.0	Efficiency & power factor		

Load (% of full load)		Efficiency	Power factor
100	:		
50	:		
25	:		
0	:		
At start	:		
Duty Point	:		

20.0	Stator winding		
i)	Connection	:	
ii)	Type & nos. of terminals: Brought out		
iii)	Resistance between terminals at 20deg C	:	
iv)	Resistance per phase at 20deg C	:	
v)	Inductance per phase	:	
vi)	Capacitance per phase	:	
21.0	Starting current as % of full load current		

i) With IS tolerance
ii) Without IS tolerance

22.0 Torque at full load in Kgm. :

23.0 Break away torque in % of full load torque :

24.0 Pull up torque in % of full load torque :

25.0 Pull out torque in % of full load torque :

26.0 Starting time in sec.

Without mechanism coupled or Mechanism coupled through hydraulic coupling when it may be presumed that load is transferred to motor shaft only after attaining almost full speed.

i) with rated voltage :

ii) with 80% of rated voltage :

iii) with 110% of rated voltage :

27.0	Starting time in sec.		
	With mechanism coupled through Flexible coupling.		
	i)	with rated voltage	:
	ii)	with 80% of rated voltage	:
	iii)	with 110% of rated voltage	:
28.0	Safe stall time (hot motor)		
	i)	At rated voltage	:
	ii)	At 80% of rated voltage	:
	iii)	At 110% of rated voltage	:
29.0	Safe stall time (Cold motor)		
	i)	At rated voltage	:
	ii)	At 80% of rated voltage	:
	iii)	At 110% of rated voltage	:
30.0	Limiting motor temperature to determine safe stall time		:
31.0	Permissible maximum accelerating time (hot motor)		
	i)	At rated voltage	:
	ii)	At 80% of rated voltage	:
	iii)	At 110% of rated voltage	:

32.0	Permissible maximum accelerating time (cold motor)			
	i)	At rated voltage	:	
	ii)	At 80% of rated voltage	:	
	iii)	At 110% of rated voltage	:	
33.0	Insulation			
	i)	Class of insulation	:	
	ii)	Material & treatment of insulation	:	
34.0	Whether insulation is suitable for 415 V, 3.3KV,11kV ungrounded system		:	
35.0	Temperature rise under normal conditions over 50^0C ambient temperature			
	i)	By resistance method	:	Degree centigrade over cooling water temp. for CACW motors. Degree centigrade overcooling air temp. for CACA motor.
	ii)	By Thermometer method	:	Degree centigrade over cooling water temp. for CACW motor. Degree centigrade over cooling air temp. for CACA motor.
36.0	Method of starting		:	
37.0	Permissible starting duty cycles		:	
38.0	Stator thermal time constant		:	
39.0	Maximum permissible voltage During high speed bus transfer & special design feature.		:	
40.0	Time required for voltage to decay down to when driving voltage is removed.		:	
	i)	At 50% of rated voltage	:	

ii) At 40% of rated voltage :

iii) At 25% of rated voltage :

iv) At 0% of rated voltage

Method of cooling

41.0 Details of water cooling system

i) No. of cooler

ii) Water requirement per cooler

iii) Losses removed by cooler

iv) Max. permissible temperature
Of cooling water at inlet

v) Max. permissible temperature
Of cooling water at outlet

vi) Maximum permissible pressure
At water outlet

vii) Water pressure drop through
The cooler

viii) Temp. of cold air coming
Out & entering the machine
For permissible cooling
Water temp.

ix) Temp. rise of air passing through machine at full load.

x) Air pressure drop through
The cooler

xi) Temp. rise of water through cooler

xii) Protection against leakage of water :

xiii) Arrangement to ensure the water flow

Bearings

i) Number :

ii) Type :

iii) Lubrication system :

iv) Quantity of lubrican reqd. for both the bearings. :

v) Life in hours at rated speed :

vi) Recommended lubricant :

vii) Bearing end play :

viii) Inlet oil pressure :

ix) Temp. rise of oil through :

x) Max. permissible temp. of Bearing :

xi) Max. permissible temp. of Oil :

xii) Permissible running time without forced oil at full load & full speed :

xiii) Whether bearings are provided with 4 wire, platinum RTD having 100-ohm resistance at 0^0C for remote temp. indication. :

xiv) Whether bearings are provided with local temperature indicator having two adjustable contacts rated for 2A at 240V AC or 0.2A at 220V DC. : Yes/No

xv) If forced lub oil system provided : Yes / No

xvi) Qty. of lubricant required for initial filling.

xvii) Recommended period after which lubricant should be replaced.

xviii) Bearing cooling water requirement.

xix) Max. permissible bearing cooling water inlet temp. (permissible)

xx) Max. permissible bearing cooling water outlet temp.

42.0 Terminal designation correspond to direction of rotation (Facing driving end).

43.0 Terminal boxes with accessories separate terminal boxes provided.

i) Main

ii) Space heaters

iii) Winding temp. detectors

iv) Bearing temp. detectors

v) Moisture detectors

vi) Neutral terminals

44.0 Main terminal box details

i) Type & Nos.

ii) Fault level permissible for 0.25 sec.

iii) Location

iv) Cable gland size & no.

v) Direction of cable entry.

45.0 Space Heater

i) Number

ii) Location

iii) Capacity of each

iv) Total power requirement

v) Voltage.

46.0 Details of 4 wire platinum RTD having 100 ohm resistance at $0^{o}C$ for winding temp. detector.

i) Nos. provided

ii) Location

47.0	Whether CTs for differential protection are provided	:	Yes / No
i)	If Yes, no. of CTs supplied alongwith motors. C.T. details		
a)	C.T. ratio		
b)	Knee point voltage		
	S.C. withstand capacity	:	
48.0	Type of mounting	:	
49.0	Shaft orientation	:	
50.0	Shaft extension	:	
51.0	Grounding pads size nos. & location		
52.0	Method of coupling to driven mechanism		
53.0	Motor GD2	:	
54.0	Lifting device		
55.0	Weight		
i)	Weight of stator (wound)		
ii)	Weight of rotor (wound)		
iii)	Weight of base plats.		
iv)	Weight of cooler		
56.0	Net weight of motor	:	
57.0	Shipping dimensions & weight	:	
58.0	Thermometer provided	:	
	i) In cold air path		
	ii) In hot air path		
	iii) For measurement of oil temp.		
59.0	Characteristic curves furnished		
	i)		Speed vs. current at rated voltage
	ii)		Speed vs. torque at

		110%, 100%, 90% and 80% of rated voltage
	iii)	Thermal withstand curve for hot & cold conditions.
	iv)	Efficiency vs. load
	v)	P.F. Vs. load
	vi)	Current vs. time
	vii)	Negative phase sequence curve

60. Drawings furnished

	i)	General arrangement of motor
	ii)	Main terminal box showing the method of terminating the Board's incoming cables

iii) Instruction manuals.

61.0 Rotor design as per specification clause 5.04.00 : Yes / No

B) DC Motor

1. GENERAL

i) Equipment driven by Motor :

ii) Motor type :

iii) Country of origin :

SECTION – 18: LV POWER CABLES

18.01.00 SCOPE OF SUPPLY

i) The LV Power cables shall be supplied, installed and commissioned in accordance with the following specification.

ii) Other cables including special cables if any which are necessary as per proven engineering practice for satisfactory & trouble free operation of the entire cable system of the power plant shall also be within the scope of supply. These shall include all such cables for electrical integral with mechanical equipment systems and subsystems.

18.02.00 CODES & STANDARDS

i) All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on zero date. In case of conflict between this specification and those (IS: codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes:

IS:1554 (Part-I)	PVC insulated (heavy duty) electric cables for working voltage up to and including 1100 V.
IS: 2982	Copper conductor in insulated cables and cords.
IS : 3961	Recommended current ratings for cables
IS : 3975	Low carbon galvanized steel wires, formed wires and tapes for armouring of cables.
IS : 4905	Methods for random sampling.
IS : 5831	PVC insulation and sheath of electrical cables.
IS:7098 (Part - I)	Cross linked polyethylene insulated PVC sheathed cables for working voltages up to and including 1100V.
IS : 8130	Conductors for insulated electrical cables and flexible cords.
IS : 10418	Drums for electric cables.
IS : 10810	Methods of tests for cables.
IEC: 60	High voltage test techniques
IEC: 230	Impulse tests on cables and their accessories
IEC: 287	Calculation of the continuous current rating of the cables (100% load factor).
IEC: 288	Nominal cross sectional area and composition of conductor of insulated cables.
IEC-331	Fire resisting characteristics of electric cables
IEC: 502	Extruded solid dielectric insulated power cables for rated voltages from 1kV up to 30kV.
IEC: 540	The methods for insulations and sheath of electric cables and cords(elastomeric and thermoplastic compounds)
IEC-754 (Part-I)	Test on gases evolved during combustion of electric cables.
IEC -60332	Tests on Electric cables under fire conditions. Part-3 : Tests on bunched wires or cables (category -B)

IEEE-383	Standard for type test of Class IE Electric Cables.
ASTM-D -2843	Standard test method for density of smoke from the burning or decomposition of plastics.
ASTM-D-2863	Standard method for measuring the minimum oxygen concentration to support candle like combustion of plastics.
NES-715-1	Temperature index
SS-4241475 classF3	Swedish Chimney test
	SVENSK Standard SS-4241475 Class F3

ii) BICC Hand Book For cables in fire regarding temperature index-chapter-6

iii) Indian Electricity Rule.

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

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

18.03.00 DESIGN CRITERIA

i) The cables shall be used for connection of power circuits of the system. Actual cable sizes shall be selected based on approved sizing calculations. Number of different sizes selected shall be kept to a minimum for optimization.

ii) Cables shall be generally laid on ladder type cable trays. For interplant connection cables shall be routed along overhead cable bridge.

iii) For continuous operation at specified rating, maximum conductor temperature shall be limited to the permissible value as per relevant standard and/or this specification.

iv) The insulation and sheath materials shall be resistant to oil, acid and alkali and shall be tough enough to withstand mechanical stresses during handling.

v) The inner and outer sheath shall have flame retardant low smoke (FRLS) characteristics or fire survival characteristics as the case may be, and shall meet the requirements of additional tests specified for the purpose.

vi) Core identification for multicore cable shall be provided by colour coding.

vii) Cables shall be so designed and manufactured that no damage occurs during handling, transit, storage, installation under any operative conditions which they may be subjected to.

viii) Maximum continuous operating temperature shall be 90 deg C under normal operation and 250 deg C under short circuit condition. The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS: 5831.

ix) Power cables shall be chosen taking into account the factors mentioned in Section-I.

18.04.00 SPECIFIC REQUIREMENTS / CONSTRUCTIONAL REQUIREMENTS

18.04.01 1.1KV Aluminium Conductor Power Cables

i) 1100 volt, 90 Deg. C rating, heavy duty power cables with stranded aluminium conductor, extruded XLPE insulation, extruded PVC,FR-LS inner sheath, aluminium round wire armour for single core cables and galvanized steel strip /wire armour for three (3) core cables, and extruded PVC, FR-LS overall sheath. Cables shall be manufactured in conformity to IS-7098 part 1 - 1988, amended up to date and bearing ISI mark.

iii) Conductor

The cable conductor shall be made from standard Aluminum of grade H2 and Class 2 to form compact conductor having a resistance within the limits specified. All the cables of size 25mm2 and above shall have sector shaped conductors.

iv) Insulation

The insulation shall be XLPE type. It shall be designed and manufactured for the specified system voltage. The manufacturing process shall ensure that insulation shall be free from voids. The insulation shall withstand mechanical and thermal stresses under steady state and transient operating conditions. The insulation of the cables shall be of high standard quality.

v) Inner Sheath

a) The laid up insulated cores of twin and multicore power cables shall be provided with an inner sheath of extruded FRLS PVC, compound conforming to Type ST2 of IS:5831. Single core power cables need not be provided with any inner sheath.

vi) Armour

a) For single core armoured cables, armouring shall be of aluminium wires/formed wires of H4 grade.

b) For multicore armoured cables, armouring shall be of galvanised steel strip /wire.

vii) Overall Sheath

a) Outer sheath shall be of extruded FRLS PVC compound conforming to type ST2 as per IS: 5831 & black in colour. In addition to meeting all the requirments of Indian standards referred to, outer sheath of all the cables shall be applied with anti rodent and termite additives.

18.04.02 1.1KV Grade Copper Conductor Fire Survival Power Cables

i) 1100 volt grade, 90 Deg. C rating, Power cables with stranded Copper conductor, heat resistance elastomeric insulation generally conforming to Type IE-2 of IS: 6380-1984, extruded Halogen free or very low Halogen elastomeric inner sheath, generally conforming to Type SE-3 of IS-6380-1984, round wire/strip armour and extruded outer sheath of elastomeric material generally conforming to Type SE-3 of IS: 6380-1984. The cables shall be generally manufactured in conformity to IS-9968 Part-1/1988. The cables can withstand 750 Deg. C temperature for three (3) hours.

ii) Conductor

a) Conductor shall be of stranded construction, consisting of high conductivity annealed plain copper wires conforming to Class-II of IS 8130.

b) A suitable heat barrier tape, preferably glass mica tape shall be provided over the conductor.

iii) Insulation

a) Cores of the cable shall be identified by colouring of insulation. Following colour scheme shall be adopted.

1 core - Red, Black, Yellow or Blue

2 core - Red & Black

3 core - Red, Yellow & Blue

4 core - Red, Yellow, Blue & Black

iv) Laying up of cores (For multi core cables only)

a) The core shall be suitably identified in accordance with IS: 9968 (Part-I).

b) The suitable fire retardant material fillers shall be used for filling in the interstices.

c) Two layers of plain glass fiber binder tape shall be applied over the laid up cores.

v) Inner Sheath

a) An inner sheath of extruded special low smoke and very low halogen content (acid gas generation shall be less than 2% by weight) elastomeric (HOFR) compound of black colour conforming to Type SE-3 of IS-6380/1984, amended up to date, shall be provided over the laid up cores. This shall be provided even for single core cables after providing two layers of plain glass fiber tape over the insulation.

vi) Armour

a) For Single core cables to be used in A.C system, the armouring over inner sheath shall consist of single layer of round copper wire.

b) For multi-core cables to be used in A.C. system and single/two core cables in D.C. System, the armouring over inner sheath shall consist of single layer of round galvanized steel wire.

vii) Outer Sheath

a) The extruded outer sheath shall be of special low smoke and very low Halogen content (Acid gas generation shall be less than 2% by weight) elastomeric HOFR compound comprising of synthetic rubber and shall generally conform to the type SE-3 of IS: 6380 latest revision.

b) Minimum value of 'Tensile Strength' and 'Percentage elongation rat rupture' shall be 8 Newton/Sq. mm and 250% respectively.

c) The colour of outer sheath shall be black or any other colour agreed mutually between Owner and Supplier.

18.04.03 Flexible Trailing Cables

1100 V Grade flexible trailing cable shall be tinned copper of Class – 5 of IS – 8130, heat resistant electrometric compound based on EPR insulation, inner sheath of heat resistant electrometric compound PCP sheath, nylon cord reinforcement and heat resistant, oil resistant and flame retardant heavy duty electrometric compound FRLS CSP outer sheath.

18.05.00 GENERAL REQUIREMENTS

18.05.01 Drum Length & tolerance

i) Cable shall be supplied in wooden drums. The standard single length of each drum shall be minimum 500 metres for large size of cable minimum 1000 metre for smaller size of cables.

ii) 1.1KV Copper Fire Survival Power cables shall be supplied in wooden drums. Each drum shall be minimum 500 metres single length of cable.

iii) Allowable tolerance on individual drum length is (+) 5%.

18.05.02 Non-standard length

Contractor shall be required to obtain Owner's approval before packing the non standard length of cables on drums. Non-standard lengths shall not be less than half of the standard packing length in any case.

18.05.03 Cable identification

Cable identification shall be provided by embossing on every meter on the outer sheath the following:

a) TANGEDCO
b) Manufacturer's name or trademark
c) Voltage grade
d) Year of manufacture
e) Type of insulation and sheath, e.g. XLPE /PVC FRLS, IE2/SE3 F.S. as applicable.
f) No. of core and size of cables.
g) Sequential length marking at an interval of 1m through out the length of the cable.
h) ISI mark with C/ML Number
i) Type of improved fire performance, e.g. FR / FR-LSH / FS.

18.05.04 Packing

i) Cables shall be supplied in non-returnable drums. The drums shall be of heavy construction as per relevant IS. All wooden parts shall be manufactured from seasoned wood. All ferrous parts used shall be treated with suitable rust preventive finish or coating to avoid rusting during transit or storage. Wooden drums shall be treated by immersing in copper nitrate solution

ii) Cable shall be wound and packed on drums in such a manner that it shall be properly sealed and firmly secured to the drum. The ends of each length shall be sealed before shipment. Heat shrinkable cable seals shall be used for this purpose

iii) A label shall be securely attached to each end of the reel indicating the length, type, voltage grade, conductor size and number of core of the cable. A tag containing the same information shall be attached to the leading end of the cable inside. An arrow and necessary instructions

shall be marked on the drum indicating the direction in which it should be rolled. Drum numbers are to be indicated on cable drums.

iv) The cable drums should carry the following details in printed form (non returnable):-

a) TANGEDCO & Manufacturer's name or trade make
b) Type of cable & voltage grade
c) Year of manufacture
d) Type of insulation / sheath e.g. XLPE /PVC FRLS, IE2/SE3 F.S. as applicable.
e) No. of core and size of cables
f) Cable code
g) Length of cable on drum
h) Direction of rotation, by arrow
i) Approx. gross mass.
j) ISI mark
i) IS / IEC number

18.06.00 TESTING PROCEDURE

18.06.01 Tests During Manufacture:-

During the manufacture of cables, manufacturer's standard tests shall be performed and record / test report shall be made available to Owner's representative during inspection / testing.

18.06.02 Type Tests:-

i) Cables shall be type tested quality. For each type and rating of cables reports on all type tests as per relevant standards, and carried out with in last five years from the zero date shall be submitted.

ii) These reports shall be for the tests conducted on the similar type of cables proposed to be supplied under this contract. These tests should have been conducted with in last 5 years from the zero date at an independent laboratory. If type test certificate are not available or in the case of type test report(s) are not found to be meeting the specification requirements, the same shall be conducted in the presence of the Owner free of cost.

18.07.00 SPECIAL TESTS ON PVC 'FR-LS' MATERIAL

i) All the sizes of XLPE power cables of the 'FRLS' PVC sheathed type shall pass following special test requirements. Inner sheath wherever applicable shall also be of the 'FR-LS' type 'PVC' to meet these special tests:-

a) Oxygen/Temperature Index test on sheath material:-

b) This test shall be carried out as per American National Std. A STM-D-2863/77.

c) The minimum oxygen index shall be 29 at room temperature.

d) For determination of the temp.index, the oxygen index test shall be carried out at different temperature upto 250°C. However, the test shall be carried out by extra-polation method beyond temperature at which the material of sheath may start deformation. The minimum temperature index (i.e. the temperature at which the oxygen index is minimum 21) shall be 250°C generally as per BICC Hand Book Chapter-6.

ii) Acid gas emission test on sheath material:-

This test shall be carried out as per IEC Std. 754-1. The maximum acid gas emission shall be less than 20 by weight.

iii) Smoke density test on sheath material:-

This test shall be carried out as per American National Standard ASTM-D-2843/1977 and also as per UITP method (3M cube test on finished cable sample). The ASTM test method is compulsory. For passing this test, the requirement of light transmission shall be minimum 40% after the test.

iv) Flammability test on finished cable sample:-

This test shall be carried out as per the following method:

v) Swedish Std.SS:424-14-75 Class-F3. This test known as Swedish Chimney test is compulsory.

vi) IEEE std. 383-1974 – This test known as the vertical tray flame propagation test shall be conducted if insisted by Owner.

vii) IEC Std: 332-1. – The cable should meet the requirement of all the above standards.

18.08.00 ROUTINE TESTS

The following tests shall be carried out as Routine tests on each and every drum length of cable, as per IS 7098 (Part 2) / 1985:-

a) High Voltage Test
b) Conductor Resistance Test
c) Partial discharge test (for screened cables) – on full drum length.

18.09.00 ACCEPTANCE TEST

i) The following test shall be carried out as Acceptance Test in the presence of TANGEDCO Inspecting Engineer on samples taken from the delivery lot. One drum out of every 10 number of drums or less shall be selected at random sampling basis in each lot for the Acceptance Tests which shall be carried out at manufacturer's/supplier's cost:-

a) High Voltage Test
b) Conductor Resistance Test

c) Tensile / wrapping test.
d) Partial discharge test (In screened cables).
e) Insulation Resistance/Volume resistivity test
f) Measurement of thickness of insulation and sheath and other dimensions
g) Tensile strength & elongation at break for insulation & sheath.
h) Hot set test on XLPE insulation
i) Flammability test as per Swedish standard SS:424-15-75 Class-F-3 (Swedish Chimney test)
j) Acid gas generation test as per IEC-754-1.
k) Smoke density test as per ASTM-D-2843/1977
l) Oxygen index test as per ASTM-D 2863/1977
m) Temp. index test as per ASTM-2863/77
n) Test for Rodent and termite repulsion property

18.10.00 TEST WITNESS

Tests shall be performed in presence of Owner's representative. The Contractor shall give atleast fifteen (15) days advance notice of the date on which the tests are to be carried out.

18.11.00 TEST CERTIFICATES

i) Certified reports of all the tests carried out at the works shall be furnished for approval of the Owner's representative.

ii) Test reports shall be completed with all details and shall also contain IS/IEC specified limit values, wherever applicable, to facilitate review.

iii) The cables shall be dispatched from works only after receipt of Owner's written approval of the test reports.

18.12.00 DRAWINGS, DATA AND MANUALS TO BE FURNISHED FOR APPROVAL

Bidder shall submit the following minimum drawings and documents for approval during detail engineering stage.

- Design basis report
- Cable sizing calculation
- General arrangement drawings
- Technical data sheet
- Test reports
- Catalogues
- Sub-vendor list
- Manufacturing quality plan
- Field quality plan

DATA SHEET

1100 V grade, power cable conforming to following requirement and in line with IS-1554, IS-5831, IS-8130 & IS-3975.			
S.NO.	**DESCRIPTION**	**:**	**SPECIFICATION**
1	Conductor	:	Stranded and compacted plain aluminium of grade H2 and class 2/stranded, high conductivity annealed plain copper, generally conforming to IS:8130
2	Insulation	:	Extruded Cross linked Polyethylene (XLPE).
3	Inner Sheath	:	Extruded FRLS PVC compound conforming to type ST2 of IS: 5831 for multicore cable. Single core power cables need not be provided with any inner sheath.
4	Armour	:	Galvanised single round/ strip steel wire armour for twin and multicore cables. Non-magnetic hard drawn aluminum single round wire conforming to H4 grade for single core cables.
	Overall Sheath	:	Extruded FRLS PVC compound conforming to type ST2 of IS: 5831.

SECTION – 19: CONTROL CABLES

19.01.00 SCOPE OF SUPPLY

The cables shall be supplied, installed and commissioned in accordance with the following specification.

19.02.00 CODES & STANDARDS

i) All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on zero date. In case of conflict between this specification and those (IS: codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes:

IS:1554 (Part-I)	PVC insulated (heavy duty) electric cables for working voltage up to and including 1100 V.
IS: 2982	Copper conductor in insulated cables and cords.
IS : 3961	Recommended current ratings for cables
IS : 3975	Low carbon galvanized steel wires, formed wires and tapes for armouring of cables.
IS : 4905	Methods for random sampling.
IS : 5831	PVC insulation and sheath of electrical cables.
IS:7098 (Part - I)	Cross linked polyethylene insulated PVC sheathed cables for working voltages up to and including 1100V.
IS : 8130	Conductors for insulated electrical cables and flexible cords.
IS : 10418	Drums for electric cables.
IS : 10810	Methods of tests for cables.
IEC: 60	High voltage test techniques
IEC: 230	Impulse tests on cables and their accessories
IEC: 287	Calculation of the continuous current rating of the cables(100% load factor).
IEC: 288	Nominal cross sectional area and composition of conductor of insulated cables.
IEC-331	Fire resisting characteristics of electric cables
IEC: 502	Extruded solid dielectric insulated power cables for rated voltages from 1kV upto 30kV.
IEC: 540	The methods for insulations and sheath of electric cables and cords(elastomeric and thermoplastic compounds)
IEC-754 (Part-I)	Test on gases evolved during combustion of electric cables.
IEC -60332	Tests on Electric cables under fire conditions. Part-3 : Tests on bunched wires or cables (catagory -B)
IEEE-383	Standard for type test of Class IE Electric Cables.
ASTM-D -2843	Standard test method for density of smoke from the burning or decomposition of plastics.
ASTM-D-2863	Standard method for measuring the minimum oxygen concentration to support candle like

	combustion of plastics.
NES-715-1	Temperature index
SS-4241475 classF3	Swedish Chimney test
	SVENSK Standard SS-4241475 Class F3

ii) BICC Hand Book For cables in fire regarding temperature index-chapter-6

iii) Indian Electricity Rule.

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

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

19.03.00 DESIGN CRITERIA

19.03.01 The cables shall be used for connecting control circuits.

19.03.02 Cables shall be generally laid on overhead cable trays/cable trays in cable trenches. For interplant connection cables routed along overhead cable bridge.

19.03.03 Perforated type cable trays to be used for control cables. Only in cable risers ladder type cable trays can be used for control cables.

19.03.04 For continuous operation at specified rating, maximum conductor temperature shall be limited to the permissible value as per relevant standard and/or this specification.

19.03.05 The insulation and sheath materials shall be resistant to oil acid and alkali and shall be tough enough to withstand mechanical stresses during handling.

19.03.06 The inner and outer sheath shall have flame retardant low smoke (FRLSH) characteristics or fire survival characteristics as the case may be, and shall meet the requirements of additional tests specified for the purpose.

19.03.07 Conductor of control cables shall have plain annealed copper. The minimum size of control cable shall be of 1.5 sq.mm. For CT circuit minimum size shall be 4.0sq.mm copper. Control cables shall have 20% spare cores. For PT circuit minimum size shall be 2.5 sqmm

19.03.08 Voltage transformer leads shall be checked for voltage drop which shall be limited to within 1% for all cases other than tariff metering. For tariff metering the voltage drop shall be limited to 0.2%. In case the voltage drop with 2.5 sq.mm copper conductor exceeds this value, higher conductor sizes shall be used.

19.03.09 The cables shall be designed and manufactured in accordance with the best engineering practice and shall be such as has been proven to be suited for the intended purpose.

19.03.10 For fire survival control cable, the armouring over inner sheath shall consist of single layer of wire/round galvanized steel wire as per IS 975 amended upto date.

19.04.00 SPECIFIC REQUIREMENTS / CONSTRUCTIONAL REQUIREMENTS

19.04.01 1100 V Copper Conductor PVC FRLS Control Cables

1100 Volt grade, control cables with stranded copper conductors, PVC Insulation Type A, extruded FRLS PVC, of type ST1 Inner sheath, round wire/strip armour as specified elsewhere in the specification and extruded FRLSPVC,of type ST1 overall sheath. The cables shall be suitable for use in 1100V non-effectively earthed system. Control cable shall generally conform to IS 1554 latest and have ISI marked with C/ML Number. Armour shall be GS.

19.04.02 Conductor

Conductor shall be stranded, non-compacted & circular, high conductivity annealed, plain (untinned) copper conductor. Conductor shall be generally conforming to Class-II of IS 8130.

19.04.03 Insulation

The conductors shall be insulated with PVC compound conforming generally to type-A of IS:5831/1984 amended up to date ,except for the special properties / parameters, necessary at normal operation.

19.04.04 Inner Sheath

The laid up insulated cores of twin and multicore control cables shall be provided with an inner sheath of extruded FRLSPVC, compound conforming to Type ST1 of IS:5831/1984 amended up to date.

19.04.05 Armouring

For cables up to and inclusive 7 cores, galvanized round steel wire armour shall be provided. However, for control cables above 7 cores, galvanized steel strip armour shall be provided.

The armouring wire/strip shall generally conforming to IS: 3975 amended up to date.

19.04.06 Overall Sheath

A tough overall sheath of extruded FRLSPVC,Compound conforming to type ST1 of IS: 5831/1984 shall be provided over armour. The colour of outer

sheath shall be black or any other natural colour (with prior approval of the Owner).

19.04.07 1100 V Copper Conductor Fire Survival Control Cables

Fire survival cable shall be of copper conductor and comply with IEC-60331 (withstanding 750 degree C temperature for 3 hours). Also the halogen acid contents in outer sheath shall not be more than 2% when tested as per IEC-60754 and the smoke density in percent light absorption shall not exceed 20% when tested as per ASTM-D-2843. 1.1 kV earthed grade fire survival cables shall constitute the following:

- Circular/shaped stranded and compacted annealed copper conductor
- Elastomeric materials (XLPE, EPR, SR, or LSOH) insulated
- Glass mica tapped
- Extruded FRLS compound or LSOH material as inner sheath
- Galvanised steel formed wire/strip
- Extruded FRLS compound or LSOH material as inner sheath

19.04.08 Laying Up Of Cores (For Multi Core Cables Only)

i) The core shall be suitably identified in accordance with IS: 9968 (Part-I).

ii) The suitable fire retardant material fillers shall be used for filling in the interstices.

iii) Two layers of plain glass fiber binder tape shall be applied over the laid up cores.

19.04.09 Inner Sheath

An inner sheath of extruded special low smoke and very low halogen content (acid gas generation shall be less than 2% by weight) elastomeric (HOFR) compound of black colour or any other natural colour with prior approval from Owner conforming to Type SE-3 of IS-6380/1984, amended up to date, shall be provided over the laid up cores.

19.04.10 Armour

The armouring over inner sheath shall consist of single layer of wire/round galvanized steel wire as per IS 3975 amended up to date.

19.04.11 Outer Sheath

The outer sheath shall be of special low smoke and very low Halogen content (Acid gas generation shall be less than 2% by weight) elastomeric HOFR compound comprising of synthetic rubber and shall generally conform to the type SE-3 of IS: 6380 latest revision.

The colour of outer sheath shall be black or any other natural colour agreed mutually between Owner.

19.05.00 GENERAL REQUIREMENTS

19.05.01 Drum Length & Tolerance

i) The cable shall be supplied in wooden drums. Each drum shall be minimum 1000 meters single length of cable. For above cable drums, allowable tolerance on individual drum length is +/- 5%.

ii) 1.1KV Copper Fire Survival control cables shall be supplied in wooden drums. Each drum shall be minimum 500 metres single length of cable. Allowable tolerance on individual drum length is +5%.

19.05.02 Non-standard length

Bidder shall be required to obtain Owner's approval before packing the non standard length of cables on drums. Non-standard lengths shall not be less than half of the standard packing length in any case.

19.05.03 Cable identification

i) Cable identification shall be provided by embossing on every meter on the outer sheath the following:

a) TANGEDCO
b) Manufacturer's name or trademark
c) Voltage grade
d) Year of manufacture
e) Type of insulation and sheath, e.g. PVC/ FRLS, IE2/SE3/FS as applicable.
f) No. of core and size of cables.
g) Sequential length marking at an interval of 1m through out the length of the cable.
h) ISI marked with C/ML Number

ii) Type of improved fire performance eg. FR/FR-LSH-FS

19.05.04 Packing

i) Cables shall be supplied in non-returnable drums. The drums shall be of heavy construction as per relevant IS. All wooden parts shall be manufactured from seasoned wood. All ferrous parts used shall be treated with suitable rust preventive finish or coating to avoid rusting during transit or storage.

ii) Cable shall be wound and packed on drums in such a manner that it shall be properly sealed and firmly secured to the drum. The ends of each length shall be sealed before shipment.

iii) A label shall be securely attached to each end of the reel indicating the length, type, voltage grade, conductor size and number of core of the cable. A tag containing the same information shall be attached to the leading end of the cable inside. An arrow and necessary instructions

shall be marked on the drum indicating the direction in which it should be rolled. Drum numbers shall be indicated on cable drums.

iv) The cable drums should carry the following details in printed form (non returnable):-

a) TANGEDCO & Manufacturer's name or trade make
b) Type of cable & voltage grade
c) Year of manufacture
d) Type of insulation / sheath e.g. PVC/ FRLS, IE2/SE3/FS. as applicable.
e) No. of core and size of cables.
f) Cable code.
g) Single length of cable on drum
h) Direction of rotation, by arrow
i) Approx. gross mass.
j) ISI mark.

19.06.00 TESTING PROCEDURE

19.06.01 1100 V Copper Conductor PVC FRLS Control Cables

i) Type Tests:-

Cables shall be type tested quality. For each type and rating of cables reports on all type tests as per relevant standards, and carried out with in last five years from the zero date shall be submitted.

a) These reports shall be for the tests conducted on the similar type of cables proposed to be supplied under this contract. These tests should have been conducted at an independent laboratory. If type test certificate are not available or in the case of type test report(s) are not found to be meeting the specification requirements, the same shall be conducted in the presence of the Owner without cost implication.

ii) Special Tests On PVC 'FRLS' Material

All the sizes of 1.1 KV Grade PVC insulated, PVC Control cables of the FRLSH sheathed type shall pass these special test requirements. Inner sheath wherever applicable shall also be of the 'FRLSH' type 'PVC' to meet these special tests.

iii) Oxygen/Temperature Index Test On Sheath Material

a) This test shall be carried out as per American National Std. ASTM-D-2863/77.The minimum oxygen index shall be 29 at room temperature.

b) For determination of the temp index, the oxygen index test shall be carried out at different temperature upto 250°C. However, the test shall be carried out by extrapolation method beyond temperature at which the material of sheath may start deformation. The minimum temp. index (i.e. the temperature

at which the oxygen index is minimum 21) shall be 250°C generally as per BICC Hand Book Chapter-6.

iv) Acid Gas Emission Test On Sheath Material

This test shall be carried out as per IEC Std. 754-1. The maximum acid gas emission shall be less than 20% by weight.

v) Smoke Density Test On Sheath Material

a) This test shall be carried out as per American National Standard ASTM-D-2843/1977 and also as per UITP method (3M cube test on finished cable sample). The ASTM test method is compulsory. For passing this test, the requirement of light transmission shall be minimum 40% after the test (Corresponding to 60 % smoke density).

vi) Flammability Test On Finished Cable Sample

a) This test shall be carried out as per the following method:-

i) Swedish Std.SS:424-14-75 Class-F3. (This test known as Swedish Chimney test is compulsory).

ii) IEEE std. 383-1974 – This test known as the vertical tray flame propagation test shall be conducted if insisted by Owner.

iii) IEC Std: 332-1. – The cable should meet the requirement of all the above standards.

vii) Routine Tests

a) The following tests shall be carried out as Routine tests on each and every drum length of cable, as per IS: 1554 / IS: 8130/1984.

1) High Voltage Test.
2) Conductor Resistance Test.

viii) Acceptance Test

a) The following test shall be carried out as Acceptance Test in the presence of Owner's Inspecting Engineer on samples taken from the delivery lot. One drum out of every 10 number of drums or less shall be selected at random sampling basis for the Acceptance Tests.

i) Tensile / wrapping test.
ii) High Voltage Test.
iii) Conductor Resistance Test
iv) Insulation Resistance/Volume resistivity test.
v) Measurement of thickness of insulation and sheath and other dimensions.

vi) Tensile strength & elongation at break for insulation & sheath.
vii) Flammability test as per Swedish standard SS: 424-15-75 Class-F-3 (Swedish Chimney test).
viii) Acid gas generation test as per IEC-754-1.
ix) Smoke density test as per ASTM-D-2843/1977.
x) Oxygen index test as per ASTM-D 2863/1977.
xi) Temp. index test as per ASTM-2863/77
xii) Test for Rodent and termites repulsion property

19.06.02 1100 V Copper Conductor Fire Survival Control Cables

i) Type Tests

Cables shall be type tested quality. For each type and rating of cables reports on all type tests as per relevant standards, and carried out with in last five years from the zero date shall be submitted.

These reports shall be for the tests conducted on the similar type of cables proposed to be supplied under this contract. These tests should have been conducted at an independent laboratory. If type test certificate are not available the same shall be conducted in the presence of the Owner.

ii) Routine Tests

a) The following test shall be carried out as Routine Tests on each and every delivery length of cable:-

1)	High Voltage Test	-	IS: 9968 (I)
2)	Conductor Resistance test	-	IS: 8130/1984

iii) Acceptance Tests

a) Following tests shall be carried out as acceptance tests in the presence of Owner's Inspecting Engineer on samples taken from the delivery lot. One drum out of every 10 drums or less shall be selected on random sampling basis:-

1)	Annealing Test	-	IS 9968 (I)
2)	High Voltage test (Water immersion Test)	-	IS 9968 (I)
3)	Conductor resistance test	-	IS8130/1984
4)	Insulation Resistance Test	-	IS6380/1984
5)	Measurements of thickness of Insulation and sheath and other Dimensions	-	IS: 9968(I)
6)	Tensile strength & elongation at	-	IS 6380/1984

	Break for sheath	
7)	Tensile strength and elongation at break of sheath	IS 6380/1984
8)	Oxygen index test on inner & outer - 2863/77	ASTM-D-
	Sheath material at room temperature	Min.29 degC
9)	Temp. index test on inner & outer material sheath	ASTM-D-2863/77 Min 350 degC IEC-331
10)	Acid gas emission test on inner & sheath material	Acid gas shall be outer less than 2% generation IEC-754-1
11)	Smoke density test on inner & outer material	Max smoke sheath density shall not exceed 20% in percentage light Absorption. ASTM-D-2863/77
12)	Flammability test on finished cable Sample as per following method	
	a) Fire Survival Test	IEC –331
	b) Swedish Chimney Test	SS-424-14-75 Class-F3)

19.07.00 DRAWINGS, DATA AND MANUALS TO BE FURNISHED FOR APPROVAL

Bidder shall submit the following minimum drawings and documents for approval during detail engineering stage.

- Design basis report
- Cable sizing calculation
- General arrangement drawings
- Technical data sheet
- Test reports
- Catalogues
- Sub-vendor list
- Manufacturing quality plan
- Field quality plan

DATA SHEET

1100 V grade, PVC Control cable conforming to following requirement and in line with IS-1554, IS-8130, IS-5831 & IS-3975.			
S.NO.	**DESCRIPTION**	**:**	**SPECIFICATION**
1	Conductor	:	Conductor shall be Stranded, non-compacted & circular, high conductivity annealed plain copper, generally conforming to IS:8130.. Conductor shall be generally conforming to Class-II of IS 8130.
2	Insulation	:	The conductors shall be insulated with PVC compound conforming generally to type-A of IS:5831/1984 amended up to date
3	Inner sheath	:	Extruded FRLS PVC compound conforming to type ST1 of IS: 5831 for multicore cables. Single core cables shall have no inner sheath
4	Armour	:	For cables up to and inclusive 7 cores, galvanized round steel wire armour shall be provided. However, for control cables above 7 cores, galvanized steel wire/strip armour shall be provided.
5	Overall sheath	:	Extruded FRLS PVC compound conforming to type ST1 of IS:5831

SECTION – 11 : 415V SWITCHGEARS AND DC BOARDS

11.01.00 SCOPE

11.01.01 This specification is intended to cover design, engineering, manufacture, assembly, shop testing, inspection, packing, delivery to site, erection, testing and commissioning of following with all fittings and accessories for efficient & trouble free operation:-

i) 415 V Power control Centre (PCC)
ii) 415 V Motor Control Centers (MCC)
iii) 415 V Motor cum Power control Centre (PMCC)
iv) 415 V Distribution Boards (DB) and Fuse boards
v) DC starters
vi) DC Distribution Board
vii) AC Fuse Board

11.01.02 Base channel frame of all boards and fuse boards along with necessary mounting hardware.

11.01.03 Set of accessories as listed below:
i) Hydraulic operated Breaker lifting & handling trolley- 1No. per board
ii) Racking in/out handle for breakers- 5 Nos. in each type per board
iii) Racking in/out handle for draw out MCC modules- 5 Nos. in each type per board

11.01.04 Bidder to ensure that at least 10% spare feeders (minimum 1 No.) of each type & rating in each 415V switchgear/MCC shall be provided at the time of handing over the plant (irrespective of the spares finalised during detailed engineering) subject to the contract provision.

11.01.05 Mandatory Spares as given in elsewhere

11.01.06 All provisions and accessories shall be furnished for termination and connection of cables, including removable gland plates cable supports, crimp type tinned copper/aluminum lugs, double compression type brass glands with tapered washer (power cables only) and terminal blocks.

11.01.07 Foundation bolts for all the floor mounted equipment, and fixing bolts and accessories for wall mounted equipment.

11.01.08 All interconnecting wiring between various panels/compartments of a switchgear or MCC shall be carried out internally by the Bidder at his works/site.

11.01.09 Certain switchgears with very long lengths shall be sectionalized and physically separated for ease of operation and maintenance. Interconnection of such sections by bus trunking shall be in Bidder's scope.

11.01.10 Bidder shall supply dummy panels, if required for floor beam crossing without any price implication.

11.01.11 All 415V PCC, PMCC & MCC shall generally be of intelligent type compatible with IEC 61850 Communication protocol. However utility MCCs as mentioned in the single line diagram shall be non-intelligent type. . A marshalling module shall be provided on each bus of LV Switchgear (PCC, PMCC, MCC) for interfacing with DCS. Control of incomers and bus-coupler breakers of LV switchgear shall be possible from the DCS. The check synchronizing relay shall be housed in the respective switchboards. Dummy panels shall be integral part of the LV Switchgear and of same size.

11.01.12 MCCs shall be used to supply power to contactor controlled motors rated below 90 kW, local panels, local starter panels etc.

11.01.13 PCCs / PMCCs shall be used to supply power to motor of ratings 90 to 200 KW through ACBs.

11.01.14 Incomers of MCCs of rating 630A and above shall be through Air Circuit Breakers while incomers of lower rating can be through motorized MCCBs.

11.01.15 All Outgoing feeders (non motor feeders) of PCC/PMCC rated 630A & above shall be Air Circuit Breakers while rated below 630A shall be MCCB.

11.01.16 Motors less than 90 KW shall be provided with MCCB/ MPCB, contactors and intelligent controllers.

11.01.17 Motors rated 90 KW and above shall have comprehensive motor protection relays. They shall be numerical type and shall communicate with DCS through Open protocol (IEC 61850).

11.01.18 All MCCs/PMCCs except PCC portion of PMCC shall be of double front construction. PCCs and PCC portion of PMCCs shall be single front. All Switchgears/MCCs shall be sectionalized unless specifically mentioned in the single line diagram.

11.01.19 All Switchgears shall be easily extendable on either side. The Bidder shall supply Switchgear in various shipping sections consisting of Incomer, Ties and Motor modules. Bidder may be required to change module types, sizes and the components in respect of certain feeders even during erection, testing and commissioning.

11.01.20 The Bidder shall furnish calculations and/or type-test certificates to prove adequacy of the bus bar sizes offered, for specified current and short time current ratings. Bus bars in particular and droppers (HBB/VBB) shall be supported on flame-retardant, track resistant type bus insulators with high creepage distance and covered with heat-shrunk PVC sleeves which shall be shrunk fit and not capable of being removed without destruction. While continuous current ratings of the droppers in each Switchgear Cubicle shall be at least equal to the corresponding Breaker rating, short time current rating shall be same as that for Horizontal Main Bus bars. Only those dropper ratings shall be allowed as have passed a type test.

11.01.21 All MCCB, MPCB and contactors shall conform to Type-II class of Co-ordination as per IS-13947. Bidder shall furnish Type-II Co-ordination, p & q type test report as per IS: 13947 for all modules.

11.01.22 The Bidder shall furnish relay application checks/ calculations to check adequacy of the CTs/VTs as well as suitability of relay settings/setting ranges proposed by the Bidder. These checks/ calculations shall be furnished during detailed engineering stage for each and every feeder.

11.02.00 AUTO CHANGEOVER

11.02.01 Auto-changeover facility shall be provided in PCC/ PMCC and MCCs. These Switchgears/MCC shall normally operate with Bus coupler open. If sustained under voltage is detected on any one of the bus section, the respective Incoming Breaker shall trip and bus - coupler shall close if voltage is available on the other bus section. Auto changeover shall be blocked if the Incoming Breaker has tripped due to bus fault. Manual change over from one source of supply to the other or vice versa shall be possible by momentary paralleling of the two supplies after checking synchronism with the help of a synchro check relay. On closing the Incoming breaker, the selected running Breaker should trip within a preset time. An annunciation shall be provided if the two bus sections remains paralleled for more than a preset time. If the selected running breaker fails to trip within the preset time the incoming breaker shall trip.

11.02.02 During auto changeover of the supply the contactors in the affected bus would have dropped off. The services which shall be restarted immediately without time lapse to keep the process running are considered essential services. Such services shall restart automatically without any action by the operator after an auto changeover.

11.03.00 GENERAL

11.03.01 Power Control Center (PCC)

POWER CONTROL CENTER (PCC), shall mean a continuous line-up of breaker panels in single front construction, used to feed Motor Control Centres/PDBs etc, ACB controlled LV motors. All PCCs shall have duplicate incomers and a bus-section. Incomers, bus section, and all outgoing feeder of a PCC shall be breaker controlled. Distribution of outgoing feeders shall be arranged such as to ensure uniform loading on each section of the PCC. The 240 V supply for panel & Motors Space Heater, wherever required shall be derived through 415V/240V isolation transformer.

11.03.02 Power-Cum-Motor Control Center

POWER-CUM-MOTOR CONTROL CENTER (PMCC), shall mean a continuous line-up of vertical sections housing breaker panels, MCCBs, and contactor-operated modules in double front construction. However PCC part of PMCC shall be single front only. All PMCCs shall have duplicate incomers and a bus-coupler. Incomers and bus-coupler shall be breaker controlled. All outgoing (non motor) feeders shall be ACB/MCCB/MPCB controlled. Motor feeders rated below 90 kW shall be MPCB, MCCB, contactor controlled with intelligent controllers depending upon the rating Distribution of outgoing feeders shall be such as to ensure uniform loading on each section of the PMCC. The 240 V

supply for panel & Motors Space Heater, wherever required shall be derived through 415V/240V isolation transformer.

11.03.03 Motor Control Center

MOTOR CONTROL CENTRE (MCC), shall mean a continuous line-up of vertical sections in double front construction, housing breaker panels and MPCB / MCCB, contactor operated outgoing modules. All incomers and Bus-sections rated 630A & above shall be breaker controlled which are electrically inter-locked. MCCBs shall be provided for incomers and bus couplers rating below 600A with castle key interlocks. All outgoing (non motor) feeders shall be MCCB/MPCB controlled. Motor feeders shall be MPCB, MCCB, contactor controlled with intelligent controllers depending upon the rating. Distribution of outgoing feeders shall be such as to ensure uniform loading on each section of the MCC. The 240 V supply for panel & Motors Space Heater, wherever required shall be derived through 415V/240V isolation transformer.

11.03.04 Distribution Board

Distribution Board (DB) shall mean a continuous line-up of vertical sections housing MCCB/MPCB modules only. PDBs/ACDBs shall have duplicate incomers and a bus-section. DCDBs shall have two incomers from its associated battery charger with bus sectionalized. Wherever bus-sections are provided, distribution of outgoing feeders shall be such as to ensure uniform loading on each section of DB.

11.04.00 CODES AND STANDARDS

11.04.01 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standard (IS) except where modified and / or supplemented by this specification. Indian Standards for the equipment covered under this specification are as follows:

IS:375	Marking and arrangements of bus bars.
IS:722	AC Electricity Meters.
IS:1248	Electrical Indicating instruments.
IS:2147	Degree of protection provided by enclosures for low voltage switchgear and control gear.
IS:2208 & IS:9224 (Part-II)}	HRC Cartridge Fuses.
IS:2516	A.C. Circuit Breakers.
IS:2629	Hot dip galvanising.
IS:2705	Current transformers
IS:2959	Contactors

IS:3072	Code of practice for installation and maintenance of Switchgear.
IS:3156	Voltage transformers
IS:3202	Code of practice for climate proofing of electrical equipment.
IS:3231	Electrical relays for power system protection.
IS:4064	Air-breaker switches, air break disconnectors, air break disconnector and fuse combination units for voltage not exceeding 1000V AC or 1200V DC.
IS:4237	General requirements for switchgear and control gear for voltages not exceeding 1000V.
IS:5082	Wrought Aluminum and aluminum alloys for electrical purposes.
IS:6005	Code of practice of phosphating iron and steel.
IS:6875	Switches and push buttons.
IS:8544	A.C. Motor starters of voltage not exceeding 1000 V.
IS:8623	Specification for factory built assemblies of switchgear & control gear for voltages up to and including 1000V AC/1200 V DC.
IS:13947	Low voltage switchgear and Control Gear.

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

11.04.03 The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS codes of practice. In addition, other rules or regulations as applicable to the work shall be followed. In case of any discrepancy, the more restrictive rule shall be binding.

11.05.00 DESIGN CRITERIA

11.05.01 The PCC/PMCC/MCC and DBs shall be used to supply auxiliary power for normal and start-up operation, control and protection for 415/240V AC and 220V DC auxiliary services of generating units.

11.05.02 Duty involves direct-on-line starting of large induction motors up to 200 KW and also under certain emergency conditions automatic transfer of loads from one source of supply to other. Motor starting current varies from 6 to 8 times full load current with maximum of 3 starts per hour.

11.05.03 The equipment shall be located in a clean but hot, humid and tropical atmosphere, highly polluted at places with coal dust and/ or fly ash.

11.05.04 Circuit breaker/ switchgear shall not produce any harmful over voltage during switching off induction motors/ supply. If required, surge protective devices shall be included in the scope of supply to limit over voltage.

11.05.05 For continuous operation at specified ratings, the temperature rise of the various equipment shall be limited to the site permissible values stipulated in this specification.

11.05.06 Loads of outgoing feeders wherever applicable shall also be considered while sizing the bus bars, equipments and components. All equipment and components shall be capable of withstanding the mechanical forces and thermal stresses of the short-circuit currents without any damage or deterioration of materials.

11.05.07 Busbars for PCC/PMCCs being fed from service transformers shall be sized based on the rated LV winding current of the transformer rounded off to the next higher standard rating

11.05.08 Busbars of MCCs/DBs shall be sized to carry continuously the running load connected to it with a 10% margin.

11.05.09 In cubicle ratings of incomer and bus section breakers/MCCBs shall be identical to the associated busbar rating.

11.05.10 The control circuitry of all modules in respective PCC/PMCC/MCC shall be suitable for interfacing with plant DCS for remote monitoring switching and control.

11.06.00 SPECIFIC REQUIREMENTS

11.06.01 Construction of PCC/PMCC / MCC/ DBs

i) The PCC/PMCC/MCC shall be of Form 3B Type 2 construction.

ii) PCC/PMCC/MCC/DBs shall be indoor, air insulated, metal-clad, floor mounting type. All PCCs/PMCCs/MCCs except for the utility MCCs shall be fully draw out type having self-aligning type secondary plug in contacts. All DBs and utility MCCs (as mentioned in single line diagram) shall be fixed type. The design and construction shall be such as to allow extension at either end.

iii) The enclosure of the equipment shall be dust and weather proof, conforming to a degree of protection IP-52 for ratings up to 1600A and IP-42 for ratings above 1600A. The switchboard frames shall be fabricated using suitable mild steel structural section or braced and shall be cold rolled sheet steel of thickness of not less than 2 mm. The frames shall be enclosed in cold rolled sheet steel of not less than 1.6 mm. The doors and covers shall also be of cold rolled steel of thickness not less than 1.6mm. Adequate stiffness shall be provided wherever necessary. Gland plates shall be 3 mm. The design shall be such that specified degree of protection shall be achieved even after a breaker control module has been taken out of the panel.

iv) SWGR/PCC/MCC/ DB assembly shall comprise a continuous line up of dead front, free-standing vertical sections, housing the control modules in multitier formation. The installations of circuit breakers, however, shall be limited to the single tier formation.

v) The design shall be fully compartmentalized with metal/ insulating partitions between compartments. The working height shall be limited within 300mm to 1900 mm. Switch boards shall be mounted on base frame of 75 mm height from the finished floor.

vi) Each breaker/ control module/ MCCB unit shall be housed in a separate compartment, complete with an individual front access door having sufficient opening with concealed type hinges. Each vertical section of single front board shall have a removable back cover.

vii) All doors and covers shall be provided with life long rubber and life long pasting neoprene gaskets. MCC module shall also be dust and vermin proof when the module is taken out from the chassis. Suitable arrangement to achieve this feature shall be provided.

viii) All switches push buttons, lamps, indicating instruments shall be flush mounted on respective module compartment whereas relays and other auxiliary devices may be mounted on a separate cubicle. All meters indicating lamps and protective relays shall be visible on the door.

ix) A full height vertical cable alley with cable supports shall be provided in each section to facilitate dressing of unit wiring. The chamber shall be liberally sized to accommodate all cables and shall have hinged doors opening on opposite sides with respect to the module doors and removable cover at back side for access. The width of the cable chamber when viewed from front of the switchboard shall not be less than 250 mm.

x) Breaker cubicle shall be so sized as to permit easy closing of the front access door when the breaker is pulled out to 'ISOLATED' position. The breaker can be operated both in SERVICE and TEST position with the door closed.

xi) A horizontal wire way, extending the entire length, shall be provided at the top of each SWGR/PCC/MCC/ DB for inter panel wiring. The chamber shall be liberally sized to accommodate all cables and shall have removable cover at the front for access.

xii) Incomers shall be provided at the ends of an assembly and bus section, wherever required, shall be provided at the middle of the assembly.

xiii) Four (4) nos. lifting lugs shall be provided for each section, two (2) nos. on either end of the section.

11.06.02 Bus and Bus Taps for SWGR/PCC/MCC/DB

i) The main, tap off buses and connections shall be of high conductivity aluminum / aluminum alloy . The size for specified current ratings shall be such that maximum temp. rise at bus bar joints shall be limited to 90 Deg. C (i.e. 40 Deg. C rise over 50 Deg. C ambient).The maximum allowable temperature rise at silver plated joints shall be 105 deg C (ie 55 deg C rise over 50 deg C ambient)

ii) Vertical bus bars shall be designed as per system requirement.

iii) All bus connections shall be provided with anti-oxide grease. For all bus connections adequate contact pressure shall be ensured by means of two bolt connection with plain and spring washers and locknuts. The protruding bolts of different phases/ poles shall be staggered and shall not see each other directly. All the joints surfaces shall be silver plated.

iv) Busbars and connections shall be fully insulated for working voltage with adequate phases/ ground clearance. Insulating sleeves for bus bars and shrouds for joints shall be provided. Shrouds for bus bar joints and tapping points shall be two part click-fit type epoxy resin cast/ fiber glass moulded.

v) Minimum clearance of 25.4mm is required between phases/ poles for entire run of horizontal and vertical bus bars and 19 mm between phase and earth irrespective of sleeve/ shroud provided for bus bars.

vi) For all other components, the clearance between two live parts, a live part and earthed part, and isolating distance shall be at least 10 mm throughout.

vii) Wherever it is not possible to maintain the above mentioned clearances, insulation shall be provided by means of barriers. All connections from busbars upto the fuses shall be fully shrouded to minimize risk of phase to phase and phase to earth faults.

viii) Insulating shrouds for busbar joints shall be moulded type. SWGR/PCC/MCC/ DB with higher clearances shall be preferred considering dust laden environmental condition in which SWGR/PMCC/ MCC/ DB has to operate. Bus bars shall be supported on flame-retardant, track resistant type bus insulators with high creepage distance and covered with heat-shrunk PVC sleeves which shall be shrunk fit and not capable of being removed without destruction. Separate supports shall be provided for each phase and neutral busbar.

ix) Cross section of busbar shall be uniform throughout the length of assembly. All buses and connections shall be supported and braced to withstand, the stresses due to maximum short-circuit current and also to take care of any thermal expansion.

x) 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 SWGR/PMCC/ MCC/ DB assembly.

xi) Bolted disconnect links shall be provided for DBS for all incoming and outgoing feeders for isolation of neutral, if necessary.

11.06.03 Module Details

i) Draw out type control module shall have self- aligning, plug in power / control disconnects. All disconnects shall be silver-plated to ensure good contacts.

ii) The design shall be such as to permit easy withdrawal / reinsertion of the unit guide rails to ensure correct alignment & all the power contacts meet accurately every time the module is inserted. Two feeders shall not be accommodated in the same module of MCC.

iii) Various module sizes should be multiples of one basic unit to facilitate modifications at site. Suitable provision for this purpose should also be incorporated in the vertical busbars.

iv) Control module shall house the control components for a circuit such as MPCB / MCCB, contactors, relays, push buttons, lamps etc. as per requirement only the push button actuators, lens of indicating lamps, and transparent windows for meters shall be mounted on module door such that when the module is withdrawn the cubicle door shall be provided the specified degree of protection when the module door is closed. These modules shall be designed to withstand internal arc faults i.e. in the event of fault occurring in one module the arc should not spread to neighboring module and should not affect their functioning.

v) The equipment layout shall provide sufficient working space in between the components and subject to Owner's approval.

vi) It shall be possible to carry out routine, maintenance checks or small changes in a module without physically taking the module away from switchboard.

vii) Automatic safety shutters shall be provided to fully cover the female primary disconnects when the module is withdrawn. Under any circumstances it shall not be possible to access the vertical dropper accidentally and also suitable means shall be provided to avoid any phase short circuit in vertical droppers.

viii) The module shall be dust & vermin proof even when module is completely withdrawn. Suitable means shall be provided to achieve this feature.

ix) Draw out type control modules of same size and type shall be electrically and physically interchangeable.

x) Draw out control modules of PCC/PMCC/MCC shall have the SERVICE, TEST & ISOLATED positions with positive indications and interlocking for each position. The doors of individual modules and the cable alley should open in opposite directions to facilitate clear view of the module when the operator is working on the cable terminals.

xi) In service position, both power and control circuits shall be engaged. It shall not be possible to open the module door when the module is in service position.

xii) In TEST position, the power circuits shall be disengaged but the control circuits shall be engaged. It shall be possible to close the module door when the module is in TEST position. Keeping the front access door of module in closed condition, the breaker can be placed in ISOLATED, TEST or SERVICE position from outside.

xiii) In ISOLATED position, both power and control circuits shall be disengaged.

xiv) For motors 90 KW and above, ACBs with numerical protection relays are envisaged. All motor feeder modules shall also be provided with local/ remote selector switches on the module itself.

11.06.04 Circuit Breakers

i) Breakers shall have anti-pumping feature.

ii) Circuit breakers shall have minimum interrupting capacity equal to the listed fault level.

iii) Circuit breaker shall be three poles air break type with stored energy, trip free mechanism and shunt trip.

iv) Circuit breakers shall be draw out type, having SERVICE, TEST & ISOLATED positions with positive indication for each position.

v) Circuit breakers of identical rating shall be physically and electrically interchangeable.

vi) All circuit breakers shall be of motor wound spring charged mechanism and also shall have hand operated spring charged mechanism facility.

vii) For motor wound mechanism, spring charging shall take place automatically after each breaker closing operation. One open-close/ open operation of the circuit breaker shall be possible after failure of power supply to the motor.

viii) 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.

ix) Automatic safety shutters shall be provided to fully cover the female primary disconnects when the breaker is withdrawn.

x) Each breaker shall be provided with closing and emergency manual trip, mechanical ON-OFF indicator, an operation counter and mechanism charge/ discharge indicator.

xi) In addition to the auxiliary contacts required for normal breaker operation and indication, each breaker shall be provided with following for interlocking purpose:-

a) Position/ cell switch with 4 NO + 4 NC contacts.

b) Auxiliary switch, with 6 NO + 6 NC contacts, mounted on the moving portion of the switchgear/ PMCC/ MCC and operated mechanically by a sliding lever from the breaker

c) Alternatively. Electrically reset latching relay may be used for the purpose. The exact requirement of contacts of position/cells switch, limit switch, auxiliary switch and latching relay shall be decided by the Bidder taking into account the scheme requirement spares.

d) Spring charge limit switch shall be provided for breakers with motor wound spring charging mechanism. These limit switches for motor duty shall be provided with minimum 2 NO + 2 NC aux. contacts.

e) Limit / auxiliary switches shall be convertible type that is suitable for changing N.O contact to N.C. and vice-versa.

xii) Provision of mechanical closing of breaker only in 'Test' and 'Widrawn' position shall be made. Alternatively, mechanical closing facility should be normally inaccessible, accessibility rendered only after deliberate removal of shrouds. It shall be possible to close the door with breaker in test position.

xiii) Mechanical tripping shall be through red 'Trip' push button outside the panels for breakers, and through control switches for other circuits.

11.06.05 Moulded Case Circuit Breakers (MCCB), Motor Protection Circuit Breaker (MPCB) and Miniature Circuit Breakers (MCB)

i) MCCBs shall be provided with spring assisted quick make/break manually operated trip free mechanism.

ii) MCCBs / MPCBs shall be provided with adjustable tripping device with inverse time characteristics for overload protection and instantaneous characteristics for short circuit protection. As per requirement, MCCBs shall also be provided with ground fault protection and 1NO contacts for tripping indication / alarm for Owner use.

iii) MCCBs / MPCBs for motor feeder shall be equipped with instantaneous magnetic adjustable tripping element only.

iv) MCCBs operating handle 'ON' and 'OFF' positions shall be displayed and the operating handle shall be mounted on the door of compartment/module housing MCCBs.

v) MCCBs/MPCBs shall be provided with minimum 2 NO + 2 NC spare auxiliary contacts

vi) MCBs shall be used in all the AC control circuits and DC control & lighting feeders, as specified. However, control fuses may be used in the ACB feeders for DC circuit.

vii) The MCBs shall be suitable for manual closing and opening and automatic tripping under overload and short circuit conditions. They shall be provided with trip-free mechanism.

viii) The MCBs shall be suitable for housing in the lighting panels and for connection of standard copper / aluminium wires at both the incoming and outgoing ends by copper lugs or bus bars connection on the incoming end.

ix) The terminals of MCB and ON and OFF positions shall be clearly and indelibly marked.

x) The interrupting current and continuous current rating of the MCCBs shall be as per the requirement.

11.06.06 Contactors

i) The contactors shall be three pole, air break type designed for duty class III category A.C. –3 for non-reversing and AC4 for reversing starters with non-bouncing silver / silver alloy contacts.

ii) Each contactor shall be provided with two (2) normally open and two (2) normally closed auxiliary contacts. Reversing contacts shall be electrically and mechanically interlocked.

iii) 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.

iv) Contactors shall break without damage 10 times rated current up to 100 amp rating and 8 times rated current for above 100 amp rating.

v) Coil continuous current shall not exceed 2 amp and initial pick up shall be limited to 9 amp. Class of insulation shall be E or better.

vi) Drop out voltage shall be 45 to 65% of rated voltage and pick up shall be 85 to 110%. Contactor duty shall be as per requirement.

vii) Coil shall be designed for the control voltage without economy resistors.

11.06.07 A.C. Starter

A.C starters shall be of TYPE II coordination.

11.06.08 DC Starter

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

ii) Starters shall be furnished in totally enclosed floor mounting, sheet steel cubicles complete with a hinged front access door. Minimum thickness of sheet steel shall be 2 mm.

iii) The cubicle enclosure shall provide dust and humidity protection, the degree of protection being not less than IP 54.

iv) The resistor enclosure shall be provided with ventilating louvers and wire mesh guard and shall have a degree of protection IP 23.

v) Cubicle space heater shall be provided to maintain internal temperature above dew point. Heater shall be furnished with SFU and thermostat control.

11.06.09 Power Distribution board (PDB)

i) PDB shall house MCCB modules only with have duplicate incomers and a bus-coupler. Distribution of outgoing feeders shall be such as to ensure uniform loading on each section of DB. Board shall be single/double front, metal clad, front matched, dust and vermin proof, fixed type compartmentalized and extensible on both sides with IP51 type enclosure.

ii) Shall have base channel of size ISMC 75.

iii) Shall have isolated busbar chamber for main bus bar at the top, running throughout the length of the board. Chamber shall have removable cover.

iv) Cable alley shall have sufficient space for aluminium power cables and bottom cable chamber shall be left free completely isolated from the vertical bus bar.

v) Bus bars shall have same cross section throughout the length. Rating of the neutral bus bar shall be 50% of the main bus bar. Earth bus bar shall run in bottom chamber throughout the length of the panel.

vi) Isolation transformer shall be provided in the PDB for driving 3 Ph, 4 Wire supply.

11.06.10 DC Distribution Boards

DCDBs shall have two incomers and a bus coupler. Incomers and outgoing feeders of DCDBs shall be switch fuse modules/MCCB modules. They shall be fixed type and floor mounted. Other constructional features shall be similar to PDB.

The feeder rating and quantity shall be as per requirement.

11.06.11 AC Fuse Boards

AC Fuse Boards, shall have switch fuse units as incomer. Fuse boards may be fed from DBs and shall have two incomer. AC fuse boards shall be of two types - one with 415V, 4-wire, triple pole- and-neutral (TPN) outgoing feeders and the other with 240V, 2- wire, single-pole-and-neutral outgoing feeders. The boards shall be wall mounted type and other constructional features as given in above specification for PDB except that fixed type module are accepted for such DBs.

For small loads, MCB boards with TPN MCB as incomer and TPN/SP MCBs for outgoing may be considered. However, to bring down the short circuit level to safe limits, isolation transformer shall be provided wherever necessary.

The feeder rating and quantity shall be as per requirement.

11.06.12 Control & Indication

i) The circuit breaker shall be wired up for local and remote operation. Each breaker cubicle shall be equipped with following:-

a) One (1) "TESTREMOTE" selector switch stay put type with black pistol grip handle and key interlock for motor feeder breaker and as well as for incoming and outgoing tie feeders.

b) Two (2) heavy duty, oil tight, push buttons for TRIP & CLOSE.

c) One (1) heavy duty, oil-tight, CLOSE-NEUTRAL-TRIP Switch

d) Indicating light on front of compartment:

GREEN	-	Breaker open
RED	-	Breaker closed
AMBER	-	Trip/Trip circuit trouble
BLUE	-	Breaker Spring charged
AMBER	-	Breaker, Auto trip
WHITE	-	Trip coil healthy
WHITE	-	Breaker in test position
YELLOW	-	Breaker in service position

e) Lamps shall be LED type with coloured dome. Lamps and lens shall be replaceable from the front. LED lamp shall be made in accordance with InP technology (Aluminuim 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.

f) Two(2) incomers and bus coupler shall be so interlocked that no two incomers shall operate in parallel except during momentarily paralleling.

ii) The control module shall be connected for local remote operation. Each control module shall be equipped with the following:

iii) Required nos. of push buttons as per scheme drawing.

iv) Each push button shall have two (2) normally open and two (2) normally closed contact rated 10A at 240V.

v) Push button shall be heavy duty, oil tight, push to actuate type with integral escutcheon plate marked with its function.

vi) One (1) MCC-REMOTE selector switch having make before break feature shall be provided for unidirectional motor feeders.

vii) For Test control supply, the Bidder shall provide separate 415/110 control transformer.

viii) DCDBs shall be provided with indication to monitor healthiness of the incoming DC supplies.

11.06.13 Current Transformer

i) Current Transformers shall be epoxy cast-resin type rated minimum of 10 VA. All secondary connections shall be brought out to terminal blocks where wye or delta connection shall be made. Insulation class shall be "E or better."

ii) 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 than MEAA
d) CTs for MEAA metering shall be as per Chapter-1

iii) Separate wire shall be used for metering and protection as far as possible. Secondary wire terminals shall be made available accordingly.

iv) Terminals with CT secondary shorting links for metering leads and TEST terminals block for C.T. secondary relay and KWH leads shall be provided.

v) VA Burden of CT's shall be adequate (15 VA minimum) for connection to remote metering system. Also additional terminal blocks etc. as may be required shall be provided in panels.

vi) CT secondary shall be rated 1 A for metering and protection.

11.06.14 Voltage Transformer

i) Three nos. single phase voltage transformer shall be provided in each incoming power supply circuit with voltmeter and selector switch. Additional three nos. voltage transformers shall be provided for each bus section voltmeter and its selector switch. These voltage transformers shall be mounted in separate compartments of the switchgears.

ii) Voltage transformers shall be epoxy cast resin and shall have an accuracy class of 1.0. Voltage Transformers mounted on breaker carriage is not acceptable. Voltage rating for the Transformer shall be 1.2 continuous and 1.5 for 30 second.

iii) Voltage transformer shall capable to withstand 200% of rated voltage continuously without change in its characteristics.

iv) High voltage windings of voltage transformer shall be protected by current limiting fuses.

v) Suitably rated three phase MCBs to prevent overload shall be installed in all ungrounded secondary leads. MCBs shall be suitably located to permit easy access while the MCC is energised.

vi) VTs for MEAA metering shall be as per Chapter-1

11.06.15 TEST Control Transformers

i) For TEST control supply control transformers of adequate rating (min. 2 KVA rating) shall be provided.

ii) For motor space heating supply, the transformers of adequate rating (min. 2 KVA rating) with 100% standby shall be provided.

iii) All the control transformers shall be placed in spacious compartments to have proper air circulation and keep lower temperature of transformer and its module.

iv) All the control transformers shall be provided with selector switch, fuses, indicating lamps. Each control transformer shall feed to its control buses of respective bus section during normal operation. In case of failure of one of the control transformer, provision shall be made to tap the control supplies from other bus section control transformer by auto changeover using aux. relays contacts/switch. Bidder has to develop scheme accordingly. This logic shall be made applicable for space heating and winding heating control transformer also.

v) All control transformer shall conform to IS: 12021.

vi) Control transformer shall have OCTC tap range of ± 5% in steps of 2.5% per tap.

11.06.16 Control supply for MCC modules

i) Each motor feeder of MCC shall be provided with suitably rated 415/110V control transformer, for arranging control supply for the module. All the necessary auxiliary and main contactors shall be provided suitable for this control supply.

ii) In test position module control supply shall be disconnected and provision shall be available to test the control circuit through test bus, obtained from separate control transformer provided for this purpose.

11.06.17 Control supply for ACBs of PCC and PMCC modules

i) Two 220 V DC feeders shall be provided in each board for power supply of control, shunt tripping and annunciation purpose.

ii) Control supply shall have supervision facility, alarm shall be provided for non-availability of any one of the control supply.

iii) MCCBs/MCBs shall be provided on incoming sides of supplies. Control buses of two sections shall be connected through auto changeover scheme.

iv) LEDs shall be provided for the indication purpose.

v) Isolation arrangement shall be provided on each panel to facilitate fault location and testing. Separate fuses shall be provided for spring charging motors, for indication lamps and for closing / Tripping circuits of each cubicle

11.06.18 Relays

i) Relays shall be of draw out design with built-in testing facilities. Small auxiliary relays may be in non-draw-out execution and mounted within the cubicle.

ii) Numerical type protective relays shall be provided to isolate the faulty equipment and system as early and as expeditiously possible.

iii) The Bidder shall furnish, install & co-ordinate all relays to suit the requirements of protection, interlock and bus transfer scheme as broadly indicated in the drawings.

iv) All relays shall be mounted on the front of the panel and shall be specified as per requirement.

v) Protection relay shall be lockout type with hand reset feature.

vi) Rated continuous making and breaking currents for contacts shall be suitable for service involved.

vii) All Relays shall be suitable for 220 V DC operation.

viii) All numerical relays shall have keypad / keys to allow relay settings from relay front. In addition, relay shall have front port for downloading / uploading of relay settings from the PC / Laptop. All hand-reset relays shall have reset button on the relay front. Relay to be self or hand reset shall be software selectable.

ix) All relays shall have LED / LCD display for settings, status, faults and events. LCD display shall be backlit and temperature compensated up to 65^0C for contrast and legibility.

x) As a minimum, the relay shall have LED indicating lamps for fault trip, relay healthy / unhealthy and control supply on.

xi) The relay shall have at least 6 programmable LEDs on relay front.

xii) Software Security

xiii) Relay shall be provided with password protection against unauthorized write access. However, viewing of metering data, setting and status and event data as read only parameters should be without password protection.

xiv) Disturbance, Event Recording & data Storage Status, disturbance data and events shall be stored in non-volatile memory or memory backed up by battery. It should be possible to store minimum 50 events with date and time stamp, last 5 fault records and last disturbance record. When auxiliary power fails, it should be possible to see the latest state of display when power is restored. Also, in case of power supply failure lock out status of the relay should be stored and kept in memory to allow the working of interlock logic properly on restoration of the supply.

xv) Trip Circuit Supervision & Lock out function

xvi) Relay shall have built in lockout function. Lock out feature shall be self reset or hand reset and shall be software selectable.

xvii) For trip circuit supervision separate relay shall be provided.

xviii) Input / Output Interface, Filters and galvanic Isolation.

xix) Relay shall have at least 4 No contacts each shall separately be programmable for either hand reset or self-reset. The contact rating shall be minimum 5A at 250V AC / DC.

xx) Relay shall be made immune to capacitance effect due to long length cables.

xxi) All IOs shall have galvanic isolation. Analog inputs shall be protected against switching surges, harmonics etc.

xxii) IEC 61850 protocol shall be used and shall be directly linked to DCS without converters. The numerical relays shall be provided with dual redundant ports for IEC 61850 communication and the numerical relays shall be connected in ring topology for linking to redundant controllers of DCS.

11.06.19 Intelligent Controllers

i) Each intelligent PCC, PMCC and MCC shall be provided with multi-function microprocessor based Numerical protective relay/ relay with intelligent controller.
This numerical relay shall have the following functions:-

a) Metering
b) Protection
c) Control
d) Monitoring
e) Communication through IEC 61850 protocol shall be used and shall be directly linked to DCS without converters. The Intelligent controllers shall be connected in daisy chain (in groups) or in star connection for linking to redundant controllers of DCS through Profibus using suitable device such as Y-link.

ii) Each panel shall be supplemented with required additional control element for features not covered by intelligent controllers.

iii) Numerical Relays of all modules in PCC / PMCC/ MCC shall be interlinked to DCS through open protocol IEC61850. Suitable hardware, software, cabling and any other interface requirement shall be taken care by this Bidder.

iv) Software for Numerical relays shall be supplied and shall be configurable from DCS based control system. Using this software, the following functions shall be carried out:-

a) Control of breakers (Close / Open / Trip)
b) Program or modify set points
c) Load or save set point from or to a disk
d) Read actual values
e) Monitor status
f) Read pre-trip data and trip record
g) Display dynamic trending of actual values
h) Get help on topic
i) Print

v) The device should have a control voltage of wide band from 110 to 240 V AC/DC, as applicable.

vi) Intelligent controller in a 415V / PMCC / MCC shall be directly interfaced to DCS control system through IEC 61850 Communication protocol for monitoring and through Hard wired interface for critical feedbacks and for commands with suitable interposing relay via remote I/O panel in MCC Room. The protection system should be independent / autonomous of the system i.e. motor protection & control should continue to be available even in the event of a communication or automation system failure.

11.06.20 Communication with DCS

i) Co-ordination between the switchgear manufacturer and DCS Supplier for protocol / mapping, procedures, interface and testing is included in the scope of services.

ii) Software for intelligent controller shall be supplied and suitably interfaced with DCS. It shall be possible to configure a device either individually or over a communication network. For this purpose, provision for connecting a laptop should be available at Numerical Relays/ Intelligent controller.

iii) Minimum of 2 Nos. laptop shall be provided along with PCCs / PMCCs / MCCs with all accessories, fully loaded software for Uploading / Downloading the switchgear data. In order to achieve minimum response time, the device shall be capable of transmitting data at a speed, suitable for operation with high speed bus systems.

11.06.21 Operations and Indications

i) Close/ open operations of all Incomer, Bus coupler & outgoing feeder breakers in "test" position, for all 0.415 kV feeders shall be through Push Buttons and test / service selector switches provided at the respective modules.

ii) Modules shall have ON, OFF & TRIP (LED indications provided.)

11.06.22 Interface with DCS

SL. NO.	DESCRIPTION	TYPE OF I/O
A.	**Incomer (ACB Controlled)**	
	Breaker Close	DO
	Breaker Trip	DO
	Line PT under voltage	DI
	Line PT Fuse Fail	DI
	Breaker ON	DI
	Breaker OFF	DI
	Incomer Disturbance (Control Supply Fail)	DI
	Numerical relay Unhealthy	DI
	Trip Coil Healthy	DI
	Incomer Available (Breaker in service/spring charged/ switchgear in remote)	DI

SL. NO.	DESCRIPTION	TYPE OF I/O
	Electrical Trip (Lockout relay optd)	DI
	Numerical relay	Interface through IEC 61850 protocol.
B.	**Incomer (MCCB Controlled)**	
	MCCB Close	DO
	MCCB Trip	DO
	Current feedback	AI
	MCCB ON	DI
	MCCB OFF	DI
	Incomer Disturbance (Contol supply fail)	DI
	Electrical Trip	DI
C.	**Bus Coupler (ACB Controlled)**	
	Breaker Close	DO
	Breaker Trip	DO
	Incomer-1 check Syn	DO
	Incomer-2 check Syn	DO
	Bus coupler check Syn	DO
	Breaker ON	DI
	Breaker OFF	DI
	Buscoupler Disturbance (Control Supply Fail)	DI
	Numerical relay unhealthy	DI
	Trip Coil Healthy	DI
	Bus-A Under Voltage	DI
	Bus-A PT Fuse Fail	DI
	Bus-B under voltage	DI
	Bus-B PT Fuse fail	DI
	DC Supply-1 fail	DI
	DC Supply-2 fail	DI
	Buscoupler Available (Bkr. In service/spring charged/swgr in remote)	DI
	Electric Trip (Lockout relay optd)	DI
	Numerical relay	Interface through IEC 61850 protocol
D.	**Bus Coupler (MCCB Controlled)**	
	MCCB Close	DO
	MCCB Trip	DO
	Current feedback	AI
	MCCB ON	DI
	MCCB OFF	DI
	Bus coupler Disturbance (Control Supply Fail)	DI
	DC Supply-1 Fail	DI
	DC Supply-2 Fail	DI
	Electrical Trip	DI

SL. NO.	DESCRIPTION	TYPE OF I/O
E.	**Outgoing ACB Feeder**	
	Breaker Close	DO
	Breaker Trip	DO
	Breaker ON	DI
	Breaker OFF	DI
	O/G Feeder Disturbance (Control Supply Fail)	DI
	Numerical relay unhealthy	DI
	Trip Coil healthy	DI
	O/G Feeder Available (Breaker in service/spring charged/swgr. In remote)	DI
	Electrical Trip (Lockout relay optd)	DI
	Numerical relay	Interface through IEC 61850 protocol
F.	**ACB Controlled Motor Feeder**	
	Start Command	DO
	Stop Command	DO
	ON Feedback	DI
	OFF Feedback	DI
	Electrical trip (Lockout relay)	DI
	Emergency LPBS Stop	DI
	Module Disturbance (Control supply fail)	DI
	Module available (Breaker in service position, Switchgear in remote & breaker spring charged)	DI
	Numercial realy unhealthy	DI
	Trip coil healthy	DI
	Numerical relays	Interface through IEC 61850 protocol
G.	**Undirectional LT Drive (MCCB/MPCB Controlled)**	
	Start Command	DO
	Stop Command	DO
	ON Feedback	DI
	OFF Feedback	DI
	Module disturbance (Control supply fail)	DI
	Emergency LPBS Stop	DI
	Intelligent Controllers	Interface through IEC 61850 protocol or Profibus.

SL. NO.	DESCRIPTION	TYPE OF I/O
H.	**Bidirectional LV Drive with Non-Integral starters (Soot blower)**	
	Forward Command	DO
	Reverse Command	DO
	Forward Feedback	DI
	Revers Feedback	DI
	Module disturbance (Control supply fail)	DI

NOTE: The above I/O shall be hard wired to DCS.

11.06.23 Metering and Protection

The feeders shall have the following protections / metering required for the switchgear panels. The minimum protections / metering required for various typical feeders including ACB operated feeders are given below. For non ACB controlled feeders having intelligent controller, the metering indicated shall be in-built.

i) ACB Controlled feeders with numerical relays

A)	Incomers		
	Protections	**Metering (for remote)**	**Local Indication**
	Instantanous over current protection 50	Current in all the three phases	Current in all the three phases
	IDMT over current protection 51	Voltage – Phase to phase, phase to neutral	Voltmeter with voltage selecter switch
	Instantanous earth protection 50N	kW	
	IDMT Earth fault protection 51N	kWH	
	Circuit breaker failure protection 50BF		
	Under voltage protection 27		
	Restricted earth fault protection 64R		
	Backup (Standby) earth fault protection 64S		
	Apart from above protection relays, each electrically operated breaker shall be provided with anti pumping (94), lockout (86) and trip circuit supervision (95) relays. Lockout relay shall be a hand reset type and		

	shall not be clubbed with numerical relay.		
	Check synchronizing 25 through relay mounted in bus coupler.		
B)	**Bus Couplers**		
	Protections	**Metering (for remote)**	**Local Indication**
	Instantanous over current protection 50	Current in all the three phases	Current in all the three phases
	IDMT over current protection 51	Voltage – Phase to phase, phase to neutral	Voltmeter with voltage selecter switch for Bus A
	Instantanous earth protection 50N	kW	Voltmeter with voltage selecter switch for Bus B
	IDMT Earth fault protection 51N	kWH	
	Circuit breaker failure protection 50BF		
	Under voltage protection 27		
	Check synchronizing 25		
	Apart from above protection relays, each electrically operated breaker shall be provided with anti pumping (94), lockout (86) and trip circuit supervision (95) relays. Lockout relay shall be a hand reset type and shall not be clubbed with numerical relay.		
C)	**Motor Feeders (90KW and above only)**		
	Protections	**Metering (for remote)**	**Local Indication**
	Numerical Composite motor protection to cover a minimum of protections such as negative phse current (46), thermal over load (49), phase over current (50/51), earth fault (50N/51N), locked rotor (51LR), No. of starts per hour (66), breaker failure (50BF), under voltage (27 from PT)	Current in all the three phases	Current (Y phase)

	Apart from above protection relays, each electrically operated breaker shall be provided with anti pumping (94), lockout (86) and trip circuit supervision (95) relays. Lockout relay shall be a hand reset type and shall not be clubbed with numerical relay.	kW, kWH	
D)	**Outgoing Feeder (630A and above)**		
	Protections	**Metering (for remote)**	**Local Indication**
	Instantanous over current protection 50	Current in all the three phases	Current (Y phase)
	IDMT over current protection 51	Voltage – Phase to phase, phase to neutral	
	Instantanous earth protection 50N	kW	
	IDMT Earth fault protection 51N	kWH	
	Circuit breaker failure protection 50BF		
	Apart from above protection relays, each electrically operated breaker shall be provided with anti pumping (94), lockout (86) and trip circuit supervision (95) relays. Lockout relay shall be a hand reset type and shall not be clubbed with numerical relay.		

ii) MCCB Controlled feeders rated below 630A.

A)	**Incomers (with motorized MCCB)**		
	Protections	**Metering (for remote)**	**Local Indication**
	Over current protection	Current transducer (Y phase)	Current (Y phase)
	Short circuit protection		Voltmeter with voltage selector switch

B)	Bus Couplers (with motorized MCCB)		
	Protections	**Metering (for remote)**	**Local Indication**
	Over current protection	Current transducer (Y phase)	Current (Y phase)
	Short circuit protection		
C)	**Outgoing Feeder (Below 630A) with MCCB (non motorized)**		
	Protections	**Metering (for remote)**	**Local Indication**
	Over current protection		Current (Y phase)
	Short circuit protection		
D)	**Incomers for ACDB/MLDB/PDB MCCB (non motorized)**		
	Protections	**Metering (for remote)**	**Local Indication**
	Over current protection		Voltmeter with voltage selecter switch
	Short circuit protection		Electronic energymeter with communication port suitable for IEC 61850 protocol

iii) Other feeders

A)	Bus PT / Line PT Modules		
	Protections	**Metering (for remote)**	**Local Indication**
	Under voltage protection 27	Voltage – phase to phase, phase to neutral	
	Fuse failure protection		
B)	**Motor feeders upto 15.0kW (MPCB with Contactors)**		
	Protections	**Metering (for remote)**	**Local Indication**
	Intelligent controllers with current measuring module and overload & short circuit protection.		
C)	**Motor feeders above 15.0kW but below 90kw (MCCB with Contactors)**		
	Protections	**Metering (for remote)**	**Local Indication**
	Intelligent controllers with current measuring module and Overload, single phase preventor & short circuit protection.	Phase current (for motors of rating 30KW and above)	

iv) DC System

A)	**Incomer Breaker/MCCB**		
	Protections	**Metering (for remote)**	**Local Indication**
	With indication only no protection with O/L alarm to DCS	Bus voltage	Load Voltage
			Bus Voltage
			Shunt with ammeter
B)	**Outgoing Feeder**		
	With indication only no protection with O/L alarm to DCS		Shunt with ammeter

Note:

Fuse failure relay shall be provided on the secondary side of voltage transformer to monitor HV and LV fuses.

11.06.24 Secondary wiring

i) The Switchgear/MCC/DB shall be fully wired at the factory to ensure proper functioning of control, protection, transfer and interlocking schemes.

ii) Fuse and links shall be provided to permit individual circuit isolation from bus wires without disturbing other circuits. All spare contacts of relays, switches and other devices shall be wired up to terminal blocks.

iii) Wiring shall be done with flexible, 1100V grade, PVC insulated switchboard wires with stranded copper conductors of 2.5 sq.mm for current circuits and 1.5 sq.mm for voltage circuits and control circuits. Colour code shall be maintained for voltage and current circuits.

iv) Each wire shall be identified, at both ends with permanent tubular type printed markers bearing wire numbers as per Bidder's wiring diagrams. Each wire shall be ferruled by plastic tube with indelible ink print at both ends having terminal block no., terminal nos., destination no, as per approved drawing.

v) Wire terminations shall be made with crimping type connectors with insulating sleeves. Wire shall not be spliced between terminals. Fork type lugs shall be provided for all control terminals. The lugs shall be suitable for 2.5 sq.mm stranded copper conductor. However, C.T. wiring shall be done by using circular type lugs.

vi) For power wiring inside module copper cables are to be used.

vii) Terminal blocks with loose wires shall be provided in each shipping section for inter panel wiring.

viii) All control terminals shall be of 10 sq.mm size and shall be sliding type for draw out module and clip on type for fixed type module.

11.06.25 Terminal Blocks

i) Terminal blocks shall be 1100V grade box-clamp type with marking strips, similar to ELMEX 10 sq.mm or equal. Terminals for C.T. secondary leads shall have provision for shorting or any other equivalent new technology terminal blocks after approval of Owner.

ii) Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20% active terminals shall be furnished.

iii) Terminal block 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.

iv) Coloured terminal blocks for connection of power cables (R,Y,B phases) shall be provided.

v) Twisted pair 0.5sq.mm copper cable shall be used for DCS/BMS surface

11.06.26 Cable Termination

i) SWGR/PMCC / PCC/MCC/DB shall be designed for cable entry from the bottom. Sufficient space shall be provided for ease of termination and connection.

ii) 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, double compression type brass glands with tapered washer (power cables only) and terminal blocks. Terminating of power cables shall be shrouded to avoid accidental touch. Suitable supporting clamps shall be provided for cables to eliminate stresses on terminals.

iii) Twisted pair 0.5 sq. mm copper cable shall be used for DCS interface.

iv) Gland plates shall be minimum 3 mm thick. The gland plate and supporting arrangement for I/C Power cables shall be such as to prevent flow of eddy current.

v) Gland plates shall be easily removable type. The gland plate shall be mounted at 40/50 mm above the bottom of base frame of switch board.

vi) Cabling area above gland plate shall be free of any earth bus, neutral bus etc. so that the total gland plate area is usable for cabling and also do not obstruct removal of gland plate.

11.06.27 Busduct Connection

i) Busduct connections, wherever provided, shall be furnished along with transition panel if required.

ii) All connecting bus work shall have the same continuous rating as associated SWGR/PMCC / PCC/MCC bus and shall be fully braced for the specified short circuit current.

iii) All provisions such as matching flange and other accessories shall be furnished for connection to busduct.

iv) All the incomers from transformer shall be connected by Bus

11.06.28 Ground Bus

i) A ground bus made of copper/GI rated to maximum fault current shall be extended to full length of the Switchgear/MCC/DB.

ii) The ground bus shall be provided with two-bolt drilling with G.S. bolts and nuts at each end to receive 50x6 mm G.S. flat.

iii) Each stationary unit shall be connected directly to the ground bus. The frame of each circuit breaker and V.T. unit shall be grounded through heavy multiple contacts at all times except when the primary disconnecting devices are separated by a safe distance.

iv) The frames of all other drawout modules shall be grounded through heavy multiple contacts at all times except when the power disconnects are separated by a safe distance.

v) Wherever the schematic diagrams indicate a definite ground at the SWGR/PCC/ MCC a single wire for each circuit thus grounded shall be run independently to the ground bus and connected thereto.

vi) C.T. and V.T. secondary neutral shall be earthed through removable links so that earth of one circuit maybe removed without disturbing others.

vii) Door earthing shall be done by using 2.5 sq.mm stranded flexible copper conductor PVC insulated (Green colour).

11.06.29 Name Plates

i) Name Plates of approved design shall be furnished at each cubicle/control compartment, at the top of each Switchgear/MCC/DB and at each instrument and device mounted on or inside the cubicle.

ii) The material shall be lamicoid or approved equal 3 mm thick with white engraved letters on black background.

iii) The name plate shall be held by self-tapping screws. Name plate size shall be minimum 40 X 150 mm of 0.5mm thick for instrument/devices & 75 x 450 mm of 1mm thick for panels. The size of lettering shall be minimum 5 mm for module/feeder designation; however, component designation letter size shall be 6 mm.

iv) Caution notice on suitable metal plate shall be affixed at the back of each vertical panel for single front construction.

v) Board labels and panel Nos. shall be provided both on front and rear at two locations each if board is more than 10 meters in length.

11.06.30 Space Heaters and Plug Sockets

i) Each vertical section shall be provided with thermostat controlled space heater and 5A, 3 pin plug socket.

ii) In addition, motor feeders 30 KW and above shall be wired up for feeding the motor space heater through suitably rated starter auxiliary NC contact.

iii) Cubicle heater, Motor heater, plug socket circuit shall have individual switch fuse units.

iv) For valve / actuator provision of space heater supply shall be provided.

11.06.31 Tropical Protection

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

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

11.07.00 PAINTING FOR SWGR/PCC/MCC/DB

11.07.01 All surfaces shall be subject to tank pretreatment process to produce a smooth, clean surface free of scale, grease and rust.

11.07.02 The SWGR/PCC/ MCC/DB and all other components shall be powdered coated as mentioned in Chapter 1.

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

11.08.00 TESTS

11.08.01 During the fabrication switchgears shall be subject to inspection by Owner or its authorized representatives. Manufacturer shall furnish necessary information concerning the supply to Owner.

11.08.02 All routine tests shall be carried out at manufacturer's work under his care and expense, in the presence of Owner or his representative.

11.08.03 Stage inspection after the pre treatment and preparation of under surface and before final painting shall be carried out by Owner.

11.09.00 ROUTINE TEST

11.09.01 A general visual check shall be carried out. This shall cover measurement of overall dimension, location, number and type of devices, terminal boxes, location and connection of terminal etc.

11.09.02 Manual and electrical operation of circuit breakers / relay shall be checked under the worst condition of the auxiliary voltage.

11.09.03 Dry insulation test with power frequency voltage shall be conducted for the main and auxiliary circuit.

11.09.04 Insulation resistance of the main and auxiliary circuits shall be checked before and after high voltage withstand test.

11.09.05 Operation checks shall be carried out for every control function / interlocks as per the schematic diagrams by manually simulating fault condition and operation of the control switches / relay etc.

11.09.06 Relay shall be tested with secondary injection test equipment.

11.09.07 Primary injection test to check winding of current transformers, ammeter, ammeter selector switch and correction of wiring connection between them.

11.09.08 For equipment bought from other sub suppliers, certified test report of tests carried out at the manufacturer's works shall be submitted. Normally all the routine test specified in the relevant standards shall be conducted by the sub-supplier at his works.

11.09.09 Interchangeability of similar modules shall be checked on random basis. This may be done on one module of each size.

11.10.00 TYPE TEST

11.10.01 The type test certificate of similar rating of switchgear performed shall be submitted.

11.10.02 In case the Bidder is not able to submit report of the type test(s) conducted or in the case of type test report(s) are not found to be meeting the specification requirements, the Bidder shall conduct all such tests in the presence of the Owner without cost implication and submit the reports for approval.

11.11.00 TEST WITNESS

Test shall be performed in presence of Owner's if so desired by the Owner. The Bidder shall give at least fifteen (15) days advance notice of the date when tests are to be carried out.

11.12.00 DRAWINGS, DATA AND MANUALS

11.12.01 Following drawings/ data and Manuals to be submitted for approval.

i) Outline dimensional drawing showing general arrangement, space requirements and bus duct / cable entry points.

ii) Cross-section with parts list

iii) Foundation plan with loading

iv) Board-wise single line diagrams

v) Control schematics

vi) Wiring diagrams

vii) Consolidated Bill of Material

viii) Relay setting calculation

ix) Test Certificates and QAP

x) Bus bar sizing

xi) CT/VT sizing

xii) Technical leaflets

11.12.02 The Bidder shall also submit all instruction manuals clearly indicating the installation method, check-up and tests that are to be carried out before commissioning the equipment.

11.12.03 Bidders shall note that the drawings, data and manuals listed herein are minimum requirements only. The Bidders shall ensure that other necessary write-ups, curves and information required to fully describe the equipment are submitted during detail engineering.

DATASHEET FOR 415V PCC/PMCC/MCC/DBs

SL NO.	DESCRIPTION		SPECIFICATION REQUIREMENTS	
(a)	Rated voltage, phases and frequency		415V, 3 phase, 4 wire, 50 Hz.	
(b)	System neutral earthing		Solidly earthed	
(c)	Reference Ambient air temperature		50°C	
(d)	Material of bus bars		Al. or Al. Alloy	
(e)	Maximum temp. of bus bars joints, droppers and along the run at site reference ambient of 50°C With Plain or Tin joints With silver plated joints Bus enclosure and structure		*40°C* 55°C 30°C	
(f)	Short time rating for 1.0 Sec. (kA rms)		50	
(g)	Momentary rating (kA peak)		105	
(h)	Degree of protection for as per IS:2147		IP-54 for outdoor IP52 for indoor panels with current rating less than and including 1600A and IP 42 for panels with current rating more than 1600A	
(i)	Thickness of sheet steel in mm			
	(i)	Load bearing members	2	
	(ii)	Non-load bearing members	1.6	
(j)	Colour finish shade		Interior	Glossy white
			Exterior	As mentioned in Chapter 1.

SL NO.	DESCRIPTION		SPECIFICATION REQUIREMENTS
Air Circuit Breaker			
1	Service	:	Indoor
2	Type	:	Air – break
3	Rated service voltage	:	415 V +/- 10%
4	Rated Current	:	As per requirement or 630A/1000A/1250A/2000A/2500A/ 3000A
5	Rated frequency	:	50 Hz +/- 5%
6	System earthing	:	Solidly grounded
7	Rated short time withstand current for 1 sec.	:	50 KA (r.m.s.)
8	Rated Symmetrical breaking current at rated voltage	:	50 KA (r.m.s.)
9	Rated making capacity (min)	:	105 KA
10	Rated operating duty	:	The duty of circuit breaker for motor feeder involves direct-on- line starting of motors. The motor starting current varies from 6 to 8 times the full load current at a very low power factor
			Frequency of starts of motors: Three (3) Starts per hour & Two (2) Consecutive Cold starts and one (1) hot restart.
11	Duty cycle	:	O-3 min-CO-3 min-CO
12	Operating mechanism	:	Stored energy type
	a) Closing	:	motor wound spring operated
	b) Opening	:	shunt trip coil
	c) Latching arrangement	:	Mechanically & Electrically trip free
13)	Auxiliary Voltage	:	
	Closing	:	220V D.C. (85% - 110%)
	Tripping	:	220V D.C. (70% - 110%)
	Spring charging motor	:	220 V +/- 10% D.C.
	Space heater & lamp	:	240 V+/- 10% AC 50 Hz
14	Anti-pumping feature	:	Electrical anti-pumping feature shall be provided.
15	No. of poles	:	3/4
16	Aux. Switch contact	:	Min (6 NO + 6 NC)
17	Mounting	:	Draw-out type transfer truck within switchgear cubicle
18	Limits of temp. rise	:	As per IS:2516 part I & II / Sec I
19	Termination	:	

SL NO.	DESCRIPTION	SPECIFICATION REQUIREMENTS		
	Incomer	:	Bus duct (top)	
	Outgoing	:	Armoured aluminum cable	
20	Static built in release	:	To be provided	
21	Finish paint shade	:	As mentioned in Chapter 1.	
	HRC FUSES	:		
	Type	:	Link type	
	Reference standard	:	IS : 9224	
	Rated current	:	As specified	
	Operation indicator	:	Required	
	Fuse characteristics	:	Bidder to furnish	
	CONTACTOR	**:**	**AC**	**DC**
1	Service	:	Indoor within steel cubicle for maximum system voltage, starting of motors and miscellaneous loads.	Indoor within steel cubicle for maximum system voltage, starting of motors and miscellaneous loads.
2	No. of Poles	:	3	2
3	Rated service voltage	:	415 V +/- 10%	220 V(190-240V)
4	Rated frequency	:	50 Hz +/- 5%	
5	System earthing	:	Solidly grounded	Ungrounded
6	Short time rating	:	To be coordinated with MCCB/MPCB Preceding it.	To be coordinated with MCCB/MPCB Preceding it.
7	Continuous current	:	To suit motor continuous current rating Conditions specified.	To suit motor continuous current rating Conditions specified.
8	Short circuit level	:	50 KA (rms) at 415 V	
9	Location of control	:	One point control Logic adopted	

SL NO.	DESCRIPTION	SPECIFICATION REQUIREMENTS		
10	Control circuit	:	110V ±10% 1-ph 50 Hz ± 5% derived from 415/110V control transformer provided in each control module.	
11	Utilization category	:	AC 3 for uni- directional motors	
			AC 4 for Bi-directional Motors.	
	CONTACTOR	**:**	**AC**	**DC**
12	Duty Class:	:	0.1	
	Intermittent class for Uni-directional motors (IS:2959)			
	Intermittent class for Bi-directional motors (IS:2959)	:	0.3	
13	Aux. Contact requirement	:	Min. 2 NO &	
			2 NC contacts	
14	Limits of operation	:		
	Closing (pick-up)	:	85% to 110%	
	Dropout	:	45 – 65% of rated	
15	High voltage test values (one Min. value)	:		
	a. Main power circuit	:	2.5 KV	
	b. Control & auxiliary circuit volts	:	2.0 KV	
16	Limits of temperature	:	As per IS:2959	
CURRENT TRANSFORMERS				
1	Service	:	Indoor	
2	System	:	415V, 3 phase, 4 wire, 50Hz, Solidly earthed neutral	
	Insulation class		E or better.	
3	Type	:	Resin cast	
4	Rated voltage	:	415 V +10%	

SL NO.	DESCRIPTION	SPECIFICATION REQUIREMENTS	
5	Quantity required	:	As per requirements of individual feeders and as mentioned in the specification drawings.
6	Ratio and burden	:	As required, C.T. secondary rating shall be 1 AMP.
7	Accuracy	:	5P10 or better for protection and class-1 for metering.
8	Power frequency withstand voltage	:	2.5 KV (r.m.s) for one minute
9	Rated short time current	:	
10.	Short time withstand current for 1 sec	:	50 KA (r.m.s)
11.	Dynamic current	:	105 KA (peak)
12	Mounting	:	Inside switchgear cubicle in stationary portion.
	Potential Transformer		
1	Service	:	Indoor
2	System	:	451V, 3 phase, 4 wire, 50 Hz, Solidly earthed neutral
3	Type	:	Cast resin
4	Rating- Voltage ratio	:	415/√3 / 110/√3
5	Rated burden	:	As specified
6	Accuracy class	:	As per requirement, to be furnish during detail engineering
7	Power frequency withstand voltage	:	Primary: 11.0 KV for one minute
			Secondary : 2.0 KV for one minute
8	Mounting	:	Fixed type
9	Quantity	:	As per requirement

Microprocessor based numerical relays with communication facility

The numerical relays for 0.415KV Switchgears shall comply with but not limited to the following technical requirements.

S. NO.	DESCRIPTION	:	SPECIFICATION
1	Purpose	:	Control & Protection, Metering and Monitoring of all switchgears and MCCs with synchro-check facility for Incomers, Bus couplers.
2	Auxiliary Supply	:	220V DC for ACBs and 110V AC for MCC only.
3	CT Secondary Current	:	1Amp.
4	PT Secondary Voltage	:	110V AC, 3 Phase
5	Ambient Temperature	:	50^{o}C
6	Degree of protection	:	IP 54
7	Communication	:	Compatible with DCS system through suitable connectivity (IEC61850) & suitable software.
8	Input & Output	:	Required number of analog and digital inputs/outputs as per scheme requirement with spare.
9	Control		Close / open control of breakers through lap top from the front fort/through key pad (Built in)/ through rear port connection from DCS.
10	Metering	:	Instantaneous and Integrated values as indicated.
11	Protection	:	Complete protection for Incomer, Tie, Bus coupler, feeders as indicated.
12	Monitoring	:	Self-diagnostic facility.
	Facilities to be made available in the relay		Programming keys for complete access without computer (built in). Provision for external programming unit through suitable software and communication ports. Display unit. Read/Write set points. Current & Voltage actual values and any other analog measurement. Event recording with Pre-trip data with starting characteristics. Statistical data. Output relays. Tamper proof security system

SUB-VENDOR LIST FOR LT MOTORS

SL NO.	VENDOR NAME	
1	ABB	14, MATHURA ROAD, FARIDABAD, HARYANA-121003
2	BHARAT BIJLEE LTD	BHARAT BIJLEE LIMITED, 1ST FLOOR, 7-B, RAJINDRA PARK, PUSA ROAD, NEW DELHI - 110 060.
3	CROMPTON GREAVES	3RD FLOOR, EXPRESS BUILDING,9-10, BAHADUR S
4	GE-POWER	KAMAK TOWER, 3RD FLOOR, PLOT NO. 12-A, TVK INDUSTRIAL ESTATE, EKKADUTHANGAL, GUINDY, CHENNAI-600032
5	KIRLOSKAR ELECTRIC CO LTD.	P.O. BOX 5555 , MALLESWARAM WEST ,BANGALORE 560055
6	LAXMI HYDRAULICS PVT. LTD	129/130, INDUSTRIAL ESTATE PATIL NAGAR, HOTGI ROAD SOLAPUR-413003, MAHARASHTRA
7	MARATHON	MARATHON ELECTRIC INDIA PRIVATE LTD.SECTOR - 11, MODEL TOWN, FARIDABAD - 121006
8	NGEF	POCKET NO.10, FLAT NO. 37 & 38, EXPANDABLE DDA FLATS, NASIRPUR DWARKA, PHASE-I NEW DELHI-110 045
9	RAJINDRA ELECT INDUSTRIES	14 SHAH IND.ESTATE VEERA DESAI RD,ANDHERI(W) MUMBAI-400053
10	SIEMENS	RC-IN I S NR DEL AREA, JIL BUILDING, TOWER-B, PLOT NO. 78, SECTOR 18, GURGAON-122015, INDIA

SUB-VENDOR LIST FOR GLANDS

1	ALLIED TRADERS & EXPORTERS	C-124 A, SECTOR-2, NOIDA -201 301, UTTAR PRADESH, INDIA
2	ARUP ENGG & FOUNDARY WORKS	391/119,PRINCE ANWAR SHAH ROAD, CALCUTTA-700068
3	BALIGA LIGHTING EQPT.PVT.LTD.	63A, CP RAMASWAMY ROAD, ALWARPET, P.B. No 6910, CHENNAI-600018
4	COMMET BRASS PRODUCTS	NUTAN CHEMICAL COMPOUND, WALBHAT ROAD, GOREGAON, MUMBAI-400063
5	DOWELLS	M/S. DOWELLS ELECTRICALS 47/47A, SATGURU INDUSTRIAL ESTATE. OFF AAREY ROAD, GOREGOAN (EAST). MUMBAI 400 063.
6	ELECTROMAC INDUSTRIES	27/28AF NEW EMPIRE IND.ESTT., R.KRISHNA MANDIR RD.JB NGR ,ANDHERI(E),MUMBAI-400059
7	INCAB	HARE STREET,KOLKATA,WEST BENGAL-700001

SUB-VENDOR LIST FOR LUGS

1	DOWELLS	M/S. DOWELLS ELECTRICALS 47/47A, SATGURU INDUSTRIAL ESTATE. OFF AAREY ROAD, GOREGOAN (EAST). MUMBAI 400 063.
2	UNIVERSAL MACHINES LTD.	4,B.B.D.BAG (EAST) 90,STEPHEN HOUSE,5TH FLR CALCUTTA-700001

SUB-VENDOR LIST FOR FRP CABLE TRAYS & ACCESSORIES

1	EPP COMPOSITES PRIVATE LIMITED	Rajkot-Gujarat
2	SUMIP COMPOSITES PVT.LTD.	Ahmedabad-Gujarat

SUB-SECTION – IC

SPECIFIC TECHNICAL REQUIREMENTS (C &I)

SCOPE MATRIX - CONDENSER ONLOAD TUBE CLEANING SYSTEM (DEBRIS FILTER)

S.No.	PROJECT	UPPUR
1	**SYSTEM APPLICABLE: DEBRIS FILTER(DF)**	Y
2	**SYSTEM CONFIGURATION: UNITISED OR COMMON OR AS APPLICABLE**	UNITISED
3	**CONTROL SYSTEM**	REFER NOTE-1
4	**LOCATION OF CONTROL SYSTEM**	
5	**CONTROL SYSTEM SCOPE (BIDDER /BHEL/ CUSTOMER)**	
6	**CONTROL FROM PUSH BUTTONS ON STARTER PANEL**	Y; REFER NOTE 3
7	**ANNUNCIATION ON STARTER PANEL (Y/N) -- IF Y, MIN NO. OF HARDWIRED ALARMS / INDICATIONS**	Y; REFER NOTE-4
8	**MIMIC ON STARTER PANEL (Y/N)**	Y; REFER NOTE-5
9	**POWER SUPPLY AVAILABLE FOR BALL MONITORING SYSTEM IN BIDDERS'S SCOPE (24V DC / 110 V AC UPS / 230 V AC UPS)**	NA
10	**PROTECTION CLASS FOR STARTER PANEL**	AS PER DATASHEET OF 'LOCAL CONTROL CUM STARTER PANEL' (herein also referred as 'Starter Panel' or 'Local Control Panel' or 'Switchgear Panel' interchangeably)
11	**ACTUATOR WITH INTEGRAL STARTER (Y/N)**	Y
12	**DPG/ DPT PER COLTCS SYSTEM ***	DIFFERENTIAL PRESSURE TRANSMITTER = 2 nos. (Across each Filter) DIFFERENTIAL PRESSURE GAUGE = 1 no. (Across each Filter)
13	**SEA WATER APPLICATION**	Y

	NOTES:
1	Type of control system shall be DDCMIS (Station C&I) based, located in Central Control Room in BHEL scope. Field instrumentation and starter panels for the package are in bidder's scope of supply.
2	For Uppur Projects, for each Unit,Debris filter shall be supplied with its Local control panel/Starter panel and its MIMIC and annunciator for its operation. Extent of MIMICs and annunciators shall be decided during detailed engg.
3	Push buttons and indication lamps for Open/Close and Start/Stop of drives/equipments shall be provided on the starter panel. Remote and local indication, indicating lamps / LED cluster for instruments/drives/equipments status and critical alarms shall be provided on the starter panel. Nos. shall be decided during detailed engineering.

4	No. of facia on Starter panel shall be decided during detailed engineering.
5	Colored MIMICS on the panel is to be provided as per system flow diagram.
6	415 V, 3 phase AC power supply shall be provided by BHEL at a single point for the starter panel. Further any electrical distribution shall be in bidder’s scope. Any other voltage requirement to be arranged/derived by bidder by providing suitable control transformer. Starter panel in bidder's scope shall have provision for redundant feeder with fast automatic changeover.
7	Bidder to terminate all instrumentation and control elements in the local control cum starter panel/Junction box for further cabling to DDCMIS.
8	Following documents shall be provided by bidder during detailed engineering for approval: a. Input/Output list, Drives list, b. Instrument datasheets and check lists/Quality plan, c. Panel external/internal GA drawing and termination details, d. Panel datasheet and QAP e. Recommended control logics / Control philosophy . f. Complete cable schedule & cable interconnection details
9	All the instruments along with necessary fittings, accessories and valve manifold etc., instrument rack and junction boxes, erection hardware shall be in bidder's scope of supply.
10	LIR (Instrument Rack) to be provided for mounting the instruments in the field.
11	Cable for local wiring, between field instruments to Starter panel shall be screened with 1.5 mm2 minimum and shall be in bidder's scope. Refer 'electrical scope sheet between BHEL and bidder' attached in electrical specification for cable scope.
12	Mandatory spare list shall be referred in 'List of mandatory spares' attached elsewhere in the specification and shall be supplied by bidder.
13	*Instruments, root valves, impulse pipe shall be suitable for sea water application having corrossion resistance where media is sea water. The minimum requirement for Sea water application is: all wetted parts & diaphragm shall be suitable for sea water (Duplex Stainless Steel or better).
14	All the transmitters and gauges shall have remote seal type having 15m capillary length.
15	Open/close limit switch feedback of valves are to be connected to DCS for remote viewing and for interlock & protection.
16	The Vendor list/ sub-vendor list shall be subject to BHEL / Customer approval during contract stage.
17	The technical requirements for instruments mentioned in the specification are minimum requirements. Items not specifically mentioned and required for the completeness of the system shall be supplied by bidder.
18	The bidders shall specifically mention any deviation they would like to take on the C&I specification. In absence of Any deviation a “No deviation” certificate is to be furnished.

SPECIFIC C&I TECHNICAL REQUIREMENTS
FOR DEBRIS FILTER

1.1 Type of control system shall be DDCMIS (Station C&I) based, located in Central Control Room in BHEL scope.

1.2 The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. The Vendor list/ sub-vendor list shall be subject to BHEL / Customer approval during contract stage. No implication in this regard shall be acceptable.

1.3 These requirements are to be read in conjunction with detailed Technical specification enclosed in the specification. Further in case of any discrepancy in the requirement within the same section noted by the bidder in the specification, the same will be brought to the notice of BHEL in the form of pre-bid clarification. In absence of any pre-bid clarification, the more stringent requirement as per interpretation of customer shall prevail without any implication.

1.4 Drawings/Documents and data to be furnished after award of the contract as per deliverables list attached elsewhere in the specification.

1.5 All local gauges as well as transmitters and sensors for parameters like pressure, temperature, flow etc. as required for the safe and efficient operation and maintenance under the scope of specification shall be provided by Bidder. The necessary root valves, impulse piping, drain cock, gauge-zeroing cocks, valve manifolds, instrument racks and all the other accessories required for mounting / erection of these local instruments, transmitters and sensors shall be supplied by bidder even if not specifically asked for. Also the proposal shall include the necessary cables, flexible conduits, instrument racks, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg / Cm2.

1.6 All local gauges, transmitters and sensors shall be mounted on suitable enclos ures, Instrument racks (LIR) in bidder's scope subject to Customer's approval.

1.7 The local control cum starter panel in bidder's scope shall be NEMA 4X. Suitable canopy on top shall be provided for the panel.

1.8 Push buttons and indication lamps for Open/Close and Start/Stop of drives/equipment's shall be provided on the starter panel. Remote and local indication, indicating lamps / LED cluster for instruments/drives/equipment's status and critical alarms shall be provided on the starter panel. Nos. shall be decided during detailed engineering.

1.9 Colored MIMICS on the panel is to be provided as per system flow diagram. No. of facia on Starter panel shall be decided during detailed engineering.

SPECIFIC C&I TECHNICAL REQUIREMENTS
FOR DEBRIS FILTER

1.10 Bidder to terminate all instrumentation and control elements in the control panel/Junction box for further cabling to DDCMIS by BHEL.

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

1.12 Sea or saline water media is applicable for UPPUR Projects. The minimum requirement for sea water or saline water media is given below:

a. Instruments shall be suitable for sea or saline water application. MOC of impulse tubing and impulse pipe shall be CPVC (3/8") Sch 80 or better, Industrial grade up to manifold. MOC of impulse tubing, fittings (from manifold to instrument) and manifold shall be Super Duplex stainless steel.
b. MOC of all wetted parts, fittings, sampling pipes, tubes, fittings, diaphragm and all types of erection hardware of instrument/drives/equipment, shall be Duplex stainless steel or better suitable for sea or saline water application.

1.13 Epoxy coated painting is required for all I & C Equipment & Instruments.

1.14 All valve actuator shall be provided with conventional actuators with integral starter for ON/OFF valves. Non-contact type electronic 2-wire position transmitters shall be provided for all inching type motorized valves and dampers. The detailed specification of actuator is given elsewhere in the specification.

1.15 Differential pressure indicators & Differential pressure Transmitters across Debris Filter shall be provided with independent impulse & isolation valves. Remote & Local indication DP transmitters & gauges across Debris Filter shall be provided.

1.16 All the transmitters and gauges shall have remote seal type having 15m capillary length minimum. Wherever transmitters & switches are provided, in addition Local gauges shall also be provided by bidder for local field monitoring.

SPECIFIC C&I TECHNICAL REQUIREMENTS
FOR DEBRIS FILTER

1.17 All the instruments/equipment's/electrical items shall be provided & designed with maximum star rating as available in line with energy conservation policies notified by BEE, GOI at the time of supply.

1.18 All primary instruments shall be with protection class of IP 65 or better.

1.19 Transmitter should not be mounted directly on the manifold, Manifold shall be non-integral and standalone type.

1.20 LVDT type instrument is not acceptable.

1.21 All limit switch shall be conforming to IEC-60947-5-1.

1.22 Use of process actuated switch shall be avoided unless unavoidable.

1.23 Number of pairs to be selected for Screen Control cable (Size : 0.5 mm2)

- F-Type: 2P/4P/8P/12P/20P
- G-Type: 2P/4P/8P/12P
- Core Cable: 3CX2.5sqmm2 / 12CX1.5sqmm2

1.24 Following minimum wire size shall be utilized for internal wiring in the panel and shall be finalized during detailed engg.:

a. Current (4-20 mA): 0.75 sq.mm Low voltage signals: (AI/AO & DI signals)
b. DO signals, Ammeter/: 1.5 sq.mm voltmeter circuit, control switches, indicator, recorder
c. Internal Illumination: 2.5 sq.mm
d. Size of Power supply cables shall be as below: -
   i. 1 to 16 Amp. - 2.5 sq. mm
   ii. 17 to 20 Amp. – 4 sq. mm
   iii. 21 to 32 Amp. - 6 sq. mm
   iv. 33 to 40 Amp. - 10 sq. mm.
   v. 41 to 60 Amp. - 16 sq. mm
   vi. Power earth - 4 sq. mm

1.25 Each switching element including the limit and torque switches of valve actuators shall be provided with minimum two SPDT OR DPDT contacts each for close, open and adjustable.

1.26 All transmitters shall be smart and electronic type, microprocessor based and HART compatible. All instruments should be supplied with valid calibration and test certificates provided by OEM.

SPECIFIC C&I TECHNICAL REQUIREMENTS FOR DEBRIS FILTER

1.27 The system shall be provided with annunciation system. It shall be an integral part of the control system. All the field contact shall be acquired through control system. The annunciation sequence/ logic shall conform to ISA sequence ISA-2A. The window lamps for the system shall be driven through output modules of the control system.

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

1.29 Signal/Electrical connection shall be screwed connection with double compression type Nickel-plated brass cable glands.

1.30 All the field instruments shall also be provided with SS tag nameplate.

1.31 Cable scope shall be referred in Electrical scope sheet attached in the Electrical portion of the specification.

1.32 Mandatory spare list shall be referred in 'List of mandatory spares' attached elsewhere in the specification and shall be supplied by bidder.

1.33 Power Supply Requirement:
415 V, 3 phase AC power supply shall be provided by Customer for the local control cum starter panel at a single point. Further any electrical distribution shall be in bidder's scope. Any other voltage requirement to be arranged/derived by bidder by providing suitable control transformer. Starter panel in bidder's scope shall have provision for redundant feeder with fast automatic changeover.

1.34 Bidder shall provide an unlimited warranty on all equipment/software for three years after the start of the warranty period, i.e. after satisfactory completion of initial operations. This warranty shall include repair, replacement or correction of identified software or hardware discrepancies at n o cost to owner.

1.35 Bidder to delegate /depute their persons/experts as per Customer's requirement.

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

1.37 The technical requirements for instruments/ equipment's/panels mentioned in the specification are minimum requirements. Items not specifically mentioned and required for the completeness of the system shall be supplied by bidder.

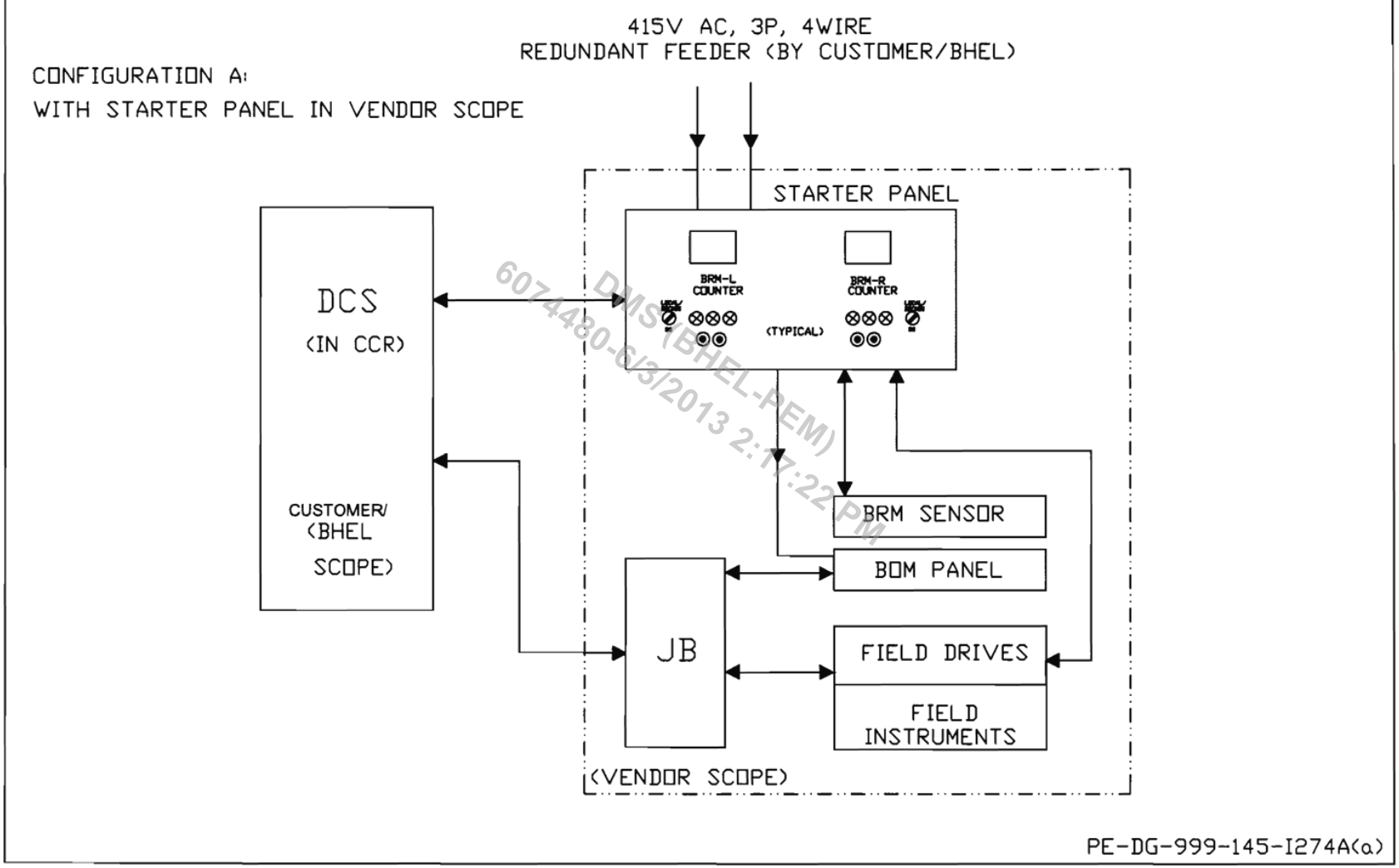
1.38 Starter panel/Local control panel with HW annunciation windows, ILPBs, Ammeters, PBs, voltmeters, indicators, mimic, recorders etc. shall be provided.

2.0 Requirements for flanged remote seal diaphragm:

Maximum pressure rating: To meet 200 percent of process pressure,
Availability of seals: for both high and low pressure sides with capillary connection in case of differential pressure measurements.
Single Capillary connection for pressure transmitters.
Capillary length: 15.0 m
Fill fluid: Suitable oil

Process connection size: 1 inch
Flange size and Accessories: As per process requirement.
Flange pressure rating: Required Class (ANSI)
Process fluid temperature: 25°C to 60°C
Diaphragm and wetted part material: Suitable for sea water (Duplex SS or better)
Flushing option: To be made available with 1/4 inch (necessary drain and gasket suitable for sea water application to be provided).
Snubbers /Pulsation dampeners shall be used where the process media is unstable for measurement such as the discharge of a pump.

STANDARD BLOCK DIAGRAM FOR DF PACKAGE WITH DCS CONTROL



	UPPUR STPP (STAGE-I, UNIT#1&2) 2X800MW	
	TECHNICAL SPECIFICATION (C&I) FOR DEBRIS FILTER	

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SPECIFICATION FOR MEASURING INSTRUMENTS (PRIMARY & SECONDARY), TRANSMITTERS, GAUGES ETC. AND LOCAL CONTROL PANEL

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CHAPTER-3

FIELD & MEASURING INSTRUMENTS AND FLOW ELEMENTS

3.00.00 FIELD & MEASURING INSTRUMENTS (PRIMARY & SECONDARY INSTRUMENTS) AND FLOW ELEMENTS

3.01.00 GENERAL REQUIREMENTS

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

3.01.02 The instrumentation and control equipment shall conform to all applicable codes and standards including those referred in Cl. no. 1.08.00 in this Volume. All equipment and systems shall also fully comply with the design criteria stated in chapter-2 of this part.

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

3.01.04 In general, front draw out type instruments with plug-in facility at the rear for connecting cables for power supply and signal shall be provided unless otherwise specified like for Explosion proof area, Flame proof area and high vibration prone area. Separate plugs & socket connection shall be provided for connecting power supply cables and signal wires/cables.

The plug & sockets shall be polarized to prevent wrong connections and have facility for secure coupling in plug-in position to prevent loose connections.

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

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

3.01.06 All field instruments shall be weatherproof, drip tight, dust tight and splash proof suitable for use under outdoor ambient conditions prevalent in the subject plant. All field-mounted instruments shall be mounted in suitable locations where maximum accessibility for maintenance is achieved. The enclosures of all electronic instruments shall conform to IP-65 unless otherwise specified (Explosion proof for NEC article 500, class 1/2, Division 1 area & flame proof area) and an anti corrosive paint shall be applied to the field mounted enclosures / instruments. All the field instruments shall also be provided with SS tag nameplate and double compression type Nickel-plated brass cable gland.

Gaskets, Fasteners, Counter and mating flange (SS316 materila), nuts & bolts etc. shall also be included, wherever required with the field instruments.

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

vi. Pressure gauges, temp. Gauges and Temp. Element at inlet and outlet of each heat exchanger and cooler.

vii. DPG, DPT & DPS across the filters/strainers.

viii. Tapping points/test points shall be provided.

xi. All Field Instruments used in acid or alkaline atmosphere shall be with standard Anti corrosion coating i.e. the combination of Polyurethane and epoxy resin baked coating (ANSI/ISA-71.04).

xii. All primary instruments installed at "Minus level or Floor" shall be with protection class of IP 68.

xiii. Transmitters (all type) for monitoring & controls purpose.

xiv All field mounted push button, selector switch etc. shall be as per IEC or NEMA 4X protection.

xv All limit switch shall be conform to IEC-60947-5-1 and shall have minimum 2SPDT/DPDT contacts.

xx. Non Contact Type, electronic 2-wire position transmitters shall be provided for all inching type motorised valve and dampers.

xxiv. Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application. For HFO, LFO Applications, SS capillary with thin wafer element with ANSI RF flanged ends are to be provided. For hazardous area, explosions proof enclosure as described in NEC article 500 shall be provided.

xxv. Gauges (all type) for local monitoring in field.

xxvi. Each switching element including the limit and torque switches of valve actuators shall be provided with minimum two contacts i.e. 2SPDT OR DPDT.

xxvii. All instruments should be supplied with valid calibration and test certificates provided by OEM.

xxviii. Canopy/Enclosure shall be provided for field instruments like transmitters, switches & flow meters, etc and any other equipment to protect from direct sun light, lightining & rain.

3.03.00 FIELD INSTRUMENTS AND PANEL MOUNTED INSTRUMENTS SHALL BE SUPPLIED & OFFERED AS PER DATA SHEETS SPECIFIED BELOW:-

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

Smart Transmitters of the electronic type shall be furnished.

All Transmitter shall be installed in closed LIE in the boiler area. Similarly transmitter for TG shall also be in LIE except the transmitters located in covered area on TG floor and these shall be mounted in LIR.

Transmitters shall be equipped with mounting brackets suitable for a mounting in transmitter enclosures.

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

Type/Construction	:	Sealed capacitance/ Inductance/ Silicon resonance type
Material		
- Body	:	Die cast Aluminum with epoxy coating for air & flue gas SS316 for other services
- Diaphragm	:	316 SS

- Measurement element	:	Teflon seal For Hydrogen gas pressure/differential pressure transmitters, the suitable material and coating shall be chosen as per the suggestion of transmitter manufacturer.
- Valves	:	Carbon steel for non-corrosive Applications SS316 for corrosive applications.
Output signal	:	4 to 20 m Amp. DC (Two wires) HART Compatible
Local Indicator	:	LCD indicator (5 digit) with scale of Engg. unit
Overall Accuracy	:	$\pm$ 0.04% or better of Span $\pm$ 0.2% or better of span for remote seal type transmitter.
Turn down ratio	:	100:1 in general 30:1 or better of Span for very high pressure & very low pressure services.
Stability	:	$\pm$ 0.15% of URL for 10 years.
Response time	:	150 msec.
Power supply	:	24V DC nominal
Drive capability	:	600 Ohms nominal
Enclosure Class	:	IP-65 /(Explosion proof for NEC Class-1, Division 1 area)/Flame proof (IEC – 79.1, Part I).
Span and Zero	:	Locally adjustable, non-interacting
Zero suppression / elevation	:	At least 100% of Span
Connection		
- Process		Quarter (1/4) inch NPT with/without oval flanges
- Electrical	:	Suitable for Plug in type connection (Both side of transmitter), unused entry with blind plug.
IBR Requirement	:	For high pressure & high temperature service, Process tapping and root valves shall be as per IBR rules and regulations.
Accessories	:	

- For Absolute Pressure Transmitters:		Two (2) valve SS316 manifold
- For Gauge & Vacuum pressure transmitter	:	Three (3) valve SS316 manifold
- For DP, level & flow transmitter	:	Five (5) valve SS316 manifold
- For oil and corrosive liquids	:	Separator diaphragm seals
- For all transmitters	:	Mounting bracket

Requirments for flanged remote seal diaphragm:

Maximum pressure rating : To meet 200 percent of process pressure

Availability of seals : for both high and low pressure sides with capillary connection in case of differential pressure transmitters and

Single Capillary connection for pressure transmitters.

Capillary length : 6.0 m

Fill fluid : Suitable oil

Process connection size : 1 inch

Flange size and Accessories : As per process requirement.
Flange pressure rating : Required Class (ANSI)
Process liquid : Sea water, Ash water, chemical, hydrogen gas, sealoil etc.,

Process fluid temperature : 25°C to 60°C

Diaphragm and wetted part material : Suitable for sea water, ash water and chemical applications.(offered material to be specified)

Flushing option : To be made available with 1/4 inch (necessary drain and gasket suitable for sea water application to be provided)

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

3.03.02 PRESSURE SWITCHES (PS) & DIFFERENTIAL PRESSURE SWITCHES (DPS)

Applicable Standards	:	IS3624 - 1966/ISA-RP-8.1 except as modified in spec.
Type/Construction	:	Bourdon/Sealed Diaphragm Piston Actuated preferable. Indicators with contacts are not acceptable.
Materials		
- Bellows	:	316 SS
- Bourdon tube	:	316 SS
- Movement	:	316 SS
- Enclosure	:	Die-cast aluminum with stoved enamel black finish. Epoxy coating shall be provided for corrosive atmosphere.
- Protective Diaphragm	:	Teflon
Accuracy	:	$\pm$ One (1) percent or better of full range.
Repeatability	:	$\pm$ 0.5(half) percent or better of full range.
Setting & Differential	:	Adjustable
Dead Band	:	Adjustment up to 10% at set point.
Contact		
- Number	:	DPDT /2 SPDT
- Type	:	Auto reset with internal Adjustable snap action micro switch
- Rating	:	5 Amp, 240V AC / 0.2 Amp, 220V DC
Connection - instrument	:	Half (1/2) inch NPT Male Process
Electrical	:	Suitable for Plug in type connection. All the switches are internally connected and brought to the surface with Amphenol male/female

connection. Cabling need not terminated inside the switch. Cable ends are to be soldiered in connector and to be inserted for easy maintenance.

- Over range protection	:	One Fifty (150) percent of full scale
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1/2, Division 1 area)/Flame Proof (IEC – 79.1, Part I) as applicable.
IBR Requirement	:	For high pressure service, Process tapping and root valves are as per IBR rules and regulations.

Accessories

- 3 / 5 valve manifold	:	As applicable depending on type of switches
- Self cleaning type pulsation dampners/Snubber (Material SS316)	:	Pump and compressor discharge lines
- Syphon	:	For all steam lines
- Protective separating diaphragm	:	For fuel oil & corrosive liquid lines.
Mounting	:	Local (in LIE/LIR for BTG package only).

3.03.03 PRESSURE & DIFFERENTIAL PRESSURE GAUGES (PG & DPG)

Applicable standard	:	IS:3602-1966, IS/3624, ASME B 40.1
Type/Construction		
-760 mm to 1.0Kg/cm2	:	Bellows/Diaphragm
-Above1.0Kg/cm2	:	Bourdon Tube
- Suction side of pumps	:	Compound gauge

Materials

- Bourdon tube	:	316 SS
- Bellows	:	316 SS
- Movement	:	316 SS
- Case	:	SS 316/ Die-cast aluminum with stoved enamel black finish. Epoxy coating shall be provided for corrosive atmosphere.
- Protective Diaphragm	:	Teflon
Dial size	:	150mm with toughened shatter proof glass. 300 mm with toughened shatter proof glass for frame mounted gauges.
Scale Details	:	Graduations in black lines on white dial, on white dial, 270 Deg. pointer deflection scale provided with

glass cover. Smallest scale division shall be one (1) percent of full scale value or smaller. Pointer stop for all gauges.

Accuracy	:	± One (1) percent or better
Connection - Instrument Process	:	1/2 inch NPT Male Bottom
Mounting	:	Local / Frame mounted.
	:	1/2 inch NPT Male (Back entry) mounted on local gauge board.
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)
IBR Requirement	:	For high pressure service, Process tapping and root valves are as per IBR rules and regulations.

Accessories

- 3 way needle valve/manifolds	:	For all gauges depending upon service.
- Self cleaning type Pulsation dampener/snubber (S316)	:	Pump and compressor discharge lines
- Syphon	:	For all steam lines
- Protective separating seal	:	For fuel oil and corrosive liquid lines

Other particulars

- External Zero adjustment	:	For all gauges
- Safety device		
Ranges 5 to 20 Kg/cm2	:	Rubber blow out disc with open front construction.
Ranges above 20 Kg/cm2	:	Neoprene safety diaphragm at the back with solid front construction.
- Over range protection	:	One Fifty (150) percent of full scale
Other Requirments	:	Movement mechanism shall be glycerin filled for oil services & vibration prone area.
	:	For Fuel oil & corrosive liquid lines diaphragm type sensors required. Armored capillary of 10 M for Fuel oil & Corrosive liquid service.
	:	Contact type pressure gauges are not acceptable for interlock & protection.
	:	For condensate storage tank and DM water storage tanks, the pressure

gauge in terms of 0-10000 mm wc or suitable range having **dial size of 300mm or bigger size** shall be provided.

3.03.36 **Solenoid Valves**

Solenoid valves shall be provided as per NAMUR standard with control valves / pneumatic control valves hooked up with process interlock requirements and where direct tripping is involved. The number of ways for solenoid valve shall be provided as indicated below:

(a) Two (2) way solenoid valves shall be provided, where process line of less than 50 mm with low pressure and temperature application.

(b) Three (3) way solenoid valve shall be provided commonly, where the pressure is admitted or exhausted from a diaphragm valve or single acting cylinder, e.g, Pneumatic operated spray water block valve.

(c) Four (4) way solenoid valve shall be provided for operating double acting cylinders, e.g, Pneumatically operated on-off type dampers.

(d) For operation of the fuel oil corner nozzle valves, fuel oil trip valves etc., **double coil solenoid valve** (latch coil & relatch coil) shall be adopted.
Single coil usage requires always power and loss of power leads to closure of above valves resulting the unit trip or loss of generation.

(e) Solenoid Valve coils insulation class shall be Class-H high-temperature or Class-F construction as applicable and shall be designed for continuous duty. Three-way solenoid valves shall be designed for universal operation so that the supply air may be connected to any port. Solenoid enclosures shall be NEMA-4)/ (Explosion proof for NEC Class-1/2, Division 1 area)/ flame proof (IEC-79.1, Part I) as applicable). Body material of solenoid valve shall be Brass or SS316 with epoxy paint as decided during engineering by owner. Material of wetted parts shall be SS316 only. Leakage class shall be class VI (Bubble tight).

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(f) All solenoid shall be with varister/RC circuit for EMI suppression, LED indication, surge

(g) Solenoid valve shall operate on 24 V DC, UPS 230 V AC or 220 V DC as per system requirements.

3.03.41 **Junction Boxes**

Type of Enclosure	:	Flame proof/weather proof IP-65/Explosion Proof as per area classification. Design as per NEC-370 Article 18, 19 & 20.
Material	:	6 mm min. thick FRP with protective Coating 3 mm min. thickness Die cast aluminum for Flame proof/Explosion proof area.
Cable entry	:	Bottom or Side
Cable glands	:	Double compression type – Nickel plated brass with PVC hoods.
Mounting	:	Indoor/Outdoor
No. of terminals	:	As required with standardization with 20% spare of each size & type.
Terminals	:	Phoenix/Wago (screw less cage clamp type spring loaded)
Grounding	:	Two terminals for body and shield ground
Door	:	Hinged, lockable type.
Accessories	:	Suitable mounting clamps and other accessories shall be in scope of bidder. The brackets, bolts, nuts, screws, glands, lugs required for erection shall be of brass, included in bidder scope of supply. High voltage & insulation resistance test shall also be conducted.

M6 Ni plated Brass earthing stud shall be provided (external 2 nos. internal 1 no.)
Gasket (Normal)- Neoprene/Polyurethene thickness 6.0 mm. Silicon for High Temperature area.

Colour : In General same as provided for control panels, and for special services, To be decided during detailed engineering & subject to owner's approval.

3.03.42 Cable Glands

Cables shall be terminated using double compression type cable glands. Cable glands shall conform to BS: 6121 & IP-67 and be of robust construction capable of clamping cable and cable Armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy-duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall be made of brass with nickel chrome plating Rubber components shall be of neoprene and of tested quality.

3.03.43 Interposing Relays (IPR)

Electromagnetic type IPRs with modular design, plug-in type connections, suitable for channel/DIN rail mounting in cabinets; coil rating 24V DC; 2 set of silver plated cadmium free with change over contacts rated for DC1 Breaking capacity of 0.5A 110 V DC/ 0.15 A 220 VDC and AC1 Capacity of 8/10 A 240 V AC. Capacity shall be as system requirements. Freewheeling diode across copper relay coil and self reset type status non-polarized LED indicator for the Coil (electronic) and a flag indicator for the Contacts (mechanical) shall be provided. Manual forcing/override facility is required. The insulation test voltage of 1.2/50 µs between the coil & contacts for relay shall not be less than 4 KV between adjacent contacts. The operating temperature of the Relay & Sockets shall be from –20 deg. C to 60 deg. C. The operating/release time of the relay shall not be more than 10/5 ms respectively.

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

Facility to stimulate IPR manually shall be provided. The VA burden of relays shall be suitable to match the capacity of output modules. Interposing relay & sockets for mounting the interposing relay shall be of same make only and sockets shall have the plug in RC circuits/Varistors, required for EMI suppression.

3.03.48 AMMETERS (AMM)

Input	:	4-20 mA DC
Mounting	:	Flush panel, compatible for mounting on mosaic grid panel

Face Dimensions	:	96 x 96 mm
Scale/Type	:	Moving coil, circular, FSD 240 deg. With six times suppression scale
Zero adjustment	:	Screw on meter face
Accuracy	:	$\pm$ 1 percent (class 1)
Indication	:	Pointer with scale
Magnetic Shield	:	Shielded Case
Quantities	:	For all HT Motors & LT motor with rating $\geq$ 30 KW and other critical application motors/drives.

3.03.49 VOLTMETER:

Input	:	4 - 20 mA DC
Mounting	:	Flush Panel, compatible for mounting on mosaic grid panel
Face Dimension	:	96x96 mm
Range	:	As per requirement
Accuracy	:	$\pm$ < 1.0 %
Indication	:	Digital type 4 1/2 digit
Magnetic Shield	:	Shielded Case
Connection	:	Plug in type
Quantities	:	For 230 V AC input power supply, UPS power supply, 24 V DC interrogation voltage & 220 V DC.

3.03.50 FREQUENCY METER (DIGITAL)

Type	:	Electronic digital 7- segment with fluorescent display
Input	:	4 - 20 mA DC
Mounting	:	Flush Panel compatible for mounting On mosaic grid panel
Number of digits	:	41/2 digit
Face Dimension	:	192X192 mm
Digit size	:	Approximately 40 mm
Range	:	As per requirements
Accuracy	:	$\pm$ 0.2 Hz
Display	:	Red LED display.
Connection	:	Plug in type
Magnetic Shield	:	Shielded Case

3.03.51 AC CURRENT TRANSDUCERS

Input	:	0 - 1 A CT current
Output	:	Dual 4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	$\pm$ 0.25%

3.03.52 DC CURRENT TRANSDUCERS

Input	:	0 - 75 mV
Output	:	Dual 4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	± 0.25%

3.03.53 AC VOLTAGE TRANSDUCERS

Input	:	0 - 110 V PT, Volts
Output	:	Dual 4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	+ 0.25%

3.03.54 DC VOLT TRANSDUCERS

Input	:	System Voltage
Output	:	Dual 4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	± 0.25%

3.03.55 TRANSDUCERS FOR POWER

Input	:	CT and PT (1A) (110V)
Output	:	Dual 4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	± 0.25%

3.03.56 TRANSDUCERS FOR FREQUENCY

Input	:	110 V PT Volts
Output	:	Dual 4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	± 0.25%

3.03.57 TRANSDUCERS FOR POWER FACTOR

Input	:	PT (110V)
Output	:	Dual 4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	± 0.25%

3.03.58 TRANSDUCERS FOR MVAR

Input	:	CT & PT (110V/1A)
Output	:	Dual 4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	± 0.25%

3.03.59 DIFFERENTIAL FREQUENCY TRANSDUCERS (FOR SYNCHRONIZATION)

Input	:	110 V PT
Output	:	Dual 4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	± 0.25%

3.03.60 DIFFERENTIAL VOLT TRANSDUCERS (FOR SYNCHRONIZATION)

Input	:	System voltage
Output	:	Dual 4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	± 0.25%

3.03.61 DIFFERENTIAL FREQUENCY & DIFFERENTIAL VOLT INDICATORS

Input	:	4 - 20 mA DC
Mounting	:	Flush Panel, compatible for mounting on mosaic grid panel
Face dimension	:	96x96 mm
Scale	:	Horizontal with zero at centre - 10%, 0, ±10%
Range	:	- 10% - 0 - + 10% (for both)
Accuracy	:	± 1.0%
Magnetic Shield	:	Shielded Case

3.03.65 **POWER FACTOR METER (DIGITAL)**

Type	:	Electronic digital 7- segment with fluorescent display
Input	:	4 - 20 mA DC
Mounting	:	Flush Panel, compatible for mounting on mosaic grid panel
Number of digits	:	41/2 digit
Face Dimension	:	192X192 mm
Digit size	:	Approximately 40 mm
Range	:	- 1 - 0 - + 1
Accuracy	:	$\pm$ 0.25 %
Display	:	Red LED display
Connection	:	Plug in type
Magnetic Shield	:	Shielded Case

3.03.66 SYNCHROSCOPE

Synchroscope shall be designed to provide an illuminate and indication of phase and frequency difference between bus voltages and generator voltage. It shall denote the

actual frequency differeence corresponding to the inverse of time taken for one rotation of the illuminated vector spot. Synchroscope shall be designed as per IEC/DIN/BS standard.

Input	:	Differential frequency & Differential Voltage
Mounting	:	Flush Panel, compatible for mounting on mosaic grid panel
Face Dimension	:	96 x 96 mm
Accuracy	:	$\pm$ 0.5%
Magnetic Shield	:	Shielded Case

3.03.67 SYNCHRONIZING RELAYS

Synchronizing check relays with necessary ancillary equipment shall be provided, which shall permit breakers to close after checking the requirements of synchronizing of incoming and running supply. The phase angle setting shall not exceed 100 and this angle shall be adjustable and shall take the account the circuit breaker closing period. This relay shall have a reponse time of less than 200 milliseconds when the two system conditions are met within preset limits and with the timer disconnected. The relay shall have a frequency difference setting not exceeding 0.45% at rated value and at the minimum time setting. The relay shall have a continuously adjustable time setting range of 0.5-3 secs. Additionally, a guard relay shall be provided to prevent the closing attempt by means of synchronizing check relay when control switch is kept in closed position long before the two systems are in synchronism. The control voltage shall be 220 V DC and PT input voltage shall be 110 V AC.

3.03.68 PUSH BUTTONS (PB)/ ILPBs FOR ON/OFF, OPEN/CLOSE, START/STOP

Type	:	Momentary/Miniaturised Suitable for mosaic grid 24x48 Mm with 2 PB and 3 coloured LED.
Contact Configuration	:	2 NO + 2 NC
Contact Material	:	Hard Silver Alloy
Contact Rating	:	500V / 10 A
Insulation Voltage terminals and earth	:	2 KV for 1 minute between
Lamp Rating :-		
a) Voltage	:	240 V AC
b) Watt	:	2 Watt (approx.)

Colour

Red	– ON/Start/Open ILPB
Green	– OFF/Stop/Close ILPB
Red	- energized, running, Start, valve open LED/Lamp
Green	- de-energized, stopped, valve closed LED/Lamp
Light yellow	- abnormal, discrepancy LED/Lamp
Red	– OFF/Stop/Close PB
Green	– ON/Start/Open PB
Red	**-** Emergency trip push buttons with red flap / hinged

Transperent arylic cover.

3.03.69 **PUSH BUTTON FOR Control DESK** : **Momentary mosaic grid mounted** 24x48 mm size, single PB 18x40 mm

Colors

DESK RELEASE	- Yellow
Desk Lamp test	- Blue
Desk Acknowledge	- Green

3.03.70 **PUSH BUTTON FOR SEQUENCE START/RELEASE** : Momentary (Miniaturised) suitable for mosaic grid 24x48 mm 3 PB + 5 LED

3.03.71 **PUSH BUTTON FOR ANNUNCIATION**

Contacts

- Number & Type	:	As per requirement
- Breaking capacity	:	1 Amp, 220V DC 10 Amp, 600V AC Different colours for Accept/Acknowledgr - Green, reset - Grey, Lamp test – Blue, System Test – Yellow & Audio Acknowledge - Black.

3.03.72 3 PB (Auto/Manual selection PB, lower PB & Raise PB) and 3 LED (Auto indication, manual indication & Fault/disturbance indication) module shall be provided on BUP for modulating type control valve.

In addition, dual indicator for position indicator & deviation indicator (between demand position & actual position) and process indicators shall also be provided on BUP for modulating type control valve.

1.All panels, cubicles, consoles, local control panels, GIU desk and enclosures furnished as per this specification shall be of free standing type and shall be constructed of specified gauge of steel plates i.e CRCA or SS316 depending upon location. The minimum sheet thickness of panels shall be as follows unless otherwise specified herein.
Top - not less than 1.6 mm.
Side, Door & mounting plate - 2.0 mm.
Base metal plate - 2.5 mm.
Gland plate - 3 mm
2.Desk & Panel material, Painting Process/procedure & Painting material shall be suitable for sea water and saline conditions at site in line with national and international standards like ASTM, ISO etc.

4.05.08 RELAY BASED LOCAL CONTROL PANEL/DESK

Local control panel shall be of 2.5 mm steel construction, free standing type, totally enclosed dust and vermin proof with enclosure protection class of IP-55 as per IS: 13947 and colour shall be as per shade no. RAL 7032/7035. Panel shall be mounted on vibration dampers secured to steel frame on to the floor. Equipment and relays mounted on the panel shall be easily accessible. The panel shall be supplied completely wired upto terminal blocks for connecting external cables entering the panel from the bottom. Blank removable gland plate shall be provided with double compression type cable glands/conduits knockout along with the panel.

Terminal block shall be rated 600 volts minimum and shall have strap cage clamp type screw less terminals suitable for connection with 2x2.5 sq mm copper conductors on each side. Terminal block shall be provided with white marking strips. Fuses shall not be mounted on terminal blocks. At least 20 percent spare unused terminals fully wired shall be provided on terminal block.

Contactors, Relays, timers and other devices mounted on the panel shall have clearly visible identification marking. Separate contactors shall be provided for start & stop

command. Common contactor for start & stop command are not acceptable. All fuses shall be HRC semiconductor type of AC supply. HRC link & fuse shall be of removable type having 45 kA rupturing capacity (min) for protection of various circuits.

The panel shall be provided with a 50x6 mm tinned copper earthing strip running throughout the length of the panel at the bottom. Panel shall be provided with space heaters with isolating DPN MCB, and thermostats. LED based illuminating lamps, complete with door switches; and 1 no. 6 pin 5/15amps sockets with DPN MCB. Separate power supply feeder shall be provided for utilities.

Panel shall be provided with LED illuminating lamps with door switch and 6 point 5/15A, 240V AC socket with switch for maintenance purposes. Panel shall have removable lifting eye bolts for safe lifting from top during handling.

Control power supply shall be provided from dual redundant UPS feeders with auto change over scheme, surge protection devices and Power/Volt/AM meter. In case UPS feeders are not available, control power supply shall be provided from dual non UPS single phase power supply feeders with dual transformers and with auto change over scheme, surge protection devices and Power/Volt/AM meter.

The panel shall be provided with push buttons, indicating lamps, annunciators, indicating instruments, interlock/ deinterlock switches etc., required for the complete system. General details as specified in chapter 6 shall also be referred for engineering and design of relay panel/desk.

Coloured Mimic with 6mm thickness sheet for respective plant lay out shall be provided as specified in Annexure A, control system philosophy.

20% spare relays of each type and rating shall be mounted and wired in relays control panel/Desk. All contacts of relays shall be terminated in terminal blocks of relay control panel/Desk, Additionally in the relay control panel/Desk, 20% spare terminal blocks shall be 'provided so that additional relays can be mounted and wired.

The annunciation system shall consist of panel mounted audio-visual windows of 50x75 mm provided with plug-in-type solid-state logic 16 nos. high intensity LEDs in parallel. EACH relay based control panel shall be provided with 30 nos min. facia windows. Initiating contacts may be either NO or NC; a jumper or switch shall be provided in each card to make it suitable for either type of contact. A set of acknowledge, reset and test push buttons shall be provided on the panel. All printed circuit boards shall be of epoxy fibre glass construction.

The sequence of annunciation shall be as follows:

Condition	**Visual**	**Audible**
Normal	OFF	OFF
Alarm	Flashing	ON
Acknowledge	Steady	OFF

Return to Normal:

a.	Before acknowledge	Flashing	ON
b.	After acknowledge	Steady	OFF

Reset:

a.	Alarm condition	No change	No change
b.	Return to normal	OFF	OFF

	UPPUR STPP (STAGE-I, UNIT#1&2) 2X800MW	
	TECHNICAL SPECIFICATION (C&I) FOR DEBRIS FILTER	

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LIST OF DOCUMENTS/DELIVERABLES

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LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT FOR DEBRIS FILTER FOR UPPUR STPP (STAGE-I, UNIT#1&2) 2X800MW			
DOCUMENT NUMBER PE-GL-425-165-I100			
Sl.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY
1	PE-V0-425-165-I903	HMI PICTURES/PLANT SCHEMATICS	A
2	PE-V0-425-165-I902	INSTRUMENT SCHEDULE with set points	A
3	PE-V0-425-165-I905	I/O LIST (ANALOG & BINARY)	A
4	PE-V0-425-165-I907	FIELD JB/LIE/LIR TERMINATIONS	A
5	PE-V0-425-165-I908	DATASHEETS FOR INSTRUMENTS,LCP, JBs, etc.	A
6	PE-V0-425-165-I909	QUALITY PLANS (INSTRUMENTS,LCP etc.)	A
8	PE-V0-425-165-I912	CABLE SCHEDULE & INTERCONNECTION	A
9	PE-V0-425-165-I913	RECOMMENDED CONTROL LOGICS / CONTROL PHILOSOPHY	A
10	PE-V0-425-165-I914	PANEL EXTERNAL/INTERNAL GA DRAWING AND TERMINATION DETAILS	A
11	PE-V0-425-165-I915	Hook up drawings and the drawings for open racks & closed racks	A

NOTES: 1. ANY OTHER DOCUMENT DECIDED DURING DETAILED ENGINEERING SHALL BE PROVIDED BY BIDDER WITHOUT ANY COMMERCIAL/TECHNICAL IMPLICATION. 2. CONTRACTOR TO SUBMIT REUSABLE DATABASE FORMATS IN BHEL/CUSTOMER APPROVED FORMATS LIKE MS EXCEL,MS ACCESS OF DOCUMENTS LIKE INSTRUMENT SCHEDULE, I/O LIST, DRIVE LIST,FIELD JB TERMINATIONS, CABLE SCHEDULE & INTERCONNECTION, etc. SOFT COPY OF FORMATS SHALL BE PROVIDED TO SUCCESSFUL BIDDERS.

	UPPUR STPP (STAGE-I, UNIT#1&2) 2X800MW	
	TECHNICAL SPECIFICATION (C&I) FOR DEBRIS FILTER	

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INSTRUMENT STUB DETAILS

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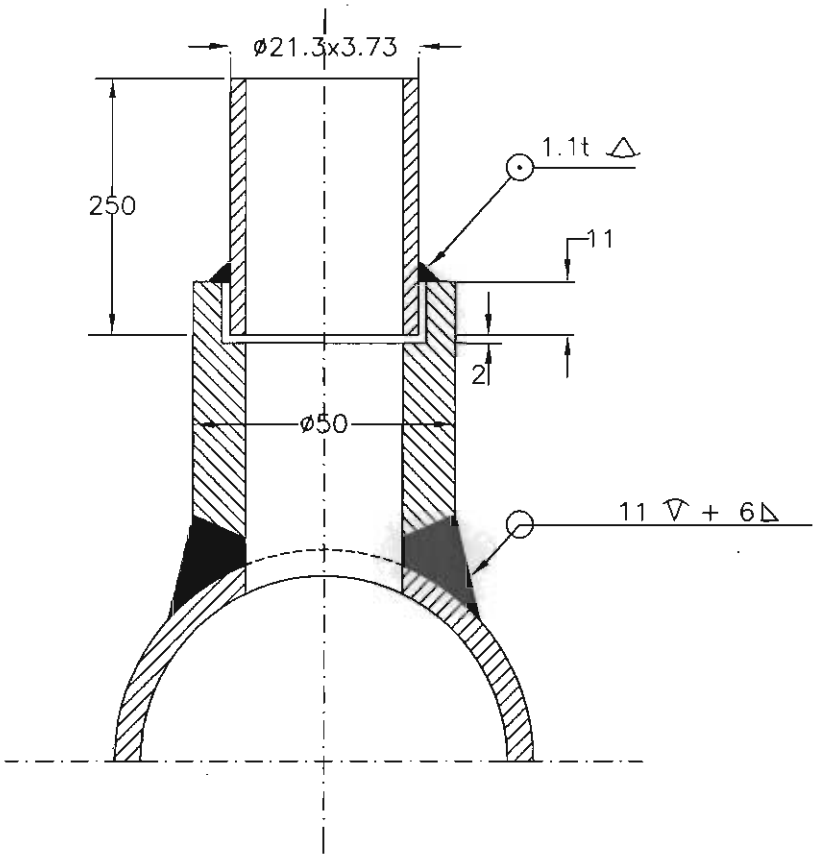

NOTE :

1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B16.11.
2. THE LENGTH OF NIPPLE SHALL BE 250 MM.
3. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED
4. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY (1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES
5. STUB LENGTH SHALL BE 64mm UPTO 200Nb, 45mm ABOVE 200Nb PIPE SIZE.
6. FOR PU COATED PIPE REFER SHEET No. 9
7. THE ACTIVITIES OF WELDING THE COUPLING (OR BOSS) ON THE PIPE, DRILLING PRESSURE CONNECTION HOLES (SAME AS ID OF NIPPLE) IN THE PIPE IN ALIGNMENT WITH HOLE IN COUPLING WILL BE COMPLETED AT THE SHOP.

बीएचईएल
BHEL

TITLE :

INSTRUMENT STUB DETAILS FOR PRESSURE MEASUREMENT

(SYSTEM PRESS UPTO 40Kg/Cm2,TEMP<400 DEG C)

DRG. NO. PE-DG-422-145-I101

REV. 00

SH. 04 OF 10 SHS.

	UPPUR STPP (STAGE-I, UNIT#1&2) 2X800MW	
	TECHNICAL SPECIFICATION (C&I) FOR DEBRIS FILTER	

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INSTRUMENT INSTALLATION DRAWING

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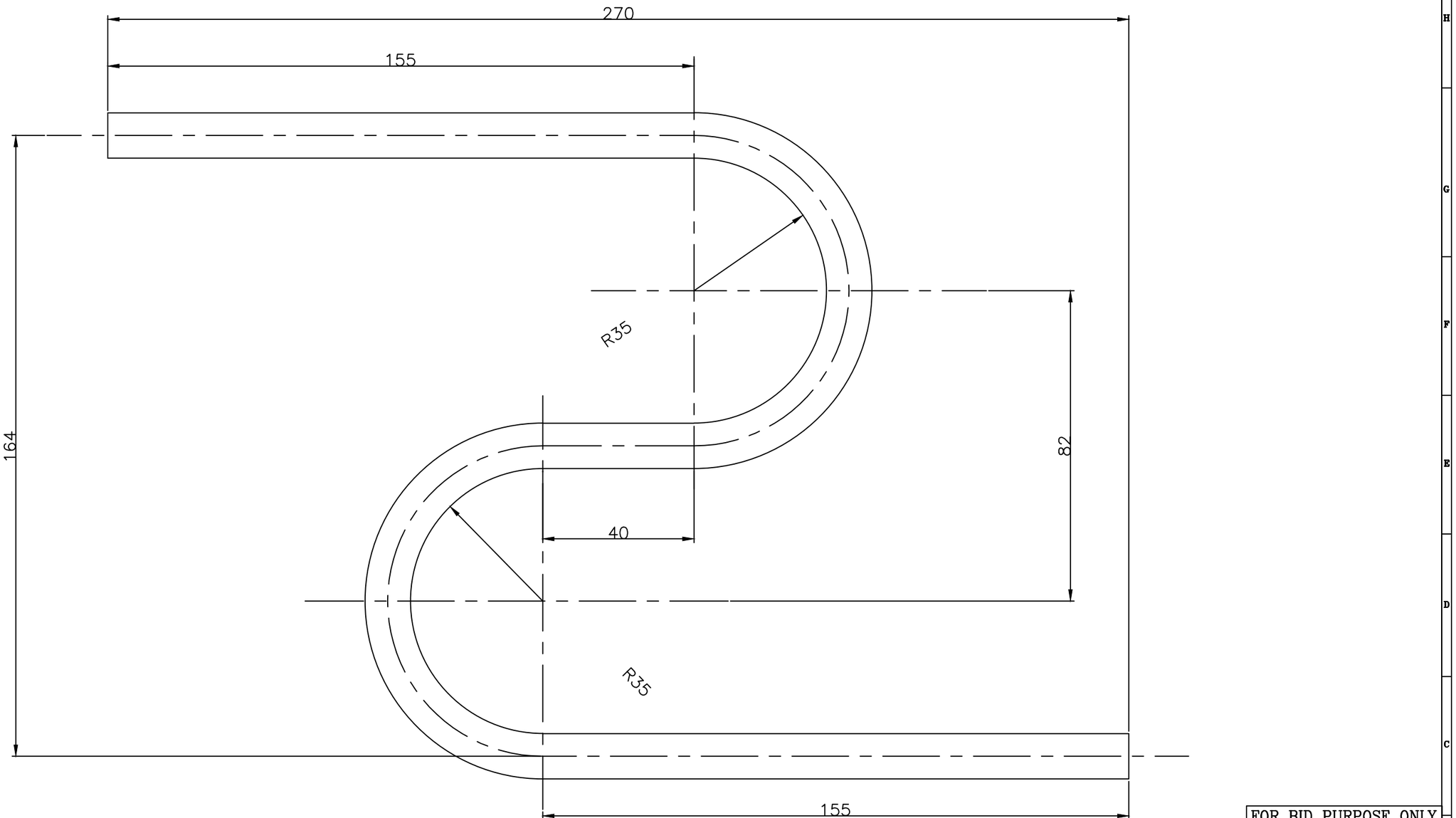

FOR BID PURPOSE ONLY

PROJECT	2x800MW SUPERCRITICAL COAL BASED UPPUR THERMAL POWER PROJECT
OWNER	TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED
OWNER CONSULTANT:-	DESEIN CONSULTING ENGINEERS NEW DELHI – INDIA

CAD/DRAWN	SANDEEP	20.07.15
DESIGNED	SKM/SN	17.07.15
CHECKED	SKM	22.07.15
APPROVED	SKM	19.08.15

TITLE: DRAWING FOR 'U'–TUBE

SCALE

JOB. No. D–0420

DWG. No. 114–04–0100 Sheet No. 2 of 19

REV. 0

APPRD. FOR CONSTRUCTION:

REFERENCE DRAWINGS.

NOTES

1. DO NOT SCALE, ASK WHEN IN DOUBT.
2. ALL DIMENSIONS ARE IN MILIMETRES UNLESS NOTED OTHERWISE.
3. ABOVE DRWINGS ARE FOR BASIC GUIDE LINE TO BE MEET BY BIDDER, ANY FURTHER IMPROVEMENT DURING DETAILED ENGINEERING SHALL ALSO BE CONFIRMED/PROVIDED BY CONTRACTOR.
4. FOR SEA/SALINE WATER APPLICATION MATERIAL OF ERECTION HARDWARE, IMPLUSE PIPE & TUBES SHALL BE SUPER DUPLEX SS ONLY.
5. ALL FITTINGS SHALL BE DOUBLE COMPRESSION TYPE.

NOTICE

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	2		
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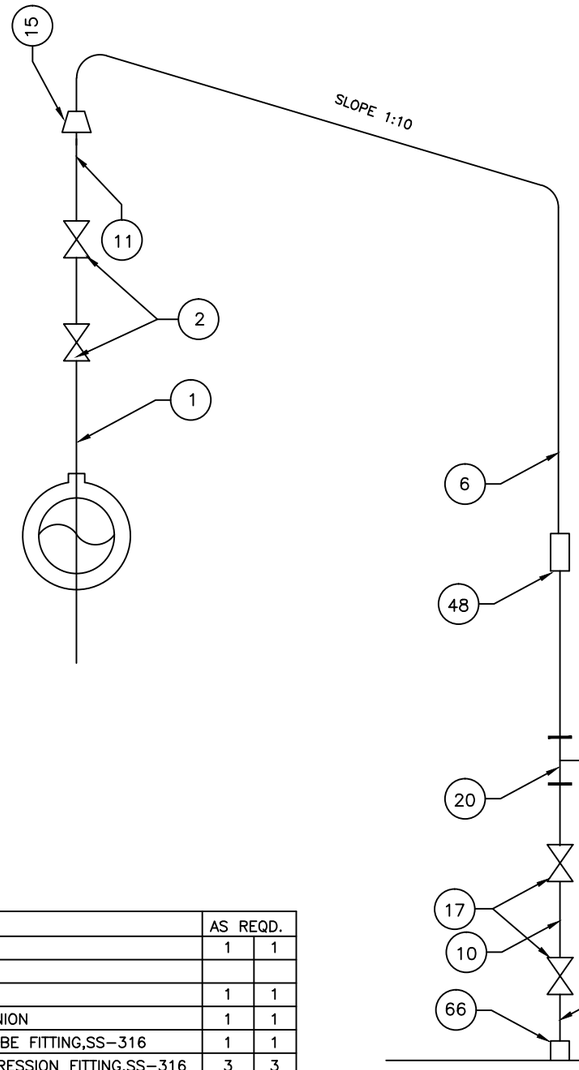
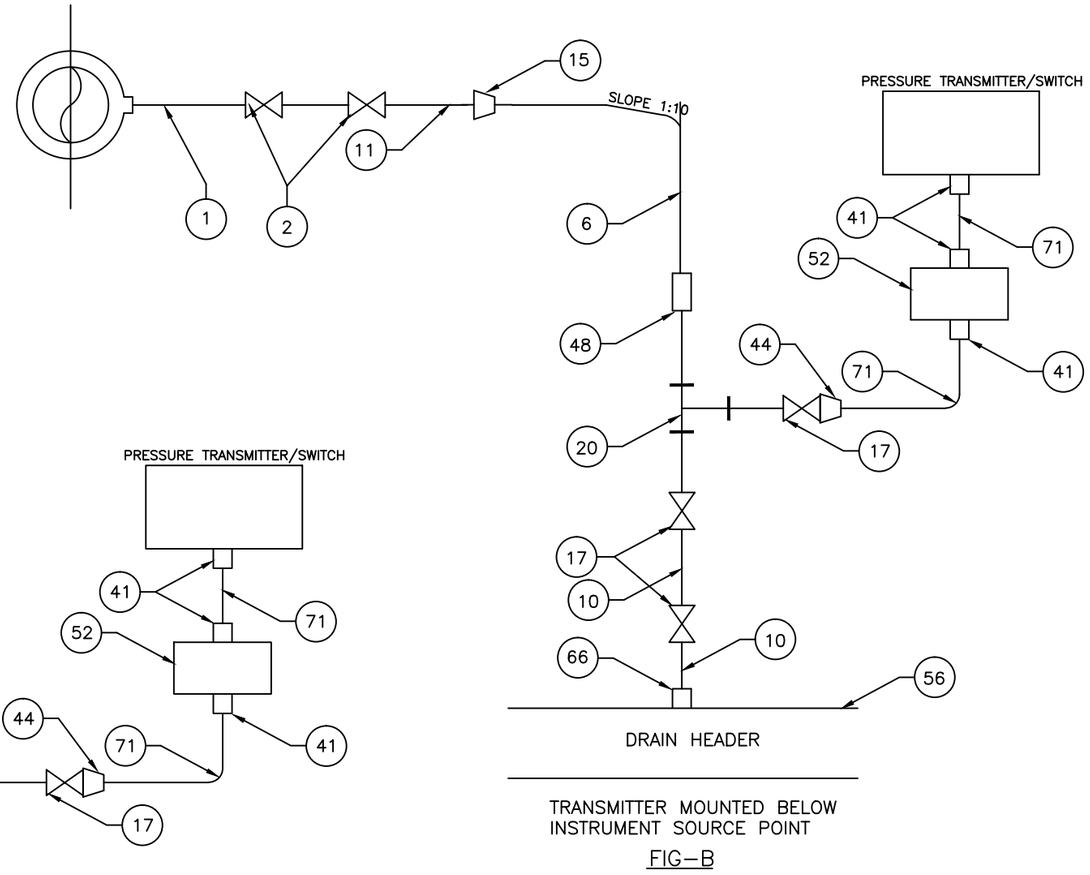
			SLN	



TRANSMITTER MOUNTED BELOW
INSTRUMENT SOURCE POINT

FIG–A



TRANSMITTER MOUNTED BELOW
INSTRUMENT SOURCE POINT

FIG–B

NOTE:–

1. FOR HIGH TEMP. SERVICE (MORE THAN °80C) A 'U'–TUBE / SYPHON (REF. DWG NO. IN–114–04–0100)SHALL BE PROVIDED BETWEEN THE MANIFOLD AND THE TRANSMITTER/SWITCH
2. WITH ROOT VLV. OF SIZE 1/2"SW NIPPLE PIECE AND 1 TO 1/2"SW REDUCER IS NOT REQUIERED
3. FOR HIGH PR.(MORE THAN 40Kg/sqcm) ONE ISOLATING VLV. IS PROVIDED IN EACH LINE BETWEEN VLV. MANIFOLD AND 1/2"SW EQUAL TEE AND 2.NOS DRAIN VLV. ARE ALSO PROVIDED.

BILL OF MATERIAL

TAG NO.	DESCRIPTION	QTY. A	QTY. B
71	1/2"OD IMPULSE TUBE,SS–316	AS REQD.	
66	1/2" GI SOCKET	1	1
56	5/3/2"NB GI DRAIN HEADER		
52	5/3/2–VALVE MANIFOLDS,SS–316	1	1
48	1/2"SW,CS/AS BULK HEAD PIPE UNION	1	1
44	1/2"BW X 1/2"OD COMRESSION TUBE FITTING,SS–316	1	1
41	1/2"NPT(M) X 1/2"00 TUBE COMPRESSION FITTING,SS–316	3	3
20	1/2"SW EQUAL TEE,CS	1	1
17	1/2" SW,CS GLOBE VALVE / NEEDLE VALVE	3	3
15	1" TO 1/2" SW REDUCER	1	1
11	1" NPS SCH–80 CS/AS NIPPLE	1	1
10	1/2" NPS,SCH 80/160, CS/AS NIPPLE	2	2
6	1/2" NPS. SCH–80/160 CS/ AS PIPE	AS REQD.	
2	1/2"/3/4"/1" ROOT VALVE	2	2
1	1/2"/3/4"/1" CARBON/ALLOY STEEL NIPPLE OF MTL. SAME AS THAT OF MAIN PIPE(AS PER PROCESS REQD.)	AS REQD.	

REFERENCE DRAWINGS.

NOTES

1. DO NOT SCALE, ASK WHEN IN DOUBT.
2. ALL DIMENSIONS ARE IN MILIMETRES UNLESS NOTED OTHERWISE.
3. BULK HEAD FITTING SW TYPE SHALL BE PROVIDED AT LIE/LIR
4. ABOVE DRWING IS FOR BASIC GUIDE LINE TO BE MEET BY BIDDER, ANY FURTHER IMPROVEMENT DURING DETAILED ENGINEERING SHALL ALSO BE CONFIRMED/PROVIDED BY CONTRACTOR.
5. QUANTITIES OF INSTRUMENTS/ ERECTION HARDWARE SHALL BE AS PER NIT AND AS FINALISED DURING DETAIL ENGINEERING
6. FOR DM PLANT MATERIAL OF ERECTION HARDWARE SHALL BE SS 316 ONLY.
7. FOR SEA/SALINE WATER APPLICATION MATERIAL OF ERECTION HARDWARE, IMPLUSE PIPE & TUBES SHALL BE SUPER DUPLEX SS ONLY.
8. ALL FITTINGS SHALL BE DOUBLE COMPRESSION TYPE.

NOTICE

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REVISIONS — APPROVED

FOR BID PURPOSE ONLY

PROJECT	2x800MW SUPERCRITICAL COAL BASED UPPUR THERMAL POWER PROJECT
OWNER	TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED
OWNER CONSULTANT:–	DESEIN CONSULTING ENGINEERS NEW DELHI – INDIA

CAD/DRAWN	SANDEEP	20.07.15
DESIGNED	SKM/SN	17.07.15
CHECKED	SKM	22.07.15
APPROVED	SKM	19.08.15

TITLE: INST. DRAWING FOR PRESS. & DIFF.PRESS. TRANSMITTERS/SWITCH (STEAM & LIQUID SERVICE)

SCALE

JOB. No. D–0420

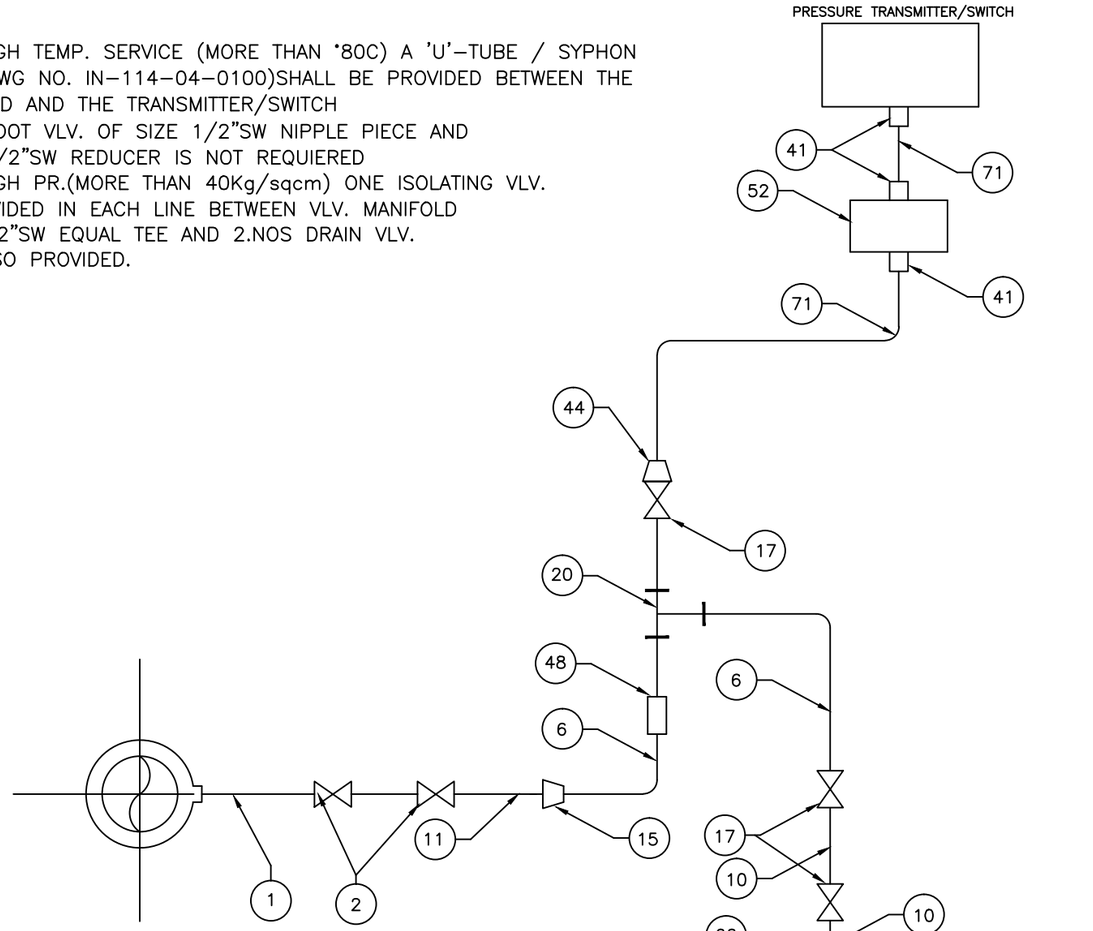
DWG. No. 114–04–0104 — REV. 0

Sheet No. 6 of 19

APPRD. FOR CONSTRUCTION:

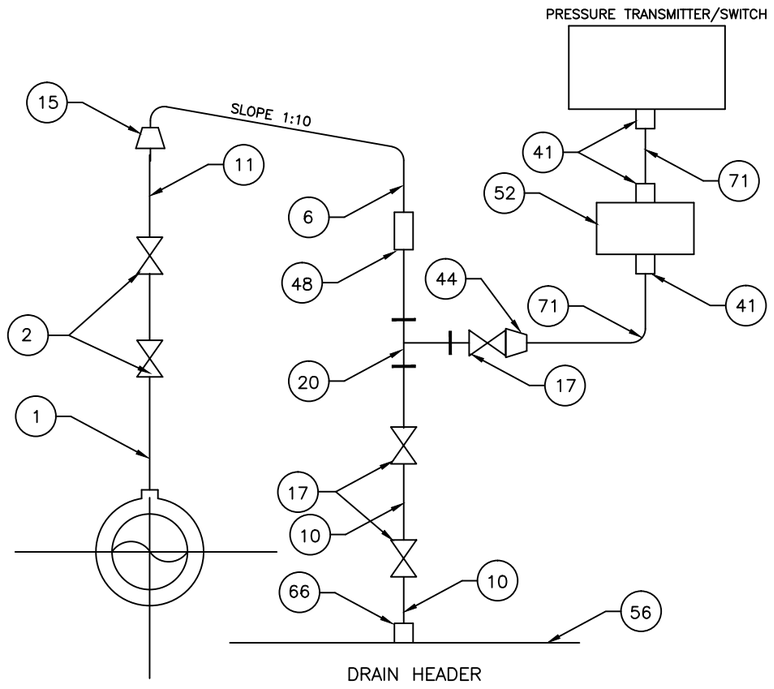
NOTE:–

1. FOR HIGH TEMP. SERVICE (MORE THAN °80C) A 'U'–TUBE / SYPHON (REF. DWG NO. IN–114–04–0100)SHALL BE PROVIDED BETWEEN THE MANIFOLD AND THE TRANSMITTER/SWITCH
2. WITH ROOT VLV. OF SIZE 1/2"SW NIPPLE PIECE AND 1 TO 1/2"SW REDUCER IS NOT REQUIERED
3. FOR HIGH PR.(MORE THAN 40Kg/sqcm) ONE ISOLATING VLV. IS PROVIDED IN EACH LINE BETWEEN VLV. MANIFOLD AND 1/2"SW EQUAL TEE AND 2.NOS DRAIN VLV. ARE ALSO PROVIDED.



TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT

FIG–D



TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT

FIG–C

TAG NO.	DESCRIPTION	QTY. C	QTY. D
71	1/2"OD IMPULSE TUBE,SS–316	AS REQD.	
66	1/2" GI SOCKET	1	1
56	2"NB GI DRAIN HEADER		
52	5/3/2–VALVE MANIFOLDS,SS–316	1	1
48	1/2"SW,CS/AS BULK HEAD PIPE UNION	1	1
44	1/2"BW X 1/2"OD COMRESSION TUBE FITTING,SS–316	1	1
41	1/2"NPT(M) X 1/2"00 TUBE COMPRESSION FITTING,SS–316	3	3
20	1/2"SW EQUAL TEE,CS	1	1
17	1/2" SW,CS GLOBE VALVE / NEEDLE VALVE	3	3
15	1" TO 1/2" SW REDUCER	1	1
11	1" NPS SCH–80 CS/AS NIPPLE	1	1
10	1/2" NPS,SCH 80/160, CS/AS NIPPLE	2	2
6	1/2" NPS. SCH–80/160 CS/ AS PIPE	AS REQD.	
2	1/2"/3/4"/1" ROOT VALVE	2	2
1	1/2"/3/4"/1" CARBON/ALLOY STEEL NIPPLE OF MTL. SAME AS THAT OF MAIN PIPE(AS PER PROCESS REQD.)	AS REQD.	

BILL OF MATERIAL

REFERENCE DRAWINGS.

NOTES

1. DO NOT SCALE, ASK WHEN IN DOUBT.
2. ALL DIMENSIONS ARE IN MILIMETRES UNLESS NOTED OTHERWISE.
3. BULK HEAD FITTING SW TYPE SHALL BE PROVIDED AT LIE/LIR
4. ABOVE DRWING IS FOR BASIC GUIDE LINE TO BE MEET BY BIDDER, ANY FURTHER IMPROVEMENT DURING DETAILED ENGINEERING SHALL ALSO BE CONFIRMED/PROVIDED BY CONTRACTOR.
5. QUANTITIES OF INSTRUMENTS/ ERECTION HARDWARE SHALL BE AS PER NIT AND AS FINALISED DURING DETAIL ENGINEERING
6. FOR DM PLANT MATERIAL OF ERECTION HARDWARE SHALL BE SS 316 ONLY.
7. FOR SEA/SALINE WATER APPLICATION MATERIAL OF ERECTION HARDWARE, IMPLUSE PIPE & TUBES SHALL BE SUPER DUPLEX SS ONLY.
8. ALL FITTINGS SHALL BE DOUBLE COMPRESSION TYPE.

ZONE	MARK	PARTICULARS	DATE	CIVIL	MECH.	ELEC.	C&I	H.O.D.
	6							
	5							
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	3							
	2							
	1							
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PROJECT	2x800MW SUPERCRITICAL COAL BASED UPPUR THERMAL POWER PROJECT
OWNER	TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED
OWNER CONSULTANT:–	DESEIN CONSULTING ENGINEERS NEW DELHI – INDIA

CAD/DRAWN	SANDEEP	20.07.15
DESIGNED	SKM/SN	17.07.15
CHECKED	SKM	22.07.15
APPROVED	SKM	19.08.15

TITLE: INST. DRAWING FOR PRESS. & DIFF.PRESS. TRANSMITTERS/SWITCH (STEAM & LIQUID SERVICE)

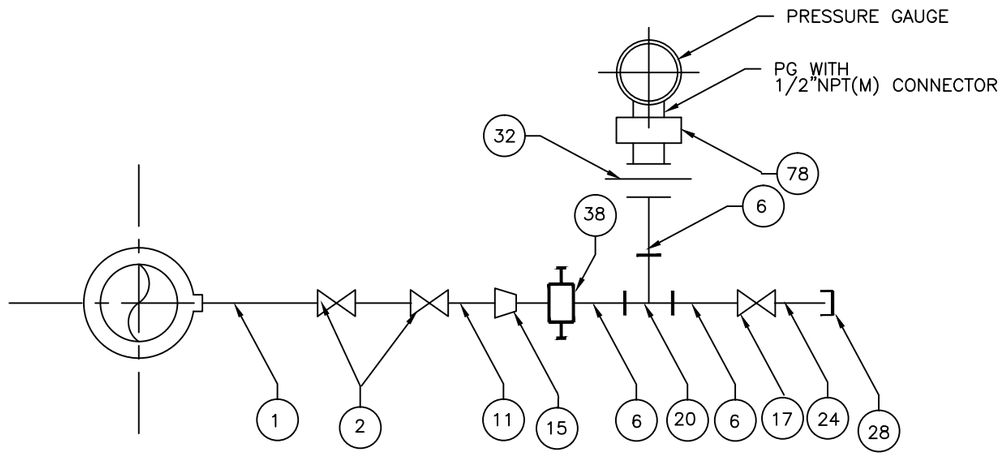
SCALE

JOB. No. D–0420

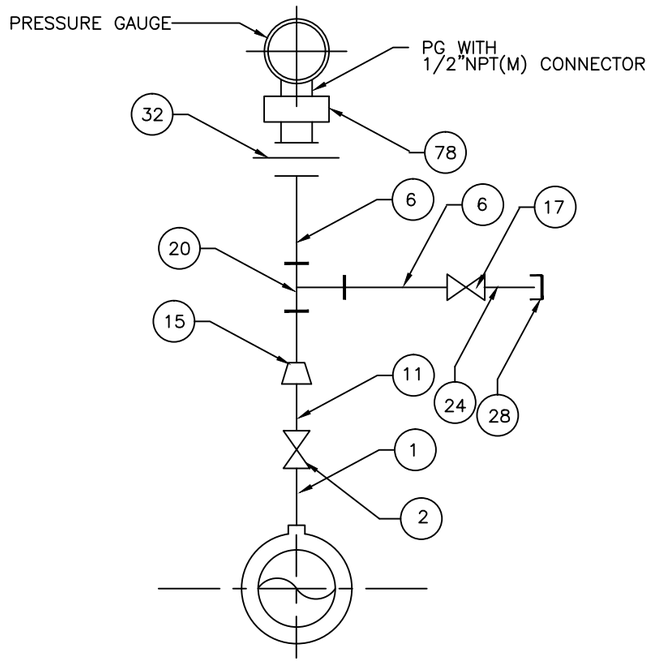
DWG. No. 114–04–0104 — REV. 0

Sheet No. 7 of 19

APPRD. FOR CONSTRUCTION:



STEAM/LIQUID SERVICE
FIG–A



AIR SERVICE
FIG–B

TAG NO.	DESCRIPTION	QTY. A	QTY. B
	BILL OF MATERIAL		
1	1/2"/3/4"/1" CARBON/ALLOY STEEL NIPPLE OF MTL. SAME AS THAT OF MAIN PIPE(AS PER PROCESS REQD.)	AS REQD.	
2	1/2"/3/4"/1" ROOT VALVE–SW GLOBE VALVE	2	1
6	1/2" NPS. SCH–80/160 CS/ AS PIPE	AS REQD.	
11	1" NPS SCH–80/160 CS/AS NIPPLE	1	1
15	1" TO 1/2" SOCKET WELDED REDUCER	1	1
17	1/2" SW CS/AS GLOBE VALVE	1	1
20	1/2"SW EQUAL TEE, CS/AS	1	1
24	1/2"NPS,SCH–80/160X1/2"NPT(M)CS/AS NIPPLE	1	1
28	1/2"NPT (F) CS CAP	1	1
32	1/2"NPS,3PIECE PIPE UNION WITH 1/2"NPT(F) SCREWED	1	1
37	6" COILED SYPHON SCH 80/160 1/2"NB CS/SS	–	–
38	3 WAY 2 VALVE MANIFOLD FOR BTG SS316 3 WAY GAUGE VALVE I/2" NB SW FOR BOP SS316	1	–
59	1/2"SW, STRAIGHT PIPE CONNECTOR, CS/AS	–	–
78	1/2"NPT(F)X1/2"NPT(M) SNUBBER/PULSATION DAMPER	1	1

REFERENCE DRAWINGS.

NOTES

1. DO NOT SCALE, ASK WHEN IN DOUBT.
2. ALL DIMENSIONS ARE IN MILIMETRES UNLESS NOTED OTHERWISE.
3. BULK HEAD FITTING SW TYPE SHALL BE PROVIDED AT I/E/I/R
4. ABOVE DRWING IS FOR BASIC GUIDE LINE TO BE MEET BY BIDDER, ANY FURTHER IMPROVEMENT DURING DETAILED ENGINEERING SHALL ALSO BE CONFIRMED/PROVIDED BY CONTRACTOR.
5. QUANTITIES OF INSTRUMENTS/ ERECTION HARDWARE SHALL BE AS PER NIT AND AS FINALISED DURING DETAIL ENGINEERING
6. FOR DM PLANT MATERIAL OF ERECTION HARDWARE SHALL BE SS 316 ONLY.
7. FOR SEA/SALINE WATER APPLICATION MATERIAL OF ERECTION HARDWARE, IMPLUSE PIPE & TUBES SHALL BE SUPER DUPLEX SS ONLY.
8. ALL FITTINGS SHALL BE DOUBLE COMPRESSION TYPE.

NOTICE

ZONE	MARK	PARTICULARS	DATE	CIVIL	MECH.	ELEC.	C&I	H.O.D.
	6							
	5							
	4							
	3							
	2							
	1							
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SR. No.	PARTY
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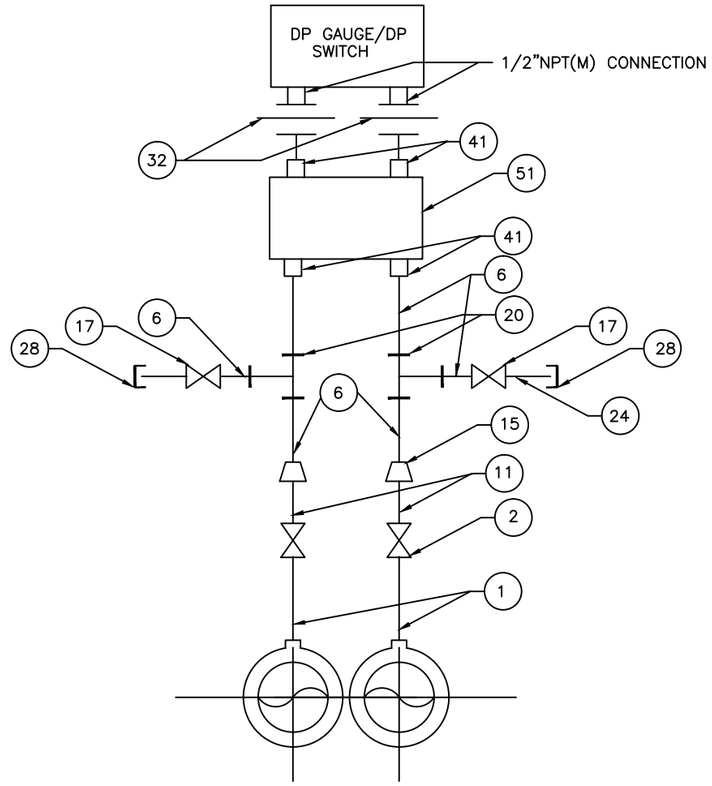
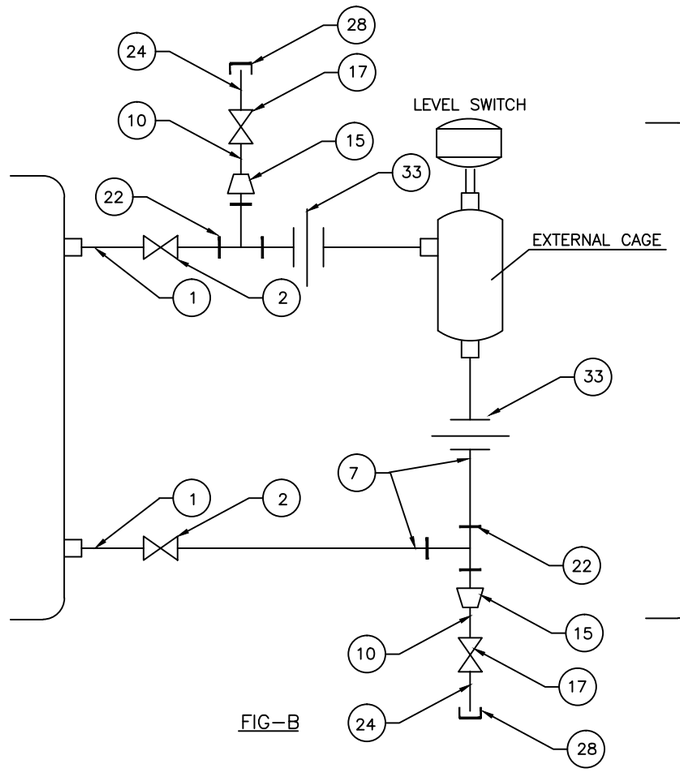
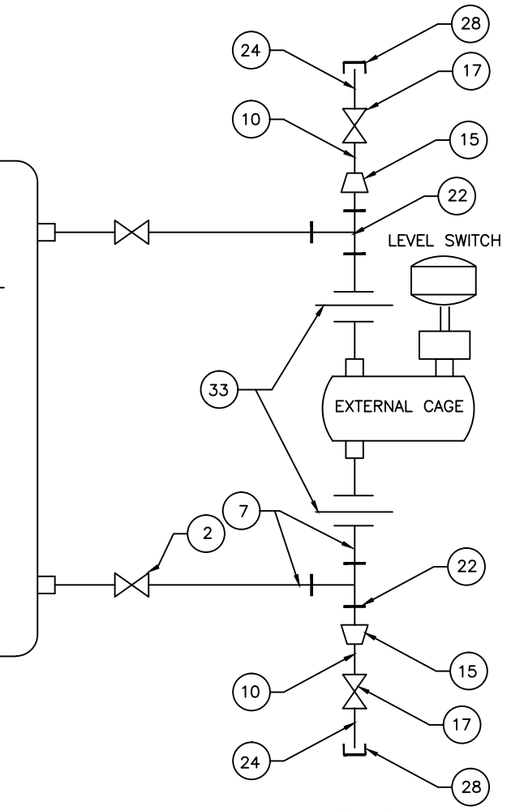
PROJECT	2x800MW SUPERCRITICAL COAL BASED UPPUR THERMAL POWER PROJECT			
OWNER	TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED			
OWNER CONSULTANT:–	DESEIN CONSULTING ENGINEERS NEW DELHI – INDIA	CAD/DRAWN	SANDEEP	20.07.15
		DESIGNED	SKM/SN	17.07.15
		CHECKED	SKM	22.07.15
		APPROVED	SKM	19.08.15
TITLE	INST. DRAWING FOR LOCAL PRESSURE GAUGE	SCALE		
		JOB. No.	D–0420	
APPRD. FOR CONSTRUCTION:		DWG. No.	114–04–0106	REV. 0
		Sheet No. 9 of 19		



FIG–A



FIG–B



FIG–C

78	1/2" NPT(F) X 1/2" NPT(M) SNUBBER/PULSATION DAMPNER	1	–	–
51	5 VALVE MANIFOLDS, SS–316	–	–	–
41	1/2" NPT(M) X 1/2" OD TUBE COMPRESSION FITTING,SS–316	–	–	–
38	3 WAY GAUGE VALVE 1/2"NB SW	1	–	–
33	1" SW EQUAL PIPE UNION	–	2	2
32	1/2" NPS,3 PIECE PIPE UNION 1/2" NPT(F) SCREWED AND 1/2" SW CONNECTION	1	–	–
28	1/2" NPT(F) CS. CAP	1	2	2
24	1/2" NPS,SCH 80/160 X 1/2" NPT(M) CS/AS NIPPLE	1	2	2
22	1" SW EQUAL TEE CS/AS	–	1	2
20	1/2"SW EQUAL TEE CS/AS	1	–	–
17	1/2" SW,CS/AS, GLOBE VALVE	1	2	2
15	1" TO 1/2" SOCKET WELD REDUCER	1	2	2
11	1"NPS SCH 80/160 CS/AS NIPPLE	1	–	–
10	1/2"NPS,SCH 80/160 CA/AS NIPPLE	–	2	2
6	1/2"NPS,SCH 80/160 CARBON/ALLOY STEEL PIPE	AS REQD.		
7	1" NPS,SCH 80/160 CS/AS STEEL PIPE	AS REQD.		
2	1/2"3/4"/1" ROOT VALVE – SW GLOBE VALVE	2	2	2
1	1/2"/3/4"/1" CARBON/ALLOY STEEL NIPPLE OF MTL SAME AS THAT OF MAIN PIPE (AS PER PROCESS REQD.)	AS REQD.		
TAG NO.	DESCRIPTION	A	B	C
		QTY.		

NOTE:–
WITH VALVE OF SIZE 1/2"SW NIPPLE PIECE IS NOT REQUIERED

REFERENCE DRAWINGS.

NOTES

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NOTICE

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FOR BID PURPOSE ONLY

PROJECT	2x800MW SUPERCRITICAL COAL BASED UPPUR THERMAL POWER PROJECT
OWNER	TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED
OWNER CONSULTANT:–	DESEIN CONSULTING ENGINEERS NEW DELHI – INDIA

CAD/DRAWN	SANDEEP	20.07.15
DESIGNED	SKM/SN	17.07.15
CHECKED	SKM	22.07.15
APPROVED	SKM	19.08.15

TITLE: INST. DRAWING FOR DIFF. PRESS. SWITCH/GAUGE/LEVEL SWITCHES

SCALE

JOB. No. D–0420

DWG. No. 114–04–0108 — REV. 0

Sheet No. 11 of 19

APPRD. FOR CONSTRUCTION:

9.02.03 **Valves**

i)	3 – way valves	SS316 body/forged CS body stellited internals and SW ends as per requirement for 3000/2500 lb/800 lb ASA ratings.
ii)	5- valve manifolds	FAS body/FCS body 316SS stellited internals with NPT(F) SCRD ends for 3000/2500 lb/1500 lb/800 lb ASA ratings. Construction – Single block (Bar stock)
iii)	3-valve manifolds	FAS body/FCS body 316SS stellited internals with NPT(F) SCRD ends for 3000/2500 lb/1500 lb/800 lb ASA ratings. Construction – Single block (Bar stock)
iv)	2-valve manifolds	FCS body, 316SS stellited internals, NPT(F) SCRD ends. Construction – Single block (Bar stock)
v)	Isolation and drain valves	Globe valves with FAS body/FCS body, 316SS stellited internals SW ends for 3000/2500 lb/1500 lb/800 ASA ratings.

9.02.04	Condensation vessels	FAS/FCS body with NPT (F) SCRD connection and vent plugs for 3000/2500/1500/800 lb ASA ratings.
9.02.05	Racks and Associated Equipment	ANSI C83.9-1972
9.02.06	Code for pressure piping, welding and Hydrostatic testing	ANSI B-31.1
9.02.07	Flexible conduits with fittings	Lead coated, paper insulated, heat resistant flexible metallic conduits with necessary fittings.

9.02.08 3 Valve manifold shall be used, wherever Diff Pressure transmitter/switch have been used for pressure measurement.

9.02.09 5 Valve manifold shall be used for Diff. Pressure & Flow measurement Transmitters/Switches.

9.02.10 2 Valve manifold shall be used for Pressure transmitter/switch/gauge every wherein the plant, used for pressure measurement.

9.02.11 Double ferruled double compression type fittings shall be used only, wherever required.

9.02.12 In addition to above, table # 9.1 shall also be followed for selection of specific erection hard ware as per process requirements.

9.03.00 TRANSMITTER & SWITCHES ENCLOSURES

In general, BTG process transmitters & switches installed at outdoor location and in areas where they are subjected to splashing oil, water, steam etc., shall be mounted in closed type transmitter rack. For other areas (indoor), open type racks may be used for installation of transmitters and process switches. However the actual requirement shall be finalized during detailed Engineering considering following:-

i) Transmitter/Switches enclosures shall be free standing, enclosed type offering protection against dust, moisture and vermin. Enclosures shall be suitable for outdoor installations, in thermal power plants.

ii) The enclosures shall comprise of Galvanized Sheet mounting plate internally. Also external-mounting brackets in Polyamide or Stainless Steel shall be available. Alternatively transmitter enclosures can be glass Fiber Reinforced Polyester (GRP) compression moulded and shall be weather proof.

iii) Instrument piping inside the enclosure shall conform to the specification and in line with typical installation drawings enclosed with the specification.

iv) Blow down header shall be provided inside the enclosure as called for.

v) Bulk head connection shall be provided to receive and terminate the impulse pipes from root valves.

vi) Instrument tubing, fittings and isolation, drain valves shall be to ANSI code for pressure piping. Piping/tubing shall be subject to hydrostatic tests at 1.5 times maximum system pressure.

vii) Support angles shall be provided for valve manifolds, wiring trays etc. Enclosures shall be complete with necessary bulk head fittings, junction boxes, drain header and other accessories as needed on the basis of approved hook up drawings.

viii) Sufficient spacing among adjacent transmitters shall be maintained to offer easy accessibility and operational convenience. The enclosure shall be designed with sizes to suit the grouping and to completely include all the hardware for hooking up the transmitters to the process on the basis of approved installation diagrams. A maximum of five (5) transmitters are envisaged to be grouped in one enclosure.

ix) A minimum of twenty (20) percent spare terminals shall be provided. Only one wire per terminal shall be used on the outgoing side of these blocks (for cable

panel). Any common connections required shall be provided on the panel side of the block. All incoming power terminals are to be clearly identified in a manner distinctly different from all other terminals and grouped in a logical pattern.

x) Chapter no. 6 of this volume shall also be referred for designing of Transmitter/Switches enclosures.

9.04.00 LOCAL INSTRUMENTS, LOCAL BOARDS AND TAPPING POINTS

i) All local gauges as well as sensors, Transmitters and switches any other instruments for parameters like pressure, temperature, level, flow etc for safe and efficient operation of equipment under the scope of specification, shall be provided by bidder as approved by Owner. Such equipment shall be listed by the Bidder detailing the items with the respective functions in service. All field mounted instruments shall be mounted in such a way as not to be affected by vibration & environmental conditions. Racks to mount these instruments shall be furnished by bidder complete with requisite erection hardware, tubings and junction boxes with all terminals of the instruments duly wired complete with cable glands. Groupings of instruments, actual number of racks for instruments and its construction shall be to Owners approval.

ii) Transmitters & Switches provided shall be mounted in transmitter/Switches enclosures to owner's approval. The junction box for electrical connections shall be outside the transmitter enclosures.

iii) All erection hardware required for complete installation/ implementation of entire instrumentation specified is included in bidders scope. Any change in size, type, rating or in quantity deemed necessary during engineering shall be supplied within package price with no additional financial implication to owner.

iv) Bidders scope includes providing counter flanges on pipe lines/ vessels to suit owner arranged flanged devices. Counter flanges shall be complete with gaskets, nuts, bolts and other requisite accessories for proper installation.

v) Separate and independent tapping on equipment/associated piping shall be provided to suit the philosophy of redundant primary sensors. Separate sensors for control and monitoring etc are as decided by Owner. This shall include application such as first stage pressure. Wherever the process value being measured needs to be compensated for temp, pressure variations, the tapping points for such compensating elements shall be provided in requisite number along with the tapping for the process value.

vi) Whereever transmitters & switches are provided, in addition Local gauges shall also be provided by bidder for local field monitoring.

vii) Local instruments and remote sensors & transmitters to be furnished with the equipment shall generally be as indicated herein and as per redundancy criteria indicated elsewhere but not be limited to the following: -

1. <u>Pressure Measurement</u>

i. **Pressure Gauge** for:

a) Shell pressures of all Deaerator, HP and LP heaters and other vessels.
b) Mercury manometers shall be provided during air outlet flows measurement.
c) Bleed steam pressure at extraction point for all turbine extractions and for pressure on drain lines.
d) Pressure gauges at inlets and outlets of condensate extraction pumps, main oil pump, each auxiliary oil pump, AC standby oil pump, DC Emergency oil pump, jacking oil pumps, DM makeup pumps, DMCW pumps, BFP, or any other pumps etc. and discharge header.
Pressure Gauge at outlet of each type of Fan.
e) Lube oil pressure before and after oil coolers, HPT & IPT front seal chamber leak off pressure.
f) MS pressure downstream of ESV, after HPT control valves and after HPT first stage, HRH steams pressure after IV, Gland steam header pressure, HPT exhaust, Aux. steam etc.
g) Condensate pressure in condensate pump discharge and discharge header, and feed water pressure at inlet and outlet of each LP & HP heaters.
h) LP turbine exhaust pressure and condenser pressure
i) Relay/Lube/Control oil pressure, Drain oil lines pressure.
j) Pressure gauges for vacuum pumps and each pump discharge.
k) Pressure gauge at Instrument and service air header in compressor room and in the field at the main location of instrument/service air header, the pressure gauges shall be provided.
l) Pressure gauges at inlet and outlet of each cooling water line of compressor, heat exchanger and cooler.
m) Frame mounted Pressure Gauges (FMG) shall be provided for Main steam Pressure, Feed water pressure to economizer, CRH Steam Pressure, HRH Steam Pressure, CEP pressure, BFP Pressure etc.
n) For condensate storage tanks and DM Water storage tanks, the pressure gauge in terms of 0-10000 mm wc or suitable range having **dial size of 300 mm or bigger size** shall be provided.
o) U tube manometer with Hg filled for direct measurement of condenser vacuum shall be provided in the fixed with isolation valve for local indications.
p) Panel mounted Gauges shall be provided for CEP, BFP and any other HT Drives.
q) Pressure Gauge at each of the hot tower riser pipe of cooling tower to measure hot water Pressure.
r) Aux Steam to Mill Inerting, water used in fire fighting and washing for mills and air heater.
s) Pressure Gauge shall be provided up stream and down stream of each control valve station.
t) Above are the minimum requirements, actual quantities shall be as decided during detailed engineering by owner.

ii. **Pressure Switches**

a) Pressure switches at condensate Extraction Pump Discharge header, Boiler feed pump, seal water line or any other pumps for alarm (high & low) and interlock purpose.
b) Pressure switches for steam supply to LP/HP heaters.
c) Pressure switches for initiation of turning gear.
d) Pressure switches for control oil, jacking oil and lube oil pressure for all required alarms and interlocks.
e) Steam pressure downstream of ESV, steam pressure after first stage of HPT, gland steam header pressure and suction line from turbine glands to Gland cooler.
f) Pressure switches for condenser vacuum low, very low alarms & interlocks.
g) Condenser water box pressure for alarm interlocks.
h) Pressure switches (low & high) for individual pumps/blowers suction/discharge and discharge header – alarms, interlocks and protection
i) At the main location of instrument air header the pressure low switches shall be provided for alarms in DDCMIS
j) Pressure switches/any other process switch etc. for OLCS / Alarms / Interlocks / Protection. Pressure switches at inlet, outlet of individual pumps and discharge header of pumps for protection and auto start / stop & alarms.
k) Above are the minimum requirements, actual quantities shall be as decided during detailed engineering as per redundancy criteria by owner.

iii. **Differential Pressure Transmitters, Diff Pressure Switches & Diff. Pressure Gauges**

a) Pressure across bag filters, strainers and filters.
b) Diff. Pressure Transmitter & DPG across condenser on CW lines, Air pre heaters on air & flue gas lines, on PA lines, across Seal air & Cold PA line, across seal air & Mill, Feed control station, Extraction steam line power assisted NRV, Lube oil strainer/filter etc.
c) Above are the minimum requirements, actual quantities shall be as decided during detailed engineering as per redundancy criteria by owner.

iv. Pressure Transmitters

a) For all services as mentioned for Pressure gauges & Pressure Switches.
b) Pressure Transmitters at condensate Extraction Pump individual Discharge and discharge header, Boiler feed pump individual suction and Discharge and discharge header, feed water, Aux. Steam, main steam, seal water line, instrument air distribution, service air distribution or any other pumps/fans/HT/LT unidirectional drive for alarm (high & low) and interlock purpose.
c) Pressure transmitter for wind box (Left/Right) & pulverizer seal air fans discharge pressure.

d) Pressure Transmitters as on required basis for monitoring, interlocks & controls as per redundancy criteria and approved by owner.

e) Pressure Transmitter at each of the hot tower riser pipe of cooling tower to measure hot water Pressure.

f) Aux Steam to Mill Inerting, water used in fire fighting and washing for mills and air heater.

g) Soot blower steam header lines, and soot blower steam line to Airpreheater.

h) Above are the minimum requirements, actual quantities shall be as decided during detailed engineering as per redundancy criteria and approved by owner.

9.05.00 **Process Connections**

The type of instrument source connection shall depend upon the process parameters and the tapping size. The source connection drawings shall be finalised during the engineering stage.

Size of tapping point stub, number and size of root valves for different types of measurements are as follows:

Sl. No.	Quantity of root valves	Size of stub and root valve	Service Condition
Pressure and Differential Pressure Measurement			
(i)	2	25NB	$\geq$ 40 bar(g) OR 425^{0}C
(ii)	1	15NB	< 40 bar(g) AND 425^{0}C.
Sampling system measurement (Steam and Water Service)			
(i)	2	25 NB	$\geq$40 bar(g) OR 425^{0}C

Sl. No.	Quantity of root valves	Size of stub and root valve	Service Condition
(ii)	1	25 NB	< 40 bar(g) AND 425^{0}C

9.06.00 SHOP TESTS FOR ERECTION HARDWARE

i) General Requirements:-

a) The equipment as per this section shall be subject to shop tests.

b) The Conductor shall furnish all materials, equipment, tools, instruments, bulkheads, blanking plates and all personnel required for completing these tests.

c) Personnel performing the tests shall be qualified and experienced. Tests shall be performed as many times as necessary to assure Proper quality of materials and workmanship. If any test reveals Unsatisfactory materials or workmanship, such materials shall be Repaired or replaced to the satisfaction of the Owner.

d) Hydrostatic and pneumatic tests shall be performed on all pipes, Tubings and systems supplied by the Bidder and shall conform To ANSI B31.1 – Code for Pressure Piping.

ii) Hydrostatic Testing

All instrument piping, which connects to process piping, shall be Hydrostatically tested.

	UPPUR STPP (STAGE-I, UNIT#1&2) 2X800MW	
	TECHNICAL SPECIFICATION (C&I) FOR DEBRIS FILTER	

`

DATA SHEETS FOR MOTORISED VALVE ACTUATOR

0

FORM NO. PEM-6666-0

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.:
		VOLUME II B
		SECTION D
		REV. NO. 00 DATE: 05.10.16
		SHEET 1 OF 4

Data Sheet A & B

		DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
GENERAL*	* PROJECT	2 x 800 MW Uppur Thermal Power Project	
	OFFER REFERENCE		
	* TAG NO. SERVICE		
	* DUTY	☐ ON / OFF ☐ INCHING	
	* LINE SIZE (inlet/outlet): MATERIAL		
	* VALVE TYPE	☐ GLOBE ☐ GATE ☐ REG. GLOBE ☐ BUTTERFLY	
	* OPENING / CLOSING TIME		
	* WORKING PRESSURE		
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF -20 to70 DEG C AND RELATIVE HUMIDITY OF 0-95%IN HOT HUMID AND TROPICAL ATMOSPHERE AND HIGHLY POLLUTED AT PLACES OF COAL DUST AND FLY DUST	
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY	
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY	
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY	
CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF,DUST TIGHT SUITABLE FOR OUTDOOR USE WITHOUT CANOPY, NEMA6/IP:68	
	MECHANICAL POSITION INDICATOR	TO BE PROVIDED FOR 0-100% TRAVEL	
	BEARINGS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.	
	GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION	METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.	
	SIZING	OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 90% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. **FOR INCHING SERVICE - 150 STARTS/HR MINIMUM.**	
HANDWHEEL	* REQUIRED	■ YES ☐ NO	
	* ORIENTATION	☐ TOP MOUNTED ☐ SIDE MOUNTED	
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.		
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY	
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY	
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT-INCLUSIVE OF **I.S.** TOLERANCE	
	ACTUATOR APPLICABLE WIRING DIAGRAM	■ ENCLOSED (BIDDER TO CONFIRM) A: ☐ DRG. NO. 3-V-MISC-24227 R00 B: ☐DRG. NO. 3-V-MISC-24550 R00 C: ■ DRG. NO. 3-V-MISC-24283 R00 D: ☐ DRG. NO. 4-V-MISC-90271 R11 E: ☐ For Thyristor based Integral starter, Bidder/Vendor to furnish wiring diagram	
	COLOUR SHADE	☐ BLUE (RAL 5012) ■ SIEMENES GRAY RAL 7030	
	PAINT TYPE **(## Refer Notes)**	☐ ENAMEL ■ EPOXY ☐	
	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	
	@ PWR SUPP TO MTR / STARTER	415V +/- 10%, 3 Phase, 3 Wire 50HZ +/-5%	
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ☐ 230 V ■ 110 V	

FORM NO. PEM-6666-0

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.:
		VOLUME II B
		SECTION D
		REV. NO. 00 DATE: 05.10.16
		SHEET 2 OF 4

Data Sheet A & B

	DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
	@ ENCLOSURE CLASS OF MOTOR	IP-68	
	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B	
	@ WINDING TEMP PROTECTION	■ THERMOSTAT (3 Nos.,1 IN EACH PHASE) ☐ ----------	
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED	
INTEGRAL STARTER	INTEGRAL STARTER	■ REQUIRED ☐ NOT REQUIRED	
	TYPE OF SWITCHING DEVICE	■ CONTACTORS(Reversing type) ☐ THYRISTORS	
	TYPE	■ CONVENTIONAL ☐ SMART (NON-INTRUSIVE)	
	IF SMART		
	a) SERIAL LINK INTERFACE	☐ INTEGRAL ☐ FIELD MOUNTED	
	b) SERIAL LINK PROTOCOL	☐ FOUNDATION FIELD-BUS ☐ PROFI-BUS ☐ DEVICE NET ☐.....	
	c) SERIAL LINK MEDIA	☐ TWISTED PAIR Cu-CBL ☐ CO-AXIAL Cu-CBL ☐ OFC	
	d) HAND HELD PROGRAMMER	☐ REQUIRED ☐ NOT REQUIRED	
	e) TYPE OF HAND HELD PROGRAMMER	☐ BLUETOOTH ☐ INFRARED ☐.....	
	f) MASTER STATION	☐ REQUIRED ☐ NOT REQUIRED	
	g) MASTER STN INTRFACE WITH DCS	☐ MODBUS ☐ TCP/IP	
	h) DETAILS OF SPECIAL CABLE	☐ ENCLOSED ☐ NOT REQUIRED	
	STEP DOWN CONT. TRANSFORMER	■ REQUIRED	
	OPEN-STOP-CLOSE PB(running open/close LED) THREE POSITION SELECTOR SWITCH	■ REQUIRED ☐ NOT REQUIRED	
	INDICATING LAMPS	■REQUIRED ☐ NOT REQUIRED	
	LOCAL-OFF- REMOTE S/S(THREE POSITION SELECTOR SWITCH)	■REQUIRED ☐ NOT REQUIRED	
	STATUS CONTACTS FOR MONITORING	■ REQUIRED ☐ NOT REQUIRED	
	INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (MOTOR THERMOSTAT TRIPO/L RELAY OPERATED, CONT. /POWER SUPPLY FAILED, S/S IN LOCAL/OFF MODE, TORQUE SWITCH OPEN/CLOSE CUT OFF/STOP PB OPTD.)	
INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter)	TYPE OF ISOLATING DEVICE	☐INTERPOSING RELAY ■OPTO COUPLER ☐ EITHER	
	QUANTITY	■ 2 NOs. ☐ 3 NOs.	
	DRIVING VOLTAGE	■ 20.5 – 24V DC ☐ _____V DC	
	DRIVING CURRENT	■ 125mA MAX ☐ _____mA MAX	
	LOAD RESISTANCE	■ > 192 ohms - <25 k ohms ☐ > _____ohms - < _____ohms	
TORQUE SWITCH (Not Applicable for Smart Actuator) **($$ Refer Notes)**	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN / CLOSE	■1 No. ☐2Nos. / ■1 No. ☐2Nos	
	CONTACT TYPE	2 NO + 2 NC	
	RATING	5A 250V AC AND 0.5A 220V DC	
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE	
	ACCURACY	+3% OF SET VALUE	
LIMIT SWITCH (Not Applicable for Smart Actuator) **($$ Refer Notes)**	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN : INT : CLOSE	■2 Nos. / 2 nos(adj) / 1 No. ■2Nos.	
	CONTACT TYPE	2 NO + 2 NC	
	RATING (AC / DC)	5A 250V AC AND 0.5A 220V DC	

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.:
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Data Sheet A & B

		DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty & other specific applications)	REQUIRED for regulating/inching duty only.	
	MFR & MODEL NO.	BIDDER TO SPECIFY	
	TYPE	☐ ELECTRONIC (2 WIRE) R/I CONVERTER ■ ELECTRONIC (2 WIRE) contactless inductive type	
	SUPPLY	■ 24V DC ☐	
	OUTPUT	■ 4-20mA	
	ACCURACY	± 1% FS	
SPACE HEATER	@SPACE HEATER	REQUIRED	
	@ POWER SUPPLY (NON INTEGRAL)	240V AC 1 ph 50Hz	
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY	
	@ RATING		
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED	
	ENCL CLASS ACTUATOR/MOTOR T.B.	@■ IP 68 @☐ NEMA6	
	@ EARTHING TERMINAL	REQUIRED	
	PLUG & SOCKET(9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT)	■ REQUIRED ☐ NOT REQUIRED☐ ■ 2 NOS. ☐ ----------	
CABLE GLANDS	@ POWER CABLE GLAND	During detailed engineering	
	@ SPACE HEATER CABLE GLAND		
	OTHER CONTROL CABLE GLANDS-1	☐ 1No. for BFV of CW PUMP(Cable size 2Px1.5mm2)	
	OTHER CONTROL CABLE GLANDS-2	1 no suitable for 8P X 0.5 sq mm Additional 1 no suitable for 2P X 0.5 sq mm(inching duty only)	

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.:
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Data Sheet A & B

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

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 INTERNATION 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.

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

EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.

8. IT SHOULD BE POSSIBLE TO OPERATE THE ACTUATOR LOCALLY. LOCKABLE LOCAL/REMOTE SELECTION SHALL BE PROVIDED ON THE ACTUATOR.

9. POSITION INDICATOR SHALL BE PROVIDED FOR 0 TO 100 % TRAVEL

10. WIRING SHALL BE SUITABLE VOLTAGE GRADE COPPER WIRE 1.5 SQ. MM.

11. 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.

12. THE ACTUATORS SHALL BE DESIGNED TO BE SELF-LOCKING UPON LOSS OF POWER. MOTOR SHALL BE DESIGNED TO CLOSE IN 30 SECS. FROM FULL OPEN POSITION AND SHALL HAVE ADEQUATE CAPACITY TO OPEN AND CLOSE UNDER FULL UNBALANCED DESIGN PRESSURE.

13. ALL SIX (6) LIMIT SWITCHES SHALL BE CHANGEOVER TYPE AND ADJUSTABLE BESIDES HAVING THE SNAP FACILITY.

14. THE INTEGRAL STARTER WHICH SHALL HAVE SOPHISTICATED ELECTRONIC CONTROLS WITH FIELD PROGRAMMING FEATURE. IT SHALL BE DESIGNED FOR REMOTE CONTROL FROM DCS/RESPECTIVE CONTROL SYSTEM. REQUIRED INTERPOSING RELAYS FOR RECEIVING OPEN/CLOSE/STOP COMMAND FROM DCS/RESPECTIVE CONTROL SYSTEM SHALL BE PROVIDED. POTENTIAL FREE CONTACTS AND TRANSDUCERS SHALL BE PROVIDED TO PROVIDE STATUS INDICATION AT REMOTE DCS/RESPECTIVE CONTROL SYSTEM.

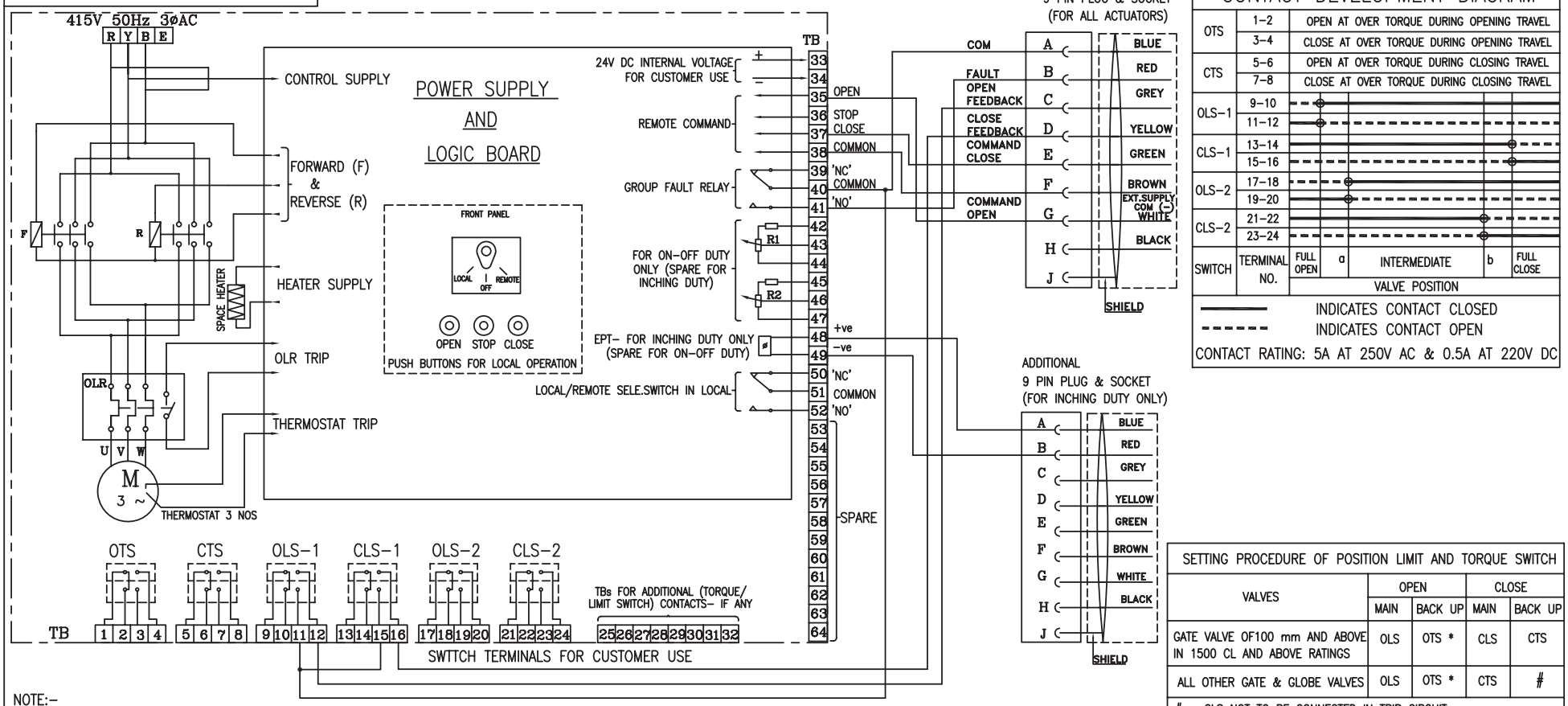
15. THE REMOTE COMMAND SIGNAL (OPEN-STOP-CLOSE) FROM DCS/RESPECTIVE CONTROL SYSTEM/CONTROL PANEL SHALL BE ISOLATED FROM CONTROL ELECTRONICS THROUGH OPTO-ISOLATOR.

16. THE FOLLOWING INDIVIDUAL STATUS ANNUNCIATION LED'S (COLOUR-GREEN) SHALL BE PROVIDED LOCALLY (INTEGRAL TO ACTUATOR) TO ANNUNCIATE THE FOLLOWING FOR EASY LOCAL MONITORING.
    ACTUATOR IN LOCAL MODE
    ACTUATOR IN REMOTE MODE
    ACTUATOR RUNNING IN OPEN DIRECTION
    ACTUATOR RUNNING IN CLOSE DIRECTION
    ACTUATOR IN INCHING MODE.
    ACTUATOR IN SELF-RETAINING MODE
    LIMIT SWITCH OPEN TRIP
    LIMIT SWITCH CLOSE TRIP
    CONTROL VOLTAGE AVAILABILITY

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

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

DRAWING NO. 3-V-MISC-24283



CONTACT DEVELOPMENT DIAGRAM

OTS	1-2	OPEN AT OVER TORQUE DURING OPENING TRAVEL
	3-4	CLOSE AT OVER TORQUE DURING OPENING TRAVEL
CTS	5-6	OPEN AT OVER TORQUE DURING CLOSING TRAVEL
	7-8	CLOSE AT OVER TORQUE DURING CLOSING TRAVEL
OLS-1	9-10	
	11-12	
CLS-1	13-14	
	15-16	
OLS-2	17-18	
	19-20	
CLS-2	21-22	
	23-24	

SWITCH TERMINAL NO. — FULL OPEN | a | INTERMEDIATE | b | FULL CLOSE — VALVE POSITION

INDICATES CONTACT CLOSED

INDICATES CONTACT OPEN

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

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

VALVES	OPEN		CLOSE	
	MAIN	BACK UP	MAIN	BACK UP
GATE VALVE OF100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS *	CLS	CTS
ALL OTHER GATE & GLOBE VALVES	OLS	OTS *	CTS	#

\# - CLS NOT TO BE CONNECTED IN TRIP CIRCUIT

* - BYPASS OTS FOR INITIAL 5% OF TRAVEL(FOR GATE VALVES ONLY)

NOTE:-

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

REV	DATE	ALTERED
		CHD & APPD

TYPE OF PRODUCT: ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS
2 X800 MW UPPUR TPP
(DRAWN FOR INTERMEDIATE POSITION OF VALVES)

BHARAT HEAVY ELECTRICALS LTD.,
UNIT: HIGH PRESSURE BOILER PLANT.
TIRUCHIRAPALLI-620014.
365-121

	NAME	SIGN	DATE	NO.OF VAR.
DRN	N.P.ESWAR	N.P	17.03.05	-
CHD	D.DINAKARAN	D.D	17.03.05	
APPD	K.ARUNACHALAM	K.A	17.03.05	

DEPT	SCALE	WEIGHT (KG).	REFERENCE INFORMATIONS	NO. OF ITEMS
VL	NTS	-		-
CODE -				

TITLE: WIRING DIAGRAM (TERMINAL PLAN)
FOR ACTUATOR WITH INTEGRAL STARTER WITH PLUG & SOCKET

CARD CODE: U 01

DRAWING NO.: 3-V-MISC-24283

REV: 0

Size A3

	UPPUR STPP (STAGE-I, UNIT#1&2) 2X800MW	
	TECHNICAL SPECIFICATION (C&I) FOR DEBRIS FILTER	

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TYPE TEST REQUIREMENTS

0

Note-1: Test to be witnessed by Owner.

NOTES:

1. The intent of the FAT is to demonstrate and ensure that the I&C system meets all the functional requirements as intended in the specification / contract. A completed integrated test of the system shall be carried out at vendor's works in the presence of Owner or Owner's representative, on completion of integration / manufacturing of the system. The shipment of I&C equipment to site will be effected only after the FAT has been accepted by Owner.

2. FAT procedure shall be prepared by vendor and to be submitted for Owners approval well in advance prior to the commencement of FAT.

13.02.04.21 **Calibration of Instruments**

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

i TESTS TO BE PERFORMED FOR FIELD INSTRUMENTS

1.	Pressure Gauges
	Calibration Hydro test (1.5 times max. pr.)
2.	Pressure switches
	Calibration test / Hydro test / Contact rating test / Accuracy test / Repeatability
3.	Differential Pressure Gauges
	Calibration test / Hydro test / Leak test / Over range test / Accuracy test / Repeatability test.
4.	Differential Pressure Switches
	Calibration test / Hydro test / Contact rating test / Leak test / Accuracy test / Repeatability test.

	Calibration / Material test / Bore concentricity test / Insulation test (≤ 500 M☐ at 500V DC) as per ISA, Hydro test for TW. Bore concentricity: ± 5% of wall thickness, Accuracy test.
8.	Thermocouple assembly
	Calibration / Material test, Insulation test (≥ 500 ☐ at 500 V, DC) as per ISA, Hydro static test (1.5 times max. pr.), Bore concentricity : ± 5% of wall thickness.
9.	Thermowells
	Material test / Bore concentricity : ± 5% of wall thickness / Hydrostatic test for TW (1.5 times max. pr.)
10.	Level Guages
	Hydrostatic test / Material test / Seat leakage test / Ball check test.
11.	Level switches (Magnetic)
	Material test / Contact rating test / Hydro test / Calibration test.
12.	Flow Switch
	Material test / Hydro static test (1.5 times max. pr.) / function test.
13.	Flow glasses
	Material test / Hydrostatic test (1.5 times max. pr.) / function test.
14.	Variable area flow meters
	Calibration test / Material test / Hydrostatic test (1.5 times max. pr.)
15.	Flow element
	100% Radiography test / Hydro test / Calibration test, IBR Certificate.
	Calibration test for flow element shall be witnessed by Owner.
16.	Control valves/Pneumatic block valve/Pressure regulating valve – Refer chapter 11.
17.	Position transmitters
	Calibration / hysteresis and Accuracy test
18.	Electro Pneumatic Convertors
	Calibration test / Accuracy test
19.	Solenoid valves
	Hydrotest / Seat leakage test / CV test / Coil insulation test
20.	~~Air filter regulators~~
	Calibration test / Accuracy test
21.	Junction Boxes
	Test for degree of protection / Material test
22.	Tests for terminal blocks
	Test for moulding for flame resistant, Non-hygroscopic and Decarbonised / Insulation test between terminals / Insulation between terminal block and frame.
23.	~~Thermocouple extension cable &~~ Instrumentation Cables ~~and Fiber Optical Cables~~

	Thermo-emf characteristic / Continuity test / Measurement on capacitance, inductance and loop resistance / Insulation resistance / High voltage test as per latest IS / Tensile and elongation test / Oxygen index test / Any other test applicable. (Also refer chapter 9 for further details). For Deatils of type and acceptance tests for Instrumentation Cables refer chapter 9. For Deatils of tests for Fiber Optical Cables refer chapter 9.
24.	Mass flow meter
	Performance test / Calibration test / Hydrostatic test.
25.	Boiler Level Gauge
	Hydrostatic test / Material test / Seat leakage test / IBR Certificate
26.	pH/Conductivity measurement / Silica / Dissolved oxygen analysers and other analysers:
	Calibration test, Accuracy test
27.	Sample cooler :
	Hydro test, IBR Certificate
28.	Sampling racks :
	Hydro test, IBR Certificate for tubes and fittings.
29.	S02 / Nox analyser / SPM analyser:
	Calibration test, accuracy test
30.	Interposing relay
	Functional test, temperature rise test, H.V test, Insulation test
31.	Transmitter Racks :
	Hydro test, air leak test for piping / tubing and fittings. IBR certification as required for tubing / piping and fittings.
32.	Pressure Transmitter
	Calibration test / Hydro test / Leak test / Over range test / Accuracy test / Repeatability test.
33.	Differential pressure transmitter
	Calibration test / Hydro test / Leak test / Over range test / Accuracy test / Repeatability test.
34.	Temperature Transmitter
	Calibration test / Accuracy test /Ambient temperature error test
35	Pneumatic & Hydraculic Block Valves

	a) IBR certificate form III C b) Hydrostatic test : ANSI B 16.34 c) Seat leakage test : As per ANSI B 16-104 d) CV test: As per ISA procedure e) Magnetic particle test ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 DegC) f) Liquid penetration test: ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 DegC) g) Radiography test: ANSI B 16.34 special class h) Calibration and Hysteresis test i) Actuator leakage test
36.	Pressure Regulating Valve (Pneumatic & Hydraculic type)
	a) IBR certificate form III C b) Hydrostatic test : ANSI B 16.34 c) Seat leakage test : As per ANSI B 16-104 d) CV test: As per ISA procedure e) Magnetic particle test ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 DegC) f) Liquid penetration test: ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 DegC) g) Radiography test: ANSI B 16.34 special class h) Calibration and Hysteresis test i) Actuator leakage test
37.	Local Panels : Visual inspection, wiring & continuity check, H.V. and I.R. tests on panels, checking of bill of materials, functional tests.
38	Wiring Termination & Accessories
	Routine test: Conductor resistance test/High voltage test/Impulse dielectric test/insulation test/Humidity test/Temperature rise test on power circuits/short time current test on power circuits.
	Type test:Annealing test/Test for insulation and sheath/ Flame retardance test - a) Oxygen index, b) Flammability / Test for acid gas generation/test for water absorption/wet dielectric test
39	Marshalling/System cabinets
	Verification of degree of protection/Electrical tests as detailed under wiring Termination& accessories/Type test and routine test as per relevant Indian standards.
40.	Transmitter/Switch Enclosures & Racks :
	Hydro test, air leak test for piping / tubing and fittings. IBR certification as required for tubing / piping and fittings.
	Notes:

	1. Test Certificates in addition to inspection at manufacturers works shall be furnished for all the instruments for Owner's review. 2. Above Test to be witnessed shall be finalized by Owner.
	3. In addition to above test, test as per approved QAP shall also be witnessed by owner.

13.02.05 TYPE TESTING

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

A. Out of these test listed , the bidder /subvendor/manufacturer is required to conduct certain type test specifically for this contract (and witnessed by employer or his authorized representative). Even if the same have been conducted earlier as clearly indicated subsequently such tests.

B. For the rest, submission of type test , results, and certificates shall be acceptable provided following points

i. The same has been carried within last five years from the date of bid opening.

ii. The same have been carried out by the bidder/ subvendor on exactly the same model/rating of equipment. (For control valves this shall be same size, type & design).

iii. There has been no change in the components from the offered equipments and tested equipments.

iv. The test has been carried out as per the latest standards along with amendemends as on the date of bid opening.

v. The test should have been either carried out at any Govt. approved laboratory and test witnessed by a client of Government Department / Government

C. In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the bidder/sub-vendor within the quoted price and no extra cost will be payable by the owner on this account.

13.02.05.1 As mentioned against certain items, the test certificates for some of the items shall be reviewed and approved by the main bidder or his authorized representative and balanced have to be approved by the employer.

The schedule of conduction of type test/submission of reports shall be submitted and finalized during pre award discussion.

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

13.02.05.3 SPECIAL REQUIREMENTS FOR SOLID STATE EQUIPEMNTS /SYSTEMS

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

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

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

ii. The dry heat test as per IEC-68-2-2 or equivalent
iii. Damp heat test as per IEC 68-2-3 or equivalent
iv. Vibration test as per IEC 68-2-6 or equivalent
v. Electrostatic Discharge test as per EN 61000-4-2 or equivalent
vi. Radio frequency immunity test as per EN 61000-4-6 or equivalent
vii. Electromagnetic Field Immunity test as per EN 61000-4-3 or equivalent

Test listed at Item no v, vi, vii above are applicable for electronic cards only as defined under item no. (i) above

13.02.05.4 TYPE TEST REQUIREMENTS FOR C&I SYSTEMS

S.No.	Item	Test requirement	Standard	Test to be specifically conducted	Owner's Approval required on Test Certificate
1	Electrical metering instruments	As per standards	IS 1248	No	Yes

2	Thermocouple	Degree of Protection Test	IS - 13947	No	No.
3	Junction Box	Degree of Protection Test	IS - 13947	Yes	Yes
4	RTD	As per standards	IEC-60751	No	No
5	Electronic Transmitter	As per standards	BS 6447/IEC 60770	No	Yes
6	E/P convertor	As per standards	Manufacturing standard	No	Yes
7	Instrumentation cable (Twisted and shielded) (Refer Vol. V, Chapter 9)				
8	Battery	As per standard	IS 10918	Yes	YES
9.	Voltage stabiliser	Over load test	Approved procedure	No	YES
		Temp. rise test without redundant fans	Approved procedure	No	YES
		Input voltage variation test	Approved procedure	No	YES
10	**DDCMIS/DCS**				
	CLCS system	Model Test	Approved procedure	No	No
	BMS & MFT	Safety requirement	VDE 0116, SEC 8.7	No	YES
11	Conductivity type level switch	Degree of protection test	IS 13947	No	No
12	Local gauges	Degree of protection test	IS 13947	No	No
13	Process actuated switches	Degree of protection test	IS 13947	No	No
14	Control valves of each type (Pneumatic & Hydraculic)	CV test	ISA 75.02	No	YES
15	PLCs	As per Standard	IEC 1131	No	YES
16	LIE/LIR	Degree of protection test	IS 13947	YES	YES
17	Flue gas O2 analyser, other Flue gas Analysers	Degree of protection test	IS 13947	No	YES
18	Flow nozzles	calibration	ASME PTC BS	YES	YES

	& Orifice plates		1042		

Note:
Type test are to be conducted only for the items, which are being supplied as part of this package.

A. For batteries with electric power supply system of main plant C&I, the bidder shall submit for owner's approval the reports of all the type tests as per IS-10918 carried out within last 5 years from the date of bid opening and the test should have been either conducted at an independent laboratory or should have been witnessed by a owner/client. The complete type test report shall be for any rating of battery in a particular group, based on plate dimensions being manufactured by supplier.

For batteries with electric power system of auxiliary plants, type test reports for batteries shall be as per standard –practice of manufacturer.

13.02.06 Testing at Site [Prior to commercial operation]

a. All equipment shall be checked thoroughly in respect of the following:

i. Visual and mechanical testing

ii. Complete system configuration loading functions; system diagnostics; system proper operation specified power supply specifications.

iii. Checking of loop configuration & OS displays; correct functioning of all keyboards; correct change-over of redundant devices; proper functioning of printer, sample printing of all types of log reports, shutdown reports and MIS reports; shutdown system.

iv. Loading of user's programme and checking out of results.

Repeating any or all such tests (as necessary) as performed at works.

b. Modulating Control Loop Test

Loop test performed after calibration of all instruments and leak test of signal lines to check the functional performance of all elements of loop. Control loop testing shall be generally by simulation of process conditions and shall fix points namely 0%, 25%, 50%, 75% and 100% of full scale inputs. The field/receiver pressure switches shall be simulated for abnormality by disconnecting the wires of terminals and checking the function of all associated systems. Performance of individual loops may be accepted for an overall accuracy of $\pm$0.5%. After the loop test is complete, the bidder shall connect back any terminations and connections removed for loop check.

c. Protection, Interlocking Sequence Control Loop Checking

	UPPUR STPP (STAGE-I, UNIT#1&2) 2X800MW	
	TECHNICAL SPECIFICATION (C&I) FOR DEBRIS FILTER	

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INSTRUMENTATION CABLE, CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY

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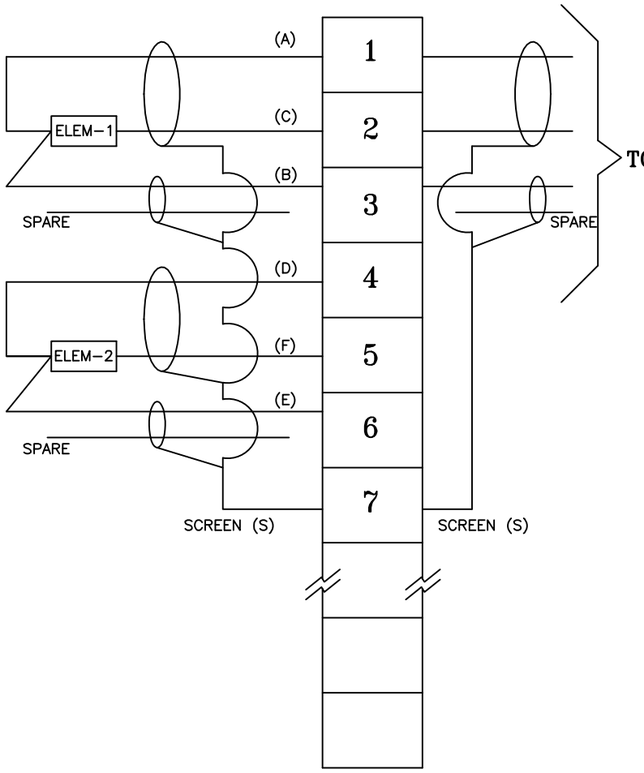
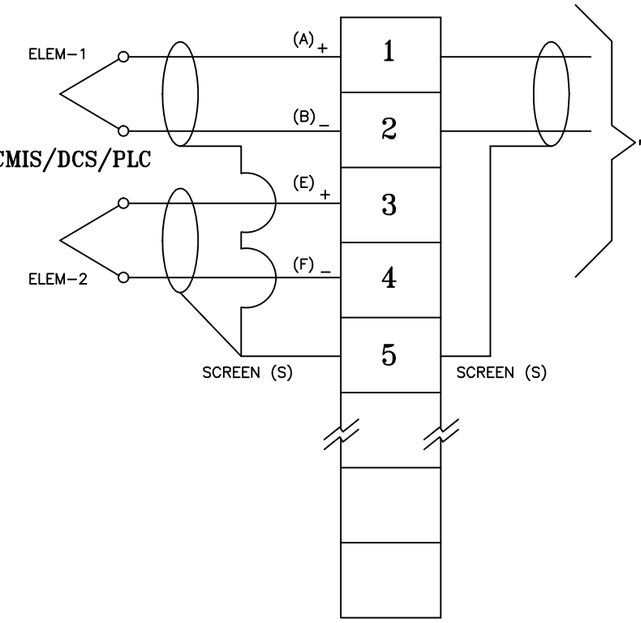
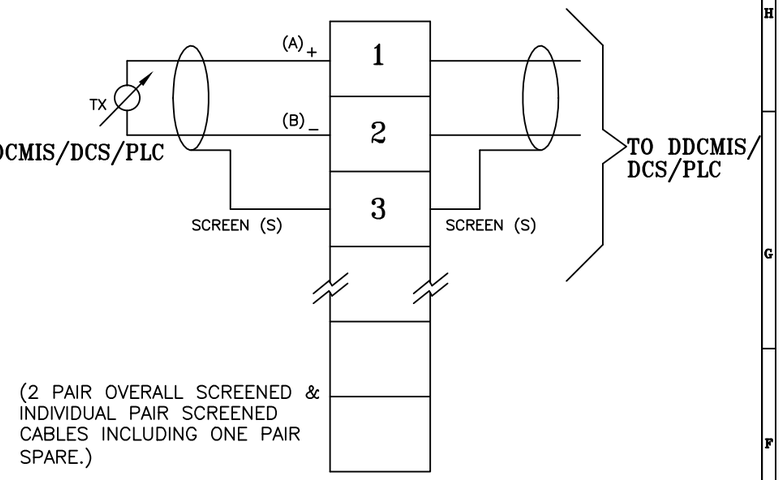


TYPICAL CONNECTION DIAGRAM
FOR DUPLEX RTD



TYPICAL CONNECTION DIAGRAM
FOR DUPLEX THERMOCOUPLE



TYPICAL CONNECTION DIAGRAM
FOR TRANSMITTER

NOTE :–

1. SPLITTING OF CABLE MAY OCCUR WHEN TERMINALS REQD FOR AN ELEMENT ARE LOCATED ON SEPARATE STRIPS.
   HENCE, NO. OF TBS ON A TERMINAL STRIP SHALL BE ADDJUSTED TO PREVENT SPLITTING.
   20% SPARE TB SHALL BE PROVIDED.
2. SCREENS SHALL BE EARTHED AT DDCMIS/DCS/PLC END ONLY. NO EARTHING OF SCREEN TO BE DONE AT JB/INSTRUMENT END
3. OVERALL SCREEN OF OUTGOING AND ASSOCIATED INCOMING CABLE TO BE CONNECTED TOGETHER ON A SPARE TERMINAL
   AND THEN CONNECTED TO EARTH AT DDCMIS/DCS/PLC END.
4. FOR SWITCH, BOTH CONTACTS SHALL BE CONNECTED TO JBs WITH 2 PAIR OVERALL SCREENED & INDIVIDUAL SCREENED PAIR CABLES.

FOR BID PURPOSE ONLY

SR. No.	PARTY
PRINT DISTRIBUTION	

REFERENCE DRAWINGS.

NOTES

1. DO NOT SCALE, ASK WHEN IN DOUBT.
2. ALL DIMENSIONS ARE IN MILIMETRES UNLESS NOTED OTHERWISE.

NOTICE

REVISIONS

ZONE	MARK	PARTICULARS	DATE
	6		
	5		
	4		
	3		
	2		
	1		
	0	FOR BID PURPOSE ONLY	19.08.15

APPROVED

CIVIL	MECH.	ELEC.	C&I	H.O.D.
			SLN	

PROJECT	**2x800MW SUPERCRITICAL COAL BASED UPPUR THERMAL POWER PROJECT**
OWNER	TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED
OWNER CONSULTANT:-	DESEIN CONSULTING ENGINEERS NEW DELHI – INDIA

CAD/DRAWN	SANDEEP	20.07.15
DESIGNED	SKM/SN	17.07.15
CHECKED	SKM	22.07.15
APPROVED	SKM	19.08.15

TITLE: TYPICAL WIRING ARRANGEMENT IN JB

SCALE:

JOB. No. D–0420

DWG. No. 114–13–0103 (Sheet No. 1 of 1)

REV. 0

APPRD. FOR CONSTRUCTION:

8.04.04.4 INSTRUMENTATION CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY

The cable interconnection philosophy to be adopted shall be such that extensive grouping of signals by large scale use of field mounted group Junction Baxes (JBs) at strategic locations is done and consequently cable with higher numbers of pairs are extensively used between field & Marshalling panels. The details of termination to be followed are mentioned in the given table below:-

Application	**Type of Termination**		
FROM (A)	**TO (B)**	**END A**	**END B**
Valves/Dampers Drives (Integral Junction Box)	Marshalling/ Marshalling-cum Termination Cubicle/ Local group JB	Plug in connector	Post mount cage clamp type
Transmitters, Process Actuated switches mounted in LIE/LIR	Integral Junction Box of LIE/LIR	Plug in connector	Cage clamp (Rail mount type)
RTD heads	Local Junction Box	Plug in Connector	Cage clamp (Rail mount type)
Thermocouple	Local Junction Box	Plug in Connector	Cage clamp (Rail mount type)
Other Field mounted Instruments	Local JB/ Group JB	Plug in Connector	Cage clamp (Rail mount type)
RTD heads	Temperature transmitter	Plug in Connector	Screwed Cage Clamp Type
Thermocouple	Temperature Transmitter	Plug in Connector	Screwed Cage Clamp Type
Local Junction box, Temperature Transmitter, Int. Junction box of LIE/LIR/Group JBs.	Group JB	Cage clamp (Rail mount type)	Cage clamp (Rail mount type)
Local Junction box, Temperature Transmitter, Int. Junction box of LIE/LIR/Group JB/ MCC/SWGR	Marshalling/ Marshalling – cum Termination Cubicles.	Cage clamp (Rail mount type)	Cage clamp (Post mounted type)
Marshalling cubicle/Termination System Cabinets	Electronic system Cabinet	Cage clamp (Post mounted type)	Plug-in connector/other system as per Mfr's standard
Marshalling/ Termination System Cabinets	UCD mounted equipments	Cage clamp (Post	Plug in Connector/ Cage

		mounted type)	clamp Type (rail mounted)
DDCMIS/PLC cabinets	OWS, Printer etc.	Plug in connector	Plug in Connector

Notes

1. For Analog signals, individual pair shieldiing & overall shielding & for Binary signals, only overall shielding of instrumentation cables (> 2 pair) shall be provided.

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

3. All screwed connections shall be provided with double compression type Nickel-plated brass cable glands.

4. All spare contacts/terminals on relays, control switches, limit switches or similar devices, process switches, duplex RTDs & Duplex T/Cs shall be wired to accessible terminal blocks/JBs for future connections. All wiring leaving a junction box or enclosure shall leave from terminal blocks and not from other devices in the enclosure. Two (2) pair (individual & overall shielded) cables shall be provided for terminating the thermocouples, transmitters & switches i.e Analog & Binary signals to local JBs. Similarly four (4) pair (individual & overall shielded) cables shall be provided for terminating the Duplex (3 wire) RTD to local JBs.

   Four (4) pair (individual & overall shielded) cables shall be provided for terminating the switches to local JBs, where both NC & NO contacts are used in DDCMIS/DCS/PLC.

5. Separate mutipaired cable shall be provided for each drive between MCC/SWGR and DDCMIS/PLC.

6. 10% spare pairs or min 1 pair cable (which ever is more) shall be provided with all type of cables.

8.04.04.5 Conduits

Conduits shall be generally used for interconnecting cables from instruments to local JB's. All rigid conduits, couplings and elbows shall be hot dipped galvanised rigid mild steel in accordance with IS:9537 Part-I (1980) and Part-II (1981). The conduit interior and exterior surfaces shall have continuous zinc coating with an overcoat of transparent enamel lacker or zinc chromate. Flexible conduit shall be heat resistant lead coated galvanised steel with, water leak, fire and rust proof protected for the areas of Mills, Drum, Main steam, RH steam Air Heaters and Furnace, BFPDT's.

And for remaining applicartion, water leak, fire and rust proof flexible GI conduits shall be provided. The temperaturerating of flexible conduit shall be suitable for actual application.

The Bidder shall install conduits according to the general routing as approved by owner and shall coordinate conduit locations with other works.

All grounding bushings within all enclosures shall be wired together and connected internally to the enclosure grounding lug or groubnding bus with 8 AWG bare copper conductors. Conduit runs to individually mounted equipment shall be groubnded to the Owner's cable tray grounding conductor with 12 AWG bare copper conductor. All grounding bushing, clamps, and connectors shall be subject to approval of the owner.

All rigid conduit fiitings shall conform to the requirements of IS: 2667, 1976. Galvanised steel fittings shall be used with steel conduits. All flexible conduit fittings shall be liquid tight, galvanised steel. The end fittings shall be compatible with flexible conduit supplied.

All individually mounted equipment and devices shall be connected to the supply conduit, using not more than one metre of flexible conduit adjacent to the equipment or device. Flexible conduit shall be installed in all conduit runs, which are supported by both building steel and structures subject to vibration or thermal expansion. This shall include locations where conduit supported by building steel enters or becomes supported by the turbine generator foundation and where conduit supported by building steel or foundation becomes supported by steam generator framing.

Special areas, such as control rooms in which external noise is to be minimized, shall have flexible conduit in conduit runs where the runs cross from the main Duilding framing to the control room framing.

Conduit supports shall be furnished and installed in accordance with these specifications. Support material shall comply with the following requirements.

i) Hanger rods shall be 12 mm diameter galvanized threaded steel rods.

ii) Single conduit supports shall be one-hole cast metal straps and clamp backs unless other types are acceptable to the Employer. Multiple conduit bank supports shall be constructed of special galvanized support channels with associated conduit clips.

Conduit sealing, explosion proof, dust proof and other types of special fittings shall be provided as required by these specification and shall be consistent with the area and equipment with which they are installed. Fittings installed outdoors and in damp locations shall be sealed and gasketed. Hazardous area fittings and conduits sealing shall conform with NEC requirements for the area classification.

Bidder shall provide double locknuts on all conduit termination not provided with threaded hubs and couplings. Water tight conduit unions and rain tight conduit hubs shall

be utilised for all the application which shall be exposed to weather. Moisture pockets shall be eliminated from conduits.

Conduits shall be securely fastened to all boxes and cabinets.

	UPPUR STPP (STAGE-I, UNIT#1&2) 2X800MW	
	TECHNICAL SPECIFICATION (C&I) FOR DEBRIS FILTER	

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SUB VENDOR LIST

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SUB VENDOR LIST AS ON 12-10-2017

Package Name	Vendor Name	Vendor Works Address
PRESSURE SWITCH/DIFF. PRESSURE SWITCH	DRESSER INDUSTRIES INC.	
PRESSURE SWITCH/DIFF. PRESSURE SWITCH	GENERAL INSTRUMENTS CONSORTIUM	
PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Barksdale GmbH, Germany	
PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SWITZER PROCESS INSTRUMENTS PVT. LTD.	Works-1->C S Shankar 127, Sidco North Phase, Ambattur Estates, -CHENNAI-TAMIL NADU INDIA Phone- 8754491904 FAX : 044-26248849 Pincode : 600050 Email : cservice@switzerinstrument.com
PRESSURE SWITCH/DIFF. PRESSURE SWITCH	PRECISION MASS PRODUCTS PVT. LTD.	Works-1->Mr. Hitesh Parmar/Mr. Hitesh Parmar Plot No.2306, Phase II, GIDC Chhatral, -Kalol-GUJARAT INDIA Phone- 9327359227 FAX : 02764-233440 Pincode : 382729 Email : hitesh.parmar@ashcroftindia.com
PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS INDUSTRIES LIMITED	
PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SOR INC.	Works-1->LARRY DEGARMO/ ROY STUMBOUGH 14685 W. 105TH STREET, LENEXA -KANSAS- USA Phone- 913-888-0767 FAX : 913-888-0767 Pincode : 66215 Email : rstumbough@sorinc.com
PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS (INDIA) LIMITED	
PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Kaustubha Udyog,	
PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INDUSTRIES	Works-1->NA NA -- Phone- FAX : Pincode : Email :
PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	BOSE PANDA INSTRUMENTS PVT.LTD.	Works-1->Mr. Partha Bose 44, Saheed Hemanta Kumar Bose,Sarani, -Kolkata-WEST BENGAL India Phone- +91 33 2548 7220 FAX : +91 33 2548 0429, Pincode : 700074 Email : parthabosebpi@gmail.com bosepanda@vsnl.net
PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	Works-1->Mr. Gautam Mukherjee Kusumba,Sonarpur Station Road,P.O. -Narendrapur, -Kolkata-WEST BENGAL INDIA Phone- 9836878855 FAX : 033-24342748 Pincode : 700103 Email : gkm_ani@hotmail.com
PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Works-1->Mr. Hitesh Parmar/Mr. Hitesh Parmar Plot No.2306, Phase II, GIDC Chhatral, -Kalol-GUJARAT INDIA Phone- 9327359227 FAX : 02764-233440 Pincode : 382729 Email : hitesh.parmar@ashcroftindia.com
PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Baumer Technologies India Pvt. Ltd.	Works-1->Mr. Shyam Warilani/Mr. V Suresh Babu Plot No 34 À GIDC À Phase 1, -VAPI-GUJARAT INDIA Phone- +91 11 4161 7111 FAX : 022 2687 3613 Pincode : 396 195 Email : pbajaj@baumer.com

PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	Works-1->Shikha Hazra/ Shyamal Hazra 32, Industrial Suburb,Yeshwanthpur -BANGALORE-KARNATAKA INDIA Phone- 080-23370300 FAX : 080-23379890 Pincode : 560022 Email : shikhahazra@hgurusouth.com
PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	FORBES MARSHALL (HYD) LTD.	Works-1->MR G.SRINIVASAN/MR ANUJ MALPANI PLOT NO:A-19/2 & T-4/2,I.DA. NACHARAM , -HYDERABAD-TELANGANA INDIA Phone- 09866550762 FAX : 040 27152193 Pincode : 560076 Email : gshrinivasan@forbesmarshall.com
PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	Works-1->Gauge Bourdon India Pvt. Ltd., Plot No-4, 5, 6,Jawahar Co-operative Industrial Estate, -Kalamboli Taluka Panvel-MAHARASHTRA India Phone- 022-27421095, FAX : 022-27421901, Pincode : 410209, Email : info@general-gauges.com
PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Works-1->Scientific Center, Others By-Pass Junction,Near Kalsekar College kausa, mumbra,Thane -Mumbai-MAHARASHTRA INDIA Phone- 022-25491409,9892230623 FAX : Pincode : 400612 Email : sdbpl@vsnl.com
PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Nesstech Instruments Private Limited	Works-1-> Others 26/2, G Type, Global Ind. Park Near Nahuli Railway Crossing, -Vapi-GUJARAT INDIA Phone- 9920576002 FAX : Pincode : 396105 Email : sales@nesstech.co.in, bkapadia@nesstech.co.in
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TRANSMITTERS	Pune Techtrol Pvt. Ltd.	
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TRANSMITTERS	YOKOGAWA INDIA LIMITED,	Works-1-> PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, -BANGALORE-KARNATAKA INDIA Phone- 080-41586000, FAX : 080-28521442, Pincode : Email : uday.shankar@in.yokogawa.com
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TRANSMITTERS	NIVO CONTROLS PVT. LTD.	Works-1->Mr. Praveen Toshniwal 104-115, Electronic Complex, -Indore-MADHYA PRADESH India Phone- 0731-4081305 FAX : 0731-255075 Pincode : 452010 Email : sales@nivocontrols.com
TRANSMITTERS	SMART INSTRUMENTS LTD, BRAZIL	
TRANSMITTERS	Honeywell Automation India Limited	Works-1->Mr.Kedar Tillu 53, 54, 56 & 57,Hadapsar Industrial Estate -PUNE-MAHARASHTRA INDIA Phone- 9665034625 FAX : 020 66039905 Pincode : 411013 Email : kedar.tillu@honeywell.com
JUNCTION BOX	Shrenik & Company,	Works-1->Mr.Pulin Shah/ Mr. Kaloesh Parmar 39 A/3 ,Panchratna Industrial Est,Sarkhej-Bavla Road, Changodhar -Ahmedabad-GUJARAT INDIA Phone- 98250 80339 1 FAX : 079-26932424 Pincode : 382213 Email : sales@sumip.com
JUNCTION BOX	SUCHITRA INDUSTRIES	Works-1->B. Srinivas Suchitra Industries, Opp No 53, Muneshwara Black Devinagar, Lottagal hal -BANGALORE-KARNATAKA INDIA Phone- 080-23511247 FAX : Pincode : 560094 Email : suchitra_industries@yahoo.com
JUNCTION BOX	FLEXPRO ELECTRICALS PVT. LTD.	Works-1->Mr. Dineshbhai Zaveri CEO C-1/ 27&37, GIDC, Kabilpore, -Navsari-GUJARAT INDIA Phone- 02637-265140,265003 FAX : 02637-265308 Pincode : 396424 Email : flexpro@flexproltd.com
JUNCTION BOX	K.S.INSTRUMENTS PVT.LTD.	
JUNCTION BOX	AJMERA INDUSTRIAL & ENGINEERING WORKS	Works-1->JIGNESH MAHENDRA AJMERA DENA BANK BLDG., SHREE NAGESHINDL. ESTATE,STATION ROAD, -MUMBAI-MAHARASHTRA INDIA Phone- 022 67973578 FAX : Pincode : 400 088 Email : ajmera@ajmera.net
INSTRUMENTS TUBE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	Works-1->S.R.SINGH/ NAVEEN SINGH B - 2, SECTOR - 6, -NOIDA-UTTAR PRADESH INDIA Phone- 0120-4352940 FAX : 0120-4352940 Pincode : 201301 Email : naveensingh@vsnl.com
INSTRUMENTS TUBE FITTINGS	Fluid Controls Pvt. Ltd.	Works-1->Mr. Tansen Choudhari/Mr. Mahesh Darekar Shed No.8, Lonavla Indl.Co-op.Estate Ltd,Nagargaon, -Lonavla-MAHARASHTRA INDIA Phone- 9823951347 FAX : (02114) 271132 Pincode : 410 401 Email : factory@hyd-air.com
INSTRUMENTS TUBE FITTINGS	PRECISION ENGINEERING INDUSTRIES	Works-1->ALEX BAPTIST/ K. SRINIVAS 7. SIDHAPURA INDUSTRIAL ESTATE,SV ROAD, GOREGAON(WEST) -MUMBAI-MAHARASHTRA INDIA Phone- 022-42631700 FAX : 022-40035259 Pincode : 400 062 Email : srinivas@precision-engg.com
INSTRUMENTS TUBE FITTINGS	AURA INCORPORATED	
INSTRUMENTS PIPE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	Works-1->S.R.SINGH/ NAVEEN SINGH B - 2, SECTOR - 6, -NOIDA-UTTAR PRADESH INDIA Phone- 0120-4352940 FAX : 0120-4352940 Pincode : 201301 Email : naveensingh@vsnl.com
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INSTRUMENTS PIPE FITTINGS	AURA INCORPORATED	

INSTRUMENT FITTINGS	AURA INCORPORATED	
INSTRUMENT FITTINGS	Comfit & Valve Pvt. Ltd.	Works-1->Miss Sonal Pithadia/Miss Pavan Chavda Survey No. 23/1, Part 2, Ahmedabad-Mehsana Highway, Laxmipura -Nandasan-GUJARAT INDIA Phone- 8460848087 FAX : 2764-267036/37 Pincode : 382705 Email : domestic@com-fit.com
INSTRUMENT FITTINGS	HP VALVES & FITTINGS INDIA PVT. LTD.	Works-1->S. Harichandran/ P.S. Pandi B-11, Mugappair Industrial Estate, -CHENNAI-TAMIL NADU INDIA Phone- 044-25252537 FAX : 044-26252538 Pincode : 600037 Email : sales@hpvalvesindia.com
INSTRUMENT FITTINGS	Arya Crafts & Engineering Pvt. Ltd.	
INSTRUMENT FITTINGS	Perfect Instrumentation Control (India) Pvt. Ltd.	Works-1->Shahanawaz Khan Vishweshwar Ind. Premises Co-op Soc. Ltd,F-18/19, Pradhikaran,Bhosadi MIDC -PUNE-MAHARASHTRA INDIA Phone- 020-30694134 FAX : 022-23013010 Pincode : 411026 Email : shahanawaz.khan@perfectinstrumentation.com
INSTRUMENT FITTINGS	PRECISION ENGINEERING INDUSTRIES	Works-1->ALEX BAPTIST/ K. SRINIVAS 7. SIDHAPURA INDUSTRIAL ESTATE,SV ROAD, GOREGAON(WEST) -MUMBAI-MAHARASHTRA INDIA Phone- 022-42631700 FAX : 022-40035259 Pincode : 400 062 Email : srinivas@precision-engg.com
INSTRUMENT FITTINGS	FLUIDFIT ENGINEERS PVT. LTD.	Works-1->Mr. Abbas Bhola Unit No. 16, Supreme Industrial Estate,Kaman Bhiwandi Road,Devdal, -Vasai East-MAHARASHTRA India Phone- 9920044113 FAX : 07303178243 Pincode : 401208 Email : ab@fluidfitengg.com
INSTRUMENT FITTINGS	VIKAS INDUSTRIAL PRODUCTS	Works-1->S.R.SINGH/ NAVEEN SINGH B - 2, SECTOR - 6, -NOIDA-UTTAR PRADESH INDIA Phone- 0120-4352940 FAX : 0120-4352940 Pincode : 201301 Email : naveensingh@vsnl.com
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INSTRUMENT FITTINGS	PANAM ENGINEERS	Works-1->Mr. Santosh Shukla Others R-628,TTC Industrial Area, MIDC Rabale, -Navi Mumbai-MAHARASHTRA India Phone- 9821350761, FAX : 022-27695559, Pincode : 400701, Email : sales@panamengineers.com

Note:-

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

2. New Sub-vendor if proposed by vendor during contract stage shall subject to BHEL/ End user approval without any commercial/delivery implication.

SUB-SECTION – ID

DATASHEET-A

	DATA SHEET - A		SPECIFICATION NO.: PE-TS-425-165-N003
	DEBRIS FILTER (DF)		REV. NO.: 00; DATE : 25.05.2017
	FOR SEA WATER APPLICATION		SECTION : I SUB-SECTION : ID
SL NO	**DESCRIPTION**	**UNITS**	**PROJECT: 2 X 800 MW SUPERCRITICAL COAL BASED UPPUR BTG**
1.00	**GENERAL**		
1.1	No. of Strainers/ Filters required for station	Nos.	Total 4 Sets (viz. 2 Nos. Per Unit)
1.2	Liquid Handled		Sea water (Refer enclosed water analysis at Annexure III of Datasheet A)
1.3	Size of Debris Filter Shell	NB	2700
1.4	Length of Debris Filter Shell	mm	Maximum 5000 including counter flanges (Flap of butterfly valve shall be extended to approx 500 mm inside the Debris Filter from starting edge of C/F)
1.5	Scope of Counter Flange of Debris Filter Shell		In Bidder's Scope. (Associated Gaskets, nuts and bolts are in Bidder's Scope)
1.6	BOQ for Debris Discharge Piping (For Sea water).		1. Dia of pipe: To be decided by bidder 2. Length of pipe: (In Purchaser's Scope) – Bidder to furnish the BOM & Isometric Drawing 3. No. of bends: (In Purchaser's Scope) – Bidder to furnish the BOM & Isometric Drawing
1.7	Filter type/ duty		On line / continuous
1.8	Location		Condenser Inlet (Outside TG Hall)
2	**DESIGN DATA**		
2.1	Operating pressure at Debis Filter Inlet Flange	kg/cm2 (g)	2.0 to 2.5
2.2	Design pressure for Debis Filter Shell	kg/cm2 (g)	5 Kg/cm2 (g) & Vacuum 0.1Kg/cm2 (abs)
2.3	Design Mechanical temperature	Deg. C	60
2.4	Flow rate through filter		
	a) Normal	Cub m/Hr	46738
	b) Maximum	Cub m/Hr	56086
2.5	Design differential pressure for filter section/ screen	kg/cm2 (g)	1.5 (Min.)
2.6	Type of suspended matter likely to enter the filter		Typical debris encountered in closed circuit CW system with Cooling Tower

	DATA SHEET - A		SPECIFICATION NO.: PE-TS-425-165-N003
	DEBRIS FILTER (DF)		REV. NO.: 00; DATE : 25.05.2017
	FOR SEA WATER APPLICATION		SECTION : I SUB-SECTION : ID
SL NO	**DESCRIPTION**	**UNITS**	**PROJECT: 2 X 800 MW SUPERCRITICAL COAL BASED UPPUR BTG**
2.7	Differential pressure measuring system set pressure		
	• For initiating flushing/ backwashing	mbar	90
	• For alarm/ annunciation	mbar	160
2.8	Filter section/ screen perforation size	mm	5 mm (Max)
2.9	Free flow area in the screen basket		Atleast 110 % of pipe inlet area
2.1	Debris discharge flow during flushing period	Cub m/ Hr.	Not to exceed 2.5% of total flow rate
3	**GUARANTEED PERFORMANCE REQUIREMENT**		
3.1	Pressure drop across the filter (i.e. between inlet and outlet connection) at normal flow		
	a) Clean condition	mbar	60
	b) Partially (50%) chocked condition	mbar	90
4	**MATERIALS OF CONSTRUCTION**		
4.1	Filter body/ housing along with Body Flange		Filter Body - Duplex SS (UNS 32205/31803) Body Flange - Duplex SS (UNS 32205/31803 or eq.) (Housing thickness to be decided by bidder and detailed thickness calculation shall be submitted by bidder to BHEL during detailed engineering. However, in any case, housing thickness shall not be less than 15 mm)
4.2	Connecting pipe (Inlet/ Outlet)		Carbon Steel to IS 2062 with internal Polyurea /corrocoat
4.3	Filter screen/ section		Duplex SS (UNS 32205/31803)
4.4	Shaft		Duplex SS (UNS 32205/31803)
4.5	Supporting cage		Duplex SS (UNS 32205/31803)
4.6	Differential measuring system		Super Duplex SS
4.7	Flushing/ backwashing unit		Duplex SS (UNS 32205/31803)
4.8	Backwash rotor shoes		Neoprene
4.9	Any other internal hardware /pipes etc.		Duplex SS (UNS 32205/31803)
4.10	Flushing Pump (If applicable)		
	a) Casing		Duplex SS (UNS 32205/31803)
	b) Impeller		Duplex SS (UNS 32205/31803)
	c) Shaft		ASTM (A276 UNS 31803)

	DATA SHEET - A		SPECIFICATION NO.: PE-TS-425-165-N003
	DEBRIS FILTER (DF)		REV. NO.: 00; DATE : 25.05.2017
	FOR SEA WATER APPLICATION		SECTION : I SUB-SECTION : ID
SL NO	**DESCRIPTION**	**UNITS**	**PROJECT: 2 X 800 MW SUPERCRITICAL COAL BASED UPPUR BTG**
4.11	Valves		
4.11.1	Check Valves (65 NB & Above)		For sizes 65 NB and above-Swing check type or dual plate type.
	a) Body & Bonnet		Duplex SS (UNS 32205/31803), Flanged Ends
	b) Disc for Check Valve		Duplex SS (UNS 32205/31803)
	c) Stem		Duplex SS (UNS 32205/31803)
4.11.2	Check Valves (50 NB & Below)		For size 50 NB and below-Piston type
	a) Body & Bonnet		Duplex SS (UNS 32205/31803), Screwed Ends
	b) Disc for Check Valve		Duplex SS (UNS 32205/31803)
	c) Stem		Duplex SS (UNS 32205/31803)
4.11.3	Gate/ Globe Valves 50 Nb & Below		
	Body & Bonnet		Duplex SS (UNS 32205/31803), Screwed Ends
4.11.4	Gate/Globe Valves (65NB & above)		
	➢ Body & Bonnet		Duplex SS (UNS 32205/31803)
	➢ Disc		Duplex SS (UNS 32205/31803)
	➢ Stem		Duplex SS
	➢ Companinon Flange		Duplex SS (UNS 32205/31803)
4.11.5	BFV Valves (65NB & above)		
	➢ Body & Disc		Duplex SS (UNS 32205/31803)
	➢ Sealing, Retaining segment & internals		EPDM
	➢ Bearing		Duplex SS (UNS 32205/31803)
	➢ Companinon Flange		Duplex SS (UNS 32205/31803)
4.11.6	Ball valves		
	i) Body		Duplex SS (UNS 32205/31803)
	ii) Ball		Duplex SS (UNS 32205/31803)
	iii) Stem		Duplex SS (UNS 32205/31803)

	DATA SHEET - A		SPECIFICATION NO.: PE-TS-425-165-N003
	DEBRIS FILTER (DF)		REV. NO.: 00; DATE : 25.05.2017
	FOR SEA WATER APPLICATION		SECTION : I SUB-SECTION : ID
SL NO	**DESCRIPTION**	**UNITS**	**PROJECT: 2 X 800 MW SUPERCRITICAL COAL BASED UPPUR BTG**
4.12	Debris discharge/ Interconnecting Piping material		In Purchaser's Scope
	MATERIAL		a) Upto 300 Nb - DUPLEX SS (AS PER SCH 40S FOR PIPE UPTO 50 NB & SCH 10S FOR PIPE SIZE ABOVE 50 NB) b) 350 NB and above - PIPING 350 NB AND ABOVE SHALL BE CARBON STEEL AS PER IS 3589 FABRICATED FROM IS 2062 PLATES INTERNALLY LINED WITH CORROCOAT OR POLYUREA COATING INSIDE OF 2000 MICRONS DFT.
4.13	Inspection hole/ Man hole		Required 600mm
5	**COUNTER FLANGES FOR DEBRIS FILTER SHELL**		In Bidder's Scope
5.1	MATERIAL		
	a) Flanges		Carbon Steel to IS -2062 Gr.B. or eq (Internally Lined with CorroCoat or PolyUrea), drilling etc refer Annexure II of Datasheet-A
	b) Fasteners		Duplex SS
	c) Gaskets		Min 4 mm thick rubber
5.2	Drilling Standard		BS 4504 or equivalent
6	**OTHER COUNTER FLANGES**		
6.1	MATERIAL		
	a) Flanges		Same as Pipe MOC
	b) Fasteners		Duplex SS
	c) Gaskets		Min 4 mm thick rubber
7	**Material of Other components not specified above**		Suitable for intended duty and shall be subject to Purchasers approval during detailed engg. In the event of order.
8	**Connecting pipe size (OD x Thk)**	mm x mm	2740X20
9	**PAINTING**		
9.1	External Surface		
	a) Surface preparation		SA - 2.5 of Swedish Specn. SIS-05-59-00-1967 / By Sand Blasting
	b) Primer		Two (2) coats of Epoxy primer coats with minimum thickness of 35 microns dft of each coat.
	c) Intermediate Paint		Epoxy based TiO2 pigmented coat
	d) Final paint		Two (2) coats of High build Epoxy paint with minimum thickness of 35 microns dft of each coat

	DATA SHEET - A		SPECIFICATION NO.: PE-TS-425-165-N003
	DEBRIS FILTER (DF)		REV. NO.: 00; DATE : 25.05.2017
	FOR SEA WATER APPLICATION		SECTION : I SUB-SECTION : ID
SL NO	**DESCRIPTION**	**UNITS**	**PROJECT: 2 X 800 MW SUPERCRITICAL COAL BASED UPPUR BTG**
9.2	Internal Surface (for Applications not in Direct Contact with Sea Water)		
	a) Surface preparation		SA - 2.5 of Swedish Specn. SIS-05-59-00-1967 / By Sand Blasting
	b) Primer		Two coat of Epoxy Resin based Zinc Phosphate epoxy primer
	c) Final paint		Adequate no. of coats of coal tar epoxy paint to achieve total dry film thickness of 200 to 250 microns
10	**SHOP TEST**		
10.1	Hydrostatic test		
	a) Test Pressure	bar (g)	1.5 times design pressure
	b) Test duration	min.	30
10.2	Leakage test		
	a) Test Pressure	bar (g)	Design Pressure
	b) Test duration	min.	30
11	**Adequate provision for future installation of cathodic protection required**		YES (Along with Sacrificial type anodic protection by Bidder)
12	**Whether automatic flushing/ back- washing operation effected by the following :**		
	i. Differential pressure		YES
	ii. Adjustable timer		YES
	iii. Push button		YES
13	**Whether provision for manual flushing / backwashing operation is made in the event of control system failure.**		YES (if required)
14	**Whether built in flushing arrangement complete with flushing pump, valves, and associated piping, is provided.**		YES (if required)
15	**MANDATORY SPARES - to be supplied under this specification –**		
15.4	**C&I Spares**		**As per attached Annexure I**

Annexure I

2x800 MW UPPUR TPS - BTG Package

LIST OF MANDATORY SPARES

CONTROI & INSTRUMENTATION

Sl. No	Description		Quantities are per unit. In case of common system, quantities shall be doubled.	TANGEDCO Remarks	Categorization	Remarks of BHEL Units
1.00.01	**Measuring and Field Instruments**		The quantity of mandatory spares indicated herein shall be as per package basis			
1.00.01.01	**Indicators, Recorders, Electrical Metering and Skid Mounted Instruments**				III	Lot price considered for (i) and (ii)
(i)	Indicators, recorders and meters offered from each model for the project. These instruments shall be supplied with three sets of blank scales.	Nos.	10 % of Installed of each type/Model or a minimum of one number for each model and type, whichever is more.			
(ii)	For skid mounted instruments	Nos.	10% of total number of instruments, valves, C&I equipment, C&I item etc. for each Type and model or a minimum of one number for each model and type, whichever is more.			

Annexure I

Sl. No	Description		Quantities are per unit. In case of common system, quantities shall be doubled.	TANGEDCO Remarks	Categorization	Remarks of BHEL Units
1.00.01.03	**Temperature Transmitters and Electronic Transmitters (For Pressure, DP, Temp, Flow, Level), Process Transmitters, Level & Flow Transmitter for each type, Rota meters, Sight Flow indicators, Temperature, Pressure, Flow & Level Switch, safety & Protection switches, Gauges, Process meters, Junction Boxes, Position Transmitters/switches, Analysers, Transducer or any other instrument etc.**	Nos.	i.) 10% of total number of each item offered for each model and type for the project or a minimum of one number, whichever is more. ii.) 10% of Electronic card/PCB assembly and power supply card/module for each type, model & rating of Transmitter, analysers & Flow Meters.		III	Included

Annexure I

1.00.03.22	Pressure gauge, solenoid valves, temperature gauge, Back Pressure regulating valves, 3 way grab valves, needle valves, isolation valves, PRV, flow switch, flow indicator and temperature switch, erection hardware's, valves in SWAS.	Nos.	Two (2) no. of each type			
1.00.03.23	Primary coolers/secondary coolers.	Nos.	Three (3) No of each type			
1.00.04	**Relay based Control Panels**				III	Lot price considered for 1.00.04.01 to 1.00.04.08
1.00.04.01	LEDs for indicating lights	Nos.	100% of qty installed.			
1.00.04.02	Control circuit fuses/	Nos.	300% of installed of each type, current rating.			

Annexure I

Sl. No	Description		Quantities are per unit. In case of common system, quantities shall be doubled.	TANGEDCO Remarks	Categorization	Remarks of BHEL Units
1.00.04.03	Relays modules & contactors.	Nos.	20% spare of qty Installed of each type & rating.			
1.00.04.04	MCB/MCCB of each current rating	Nos.	Ten percent of each current rating required			
1.00.04.05	Cooling Fans of each type, model and rating.	Nos.	20% or 2 nos. of each type and rating, (whichever is more).			
1.00.04.06	Push buttons, ILPBs	Nos.	Ten (10) percent or 2 nos (whichever is more) of each type.			
1.00.04.07	Electric meter.	Nos.	Ten (10) percent or 2 nos (whichever is more) of each type			
1.00.04.08	Power supply modules.	Nos.	Ten (10) percent or 2 nos (whichever is more) of each type			
1.00.05	**Alarm Annunciation System**				III	Included
1.00.05.01	logic modules, group card modules, power supply modules, Hooters and any other electronic module.	Nos.	20% spares of each type installed			
1.00.05.02	un-engraved window boxes complete with LED etc.	Nos.	5% spares of each size installed			
1.00.05.03	LEDs for annunciation facia windows and LEDs box assemblies offered for the project	Nos.	20% of qty installed			
1.00.05.04	Annunciator hooter	Nos.	One (1) No. of each type			

Annexure I

1.00.07	**Erection hardware**				III	Lot price considered for 1.00.07.01 to 1.00.07.06
1.00.07.01	Instrument valves, manifold, fittings, impulse pipe, impulse tubes, drains pipes,	Nos.	Ten (10) percent of each type, rating, model number & Size installed			

Annexure I

Sl. No	Description		Quantities are per unit. In case of common system, quantities shall be doubled.	TANGEDCO Remarks	Categorization	Remarks of BHEL Units
1.00.07.02	Condensate pots of each type, rating , model no. & Size installed	Nos.	Ten (10) percent of total number of Installed or four numbers whichever is higher .			
1.00.07.03	Manifold	Nos.	Ten (10) percent of each type & Size installed			
1.00.07.04	Fittings	Nos.	Ten (10) percent of each type & Size installed			
1.00.07.05	MCB, and Power sockets used in LIE/LIR.		Ten (10) percent of each type.			
1.00.07.06	Fuses used in LIE/LIR.		Fifty (50) percent of each type.			

Annexure I

1.00.15	**Mandatory spares not covered above**				III	Included

Sl. No	Description		Quantities are per unit. In case of common system, quantities shall be doubled.	TANGEDCO Remarks	Categorization	Remarks of BHEL Units
	Sensor/instrument, analysers /special instruments/Electronic card, instrumentation/mechanical fittings etc. for any other electronic system, feeder control cabinets, hydrastep (EWLI), CCTV, C&I Lab Instruments, On line Carbon in Ash analyser system, On line Coal mass flow/speed measurement system, On line secondary air flow measurement system Mass Flow meter, Solid flow meter, 3 D Acoustic type level transmitters, Nucleonic & non nucleonic density transmitter, Chemical dosing system, O2 dosing system, Station LAN, MIS, mercury analyser, Viscosity meter, Hydrogen		10% or 1 no. (whichever is more) of each type.			

Annexure I

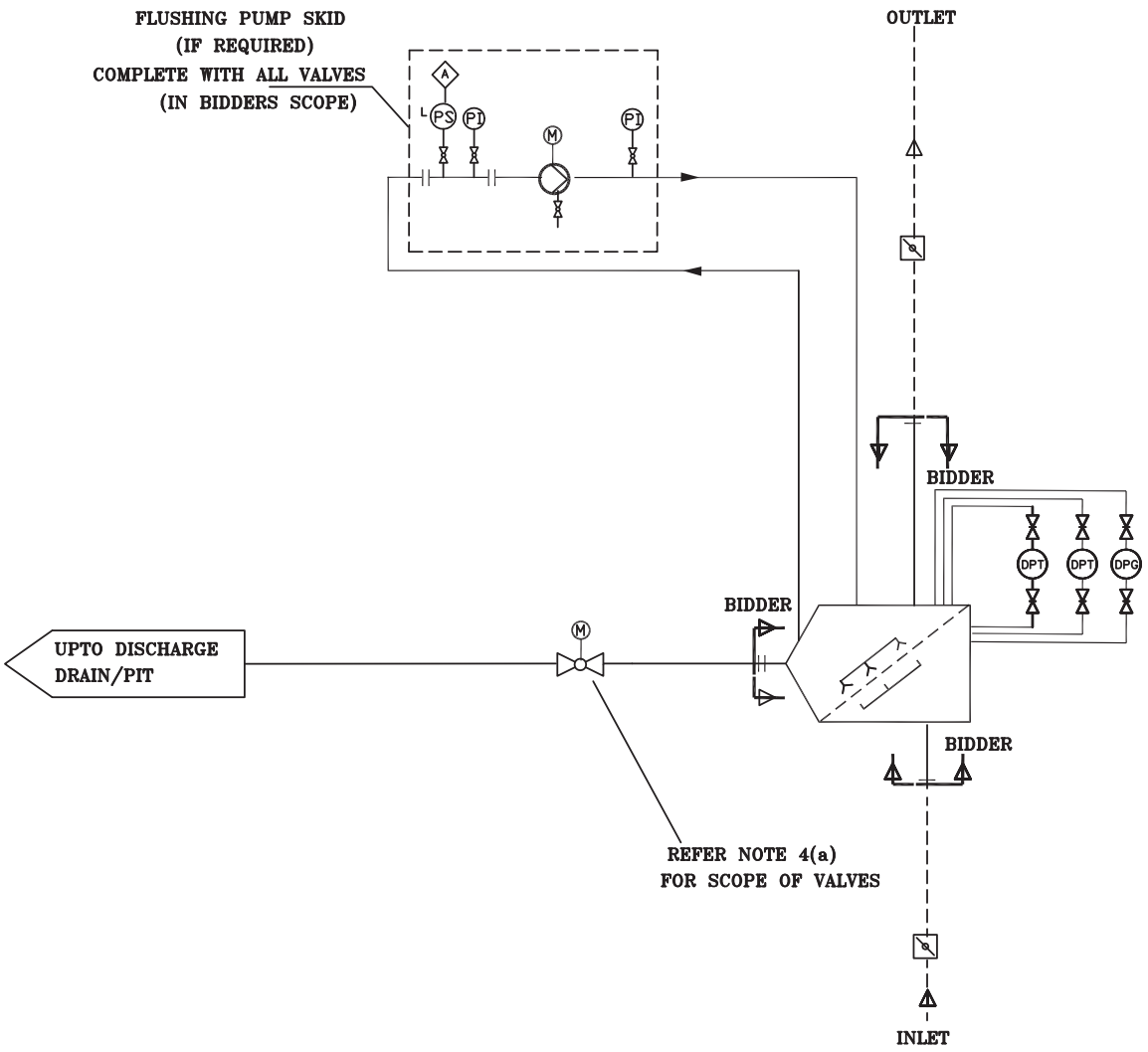
List of Control & Instrumentation Mandatory Spares

S. No.	Description	Unit	Quantity
1.00.18	**IDENTIFICATION**		
	Each spare shall be clearly marked and labeled on the outside of the packing with its description. When more than one spare part is packed in a single case, a general description of the contents shall be shown on the outside of such case and a detailed list enclosed. All cases, containers, and other packages must be suitably marked and numbered for the purpose of identification.		
1.00.19	**CONTRACT-QUANTITIES**		
	The quantities & mandatory spares shall be as specified herein. Any other mandatory spares not listed above however required for any instrumentation item shall also be supplied by bidder. The final quantities may require addition/deletion during the contract stage. The Bidder shall furnish unit price for each mandatory spare under appropriate schedules which shall be used for adjusting the contract price in the event of addition/deletion from contract quantities specified herein.		
1.00.20	**DOCUMENTATION**		
	Bidder shall furnish detailed catalogue, part number and subassembly/assembly drawings with manufacturer's cross reference for each spare part. The data and information furnished shall be of nature and content as per owner's approval to enable owner procurement of these spare parts directly from the respective manufacturer.		

1.00.21 Notes:

1. Wherever quantity has been specified percentage (%) the quantity of mandatory spares to be provided by the bidder shall be distributed into various ranges/size/rating/type (as the case may be) in the same proportion of the main population. In case the quantity so calculated happens to be fraction, the same should be rounded off to next higher whole number.
2. Wherever the quantities have been indicated for each type, size, thickness, material, radius, range etc., these shall cover all items supplied and installed and the breakup for these shall be furnished in the bid.

ANNEXURE I-A



NOTE :-

1. SCHEMATIC SHOWN IS TYPICAL FOR ONE DF, SHALL BE IDENTICAL FOR THE SECOND DF.

2. INSTRUMENTS/ANNUNCIATIONS/ INTERLOCKS INDICATED IN THE SCHEME ARE TENTATIVE, SHALL BE PROVIDED AS PER APPROVED DRGS./ DOCUMENTS/ CONTROL PHILOSOPHY IN THE EVENT OF ORDER.

3. COUNTERFLANGES FOR DF ARE EXCLUDED FROM BIDDERS SCOPE. ALL INTERCONNECTING / DEBRIS DISPOSAL PIPING IS INCLUDED IN PURCHASER SCOPE.

4. BIDDER's SCOPE OF SUPPLY ALSO INCLUDES :
   a) ALL VALVES ON PURCHASER'S INTERCONNECTING /DEBRIS DISPOSAL PIPING ALONGWITH THEIR COUNTER FLANGES.
   b) FLUSHING PUMP SKID, IF REQUIRED COMPLETE WITH FLUSHING PUMP, VALVES, INSTRUMENTS ETC.

5. PURCHASER —|— BIDDER'S SCOPE OF SUPPLY

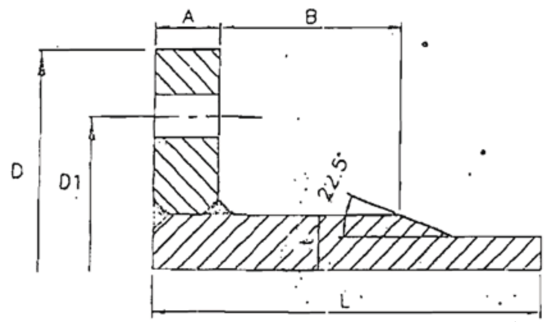
FLOW DIAGRAM FOR
DEBRIS FILTER

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

DRAWING NO. PE-DG-999-141-M017

ANNEXURE-II



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 THK.	FLANGE OD 'D'	Bolt PCD 'D1'	WELD NECK FLANGE				SLIP-ON FLANGE THICKNESS
				FLANGE THK. 'A'	NECK THK. 't'	NECK Length 'B'	Appx. Total Length 'L'	
1200	10-12	1465	1380	40	24	70	200	90
1400	14	1675	1590	50	24	70	200	100
1600	14	1915	1820	60	32	80	220	110
1800	14-16	2115	2020	70	32	90	250	120
2200	18	2550	2420	80	36	100	300	140
2300	20			90	38	110	325	150
2500	20			90	38	110	325	150
2700 (CS)	20			90	38	110	325	150
2700 (Dup. SS)	20			50 (Min.)				125 (Min.)

— TENTATIVE

DRAWING FOR BAL SEPARATOR COUNTER FLANGE

REV.	DATE	ALTD	CHD	APPD

JOB NO. 999

STATUS -

DISTRIBUTION

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

TITLE COUNTER FLANGE/ BODY FLANGE DETAILS

DEPT CODE		NAME	SIGN	DATE
	DRN	PH		25.06.07
	DSGN	PH		25.06.07
	CHD	SPV		25.06.07
	APPD	SH		25.06.07

DRAWING NO. PE-DG-999-141-M017

SHEET 01 OF 01 REV 00

17

R6

Annexure III

1.10 Source Of Water

1.10.1 Source

The raw water intake shall be from Bay of Bengal.

1.10.2 Chemical analysis of Sea Water:

S.No.	Parameters	Value (ppm)
1.	Total Solids	35,000
2.	Dissolved solids	21,620
3.	Suspended Solids	580
4.	Ignited residue	17,500
5.	Volatiles Solids	4,700
6.	Acid Insolubles	112
7.	Chlorides (as Cl)	20,232
8.	Sulphates (as SO_4)	1,457
9.	Iron (as Fe)	70
10.	Total alkalinity (as $CaCO_3$)	525
11.	Alkalinity due to Normal Carbonates (as $CaCO_3$)	Nil
12.	Alkalinity due to bi-Carbonates (as $CaCO_3$)	525

13.	Total hardness (as $CaCO_3$)	8,155
14.	Permanent hardness (as $CaCO_3$)	6,200
15.	Temporary hardness (as $CaCO_3$)	1,955
16.	Calcium hardness (as $CaCO_3$)	1,255
17.	Magnesium hardness (as $CaCO_3$)	6,900
18.	P_H	8.2

C.O.C. is 1.3

SUB-SECTION - IIA

STANDARD TECHNICAL SPECIFICATION (MECHANICAL)

STANDARD TECHNICAL SPECIFICATION FOR DEBRIS FILTER

STANDARD QUALITY PLANS

1.00.00 **GENERAL**

This specification covers the Design, Performance and Operational Requirements, Constructional Features, Manufacture, Assembly. Inspection and Testing at the Manufacturer's and/or his Sub-contractor's works and Painting for delivery of Debris Filter (Backwash Type) complete with all accessories as specified hereinafter.

2.00.00 **CODES AND STANDARDS**

2.01.00 The design, materials manufacture, inspection and testing of the Debris Filter complete with all accessories, shall comply with the requirements of the latest revisions of the following appropriate codes and standards :

2.01.01 IS/ BS/ DIN/ US Standards regarding pressure vessels, pipes, flanges and others as necessary.

2.01.02 IS/ BS/ DIN/ ASTM Standards for materials specification and testing procedures.

2.01.03 IS/ BS/ DIN/ AWWA Standards for valves and their testing.

2.02.00 In case of any conflict between the above codes/ standards and this specification, the later shall prevail and in case of any further conflict in the matter, the interpretation of the specification by the Engineer shall be final and binding.

3.00.00 **DESIGN AND CONSTRUCTION**

3.01.00 **General Requirements**

3.01.01 Unless otherwise necessary manufacturer's standard and proven models of the Debris Filter shall be supplied.

3.01.02 The Debris Filter shall be capable of safe, proper and continuous operation. Vibration, noise, mechanical stresses shall be kept within allowable limits specified by relevant codes / standards, in design due attention shall be given to ease of maintenance, repair and cleaning.

3.01.03 Suitable corrosion allowance shall be provided wherever necessary. Adequate provision for future installation of cathodic protection shall be provided.

3.01.04 The Debris Filter shall be designed to suit installation in on-line or off-line arrangement as specified in Data Sheet-A.

In the on-line arrangement, the inlet and outlet pipes of the debris filter shall be in line with each other on the same axis without any off-set between the centre lines of inlet and outlet pipes.
In the off-line arrangement, the debris filter inlet and outlet pipes shall be at right angle (90^{o}) to each other.

3.02.00 **Performance Requirements**

The Debris Filter with all accessories shall be designed and guaranteed to meet the following requirements:-

3.02.01 The Debris Filter shall perform satisfactorily under the flow and pressure conditions specified in Data Sheet -A and shall be capable of housing the various forms of debris / sludge i.e., suspended particles / matter, mussels, grass, leaves, wood pieces etc. The performance of the Debris Filter shall be continuous with minimum number of flushing/ backwashing operations.

3.02.02 The Debris Filter shall be designed such that the pressure drop across the Debris Filter (i.e., between inlet and outlet connections) under clean conditions and partially (50%) chocked conditions shall not be more than those specified in Data Sheet -A.

3.02.03 Unless otherwise specified in Data Sheet -A, debris discharge / wash water flow rate during flushing/back washing operation shall be limited to 10% of the total flow rate and flushing / backwashing operation shall be completed within a period of maximum three (3) minutes. The pressure drop across the debris filter during flushing/ backwashing operation shall not be more than the pressure drop under partially (50%) chocked condition.

3.02.04 The coarse particles and floating matter accumulating at the filter section/screen are flushed out of the system by the system by the debris flushing / backwash unit such that the pressure drop across the filter after flushing / backwashing, shall not be more than 1.1 times the pressure drop under clean conditions.

3.03.00 **Operational Requirement**

The Debris Filter and other accessories shall be designed for the following flushing/backwashing operation modes:

3.03.01 Complete automatic flushing/backwashing operation effected by the following:-

- differential pressure measuring system at a pre-determined differential pressure across the filter screen.
- adjustable timer (0-24 hours)
- push button (for manual initiation of sequential flushing / backwashing)

3.03.02 Manual operation in the event of failure of control system.

3.04.00 **Filter Housing/ Body**

3.04.01 The Debris Filter housing/body shall be designed and manufactured as per the applicable codes for pressure vessels. It shall house the filter section / screen assembly and shall have flanged inlet, outlet, flushing/ debris discharge openings and pressure measuring tappings etc.

3.04.02 In design of Debris Filter housing/ body due attention shall be given for easy removal and replacement of filter section / screen assembly.

3.04.03 The Debris Filter shall be provided with inspection hole with bolted cover.

3.04.04 The Debris Filter body / housing shall be provided with vent and drain connections with isolating valves. It shall be possible to drain unfiltered and filtered water.

3.04.05 If specified in Data Sheet-A, filter body/housing shall be epoxy painted.

3.05.00 **Filter Section / Screen assembly.**

3.05.01 The Debris Filter section/screen shall be designed for the maximum differential pressure across the filter and shall be securely positioned by a supporting cage and shall be securely mounted in the housing or body.

3.05.02 The perforation/mesh size of the Debris Filter section shall not be more than that specified in Data Sheet-A.

3.05.03 The arrangement of the Debris Filter section shall be such that the forced accumulation of debris on the filter screen / section shall be minimum.

3.06.00 **Differential Pressure Measuring System**

3.06.01 The Debris Filter shall be provided with a measuring system for differential pressure across the filter section/screen, to check debris accumulation and to initiate flushing/ backwashing operation. This shall consist of a differential pressure transmitter for automatic flushing operation, a differential pressure gauge for manual observation with adequate number of taping with isolating valves and equalising valves.

3.06.02 The contacts for differential pressure transmitter and for differential pressure gauge shall be independent so that in the event of failure of one, the other is available.

3.06.03 The differential pressure measuring system shall be provided with D.P. transmitter & DPG of remote seal arrangement..

3.07.00 **Flushing / Backwash Unit. :**

3.07.01 The Debris Filter shall be provided with suitable flushing/backwash unit (to be installed at ground floor) and debris discharge/ backwash outlet valve with associated actuator to flush out the accumulated debris/ sludge.

3.07.02 The flushing pump shall be provided with mechanical seals to the extent possible. If gland packing is provided it should be of good quality to prevent leakage of water bran pump glands.

3.07.03 The flushing arrangement shall be either fixed type with flushing valves or a rotating debris extractor.

3.07.04 If any water is to be injected for backwashing the filter section/screen, water shall be taken from down-stream side of the filter section/ screen. Necessary pump, valves and piping for water injection shall be supplied.

3.07.05 View glass to be provided in debris outlet pipe to monitor the flushing of debris.

3.08.00 **Valves**

The flushing valves (if any,) the debris discharge/backwash outlet valve, isolation, vent and drain valves shall conform to appropriate codes / standards.

3.09.00 **Instrumentation and Control System**

3.09.01 Complete instrumentation and control system for automatic flushing/ backwashing operation, protection, interlocking, indication/ annunciation of high differential pressure and other malfunctions etc. shall be provided. This shall consist of adequate operational hardware, local control panel and interconnecting control and power cabling between the control panel and the debris filter and its associated electrical devices.

3.09.02 The control panel shall house all necessary instruments, indicating/ annunciation lamps, alarms, differential pressure indicator, timer, function selector switches, relays, protection and interlocking systems, start/stop push buttons, counter to register number of flushing operations etc., and shall be complete with internal wiring. In addition to the above, the control panel shall meet the requirements of the enclosed specification.

3.09.03 All instrumentation shall be of reputed make and shall meet the requirement of the enclosed specification.

3.10.00 **Actuators :**

The actuators for flushing arrangement and debris discharge valve shall be electric motor operated and shall meet the requirements of the enclosed specification. The actuators shall be provided with auxiliary hand-wheel for manual operation in the event of power failure.

3.11.00 **Electric Motors :**

The drive motors for differential pressure measuring system flushing pump and water injected pump (if applicable) shall confirm to the requirements of the enclosed specification.

3..12.00 **Other Accessories.**

3.12.01 Counter flanges, complete with gaskets, bolts and nuts etc., shall be supplied for the filter inlet, outlet connections and all other terminal points. Fabrication, dimensions and drilling of the flanges shall conform to the codes/standards specified in Data Sheet-A/ Section -C.

3.12.02 Debris Filter shall be provided with suitable lifting arrangement for handling during erection and maintenance.

4.00.00 **SHOP INSPECTION AND TESTS**

4.01.00 **General:**

4.01.01 Manufacturer shall conduct all tests and stage inspections as per the approved quality plan to ensure that the Debris Filter and other accessories shall conform to the requirements of this specification and of the applicable codes/ standards.

4.01.02 All materials used for manufacture/fabrication of the Debris Filter shall be of tested quality. Relevant test certificates for chemical analysis, mechanical tests and heat treatment shall be made available before the final shop inspection. In case the relevant test certificates are not available, the manufacturer shall arrange to carry out the necessary tests as per approved quality plan and applicable codes at his cost, for which samples shall be identified by BHEL's representative.

4.01.03 All shop tests shall be conducted in the presence of BHEL's representative and test certificates / reports for the same shall be furnished to BHEL for approval.

4.01.04 Qualification of welding procedures and welders shall be as per ASME B&PV Code, Section-IX / applicable codes.

4.02.00 **Filter Housing / Body**

4.02.01 Chemical analysis, mechanical tests shall be carried out on housing/body, strainer/ screen, strainer/ screen shaft and other appurtenances as per the applicable material specification standards.

4.02.02 All butt welded joints shall be subjected to radiographic / ultrasonic testing as per applicable codes. However all welded joints shall be subjected to 100% magnetic particle / penetrant testing to ensure freedom from defects.

4.03.00 **Rubber Lining (as applicable)**

Rubber lining shall be subjected to surface crack test, 100% spark and hardness tests and shall be checked for layer thickness, defects etc.

4.04.00 **Filter Section/Screen assembly**

Supporting cage and filter section/screen materials shall be tested for chemical properties. Checks shall be carried out for perforation/mesh size, defects etc.

4.05.00 **Flushing / Backwash Unit**

4.05.01 Material of various components of the flushing/Backwash Unit shall be tested for chemical and mechanical properties.

4.05.02 Hollow shaft of backwash rotor shall be ultrasonically tested as per ASTM-A 388 for internal flaws. Penetrant test shall be carried out for surface flaws.

4.06.00 **Valves**

Inspection and testing of valves including leakage test shall be carried out as per the requirements of the applicable standards. Correlating test certificates for materials of the valve components shall be furnished.

4.07.00 **Flanges**

4.07.01 In case of fabricated flanges, all the welds shall be subjected to 100% radiography as per ASME B&PV code, section VIII, Division-1.

4.07.02 In case of forged flanges, ultrasonic testing shall be carried out as per ASTM-A 388.

4.07.03 If the thickness of the plate used for flanged is 40mm or more the same shall be checked ultrasonically as per ASTM-A435 to demonstrate the absence of lamination and lack of fusion etc.

4.07.04 Chemical and mechanical test certificates shall be furnished for flange materials.

4.07.05 Flanges shall be checked for edge preparation, fit up and satisfactory working with matching parts.

4.08.00 All materials for various nozzles, seals, pipes, gaskets, nuts bolts etc., shall be of tested quality and correlating test certificates for chemical and mechanical properties shall be furnished.

4.09.00 **Dimensional Checks**

Dimensional checks of various components of the Debris Filter shall be carried out as per the drawings approved by BHEL. Alignment and fit up of movable parts shall be checked.

4.10.00 **Hydrostatic Test**

Hydrostatic test shall be conducted on the Debris Filter housing/body at a pressure of 1.5 times the design pressure. The duration of the test shall be minimum 30 minutes.

4.11.00 **Leakage Test**

Leakage test shall be conducted at the design pressure to demonstrate that the filter assembly is leak tight and no water seepage shall take place at various nozzle and valve connections.

4.12.00 **Functional Tests**

The Debris Filter assembly complete with valves, actuators and other accessories shall be subjected to functional tests and the following shall be checked:-

4.12.01 Smooth and free operation of all movable parts.

4.12.02 Interlocks and sequential operation.

4.12.03 Satisfactory operation of actuator torque switches, limit switches etc.

4.13.0 Performance Test:

Performance Test shall be conducted to ensure that the Debris Filter meets the specified performance requirements.

5.00.00 **TESTING AT SITE**

After completion of installation at site, the Debris Filter with complete accessories, will be tested to check that the filter performance meets the requirements of its specification, Rectification of all defects shall have to be done by the supplier at no extra cost to the Owner / Purchaser. However the Owner / Purchaser reserves the right to reject the equipment/ parts not meeting the requirement if the deficiency still persists.

6.00.00 **QUALITY ASSURANCE & QUALITY PLAN**

6.01.00 The Debris Filter and other accessories to be supplied shall have assured quality and workmanship.

6.02.00 Typical quality plans are enclosed herewith this specification for bidder's guidance. The bidder shall comply with these minimum requirements and shall furnishing own quality plan based on materials and components of the filter being offered.

7.00.00 **NAME PLATE AND TAG NUMBERS**

7.01.00 The Debris Filter shall be provided with a permanently attached brass or stainless steel plate indicating the following details:-

a) Design and maximum flow rates
b) Design and test pressures
c) Design temperature
d) Filter section/screen mesh size
e) Empty and operating weights
f) Revolving speed of backwash rotor

7.02.00 Each valve shall be provided with a name plate indicating the following:-

a) Service
b) Design and test pressures
c) Maximum flow and flow direction
d) Size
e) Tag Number

Tag numbers will be indicated on the drawing submitted for approval during contract stage.

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

a) Supply conditions.
b) KW Rating
c) Make

8.00.00 **DRAWINGS, DATA & INFORMATION TO BE SUBMITTED AFTER THE AWARD OF CONTRACT**:

The drawings, data and other documents as required in Data Sheet-C shall be furnished after the award of contract.

1.00.00 **DRAWINGS, DATA AND INFORMATION TO BE SUBMITTED AFTER THE AWARD OF CONTRACT:**

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

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

1.01.01 Data Sheet -B.

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

a) General arrangement / Installation drawings of the Debris Filter with all accessories, indicating the principal dimensions and weights of equipment offered, size and location of various nozzle connections, withdrawal space and scope of supply etc.

b) Foundation arrangement drawings (wherever applicable) showing load data on supports, size and location of anchor bolts etc.

1.02.00 **Within the stipulated time period as per vendor's drawing/document list, the following shall be submitted:**

1.02.01 Cross-sectional/detailed drawings of filter housing/body, filter screen/section assembly, flushing / backwash unit, differential pressure measuring system, actuators, motors, control panel etc. indicating bill of quantities and materials of construction.

10.02.02 Flow and control logic diagrams for complete filter during normal and flushing operation and system write-up covering all modes of operation.

1.02.03 Final version of performance evaluation procedures at site.

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

1.02.05 Detailed schedule of power & control cable.

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

1.02.07 Control panel layout and list of instruments provided on control panel and internal wiring diagrams.

1.02.08 List of annunciations, protections and interlocks provided.

1.02.09 Detailed drawings of flanges.

1.02.10 Quality Plan

1.02.11 Material test certificates.

1.02.12 Shop tests reports and certificates.

1.02.13 Write-up and instruction manuals for erection, operation and maintenance.

1.02.14 Storage instructions.

1.02.15 Vendor to send 3 sets of final documents (O&M Manual, GA drg, P&ID) direct to site under intimation to PEM.

	Manufacturer's Name & Address P.O. No.	**STANDARD QUALITY PLAN**		BHEL Doc No.: PE-QP-999-165-N003
		INDEX	Vendor Q.P. NO. PACKAGE : DEBRIS FILTER Date : Page 01 of 10	PROJECT: CUSTOMER: PURCHASER: CONSULTANT:

Note: Items not included in quality plan to be inspected as per Approved datasheet/drawings.

		LEGEND * Records identified with "STAR" shall be essentially included by contractor in QA Documentation. ** M : Manufacturer/ Sub-contractor C : Contractor O : Owner Indicate : "P" - Perform, "W" - Witness and "V" - Verification		
Manufacturer / Sub-Contractor	Contractor			Name & Sign. Of approving authority & Seal
Signature				

	Manufacturer's Name & Address	STANDARD QUALITY PLAN		BHEL Doc No.: PE-QP-999-165-N003
		Item :	Vendor Q.P. NO.	PROJECT:
	P.O. No.	DEBRIS FILTER	PACKAGE : DEBRIS FILTER	CUSTOMER:
			Date :	PURCHASER:
			Page 02 of 10	CONSULTANT:

Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record		Agency M	Agency C	Agency O	Remarks
1	2	3	4	5	6	7	8	9		** 10			11
1.0.0	**DEBRIS FILTER**												
1.1.0	Raw Material												
[a]	Housing Shell, Nozzle flanges & Main flanges/Counter Flange	Chemical properties	Major	Chemical Analysis	One sample/cast / heat / batch	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / lab test report / raw material flow sheet	*	P	V	V	All raw material identification as per manufacturer TC/Lab report by BHEL
		Physical properties	Major	Physical test	One sample/cast / heat / batch	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / lab test report / raw material flow sheet	*	P	V	V	
		Surface Defects	Minor	Visual	100%	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate /Inspection Report	--	P	V	V	
		Sub Surface Defects	Major	Ultrasonic Test	100%	ASME A 435/A609	ASME A 435/A609	Inspection report	*	P	V	V	Plates > 20mm Thk only
[b]	Nozzle Pipes	Chemical properties	Major	Chemical Analysis	One sample/cast / heat / batch	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / lab test report / raw material flow sheet	*	P	V	V	
		Physical properties	Major	Physical test	One sample/cast / heat / batch	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / lab test report / raw material flow sheet	*	P	V	V	
		Surface defects	Minor	Visual	100%	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate /Inspection Report	--	P	V	V	
		Leak tightness	Major	Hydrostatic test	100%	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate /Inspection Report	--	P	V	V	
[c]	Screen basket	Chemical properties	Major	Chemical Analysis	One sample/cast / heat / batch	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / lab test report / raw material flow sheet	*	P	V	V	
		Physical properties	Major	Physical test	One sample/cast / heat / batch	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / lab test report / raw material flow sheet	*	P	V	V	
		Surface Defects	Minor	Visual	100%	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate /Inspection Report	--	P	V	V	
		Sub-surface defects	Major	Ultrasonic test	100%	ASME A 745	ASME A 745	Inspection report	*	P	V	V	Plates > 20mm Thk only (UT full volume)
		Corrosion Resistance	Major	IGCI	One/Heat	ASTM A 923	ASTM A 923	Test Report	*	P	V	V	

LEGEND

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Manufacturer / Sub-Contractor	Contractor
Signature	

Name & Sign. Of approving authority & Seal

	Manufacturer's Name & Address	STANDARD QUALITY PLAN		BHEL Doc No.: PE-QP-999-165-N003
	P.O. No.	**Item :** DEBRIS FILTER	Vendor Q.P. NO. PACKAGE : DEBRIS FILTER Date : Page 03 of 10	PROJECT: CUSTOMER: PURCHASER: CONSULTANT:

Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record		Agency			Remarks
										M	C	O	
1	2	3	4	5	6	7	8	9		**	10		11
1.2.0	**Inprocess Quality Control**												
1.2.1	Welding procedure specification	Correctness	Critical	Scrutiny	100%	ASME Sec. IX	ASME Sec. IX	QW 482 of ASME Sec.IX	--	P	V	V	
1.2.2	Welding procedure qualification	Weld soundness	Critical	Physical test	100%	ASME Sec. IX	ASME Sec. IX	QW 483 of ASME Sec.IX	--	P	V	V	Welding procedure already approved by BHEL/ LRQA / NTPC shall be followed.
1.2.3	Welder performance qualification	Weld soundness	Critical	Physical test	100%	ASME Sec. IX	ASME Sec. IX	QW 484 of ASME Sec.IX	--	P	V	V	Welders already qualified by BHEL/ LRQA / NTPC shall be employed for this job.
1.2.4	Fit-up of butt weld	Alignment.and dimensions	Major	Template, visual	100%	Manufacturing Drawng	ASME Sec.VIII Div. I	Log book	--	P	V	–	
1.2.5	Fit-up of shell flange and nozzle assembly to shell	Orientation,alignment and dimensions	Major	Template, visual	100%	Manufacturing Drawng	ASME Sec.VIII Div. I	Log book	--	P	–	–	
1.2.6	**Weld quality for Pressure Parts**												
	[a] Root run	Surface defects	Major	Penetrant test / Visual	100%	ASME Sec.VIII Div. I / sec V	ASME Sec.VIII Div. I Appendix 8	Operation Process Sheet		P	–	–	
1.2.7	[a] Completed butt welds	1.Surface defects	Major	Penetrant test	100%	ASME Sec.VIII Div. I / sec V	ASME Sec.VIII Div. I Appendix 8	Inspection report	*	P	V	V	
		2.Sub-surface defects	Critical	Radiography test	10% of total weld length+ 100% T Joints.	ASME Sec.VIII Div. I / sec V	ASME Sec.VIII Div. I Appendix 4 / UW 52	Radiographs and inspection report	*	P	V	V	RT films will be reviewed by BHEL
	[b] Completed fillet welds	Surface defects	Major	Penetrant test	100%	ASME Sec.VIII Div. I / sec V	ASME Sec.VIII Div. I Appendix 8	Inspection report	*	P	V	V	

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Signature			

	Manufacturer's Name & Address	STANDARD QUALITY PLAN		BHEL Doc No.: PE-QP-999-165-N003
BHEL	P.O. No.	Item : DEBRIS FILTER	Vendor Q.P. NO. PACKAGE : DEBRIS FILTER Date : Page 04 of 10	PROJECT: CUSTOMER: PURCHASER: CONSULTANT:

Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record		Agency			Remarks
										M	C	O	
1	2	3	4	5	6	7	8	9		**	10		11
1.2.8	Pickling and Passivation	Protection Layer	Major	Visual	100%	IS : 10117	IS : 10117	Log Book	--	P	–	–	
1.2.9	Fabricated Shell (Prior to sand blasting)	1.Dimensions, Orientation	Major	Measurement by visual	100%	Manufacturing Drawing	Manufacturing Drawing	Inspection report	*	P	V	V	
		2. Hydro test	Critical	Hydrostatic Pr. @ 1.5 times of design pr.(positive) [Duration 30 minutes]	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1	Inspection report	*	P	V	V	
1.2.10	Final tests (completed equipments) - After assembly	1.Dimensions, orientation, workmanship & finish	Major	Measurement by visual	100%	G.A.drawing	G.A.drawing	Inspection report	*	P	V	V	
		2. Leak tightness for aasembly	Critical	Leak test @ design pr.(positive) [Duration 30 minutes]	100%	ASME Sec.VIII Div.1	No leakage	Inspection report	*	P	W	V	
		3.Dry function test for Debris filter	Critical	Operational test	100%	Approved PROC	Approved Procedure	Inspection report	*	P	W	V	
1.3.0	**Rubber Lining (Shell)**												
1.3.1	Rubber Formulation	Tensile, elongation & hardness	Major	Physical test	One per lot	Manufacturer's procedure	BS 6374/Equivalent	Manufacturers Test certificate	*	P	V	V	
		Polymer Identification	Major	Flame test	One per lot	For Semi Ebonite /Ebonite Polymer catches fire and on removal from fire continues to burn	For Semi Ebonite /Ebonite Polymer catches fire and on removal from fire continues to burn	Inspection report		P	V	V	
		% Change in weight after 24 hours of immersion in sea water at 70°	Major	Immersion test (bleeding test)	One per lot	ASTM D 471	+ / - 1%	Inspection report		P	V	V	
1.3.2	Surface preparation of items to be lined	Free from rust, scale,dust & grease	Major	Visual	100%	SA 2.5	SA 2.5	Manufacturers Internal Inspection report		P	–	–	
1.3.3	Vulcanising	Temperature, Pressure & Time	Major	Process monitoring	100%	Manufacturer's procedure	Manufacturer Procedure	Process Procedure		P	–	–	
1.3.4	Vulcanised Rubber Lined items	[a] Chip test	Major	Chip test	One per lot	Approved Drawing & BS 6374/Equivalent	BS 6374/Equivalent	Inspection report	*	P	V	V	
		[b] Adhesion, Visual defects, Thickness & Hardness	Major	Measurement, Visual Inspection	100% visual. Thickness/ hardness at random	Approved Drawing & BS 6374/Equivalent	BS 6374/Equivalent	Inspection report	*	P	V	V	
		[c] Spark test for Pin Holes at 5 kv/mm	Major	Spark test for Pin Holes	100%	Approved Drawing & BS 6374/Equivalent	BS 6374/Equivalent	Inspection report	*	P	V	V	

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Signature			

	Manufacturer's Name & Address	STANDARD QUALITY PLAN		BHEL Doc No.: PE-QP-999-165-N003
		Item : Ball Valve	Vendor Q.P. NO.	PROJECT:
	P.O. No.		PACKAGE : DEBRIS FILTER	CUSTOMER:
			Date :	PURCHASER:
			Page 05 of 10	CONSULTANT:

Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record		Agency			Remarks
										M	C	O	
1	2	3	4	5	6	7	8	9		**	10		11
2.0.0	**Ball valves**												
2.1.0	**Materials**												
2.1.1	Body and Tail end pieces	Chemical,Physical properties	Major	Chemical & Physical analysis	One Sample/Cast / heat	Approved drg/ Data sheet	Approved drg/ Data sheet	Manufacturer's T.C.	*	P	V	V	
2.1.2	Ball	Chemical,Physical properties	Major	Chemical & Physical analysis	One Sample/Cast / heat	Approved drg/ Data sheet	Approved drg/ Data sheet	Manufacturer's T.C.	*	P	V	V	
2.1.3	Stem	Chemical,Physical properties	Major	Chemical & Physical analysis	One Sample/Cast / heat	Approved drg/ Data sheet	Approved drg/ Data sheet	Manufacturer's T.C.	*	P	V	V	
2.2.0	**In-process inspection**												
2.2.1	Machining of body, end, pieces, ball	Dimension	Major	Measurement	100%	Approved drg/Data sheet	Approved drg/Data sheet	Log book	--	P	V	V	
2.2.2	Ball	a) Surface defects	Critical	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	*	P	V	V	
		b) Hardness	Major	Hardness testing	Random	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report	*	P	V	V	
2.3.0	**Assembly**	a) Dimensions	Major	Measurement	100%	EN ISO 17292	EN ISO 17292	Manufacturer's T.C.	*	P	V	V	
		b) Opening / Closing	Major	Operation	100%	---	As per approved data sheet	--	--	P	V	V	
2.4.0	**Testing**												
	[a] Body	Leakage	Critical	Hydraulic test	100%	EN 12266-1&2/API 598/Appd data sheet	EN 12266-1&2/API 598 & Appd. Data sheet	Manufacturer's T.C.	*	P	V	V	
	[b] Seat test	Leakage	Critical	Hydraulic test	100%	EN 12266-1&2/API 598/Appd data sheet	EN 12266-1&2/API 598 & Appd. Data sheet	Manufacturer's T.C.	*	P	V	V	
	[c] Seat	Leakage	Critical	Air test	100%	EN 12266-1&2/API 598/Appd data sheet	EN 12266-1&2/API 598 & Appd. Data sheet	Manufacturer's T.C.	*	P	V	V	

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Manufacturer / Sub-Contractor	Contractor		
Signature			Name & Sign. Of approving authority & Seal

	Manufacturer's Name & Address	STANDARD QUALITY PLAN		BHEL Doc No.: PE-QP-999-165-N003
	P.O. No.	Item : Butterfly valve	Vendor Q.P. NO. PACKAGE : DEBRIS FILTER Date : Page 06 of 10	PROJECT: CUSTOMER: PURCHASER: CONSULTANT:

Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record		Agency M	Agency C	Agency O	Remarks
1	2	3	4	5	6	7	8	9		** 10			11
3.0.0	**Butterfly valves**												
3.1.0	**Materials**												
	Body and Disc	Chemical properties	Major	Chemical properties	One Sample/Cast / heat	Approved drg/Data sheet	Approved drg/Data sheet	Manufacturer's T.C.	*	P	V	V	
		Physical properties	Major	Physical properties	One Sample/Cast / heat / batch	Approved drg/Data sheet	Approved drg/Data sheet	Manufacturer's T.C.	*	P	V	V	
3.1.1	Shaft	Chemical properties	Major	Chemical properties	One Sample/Cast / heat	Approved drg/Data sheet	Approved drg/Data sheet	Manufacturer's T.C.	*	P	V	V	
		Physical properties	Major	Physical properties	One Sample/Cast / heat / batch	Approved drg/Data sheet	Approved drg/Data sheet	Manufacturer's T.C.	*	P	V	V	
3.1.2	Seat	_	Major	_	One Sample/Cast / heat	Approved drg/Data sheet	Approved drg/Data sheet	Manufacturer's T.C.	*	P	V	V	
3.1.3	Stem	Chemical properties	Major	Chemical properties	One Sample/Cast / heat	Approved drg/Data sheet	Approved drg/Data sheet	Manufacturer's T.C.	*	P	V	V	
		Physical properties	Major	Physical properties	One Sample/Cast / heat / batch	Approved drg/Data sheet	Approved drg/Data sheet	Manufacturer's T.C.	*	P	V	V	
3.2.0	**Assembly**	a) Dimensions	Major	Measurement	100%	EN ISO 17292/Appd data sheet	EN ISO 17292/Appd data sheet	Manufacturer's T.C.	*	P	V	V	
		b) Opening / Closing	Major	Operation	100%	---	As per approved data sheet	--	*	P	_	_	
3.3.0	**Testing**												
	[a] Body	Leakage	Critical	Hydraulic test	100%	EN 12266-1&2/API598	EN 12266-1&2/API 598 & Appd. Data sheet	Manufacturer's T.C.	*	P	V	V	
	[b] Seat test	Leakage	Critical	Hydraulic test	100%	EN 12266-1&2/API598	EN 12266-1&2/API 598 & Appd. Data sheet	Manufacturer's T.C.	*	P	V	V	
	[c] Seat	Leakage	Critical	Air test	100%	EN 12266-1&2/API598	EN 12266-1&2/API 598 & Appd. Data sheet	Manufacturer's T.C.	*	P	V	V	

LEGEND

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** M : Manufacturer/ Sub-contractor
C : Contractor O : Owner

Indicate : "P" - Perform, "W" - Witness and "V" - Verification

Manufacturer / Sub-Contractor	Contractor
Signature	

Name & Sign. Of approving authority & Seal

	Manufacturer's Name & Address	STANDARD QUALITY PLAN	BHEL Doc No.: PE-QP-999-165-N003
	P.O. No.	**Item : Pressure Gauge, DP Gauge, DP switch&DP Transmitter**	Vendor Q.P. NO. PACKAGE : DEBRIS FILTER Date : Page 07 of 10	PROJECT: CUSTOMER: PURCHASER: CONSULTANT:

Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record		Agency M	Agency C	Agency O	Remarks
1	2	3	4	5	6	7	8	9		** 10			11
4.0.0	**Pressure Gauge, DP Gauge, DP switch & DP Transmitter**												
4.1.0	**In process quality control**	Make, Range and Model	Critical	Visual	100%	Approved Data Sheet	Approved Data Sheet	Manufacturer test certificate	*	P	V	V	
		Calibration	Critical	Calibration test	100%	Approved Data Sheet	Approved Data Sheet	Manufacturer test certificate	*	V	V	V	
		Degree of protection	Critical	_	Type test certificate	Approved Data Sheet	Approved Data Sheet	Manufacturer test certificate	*	V	V	V	

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Manufacturer / Sub-Contractor	Contractor
Signature	

Name & Sign. Of approving authority & Seal

	Manufacturer's Name & Address	STANDARD QUALITY PLAN		BHEL Doc No.: PE-QP-999-165-N003
	P.O. No.	**Item :** **Gear Motor Drive** **Worm Planetary Gear box** **Actuators**	Vendor Q.P. NO. PACKAGE : DEBRIS FILTER Date : Page 08 of 10	PROJECT: CUSTOMER: PURCHASER: CONSULTANT:

Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record		Agency M	Agency C	Agency O	Remarks
1	2	3	4	5	6	7	8	9		**	10		11
5.0.0	**GEARED MOTOR DRIVE**	Running Test	Critical	Functional Test	100%	Approved Data Sheet	Approved Data Sheet	Manufacturer's compliance certificate	*	P	V	V	
		No load	Critical	Functional test	100%	Approved Data Sheet	Approved Data Sheet			P	V	V	
		Noise test	Critical	Functional test	100%	Approved Data Sheet	Approved Data Sheet			P	V	V	
		Oil leakage test	Critical	Functional test	100%	Approved Data Sheet	Approved Data Sheet			P	V	V	
		Visual	Critical	_	100%	Approved Data Sheet	Approved Data Sheet			P	V	V	
		Name plate verification	Critical	_	100%	Approved Data Sheet	Approved Data Sheet			P	V	V	
6.0.0	**Complete Unit of planetary gear**	No Leak Test	Critical	Functional test	One Sample/lot	Approved Data Sheet	Supplier Catalogue	Manufacturer's compliance certificate	*	P	V	V	
		Noise Level	Minor	Functional test	One Sample/lot	Approved Data Sheet	Approved Data Sheet			P	V	V	
		Visual Name plate Verification	Minor	_	100%	Approved Data Sheet	Approved Data Sheet			P	V	V	
7.0.0	**Actuators**	Functional test	Major	Electrical test	100%	Supplier catalogue/Appd data sheet	Supplier catalogue/Appd data sheet	Test certificate	*	P	V	V	
		Make, Range, Model	Major	Visual	100%	Supplier catalogue/Appd data sheet	Supplier catalogue/Appd data sheet	Inspection Report	_	P	_	_	
		Assembly check alongwith valves	Major	Visual	100%	Supplier catalogue/Appd data sheet	Supplier catalogue/Appd data sheet	Inspection Report	_	P	_	_	
		Functional Check along with settings / Auxillary Contacts	Major	Visual	100%	Supplier catalogue	Supplier catalogue/Appd data sheet	Inspection Report	_	P	_	_	Review of TC's

LEGEND

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Indicate : "P" - Perform, "W" - Witness and "V" - Verification

Manufacturer / Sub-Contractor	Contractor	
Signature		Name & Sign. Of approving authority & Seal

	Manufacturer's Name & Address	STANDARD QUALITY PLAN	BHEL Doc No.: PE-QP-999-165-N003
	P.O. No.	Item : STARTER PANEL Vendor Q.P. NO. PACKAGE : DEBRIS FILTER Date : Page 9 of 10	PROJECT: CUSTOMER: PURCHASER: CONSULTANT:

Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record		Agency			Remarks
										M	C	O	
1	2	3	4	5	6	7	8	9	D*	**	10		11
8.0.0	**Starter panel**												
8.1.0	**Incoming Material**												
8.1.1	Fabricated & Painted Panel	Dimension	Major	Measurement	100%	Approved Drgs.	Approved Drgs.	Inspection report	_	P	--	--	
		Panel G.A.	Major	Measurement	100%	Approved Drgs.	Approved Drgs.	Inspection report	_	P	--	--	
		Paint colour	Major	Visual	100%	Approved Drgs.	Approved Drgs.	Inspection report	_	P	--	--	
		Paint thickness	Major	Measurement	100%	Approved Drgs.	Approved Drgs.	Inspection report	_	P	--	--	
		Paint Shade, Adhesion	Major	Visual	Sample	Approved Drgs.	Approved Drgs.	Inspection report	_	P	--	--	
8.1.2	Wire	Size / Colour / Rating / Surface Defects	Major	Visual / Dimension	Sample	IS 694	Specification / drawings	Inspection report	_	P	--	--	ISI Marked wire
8.1.3	Panel Mounting	Make, Functional, Type & Rating	Major	Visual / Electrical	100%	Approved BOM	Approved BOM	---		P	V	V	
8.2.0	**In Process Inspection**												
8.2.1	Name Plate, Component Mounting, Etc.	Workmanship, Finish, Correctness	Major	Visual	100%	Approved Drgs.	Approved drawings	Inspection report	_	P	--	--	
8.2.2	Electrical Wiring of Panels	Continuity, Colour of wires, Bunching and Grouping	Major	Visual	100%	Mounting Drawing	Approved drawings	Inspection report	_	P	--	--	
8.2.3	Ferruling of Cables	Start & End	Major	Visual	100%	Manufacturer's drawing	Manufacturer's drawing	Inspection report	_	P	--	--	
8.3.0	**Final Inspection**									P	--	--	
8.3.1	Workmanship, Finish & Paint shade / Thickness	Visual	Major	Visual	100%	G.A Drawing	Approved drgs.	Inspection report	*	P	W	V	
8.3.2	Overall Dimension, G.A of starter panel	Measurement	Major	Visual	100%	G.A Drawing	Approved drgs.	Test Certificate	_	P	W	V	
8.3.3	Component Identification	Visual	Major	Visual	100%	G.A Drawing	Approved drgs.	Inspection report	_	P	W	V	
8.3.4	Degree of Protection	Ingres Protection	Critical	Environmental	Verification	G.A Drawing	Approved drgs.	Inspection report		P	V	V	For enclosure
8.3.5	IR - HV - IR	Electrical	Critical	Electrical	100%	MFG. Procedure	MFG.. Pocedure	Inspection report	_	P	V	V	
8.3.6	Functional & Continuity	Functional	Major	Functional	100%	Appd Drawing	Appd Drawing	Inspection report	*	P	W	V	

LEGEND

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C : Contractor O : Owner

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Manufacturer / Sub-Contractor	Contractor		
Signature		Reviewed By	Name & Sign. Of approving authority & Seal

	Manufacturer's Name & Address	STANDARD QUALITY PLAN	BHEL Doc No.: PE-QP-999-165-N003
	P.O. No.	**Item :** Fasteners All Components & Equipments	Vendor Q.P. NO. PACKAGE : DEBRIS FILTER Date : Page 10 of 10	PROJECT: CUSTOMER: PURCHASER: CONSULTANT:

Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record		Agency M	Agency C	Agency O	Remarks
1	2	3	4	5	6	7	8	9		** 10			11
9.0.0	**Fasteners**												
9.1.0	**Internal Fasteners (Duplex SS)**	Chemical & Physical properties	Major	Chemical & Mechanical analysis	1 Per heat/HT Batch	Approved drg/Data sheet	Approved drg/Data sheet	Mfr 's TC / Lab Report	*	P	V	V	
		Visual & workmanship finish	Major	Visual	Sample	Approved drg/Data sheet	Approved drg/Data sheet	Inspection Report	_	P	V	V	
		Dimensions	Major	Measurement	Sample	Approved drg/Data sheet	Approved drg/Data sheet	Inspection Report	_	P	V	V	
9.2.0	**Main Fasterners**	Visual	Major	Visual	Sample	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report / Mfr TC	*	P	V	V	
		Dimensions	Major	Measurement	Sample	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report / Mfr TC	*	P	V	V	
		Chemical & Physical properties	--	Chemical & Physical test a) Tensile b) Yield c) Elongation d) Proof load	1 sample per heat	Approved drg/Data sheet	Approved drg/Data sheet	Mfr TC/Lab report	*	P	V	V	
10.0.0	**All Components / Equipments**	Painting Dry film thickness and	Major	Measurement	Random	Painting schedule	Painting schedule	Inspection report		P	V	V	
		Packing	Major	Measurement	100%	Packing Procedure	Packing Procedure	Inspection report		P	_	_	

LEGEND

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Indicate : "P" - Perform, "W" - Witness and "V" - Verification

Manufacturer / Sub-Contractor	Contractor	
Signature		Name & Sign. Of approving authority & Seal

SUB-SECTION - IIB

STANDARD TECHNICAL SPECIFICATION (ELECTRICAL)

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.: PE-SS-999-506-E101 Rev 00

1.0 INTENT OF SPECIFIATION

The specification covers the design, materials, constructional features, manufacture, inspection and testing at manufacturer's work, and packing of Low voltage (LV) squirrel cage induction motors along with all accessories for driving auxiliaries in thermal power station.

Motors having a voltage rating of below 1000V are referred to as low voltage (LV) motors.

2.0 CODES AND STANDARDS

Motors shall fully comply with latest edition, including all amendments and revision, of following codes and standards:

IS:325	Three phase Induction motors
IS : 900	Code of practice for installation and maintenance of induction motors
IS: 996	Single phase small AC and universal motors
IS: 4722	Rotating Electrical machines
IS: 4691	Degree of Protection provided by enclosures for rotating electrical machines
IS: 4728	Terminal marking and direction of rotation rotating electrical machines
IS: 1231	Dimensions of three phase foot mounted induction motors
IS: 8789	Values of performance characteristics for three phase induction motors
IS: 13555	Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment
IS: 2148	Flame proof enclosures for electrical appliance
IS: 5571	Guide for selection of electrical equipment for hazardous areas
IS: 12824	Type of duty and classes of rating assigned
IS: 12802	Temperature rise measurement for rotating electrical machnines
IS: 12065	Permissible limits of noise level for rotating electrical machines
IS: 12075	Mechanical vibration of rotating electrical machines

In case of imported motors, motors as per IEC-34 shall also be acceptable.

3.0 DESIGN REQUIREMENTS

3.1 Motors and accessories shall be designed to operate satisfactorily under conditions specified in data sheet-A and Project Information, including voltage & frequency variation of supply system as defined in Data sheet-A

3.2 Motors shall be continuously rated at the design ambient temperature specified in Data Sheet-A and other site conditions specified under Project Information
Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment, under entire operating range including voltage & frequency variation specified above.

3.3 Starting Requirements

3.3.1 Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.

3.3.2 Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.

The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.

3.3.3 The following frequency of starts shall apply

i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.

ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)

iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for mimimum 20,000 starts during the life time of the motor

3.4 **Running Requirements**

3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.

3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.

3.5 **Stress During bus Transfer**

3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechanical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.

3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.

3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.

4.0 **CONSTRUCTIONAL FEATURES**

4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy

4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.

Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled

4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.

4.4. Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.

4.5 Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.

4.6 In case Class 'F' insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation.
In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.

4.7 **Terminals and Terminal Boxes**

4.7.1 Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.

Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet "A".

4.7.2 unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.

4.7.3 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively.

4.7.4 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.

4.7.5 Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.

4.7.6 Degree of protection for terminal boxes shall be IP 55 as per IS 4691.

4.7.7 Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.

4.7.8. Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.

4.7.9 Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.

4.8 Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.

4.9 **General**

4.9.1 Motors provided for similar drives shall be interchangeable.

4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.

4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.

4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.

4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.

4.9.6 Name plate with all particulars as per IS: 325 shall be provided

4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.

5.0 INSPECTION AND TESTING

5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.

5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.

5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.

5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.

6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT

a) OGA drawing showing the position of terminal boxes, earthing connections etc.
b) Arrangement drawing of terminal boxes.
c) Characteristic curves:
(*To be given for motor above 55 kW unless otherwise specified in Data Sheet*).

i) Current vs. time at rated voltage and minimum starting voltage.
ii) Speed vs. time at rated voltage and minimum starting voltage.
iii) Torque vs. speed at rated voltage and minimum voltage.
For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.
iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.

	QUALITY PLAN		CUSTOMER	TAMILNADU GENERATION & DISTRIBUTION CORPORATION LIMITED		PROJECT	2X800 MW SUPERCRITICAL COAL BASED UPPUR TPP		SPECIFICATION :			
						TITLE			NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION TITLE			
	SHEET 1 OF 2		SYSTEM			ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	2	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1		NOTE -1 & NOTE-3
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	NOTE -1 & NOTE-3

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

		QUALITY PLAN	CUSTOMER	TAMILNADU GENERATION & DISTRIBUTION CORPORATION LIMITED		PROJECT	2X800 MW SUPERCRITICAL COAL BASED UPPUR TPP		SPECIFICATION :			
						TITLE			NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION : TITLE :			
		SHEET 2 OF 2	SYSTEM			ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	

NOTES:

1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON

2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.

3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.

Legends for Inspection agency

1. BHEL/CUSTOMER
2. VENDOR (MOTOR MANUFACTURER)
3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)

P. PERFORM
W. WITNESS
V. VERIFY

BHEL	**PARTICULARS**	**BIDDER/VENDOR**
	NAME	
	SIGNATURE	
	DATE	BIDDER'S/VENDORS COMPANY SEAL

SUB-SECTION - IIC

STANDARD TECHNICAL SPECIFICATION (C &I)

FORM NO. PEM-6666-0

	DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE FOR DF	SPECIFICATION NO.: PE-TS-XXX-145-I100
		VOLUME
		SECTION
		REV. NO. 00 | DATE: 03.04.2017
		SHEET 1 OF 3

TAG No. …… Qty..... Data Sheet No.: **PE-DC-999-145-I026**

Data Sheet A & B

DATA SHEET-A FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

GENERAL	MANUFACTURER		
	MODEL NUMBER		
TECHNICAL	PRESSURE ELEMENT	■ BOURDON ■ DIAPHRAGM ■ BELLOW	
	MATERIAL	**THE MINIMUM REQUIREMENT FOR SEA WATER APPLICATION : ALL WETTED PARTS & DIAPHRAGM SHALL BE SUITABLE FOR SEA WATER (DUPLEX SS OR BETTER)**	
	A) BELLOW	■ 316 SS	
	B) BOURDON TUBE	■ 316 SS	
	C) MOVEMENT	■ 316 SS	
	D) CASE ENCLOSURE	■ 316 SS	
	E) PROTECTIVE DIAPHRAGM	■ TEFLON COATED SEALS	
	ENCLOSURE	■ IP-65 OR BETTER	
	DIAL	SIZE: ☐ 100MM ■ 150MM WITH SHATTER PROOF GLASS COLOR: WHITE NUMERALS: BLACK SCALE: ■ LINEAR, 270 DEG ARC GRADUATED IN METRIC UNITS	
	CASE	COLOUR : BLACK	
	MOUNTING	■ LOCAL / FRAME MOUNTED ■ INSTRUMENT RACK	
	OVER RANGE PROTECTION	☐ 115% OF MAX. OF SCALE ■ 150% OF MAX. OF SCALE	
	CAPILLARY LENGTH	■ MINIMUM LENGTH OF 15 M REQUIRED	
	BLOW OUT DISC	■ REQUIRED , WITH OPEN FRONT CONSTRUCTION OF SUITABLE MATERIAL	
	SWITCHING FACILITY	■ YES ☐ NO	
	TYPE	■ MICRO SWITCH ☐ OTHER	
	NO. / TYPE OF CONTACTS	2 NOS. SPDT	
	CONTACT RATING	5A 230V AC, 0.25A 220V DC	
	SETTING RANGE RANGE SELECTION	FIELD ADJUSTABLE OVER FULL RANGE; COVERS 125% OF MAX. OF SCALE	
	REPEATABILITY	± 1% OF FSR	
	POWER SUPPLY	■ 230V AC ■ 110V AC	
	OVER RANGE TEST	TEST PR. FOR THE ASSEMBLY SHALL BE 1.5 TO THE MAX. DESIGN PRESSURE AT 38 DEG C.	
	ZERO/ SPAN ADJUSTMENT	■ MICROMETER SCREW EXTERNAL FOR ZERO ADJUSTMENT ■ MICROMETER SCREW INTERNAL FOR RANGE ADJUSTMENT	

FORM NO. PEM-6666-0

	DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE FOR DF	SPECIFICATION NO.: PE-TS-XXX-145-I100
		VOLUME
		SECTION
		REV. NO. 00 / DATE: 03.04.2017
		SHEET 2 OF 3

TAG No. …… Qty..... Data Sheet No.: **PE-DC-999-145-I026**

Data Sheet A & B

DATA SHEET-A FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

PERFORMANCE	ACCURACY	± 1% OR BETTER OF FULL SCALE DEFLECTION	
CONNECTION	PROCESS	½ " NPT (M)	
	LOCATION	☐ BACK ☐ BOTTOM	
ACCESSORIES	NAME PLATE / METAL TAG	SS	
	MOUNTING	☐ WALL ☐ PIPE – U CLAMPS & BOLTS ☐ PANEL / RACK TO BE DECIDED DURING DETAILED ENGG.	
		3 WAY NEEDLE VALVE / MANIFOLDS PROTECTIVE SEPARATING, CHEMICAL SEAL DIAPHRAGM – FOR CORROSIVE LIQUID LINES Union, nut & tail piece and other Installation accessories as required. 3-Way SS316 Gauge cock for pressure gauges	

NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

FORM NO. PEM-6666-0

	DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE FOR DF	SPECIFICATION NO.: PE-TS-XXX-145-I100
		VOLUME
		SECTION
		REV. NO. 00 / DATE: 03.04.2017
		SHEET 1 OF 2

TAG No. …… Qty..... Data Sheet No.: **PE-DC-999-145-I026**

Data Sheet C

DATA SHEET-C FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

GENERAL	MANUFACTURER	
	MODEL NUMBER	
TECHNICAL	PRESSURE ELEMENT	
	MATERIAL	
	ENCLOSURE	
	DIAL	
	CASE	
	ADJUSTMENT	
	MOUNTING	
	OVER RANGE PROTECTION	
	BLOW OUT DISC	
	SWITCHING FACILITY TYPE NO. / TYPE OF CONTACTS CONTACT RATING SETTING RANGE REPEATABILITY POWER SUPPLY	
PERFORMANCE	ACCURACY	
CONNECTION	PROCESS	
	LOCATION	
ACCESSORIES	NAME PLATE / METAL TAG	
	MOUNTING	
	OTHER	

NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

FORM NO. PEM-6666-0

	DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER FOR DF	SPECIFICATION NO.: PE-TS-XXX-145-I100
		VOLUME
		SECTION
		REV. NO. 00 / DATE: 04.04.2017
		SHEET 1 OF 2

TAG No. …… Qty..... Data Sheet No.: **PES-145-01-DS1-0**

Data Sheet A & B

DATA SHEET-A FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

	MANUFACTURER		
	MODEL NUMBER		
TECHNICAL	TYPE	■ CAPACITANCE ■ SILICON RESONANCE TYPE	SMART TRANSMITTER OF ELECTRONIC TYPE, MICROPROCESSOR BASED, HART COMPATIBLE
	POWER SUPPLY	■ 24V DC NOMINAL	
	TRANSMITTER MEASUREMENT	■ PRESSURE ■ DIFF. PRESSURE	
	OUTPUT SIGNAL	■ 4 to 20 m Amp. DC	
	NO. OF WIRE	■ TWO	
	ACCURACY	■ ± 0.04% OF SPAN OR BETTER	
	LINEARITY, HYSTERISIS, DEAD BAND AND REPEATABILITY	■ ± 0.05 % OF SPAN OR BETTER	
	STABILITY	■ ± 0.1 % OF URL FOR 10 YEARS	
	SENSITIVITY	■ ± 0.05% OF SPAN OR BETTER	
	MATERIAL	**THE MINIMUM REQUIREMENT FOR SEA WATER APPLICATION : ALL WETTED PARTS & DIAPHRAGM SHALL BE SUITABLE FOR SEA WATER (DUPLEX SS OR BETTER)**	
	A) BODY	■ 316 SS	
	B) ELEMENT	■ 316 SS	
	C) DIAPRAGM	■ 316 SS	
	C) SEAL	■ TEFLON	
	FLANGED REMOTE SEAL DIAPHRAGM	AS REQUIRED	
	CAPILLARY LENGTH	■ MINIMUM LENGTH OF 15 M REQUIRED	
	CONTINUOUSLY ADJUSTABLE SPAN AND ZERO ADJUSTMENT PROVIDED	■ YES, Locally adjustable, non-interacting ☐ NO	
	MOUNTING	☐ WALL/PIPE STAND ■ INSTRUMENT RACK	
	ENCLOSURE	☐ NEMA-4 ☐ NEMA-7 ■ IP-65 WITH CORROSION RESISTANCE EPOXY COATING	
	PAINT	■ EPOXY COATING FOR ALL C&I EQUIPMENT ■ Anticorrosive paint shall be applied to field mounted enclosures / instruments.	
	TURN DOWN RATIO	■ 100:1 in general	

FORM NO. PEM-6666-0

	DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER FOR DF	SPECIFICATION NO.: PE-TS-XXX-145-I100
		VOLUME
		SECTION
		REV. NO. 00 / DATE: 04.04.2017
		SHEET 2 OF 2

TAG No. …… Qty..... Data Sheet No.: **PES-145-01-DS1-0**

Data Sheet A & B

DATA SHEET-A FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER (TO BE FILLED BY PURCHASER)		DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
INSULATION RESISTANCE	TO BE SPECIFIED BY BIDDER	
OVER PRESSURE	■ 150% OF MAX. OPR. PRESS	
ZERO SUPPRESSION/ ELEVATION RANGE	■ ATLEAST 100% OF SPAN	
INTEGRAL INDICATOR	■ YES, LCD indicator (5 digit) with scale of Engg. unit ☐ NO	
RESPONSE TIME	■ 150 msec.	
TRANSMITTER SHALL BE ABLE TO DRIVE LOAD IMPEDANCE OF 500 OHMS (min.) WITH DRIVE CAPABILITY OF 600 OHMS NOMINAL	■ YES ☐ NO	
ELECTRICAL CONNECTION	■ PLUG & SOCKET TYPE	
PROCESS CONNECTION	■ I/2 " NPT (F)	
ZERO & SPAN DRIFT	■ ± 0.015 % PER DEG.C AT MAX. SPAN ■ ± 0.11 % PER DEG.C AT MIN. SPAN	
DIAGNOSTICS	■ SELF INDICATING FEATURE	
MANIFOLD		
a) NAME PLATE / METAL TAG	SS	
b) PRESSURE MEASUREMENT	■ 2 WAY ■ MATERIAL: 316 SS	
c) DIFFERENTIAL PRESSURE MEASUREMENT	■ 5 WAY ■ MATERIAL: 316 SS	
CABLE ENTRY DETAIL	SUITABLE FOR DIA OF 17.5 mm	
NOTES: 1. TRANSMITTERS SHOULD NOT BE MOUNTED DIRECTLY ON MANIFOLD. MANIFOLD SHOULD BE NON-INTEGRAL AND STAND ALONE TYPE. 2. TRANSMITTERS TO BE EQUIPPED WITH MOUNTING BRACKETS. 3. UNION, NUT,PIPE-U CLAMPS,BOLTS & TAIL PIECE AND OTHER INSTALLATION ACCESSORIES AS REQUIRED.		

	PREPARED BY	**CHECKED BY**	**APPROVED BY**	COMPANY SEAL
NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

FORM NO. PEM-6666-0

	DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER FOR DF	SPECIFICATION NO.: PE-TS-XXX-145-I100
		VOLUME
		SECTION
		REV. NO. 00 / DATE: 04.04.2017
		SHEET 1 OF 2

TAG No. …… Qty..... Data Sheet No.: **PES-145-01-DS2-0**

Data Sheet C

DATA SHEET-C FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

MANUFACTURER	
MODEL NUMBER	
TYPE	
POWER SUPPLY	
TRANSMITTER MEASUREMENT	
OUTPUT SIGNAL	
NO. OF WIRE	
ACCURACY	
LINEARITY, HYSTERISIS, DEAD BAND AND REPEATABILITY	
STABILITY	
SENSITIVITY	
MATERIAL	
A) BODY	
B) ELEMENT	
C) DIAPRAGM	
C) SEAL	
CONTINUOUSLY ADJUSTABLE SPAN AND ZERO ADJUSTMENT PROVIDED	
MOUNTING	
ENCLOSURE	
PAINT	
TURN DOWN RATIO	
INSULATION RESISTANCE	
OVER PRESSURE	
ZERO SUPPRESSION/ ELEVATION RANGE	

FORM NO. PEM-6666-0

BHEL	**DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER FOR** DF	SPECIFICATION NO.: PE-TS-XXX-145-I100
		VOLUME
		SECTION
		REV. NO. 00 / DATE: 04.04.2017
		SHEET 2 OF 2

TAG No. …… Qty..... Data Sheet No.: **PES-145-01-DS2-0**

Data Sheet C

DATA SHEET-C FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

INTEGRAL INDICATOR	
RESPONSE TIME	
TRANSMITTER SHALL BE ABLE TO DRIVE LOAD IMPEDANCE OF 500 OHMS(min.) WITH DRIVE CAPABILITY OF 600OHMS NOMINAL	
ELECTRICAL CONNECTION	
PROCESS CONNECTION	
ZERO & SPAN DRIFT	
DIAGNOSTICS	
MANIFOLD	
d) PRESSURE MEASUREMENT	
B) DIFFERENTIAL PRESSURE MEASUREMENT	
CABLE ENTRY DETAIL	

	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL
NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

FORM NO. PEM-6666-0

	DATA SHEET FOR LOCAL CONTROL CUM STARTER PANELS FOR DF	SPECIFICATION NO.: PE-SS-999-145-054A
		VOLUME
		SECTION
		REV. NO. 00 / DATE: 04.04.2017
		SHEET 1 OF 3

TAG No. …… Qty..... Data Sheet No.: **PES-145A-DS1-0**

Data Sheet A & B

			DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
GENERAL	MANUFACTURER			
	CONSTRUCTION		■ FOLDED ☐ WELDED	
	ENCLOSURE SHEET THICKNESS	FRONT	■ 3.0 mm	
		OTHER	■ 2.0 mm	
		DOOR	■ 2 mm	
		HEIGHT	■ 2365 mm for stand-alone panels (THIS SHALL BE DECIDED BY BHEL DURING DETAILED ENGG.)	
		OTHER	■ Load bearing sheet front shall have 3mm thickness	
TECHNICAL	INPUT POWER SUPPLY * (ANY OTHER POWER REQUIREMENT TO BE DERIVED FROM THIS SUPPLY ONLY)		☐ 240V 50 Hz AC ☐ 220V DC ■ 415V 3 PHASE Kindly refer Electrical scope sheet	
	NO. OF FEEDERS		☐ ONE ■ TWO	
	STARTER WITH MCC		■ REQUIRED ☐ NOT REQUIRED	
	IPR POSITION		☐ MCC ■ CONTROL PANEL	
	CONTACT RATING OF RELAY		■ 5 Amp, 230 V AC ■ 0.25 Amp, 220V DC	
	CONTROL SUPPLY		☐ 10V AC ☐ 220V AC ■ 220V DC ☐ Other. (As per requirement)	
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)		■ REQUIRED 20 nos. Actual no. shall be decided during detailed engg.	
	TEMP SCANNER (IF REQUIRED –NO. OF CHANNELS TO BE SPECIFIED UNDER SEC-C)		☐ REQUIRED ■ NOT REQUIRED	
	PAINT TYPE		■ EPOXY ENAMEL ☐ EPOXY POWDER COATED OR BETTER	
	MIMIC (TYPE OF MIMIC- MATERAIL, THICKNESS TO BE SPECIFIED DURING DETAILED ENGG.)		■ REQUIRED ☐ NOT REQUIRED	
	PANEL COLOUR (EXTERNAL)		☐ LIGHT GREY (Shade 631 IS-5) ☐ OPALINE GREEN (Shade 275) ☐ RAL 7032 SHALL BE DECIDED DURING DETAILED ENGINEERING	
	FINISH (EXTERNAL)		☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY	
	PANEL COLOUR (INTERNAL)		☐ WHITE ☐ CREAM ☐ OFF WHITE SHALL BE DECIDED DURING DETAILED ENGINEERING	
	FINISH (INTERNAL)		☐ MATT ■ GLOSSY ☐ SEMI GLOSSY SHALL BE DECIDED DURING DETAILED ENGINEERING	

FORM NO. PEM-6666-0

BHEL	**DATA SHEET FOR LOCAL CONTROL CUM STARTER PANELS FOR** DF	SPECIFICATION NO.: PE-SS-999-145-054A VOLUME SECTION REV. NO. 00 DATE: 04.04.2017 SHEET 2 OF 3

TAG No. …… Qty..... Data Sheet No.: **PES-145A-DS1-0**

Data Sheet A & B

	DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)		DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
	CLASS OF PROTECTION	☐ IP-66 (FOR OUTDOOR LOCATIONS) ■ IP-55 (FOR INDOOR LOCATIONS) THE PANEL SHALL BE NEMA 4X WITH A SUITABLE CANOPY AT THE TOP.	
	CONTROL HARDWARE	☐ RELAY BASED	
	FOUNDATION ARRANGEMENT	☐ FOUNDATION BOLTS ☐ ANCHOR FASTENERS	
	WEIGHT OF PANEL (Kg.)	……..(Vendor to specify)	
	PANEL TYPE	☐ PRESSURISED ■ UNPRESSURISED As per Requirement	
	CABLE GLAND	■ DOUBLE COMPRESSION	
	AMMETER (TYPE OF INPUT)	☐ 1 Amp CT ☐ 4-20 Ma NOT REQUIRED BELOW 30KW.	
	SCOPE OF SUPERVISION FOR ERECTION & COMMISSIONING	☐ APPLICABLE ☐ NA	

	PREPARED BY	**CHECKED BY**	**APPROVED BY**	COMPANY SEAL
NAME				NAME:
DESIGNATION				
SIGNATURE				SIGNATURE:
DATE				DATE:

FORM NO. PEM-6666-0

	DATA SHEET FOR LOCAL CONTROL CUM STARTER PANELS FOR DF	SPECIFICATION NO.: PE-SS-999-145-054A
		VOLUME
		SECTION
		REV. NO. 00 / DATE: 04.04.2017
		SHEET 3 OF 3

TAG No. …… Qty..... Data Sheet No.: **PES-145A-DS1-0**

Data Sheet C

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

GENERAL	MANUFACTURER			
	CONSTRUCTION		☐ FOLDED ☐ WELDED (As per requirement)	
	ENCLOSURE SHEET THICKNESS	FRONT		
		OTHER		
		DOOR		
		HEIGHT		
		OTHER		
TECHNICAL	INPUT POWER SUPPLY			
	NO. OF FEEDERS			
	CONTACT RATING OF RELAY			
	TEMP SCANNER			
	CONTROL SUPPLY			
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)			
	PAINT TYPE			
	PANEL COLOUR (EXTERNAL)			
	FINISH (EXTERNAL)			
	TYPE OF MIMIC MATERIAL OF MIMC THICKNESS OF MIMIC			
	PANEL COLOUR (INTERNAL)			
	FINISH (INTERNAL)			
	CLASS OF PROTECTION			
	CONTROL HARDWARE			
	FOUNDATION ARRANGEMENT			
	WEIGHT OF PANEL (Kg.)			
	PANEL TYPE			
	CABLE GLAND			

FORM NO. PEM-6666-0

BHEL	**DATA SHEET FOR LOCAL CONTROL CUM STARTER PANELS FOR** DF	SPECIFICATION NO.: PE-SS-999-145-054A VOLUME SECTION REV. NO. 00 DATE: 04.04.2017 SHEET 3 OF 3

TAG No. …… Qty..... Data Sheet No.: **PES-145A-DS1-0**

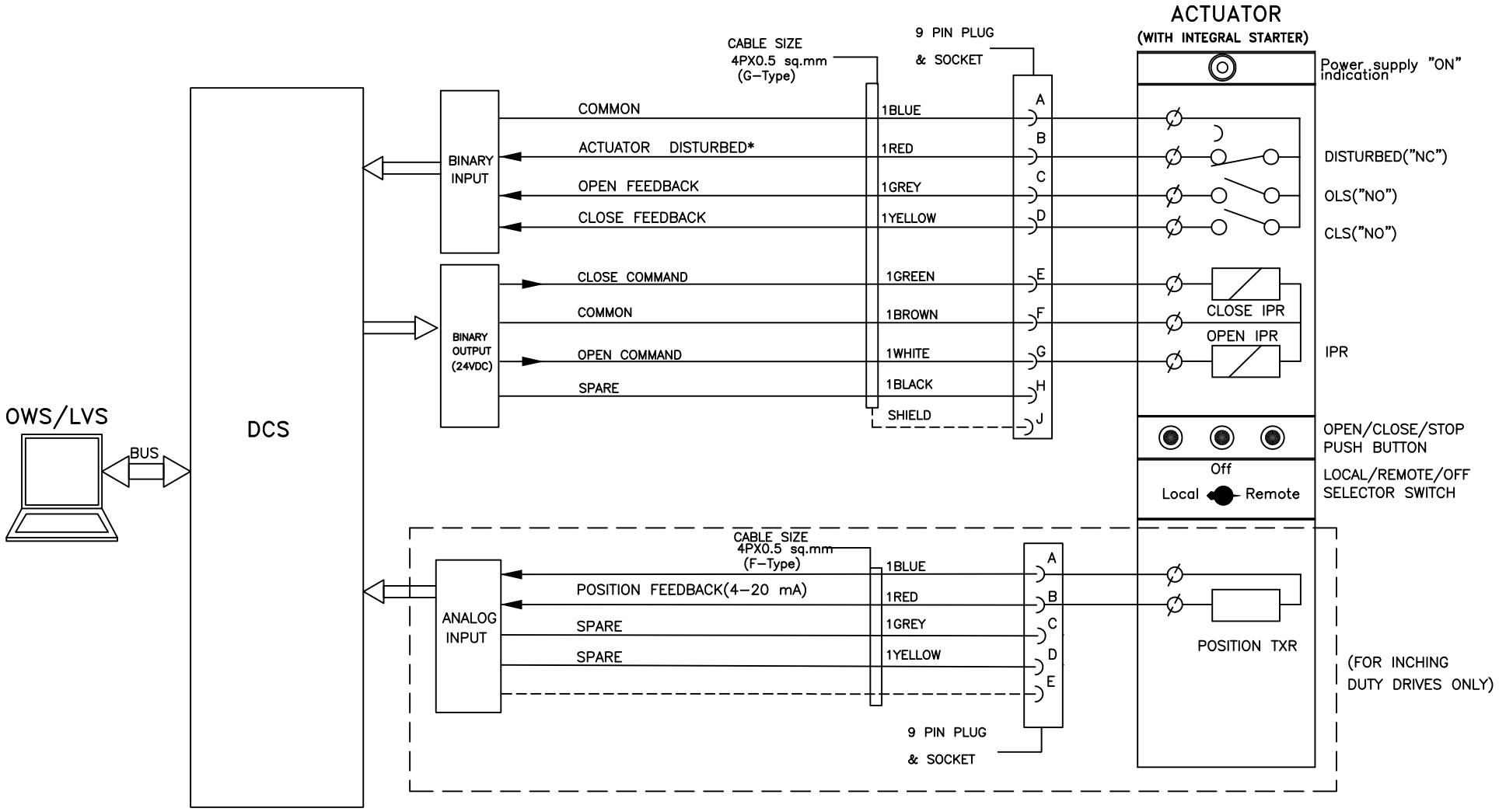
Data Sheet C

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

	AMMETER (TYPE OF INPUT)		
	SCOPE OF SUPERVISION		

	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL
NAME				NAME:
SIGNATURE				SIGNATURE:
DATE				DATE:

DCS INTERFACE FOR (BIDIRECTIONAL DRIVE WITH INTEGRAL STARTER) (BID/BIDI)



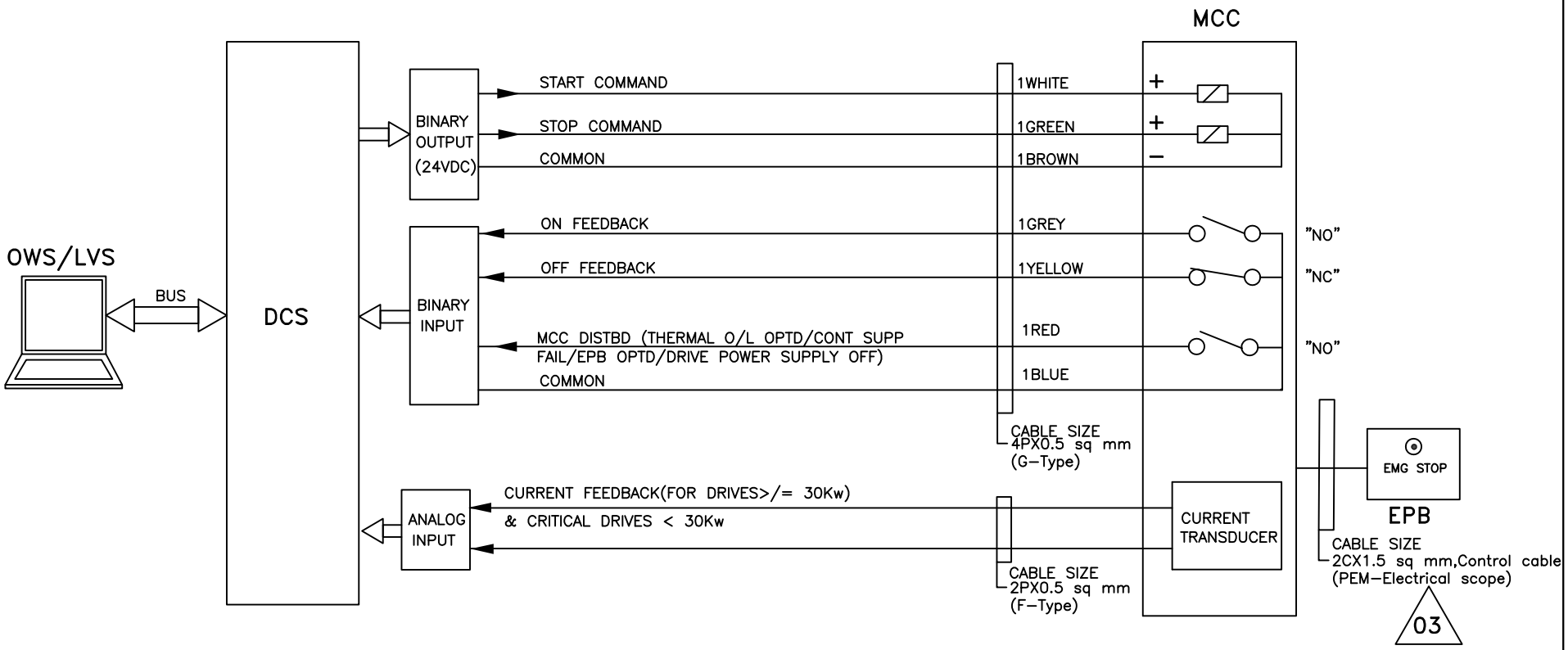
NOTE:

* DISTURBED= Loss of Power supply (1 Phase/3 Phase)/ Loss of control supply/ Motor thermostat trip/ Thermal over load/Torque open/close cut off/ Local/Off/Remote Sel. switch in local or off mode/ Stop PB operated.

01

BHEL	PROJECT: ROURKELA PP–II EXPANSION (1X250MW)	DRG.NO.	PE–DM–427–145–I002
		DATE	16.01.2017
	TITLE DDCMIS INTERFACE FOR BIDIRECTIONAL DRIVE	REV.NO.	03
		SHT	7 OF 14

DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE (CONTACTOR CONTROLLED) (LTUD)



BHEL	PROJECT: ROURKELA PP-II EXPANSION (1X250MW)	DRG.NO.	PE-DM-427-145-I002
		DATE	16.01.2017
	TITLE DDCMIS INTERFACE FOR UNIDIRECTIONAL LT DRIVE	REV.NO.	03
		SHT	8 OF 14

	UPPUR STPP (STAGE-I, UNIT#1&2) 2X800MW	
	TECHNICAL SPECIFICATION (C&I) FOR DEBRIS FILTER	

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KKS TAGGING PHILOSOPHY

TYPICAL DRIVE LIST WITH KKS TAG		
KKS_CODE	**DESCRIPTION**	**AREA**
PCA11AA001	DEBRIS DISCHARGE VALVE	DF- 1
PCA11AE011	DF GEARED MOTOR DRIVE	DF-1
PCA21AA001	DEBRIS DISCHARGE VALVE	DF- 2
PCA21AE011	DF GEARED MOTOR DRIVE	DF-2

NOTES:-

1.IF THE NUMBER OF EQUIPMENT/INSTRUMENTS CHANGES, THE KKS FOR THE SAME SHALL BE FINALIZED DURING DETAILED ENGINEERING.

2.FOR INSTRUMENTS KKS 6th AND 7th PLACE VALUE OF KKS CODE SHALL BE CHANGED FOR CORRESPONDING EQUIPMENT AS FOLLOWS:-

1.FOR PRESSURE -CP

FOR INSTRUMENTS 8th,9th AND 10th PLACE VALUE OF KKS CODE SHALL BE CHANGED FOR CORRESPONDING EQUIPMENT AS FOLLOWS:-

1.FOR PRESSURE/TEMPERATURE/LEVEL TRANSMITTER-011

2.FOR PRESSURE/TEMPERATURE/LEVEL GAUGE-511

3.FOR PRESSURE/TEMPERATURE/LEVEL SWITCH-111

	UPPUR STPP (STAGE-I, UNIT#1&2) 2X800MW	
	TECHNICAL SPECIFICATION (C&I) FOR DEBRIS FILTER	

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QUALITY ASSURANCE FOR INSTRUMENTS & LCP AND TYPE TEST REQUIREMENTS

0

PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	1 OF 7

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

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

$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.

1 - BHEL; 2 - Vendor; 3 - Sub-vendor

PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	2 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
		3. Conductor a) Resistance b) Size c) Sheet colour	 MA MA MA	 Electrical Measurement Visual	 100% 100% 100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	3	---	2	
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type	CR	Visual	Sample	BHEL Spec. and BOM	BHEL Spec. and BOM	Log Book	2	---	---	
		2. Verification of Test Certificates	CR	Scrutiny of Type / Routine T.Cs.	100%	Relevant IS	Relevant IS	Log Book	2	---	---	
		3. Operation / Functional check	CR	Electrical	Sample+ 100%@	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---	+ for relay & contactors only
		4. I.R.	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---	@ for all components except relays & contactors.
		5. H.V.	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---	
		6. Calibration	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	1	
		7. Pick up / Drop off Voltage	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---	

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

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1 - BHEL; 2 - Vendor; 3 - Sub-vendor

PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	3 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		2. Surface defects	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		3. IR / HV on Terminal Blocks	MA	Electrical	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
	IN PROCESS											
6.0	Blanking / Bending / Forming	1. Dimensions	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Surface defects after bending	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	---	
7.0	Nibbling / Punching	1. Cutout Sizes	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Deburring	MA	Visual	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
	ASSEMBLY											
8.0	Frame Assembly & Sheet fixing	1. Dimensions	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		2. Alignment	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		3. Welding Quality	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		4. Surface defects	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	

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

$ P - Agency Performing the Test.; W - Agency Witnessing the Test.; V - Agency Verifying the Test.

1 - BHEL; 2 - Vendor; 3 - Sub-vendor

PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	4 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		3. Dipping / Removal Time	MA	Measurement	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		4. Surface quality after every dip	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		5. Primer after phosphating	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		6. Putty Application & Rubbing after primer	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		7. Paint first coat	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	

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

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1 - BHEL; 2 - Vendor; 3 - Sub-vendor

PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.: **PE-QP-999-145-I056**
VOLUME IIB
SECTION D
REV. NO. 01 DATE: 22-02-2008
SHEET 5 OF 7

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

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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

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

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PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

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

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STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR ANNUNCIATORS

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE/ MODEL						
	DIMENSIONS OF HARDWARE						
	MODULARITY						
	SEQUENCE						
	FACIA DETAILS						
2	FUNCTIONAL TEST	100%		P	W	V	
3	IMMUNE TO STEP VARIATIONS IN THE POWER SUPPLY	SEE NOTE-1 BELOW		P	W	V	
4	DEGREE OF PROTECTION FOR ENCLOSURE	TYPE TEST		P	W	V	
5	I/R CHECK	SEE NOTE-1 BELOW		P	W	V	
6	RESPONSE			P	W	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR PRESSURE & DP GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	SENSOR TYPE						
	DIAL SIZE						
	MODEL NO/TAG NO						
	RANGE/SCALE						
	SWITCH CONTACT RATING & NOS.						
	END CONNECTION						
2	CALIBRATION			P	W	V	
	ACCURACY						
	REPEATABILITY						
	SET POINT ADJUSTMENT						
3	OVER PRESSURE & LEAK TEST			P	W	V	
4	OPERATION OF PRESSURE. RELIEF DEVICE	ONE		P	W	V	
5	REVIEW OF TC FOR	FOR LOT		V	V	V	
	MATERIALS OF SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. When material corelation is not available, MFR's compliance to be provided
5. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

PEM :: C&I

STANDARD QUALITY PLAN FOR PRESSURE / DP/LEVEL TRANSMITTER

QUALITY PLAN NO.:	**PE-QP-999-145-I001**
VOLUME	IIB
SECTION	D
REV. NO.	00 DATE: 12.10.99
SHEET	1 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
1.0	**RAW MATERIAL INSPECTION**											
1.1	Body/Casing, Cable Gland and Mounting Bracket	1. Chemical & Mech. Properties	MA	Analysis	1 / Lot	Tech. Specn. Data Sheet, Mfr. standard	Tech. Specn. Data Sheet, Mfr. standard	Test certificate	3	---	2	Compliance report verification by BHEL.
		2. Dimensions	MA	Measurement	10% Min. 3 Nos.	Manufacturer drg.	Manufacturer drg.	Log Book	2	---	---	
		3. Visual	MA	Visual	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Log Book	2	---	---	
		4. Degree of Protection (If applicable)	CR	IS-2147 IS-2148	1 / Type	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Test certificate	3	---	2	
		5. Leak Tightness	MA	Hydro Test	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Log Book	2	---	---	
1.2	Sensor (Diaphragm, Capsule, Bellows, Strain, Gauge, Capacitance etc.)	1. Material Properties (Chemical & Mechanical)	MA	Analysis	1 / Lot	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Test certificate	3/2	---	2	
		2. Dimension	MA	Measurement	1 / Lot	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Test certificate	2	---	---	
		3. Performance	CR	Function	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Test certificate	2	---	---	
		4. Type Test	CR	Mech. & Elect.	1/Type	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Test certificate	3/2	---	2	

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PEM :: C&I

STANDARD QUALITY PLAN
FOR
PRESSURE / DP/LEVEL TRANSMITTER

QUALITY PLAN NO.:	**PE-QP-999-145-I001**
VOLUME	IIB
SECTION	D
REV. NO.	00 DATE: 12.10.99
SHEET	2 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
1.3	Gasket	1. Dimension	MA	Measurement	Sample	Manufacturer standard	Manufacturer standard	Test certificate	3/2	---	2	
		2. Sheer Hardness	MA	Analysis	Sample	Manufacturer standard	Manufacturer standard	Test certificate	3/2	---	2	
1.4	Electrical & Electronic Components	1. Marking & Rating	MA	Visual	10%	Manufacturer standard	Manufacturer standard	Log Book	2	---	---	
		2. Electrical Parameters	CR	Electrical Tests	10%	Manufacturer standard	Manufacturer standard	Log Book	2	---	---	
		3. Dimensions	MA	Measurement	10%	Manufacturer standard	Manufacturer standard	Log Book	2	---	---	
		4. Solderability	MA	Electrical	3 / Type	Manufacturer standard	Manufacturer standard	Log Book	2	---	---	
1.5	PCBs	1. Visual	MA	Visual	100%	---	---	---	3/2	---	2	
		2. Dimensions	MA	Measurement	10%	Manufacturer standard	Manufacturer standard	Log Book	3/2	---	2	
		3. Type Test	CR	Mech. & Elect. Tests	1 / Type / Batch	IS:7405 BS:4025	IS:7405 BS:4025	Test certificate	3/2	---	2	

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PEM :: C&I

STANDARD QUALITY PLAN
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SHEET	3 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
2.0	**In-Process Inspection**											
2.1	Electrical Unit											
2.1.1	Etched PCB	1. Dimension – Trade width, Gap etc.	MA	Measurement	Sample	Manufacturer standard	Manufacturer standard	Inspection report	2	---	---	
		2. Defect of undercuts	MA	Visual	Sample	Manufacturer standard	Manufacturer standard	Inspection report	2	---	---	
		3. Quality and plating of plating through holes.	CR	Visual	100%	Manufacturer standard	Manufacturer standard	Inspection report	2	---	---	
		4. Screen printing	CR	Visual	100%	Manufacturer standard	Manufacturer standard	Inspection report	2	---	---	Compliance verification report by BHEL
2.1.2	Component Mounting and soldering	1. Correctness of components	MA	Visual	100%	Manufacturer standard	Manufacturer standard	Inspection report	2	---	---	
		2. Mounting and orientation	MA	Visual	100%	Manufacturer standard	Manufacturer standard	Inspection report	2	---	---	
		3. Soldering defects and finish	CR	Visual	100%	Manufacturer standard	Manufacturer standard	Inspection report	2	---	---	
2.1.3	Assembled PCBs	Functional check	CR	Electrical checks before & after soaking*	100%	Manufacturer standard	Manufacturer standard	Inspection report	2	---	---	

*Soaking means subjecting PCB (Assembled) at 70 Deg. C for 72 hours at energised condition and rapid temperature cycle test at 70 Deg. C and (-) 20 Deg. C for 30 minutes at each temp. (Five such cycles).

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PEM :: C&I

STANDARD QUALITY PLAN FOR PRESSURE / DP/LEVEL TRANSMITTER

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
2.1.4	Conformal coating	Uniformity and finish of conformal coating on both sides	CR	Visual	100%	Manufacturer standard	Manufacturer standard	Inspection report	2	---	---	
2.2	Mounting, Fitting, Assembly of various mechanical parts	1. Correct Mounting	MA	Visual	100%	Manufacturer standard	Manufacturer standard	Log Book	2	---	---	
		2. Defects	MA	Visual	100%	Manufacturer standard	Manufacturer standard	Log Book	2	---	---	Compliance verification report by BHEL
		3. Dimensions	MA	Measurement	100%	Manufacturer standard	Manufacturer standard	Log Book	2	---	---	
2.3	Interconnection – Sensor to Electronic unit	Correctness of Interconnection	MA	Visual	100%	Manufacturer standard	Manufacturer standard	Log Book	2	---	---	
2.4	Interconnection – Pneumatic unit / Electronic unit and output / Local indicator.	Correctness of Interconnection	MA	Visual	100%	Manufacturer standard	Manufacturer standard	Log Book	2	---	---	

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STANDARD QUALITY PLAN FOR PRESSURE / DP/LEVEL TRANSMITTER

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
3.0	**Complete Transmitter**	1. Workmanship	MA	Visual	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report / Log Book	2	1	---	
		2. Dimension	MA	Measurement	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report / Log Book	2	1	---	
		3. Type / Model	CR	Visual	10%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report / Log Book	2	1	---	
		4. Range	CR	Visual	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report / Log Book	2	1	---	
		5. Calibrated Range	CR	Visual	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report / Log Book	2	1	---	
		6. Local Indicator / Scale marking	MA	Visual	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report / Log Book	2	1	---	
		7. Process connection type	CR	Measurement	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report / Log Book	2	1	---	
		8. Wetted parts material	MA	Analysis (Chemical, Mechanical)	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report / Log Book	2	---	1	
		9. Mounting bracket type	MA	Visual / Dimension	10%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report / Log Book	2	1	---	
		10. Calibration	CR	Electrical / Pneumatic	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report / Log Book	2	1	---	
		11. Soaking	CR	Electrical	100%	BHEL Spec	BHEL Spec.	Inspection report / Log Book	2	1	---	

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
3.2	Acceptance Tests	1. Accuracy	CR	Electrical	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report	2	1	1	
		2. Repeatability	CR	Electrical	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report	2	1	1	
		3. Dead Band	CR	Electrical	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report	2	1	1	
		4. Hysterisis	CR	Electrical	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report	2	1	1	
		5. HV & IR	CR	Electrical	100%	Manufacturer standard	Manufacturer standard	Inspection report	2	1	1	
		6. Linearity	CR	Electrical	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report	2	1	1	
		7. Supply voltage variation effect	CR	Electrical	100%	BHEL Spec.	BHEL Spec.	Inspection report	2	1	1	
		8. Temperature variation effect over range	CR	Electrical	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report	2	1	1	
		9. Over range	CR	Electrical	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report	2	1	1	

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
3.3	Type Test	1. Surge withstand capability	CR	Elect. & Mech	1 / Type	ANSI-C.37	ANSI-C.37	Inspection Report	3	---	2,1	
		2. Radio frequency interference	CR	Elect. & Mech	1 / Type	ANSI-C.37	ANSI-C.37	Inspection Report	3	---	2,1	
		3. Vibration effect	CR	Elect. & Mech	1 / Type	BHEL Spec.	BHEL Spec.	Inspection Report	3	---	2,1	
		4. Electro Magnetic field effect	CR	Elect. & Mech	1 / Type	BHEL Spec.	BHEL Spec.	Inspection Report	3	---	2,1	
		5. Degree of protection	CR	Mech. & Elect.	1 / Type	IS:2147	BHEL Spec.	Inspection Report	3	---	2,1	
		6. Explosion proofnexx (If applicable)	CR	Mech. & Elect.	1 / Type	IS:2148	BHEL Spec.	Inspection Report	3	---	2,1	
		7. Dry Heat	CR	Thermal	1 / Type	IS:9000	ANSI-C.37	Inspection Report	3	---	2,1	85 Deg. C for 16 Hrs.
		8. Damp Heat	CR	Thermal	1 / Type	IS:9000	ANSI-C.37	Inspection Report	3	---	2,1	40 Deg. C; 6 cycle
4.0	**Packing**	1. Packing Material	MA	Visual	100%	Manufacturer standard	Manufacturer standard	Log Book	2	---	2	
		2. Packeging and Marking	MA	Visual & Measurement	100%	Manufacturer standard	Manufacturer standard	Log Book	2	---	2	

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SECTION III

DOCUMENTS TO BE SUBMITTED BY BIDDER

	TITLE : SCHEDULE OF PERFORMANCE GUARANTEES FOR DEBRIS FILTER (DF)	SPEC. NO. PE-TS- 425-165-N003
		SECTION : III
		SUB SECTION : IIIA
		Sheet 1 of 1 Date- 13.10.17

S.NO.	DESCRIPTION	UNITS	PROJECT NAME: 2x800 MW UPPUR STPP (STAGE -I, Unit 1 & 2) - BTG
1.	Pressure drop across the Debris Filter (i.e. between inlet & outlet nozzle) under clean condition and Normal flow condition	MWC	

PARTICULARS OF BIDDER/ AUTHORISED REPRESENTATIVE				
NAME	DESIGNATION	SIGNATURE	DATE	COMPANY SEAL

COMPLIANCE CERTIFICATE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate and furnish same with the offer.

a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions with regard to same.

b) There are no other deviations w.r.t. specification other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'

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

d) Any drawing/ document/ data-sheet/ calculation/ Quality plan/ Instrumentation etc. submitted along with the offer shall be considered for reference only, same shall be subject to BHEL/ Customer/Customer's Consultant approval in the event of order.

e) The offered materials shall be either equivalent or superior to those specified in the specification. For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.

f) The commissioning spares shall be supplied on 'As Required Basis' and to be supplied at the time of commissioning of Debris Filter & prices for same included in the base price itself.
Prices for special tools & tackles, if any, shall also be included in the base price.
Recommended spares for 3 years shall be quoted separately with price indicated separately.

g) Charges for Installation Checks, Commissioning of equipment, Trial run and Performance Testing at site shall be included by bidder in the base price itself.

h) The main flanges for DF shall be suitable for the forces and moments as per the specification.

i) The hydrostatic test pressure shall be 1.5 times the design pressure.

j) All sub - vendors shall be subject to BHEL/ Customer/Customer's Consultant approval in the event of order.

k) The Performance guarantees of equipments shall stand valid till the satisfactory completion of performance testing & its acceptance by BHEL/ Customer/Customer's Consultant.

l) The orientation of piping around DF shall be finalised during detailed Engg.

m) Electrical/ C&I :

- All selected motor ratings have minimum 15 % margin over maximum continuous demand of the driven equipment including voltage and frequency variations, temperature rise and other factors.

- Supply of electrical viz. LT power cables, instrumentation and control cables, cable glands, lugs, cable trays etc. shall be as per specification. Their erection shall be done by BHEL

- The junction boxes for termination of DPT/ DPS/ Actuator LS/ solenoid valves/ Ball oversize monitor/ Ball recirculating monitor are included in bidder's scope. The instrumentation cable and cabling from instruments/ actuators to junction boxes is also included in bidder's scope.

- Valve actuators and controls shall be provided as specified in Data Sheet-A and Project specific requirements as specified in Section C-2 & Section C-3

- Alarms/ annunciations/ instruments shall be finalised during detailed engineering in the event of order which shall be subject to BHEL/ Customer/Customer's Consultant approval and shall be without any commercial implications to BHEL.

- Switch gear panel should have suitable arrangement like bus coupler for providing redundancy to incoming supply feeder.

	Title	SPECIFICATION NO.
	DATA SHEET - B **DEBRIS FILTER** **(BACKWASH TYPE)**	PE-TS-XXX-165-N003
		SECTION: **C** SUB-SECTION: **IIIC**
		SHEET 1 OF 9

INSTRUCTION TO BIDDER
1. This data sheet shall be read in conjunction with Specification No. PE-TS-XXX-165-N003
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO.	ITEM	UNIT	PARTICULARS
1.0	**General :**		
1.1	Number of Debris Filter being supplied.	Nos.	
1.2	Type & Model (on-line/off-line)		
1.3	Manufacturer		
1.4	Country of origin		
1.5	Capacity, each	M^3/hr	
1.6	Size		
	a) Inlet connection	mm	
	b) Outlet connection	mm	
1.7	Liquid to be filtered		
2.0	**Design :**		
2.1	Design Pressure	Bar (g)	
2.2	DesignTemperature	°C	
2.3	Flow rate through the Filter : a) Normal b) Maximum allowable c) Minimum	M^3/hr	
2.4	Design differential pressure for filter section/ screen	bar (g)	
3.0	**Guaranteed Performance**		
3.1	Pressure drop across the Filter (i.e., between inlet and outlet connections) at normal flow rate a) Clean condition b) 50% chocked condition c) During flushing operation d) After flushing operation	Bar	
3.2	Debris discharge flow during flushing operation.	M^3/hr	
3.3	Flushing period	Minutes	

Name of Bidder/ Vendor					
Revision Number	**0**	**1**	**2**	**3**	**4**
Signature of Bidder/ Vendor Authorised Representative					
Date :					

INSTRUCTION TO BIDDER
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SL.NO.	ITEM	UNIT	PARTICULARS
3.4	Minimum pressure differential to cause flushing/ backwashing		
3.5	Maximum size of Particle/ debris which can be safely handled by the filter.		
3.6	Power consumption during flushing	KW	
	a) Flushing Valves(s)		
	b) Debris Discharge Valve		
	c) Debris Extractor		
	d) Water Injector Pump (if any)		
	e) Any other		
	f) Total		
4.0	Operation :		
4.1	Whether automatic flushing/ back-washing operation effected by the following		
	a) Differential pressure		YES/NO
	b) Adjustable timer		YES/NO
	c) Push button		YES/ NO
	d) Any other		YES/NO
4.2	Whether provision for manual flushing / backwashing operation is made in the event of control system failure.		YES/ NO
5.0	**Filter Housing Body :**		
5.1	Code/ Standard		
5.2	Outer diameter	mm	
5.3	Thickness	mm	
5.4	Materials		
	Housing/ Body		
	Internal Hardware		

Name of Bidder/ Vendor					
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	Title	SPECIFICATION NO.
	DATA SHEET - B **DEBRIS FILTER** **(BACKWASH TYPE)**	PE-TS-XXX-165-N003
		SECTION: **C** SUB-SECTION: **IIIC**
		SHEET 3 OF 9

INSTRUCTION TO BIDDER
1. This data sheet shall be read in conjunction with Specification No. PE-TS-XXX-165-N003
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SL.NO.	ITEM	UNIT	PARTICULARS
	External hardware		
5.5	Lining materail (if applicable) and thickness		
5.6	Inspection Hole :		
	a) Type		
	b) Size	mm	
5.7	Whether sight glass is provided		YES/ NO
6.0	**Filter Section/ Screen Assembly :**		
6.1	Perforation/ mesh size	mm	
6.2	Free filter surface area	m^2	
6.2	Total surface area	M^2	
6.4	Thickness	mm	
6.5	Materails :		
	a) Filter section/ scree		
	b) Supporting cage		
	c) Hardware for fixing the filter section/ screen		
7.0	**Flushing/ Backwashing Unit :**		
7.1	Type		
7.2	Flushing Valves (if applicable)		
	a) Nos. provided	Nos.	
	b) Type		
	c) Materials • Body • Disc/ Flap • Shaft		
	d) Tag Number		

Name of Bidder/ Vendor					
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Signature of Bidder/ Vendor Authorised Representative					
Date :					

INSTRUCTION TO BIDDER
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SL.NO.	ITEM	UNIT	PARTICULARS
7.3	Debris Extractor (if applicable)		
	a) Type		
	b) Materials		
7.4	Debris discharge/ backwash outlet valves :		
	a) Type		
	b) Size	mm	
	c) Materials		
	♦ Body		
	♦ Disc/ Trim		
	♦ Shaft		
	d) Tag Number		
7.5	Size of Debris discharge/ backwash outlet valves is greater than pipe line size		YES/NO
7.6	Any water injection is required		YES/ NO
7.7	Whether Pump, valves and piping for water injection is included in the offer.		YES/ NO.
7.8	Debris discharge/ backwash outlet pipe		
	a) Material		
	b) O.D. and thickness	mm	
8.0	**Differential Pressure Measuring System:**		
8.1	Differential Pressure Switch/ Transmitter		
	a) Type		
	b) Make and Model		
	c) Range		
	d) Accuracy		
	e) Material of sensing element		

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SL.NO.	ITEM	UNIT	PARTICULARS
	f) No. of contacts	Nos.	
	g) Contact rating		
	h) Enclosure		
	i) Type of Mounting		
8.2	Whether differential Pressure gauge is provided for manual observation.		YES/ NO
8.3	Diffrential Pressure Gauge :		
	a) Type		
	b) Make and Model		
	c) Range		
	d) Accuracy		
	e) Material of sensing element		
	f) No. of contacts	Nos.	
	g) Dial size	mm	
	h) Enclosure		
	i) Mounting		
8.4	Whether built in flushing arrangement complete with flushing pump, valves, and associated piping, is provided.		YES/ NO
8.5	Whether remote seal type D.P. Transmitter		YES/ NO
9.0	**Timer for Flushing Operation**		
9.1	Timer make		
9.2	Range of duration setting		
10.0	**Actuators :**		
10.1	Actuators for flushing valves :		
	a) Type and make		

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SL.NO.	ITEM	UNIT	PARTICULARS
	b) Nos. provided		
	c) Motor rating	KW	
10.2	Actuators for debris discharge/ backwash outlet valves		
	a) Type and make		
	b) Motor rating	KW	
1.03	Actuator for Debris Extractor	KW	
	Type & make Nos. provided Motor rating		
10.4	Any other		
11.0	**Electric Drive Motors**		
11.1	Drive motor for water injection pump (if applicable)		
	a) Type and make		
	b) Rating	KW	
11.2	Drive motor for debris extractor		
	a) Type and make		
	b) Rating	KW	
11.3	Drive motor for differential pressure measure, measuring system flushing pump (if applicable).		
	a) Type and make		
	b) Motor rating	KW	
11.4	Any other		

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	DATA SHEET - B **DEBRIS FILTER** **(BACKWASH TYPE)**	PE-TS-XXX-165-N003
		SECTION: **C** SUB-SECTION: **IIIC**
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INSTRUCTION TO BIDDER
1. This data sheet shall be read in conjunction with Specification No. PE-TS-XXX-165-N003
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SL.NO.	ITEM	UNIT	PARTICULARS
12.0	**Counter Flanges for inlet & outlet** :		
12.1	Nos. provided	Nos.	YES/ NO
12.2	Type		
12.3	Size		
12.4	Rating		
12.5	Materials		
	a) Flanges b) Bolts and Nuts c) Gaskets		
12.6.	Code/ Standard		
12.7	Counter flanges for all other terminal points are provided.		YES/ NO
13.0	**Control Panel**		
13.1	Type		
18.2	Model & Manufacturer		
13.3	Operating Voltage/ frequency	V/ Hz	
13.4	Control Voltage/ frequency	V/ Hz	
13.5	Materials of housing and door		
13.6	Protections/ interlocks provided for :		
13.7	Alarms/ Annunciations provided for :		
13.8	Indicators provided for :		

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INSTRUCTION TO BIDDER
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SL.NO.	ITEM	UNIT	PARTICULARS
13.9	Whether counterto register number of flushing operations, is provided.		YES/ NO
13.10	Whether interconnecting control and power cabling between the control panel and filter is included in the offer.		YES/ NO
14.0	Whether lifting lugs are provided.		YES/ NO.
15.0	Whether supports complete with foundation plates, bolts, nuts, etc. are included in the offer (wherever required).		YES/ NO
16.0	**Shop Inspection and Tests**		
16.1	Whether all the tests and inspections as detailed in the specification/ quality plan are carried out.		YES/ NO
16.2	Hydorstatic Test :		
	a) Test Pressure	Bar (g)	
	b) Test duration	Minutes	
17.0	**Painting :**		
17.1	External Surfaces :		
	a) Surface Preparation b) Primer c) Finish		
17.2	Internal Surfaces :		
	a) Surface Preparation b) Primer c) Finish		
18.0	**Weights :**		
18.1	Empty Weight	Kg.	
18.2	Operating	kg	

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	DATA SHEET - B **DEBRIS FILTER** **(BACKWASH TYPE)**	PE-TS-XXX-165-N003
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INSTRUCTION TO BIDDER
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SL.NO.	ITEM	UNIT	PARTICULARS
19.0	Overall Dimensions		
	a) Debris Filter		
	b) Flushing skid		
	c) D.P. measuring system skid		
20.0	Weight of heaviest unit/ component to be handled.		
21.0	Space required for removal.		
22.0	Headroom required during installation at site.		
23.0	Other information (if any)		

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Name of Bidder/ Vendor					
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Date :					