TANGEDCO
1X800 MW NORTH CHENNAI TPP STAGE III BTG

TECHNICAL SPECIFICATION
FOR
DEBRIS FILTER (DF).

Specification No. : PE-TS- 423-165-N003 Rev 00

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

INDEX

THIS TECHNICAL SPECIFICATION CONSISTS OF FOLLOWING SECTIONS:

CONTENTS

SECTION - I

SPECIFIC TECHNICAL REQUIREMENTS

SUB-SECTION IA - Specific Technical Requirements (Mech.)
SUB-SECTION IB - Specific Technical Requirements (Electrical)
SUB-SECTION IC - Specific Technical Requirements (C & I)
SUB-SECTION ID – Datasheet-A

SUB-SECTION – IA

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 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-V3-423-165-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-V3-423-165-N002	TECHNICAL DATA SHEET-DF	
	PE-V3-423-165-N003	INSTALLATION PLAN- DF	
	PE-V3-423-165-N004	GENERAL ARRANGEMENT OF DF	
	PE-V3-423-165-N006	C&I Part-I, PANEL-TDS, I/O LIST, CABLE SCH AND CONTROL PHILOSPHY FOR DF	
	PE-V3-423-165-N008	QP-DF	
	Secondary Documents -		
	PE-V3-423-165-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-V3-423-165-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.
	PE-V3-423-165-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 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/ quality assurance requirements stipulated. In line with this, the bidder as technical offer shall furnish two signed and stamped copies of the following:

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

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

ANNEXURE-I REV-0, DATE: 14.03.17

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

PACKAGES: DF

SCOPE OF VENDOR: SUPPLY

PROJECT: 1 X 800 MW NORTH CHENNAI STAGE - III

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

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

PACKAGES: DF

SCOPE OF VENDOR: SUPPLY

PROJECT: 1 X 800 MW NORTH CHENNAI STAGE - III

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.	423	ORIGINATING AGENCY		PEM (ELECTRICAL)	
PROJECT TITLE	1X800 MW NORTH CHENNAI	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

ANNEXURE-IV

SUB-VENDOR LIST

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

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

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

	TITLE	SPECIFICATION NO.
BHEL	**LV MOTORS**	VOLUME II B
		SECTION D
	DATA SHEET-A	REV NO. 00 DATE 26.10.16
		SHEET 1 OF 1

1.0	Design ambient temperature	:	50 °C
2.0	Maximum acceptable kW rating of LV motor	:	Upto 200KW
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Degree Of Protection	:	IP55
5.0	Cooling	:	TEFC
6.0	Details of supply system		
	a) Rated voltage (with variation)	:	415V ± 10%
	b) Rated frequency (with variation)	:	50 Hz (Variation: +3% TO –5%)
	c) Combined voltage & freq. variation	:	10% (sum of absolute values)
	d) System fault level at rated voltage	:	50 kA for 1 sec
	e) Short time rating for terminal box	:	50 kA for 0.25 sec
	f) LV System grounding	:	Solidly
7.0	Class of insulation	:	Class 'F', with temp rise limited to class B.
8.0	Minimum voltage for starting (As percentage of rated voltage)	:	80% of rated voltage
9.0	Power cables data	:	Shall be given during Detailed engg.
10.0	Earth Conductor Size & Material	:	Shall be given during Detailed engg.
11.0	Space heater supply **(30KW & ABOVE)**	:	240 V, 1Φ , 50 Hz
12.0	Rating up to which Single phase motor	:	Acceptable below 0.20 Kw
13.0	TYPE OF STARTER PROVIDED IN MCC	:	DOL
14.0	Locked rotor current		
	a) Limit as percentage of FLC	:	As per IS 12615
	b) Permissible tolerance, if any	:	
15.0	Additional tests	:	As per QP
16.0	Flame-proof motor		
	a) Enclosure suitable (As per IS:2148)	:	As per requirement
	b) Classification of Hazardous area (As per IS: 5572 part-I)	:	As per requirement
	c) Degree of protection	:	IP65
17.0	Makes	:	AS PER ANNUXURE-I
18.0	Terminal box	:	Suitable to rotate at 90 degrees
19.0	Paint shade	:	RAL 5012

20.0 Efficiency class : IE3

NOTE :

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

LT Switchgear

2.2.11 LT SWITCHGEAR

2.2.11.1 CODES AND STANDARDS

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

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

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.

All works shall be carried out as per the following codes and standards.

Sl.No	Code	Description
1	IEC-60947 IEC-60439 IS-13947	Low voltage switchgear and control gear assemblies.
2	IS-8623	Specification for Low-Voltage Switchgear and Control gear Assemblies
3	IEC-60664 IS-15382	Insulation coordination for equipment with low voltage systems
4	IEC-60044	Instrument transformers
5	IEC-60529	Degrees of protection provided by enclosures
6	IS-13118	High Voltage alternating circuit breakers
7	IS-2675	Enclosed distribution fuse boards and cut outs for voltages not exceeding 1000 V AC and 1200 V DC
8	IS-8828	Electrical Accessories – Circuit breaker for over current Protection
9	IS -12021	Specification for Control transformer for switchgear and control gear for voltages not exceeding 1000V AC
10	IS-5082	Wrought aluminium & aluminium alloy for electrical Purposes
11	IS-13703	Specification for low voltage fuses for voltages not exceeding 1000 V AC and 1500 V

		DC
12	IS-8187	Specification for D Type fuses
13	IS- 6005	Code of practice for phosphating iron and steel
14	IS-694	694 PVC insulated cables for working voltages up to and including 1100
15	IS-722	AC Electricity Meters
16	IS-1248	Electrical Indicating instruments
17	IS-2551	Danger Notice Plates
18	IS-2629	Hot dip galvanizing
19	IS-2705	Current Transformers
20	IS-3043	Code of practice for earthing
21	IS-3072	Code of practice for installation and maintenance of Switchgear
22	IS-3156	Voltage Transformers
23	IS-3202	Code of practice for climate proofing of electrical equipment
24	IS-3231	Electrical relays for power system protection
25	IS-8686	Static Relays
26	IS-10118 (4 parts)	Code of practice for selection, installation and maintenance of switchgear and control gear
27	IS-11171	Specification for dry type transformers
28	IS-11353	Guide for uniform system of marking and identification of conductors and apparatus terminals

2.2.11.3.1 TYPE

Circuit Breakers	Shall be air break, three pole, spring charged, and horizontal
Switchgear	Fully draw out type single front

MCC	Fully draw out type single front/Double front.
ACDB/DCDB	Fixed type single front

2.2.11.3.2 SYSTEM PARAMETERS

1)	Nominal system voltage	415 V AC	220 V DC
2)	Highest system Voltage	433 V	240 V DC
3)	Voltage variation	±10%	190 - 240
4)	Rated frequency	50 HZ	-
5)	Frequency variation	+3% to (-5%)	-
6)	One minute Power	2.5 kV	2.5 kV
	frequency withstand voltage Main circuit Auxiliary Circuit	2.0 KV	2.0 KV
7)	System Earthing	Solidly Grounded	Unearthed
8)	Maximum system fault level	50KA for 1sec	25KA for 1 sec

2.2.11.3.3 General Technical Requirements

Power from LV service transformers shall be supplied to 415 V switchgears. Power from 415 switchgears to the various MCCs, PDBs, ACDBs etc. shall be supplied from redundant incomers. These switchgears shall distribute power to LV auxiliary motors and also to other auxiliary loads viz. MCCs / ACDBs, etc. LV switchgears shall be of metal enclosed indoor type. Incomers / bus-couplers, outgoing tie feeders rated 630A & above and motor feeders rated 90 kW & above shall be equipped with air circuit breakers of fault interrupting capacity of 50 KA rms.

All PCC/PMCC/MCC shall be of intelligent type compatible with IEC-61850 communication protocol. Utility MCCs like service building MCC, Welding DBs, AC & Ventilation MCCs,etc., shall be non-intelligent type.

All the boards shall be sectionalized, except for turbine valve DB.

Not more than 2 out of 3 ACBs can be closed at a time unless at the time of planned short time paralleling through synchro check.

Under normal mode of operation each incoming source shall be connected to the respective bus sections with bus coupler open.

During the normal mode of operation if there is a loss of normal source to any bus-section, slow bus auto changeover shall be initiated to first trip the normal incomer connected to this section and further close the bus coupler to extend power from healthy bus section.

Restoration of normal operating condition (described in 1.14.6 above) shall be through planned manual changeover through synchro check paralleling or manual dead bus closing.

Incase parallel running between two sources prolong over a set time, an alarm shall be generated and the last ACB to close shall be opened.

The AC control supply voltage for motors rated below 90 kW shall be 110V AC. For this purpose each motor feeder of PMCC/MCC shall be provided with suitable rated 415/110V Control Transformer. Separate control transformer for test bus supply shall be provided for each bus section.

All circuit breakers shall have 220V DC control.

2.2.11.3.4 List of minimum required LV switchgears

S.No	N a m e of LV Switchboard
1.	UNIT PMCC
2.	BUNKER FLOOR MCC
3.	UNIT MLDB
4.	VENTILATION MCC
5.	AC MCC
6.	BOILER MCC
7.	SOOT BLOWER MCC
8.	BOILER VALVE DAMPER MCC
9.	MILL SYSTEM MCC

10. TURBINE AUX. MCC
11. TURBINE VALVE DB
12. BOILER ACDB
13. ESP # 1A PMCC
14. ESP # 1B PMCC
15. ESP # 1C PMCC
16. ESP # 1D PMCC
17. ESP # 1E PMCC
18. ESP # 1F PMCC
19. ESP ACDB
20. ESP AC & VENTILATION MCC
21. ESP MLDB
22. DG SWGR AMF PANEL
23. UNIT NORMAL CUM EMERGENCY PMCC
24. 415 V AC ELDB
25. 415 V AC TG Building
26. FUEL OIL UNLOADING PH PMCC
27. SERVICE BUILDING MCC
28. AIR WASHER MCC
29. WELDING PDBs
30. AC AND VENTILATION MCC
31. CPU REGENERATION MCC
32. Main Lighting Distribution Boards (MLDB)
33. Emergency Main Lighting Distribution Board (EMLDB)
34. DC Lighting Distribution Board (DCLDB)
35. AC Fuse Boards

Any other PCC/PMCC/MCC/DB required as per the geographical distribution of load and for any other system which is part of mechanical system under BTG package and required for safe and reliable functioning of the plant.

2.2.11.2 TEMPERATURE RISE

The temperature rise of the horizontal and vertical busbars and main bus link including all the power drawout contracts when carrying 90% of the rated current along the full run shall in no case exceed 55 deg c with silver plated joints and 40 deg c with all other types of joints over an ambient of 50 deg c.

2.2.11.3 OPERATIONAL REQUIREMENTS

2.2.11.3.1 Breakers

I. Breakers shall have anti-pumping feature and it shall be electrically drawout type. The incomer and bus coupler breakers for switchgear shall be electrically operated with over current releases or relays.

II. Breakers shall have inherent fault making and breaking capacities. They shall have shunt trip coils. In case releases are offered, the same shall have contact for energisation of lockout relay. All breakers Shall have built in interlocks for equipment and personnel safety

III. Paralleling of two supplies shall be avoided by except for switchgear where auto-changeover is provided. Breaker contact multiplication, if required, shall be through latch relay.

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

V. Provision of mechanical closing of breaker only in 'Test' and 'Withdrawn' 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.

VI. Clear status indication for each circuit shall be provided through lamps, switch positions or other mechanical means.

VII. Supervision relay shall be provided for trip coil monitoring

2.2.11.3.2 Switches, Contactors and Fuses

a. Incomers for MCCs and DBs rated up to 630A could be MCCB's & for above ratings ACB are preferred.

b. Motor starter contactors shall be of air break, electromagnetic type suitable for DOL starting of motor, and shall be of utilisation category AC-3 for ordinary and AC-4 for reversing starters. DC contactor shall be of DC-3 utilisation category.

c. Fuses shall be HRC, preferably link type, with a minimum interrupting capacity equal to the short circuit current of the LT system. Fuses shall be furnished complete with fuse bases and fittings of such design as to permit easy and safe replacement of fuse element. Visible indication shall be provided on blowing of the fuse.

d. Motor fuse characteristics and ratings shall be chosen to ride over starting period without blowing. The fuse on incoming feeder wherever provided, shall be chosen to provide discrimination with motor/feeder fuses.

e. Isolating switches and MCCBs shall have door interlocks and padlocking facility.

f. Wherever two incoming switches and one bus-section switch/breaker are provided for an assembly, these shall be electrically interlocked to ensure that only two out of the three can be closed at time.

g. Wherever two incoming switches are provided for an assembly, these shall be electrically interlocked to ensure that one of the two can be closed at time.

2.2.11.3.3 Panels

a. All switchgears, MCCs, DBs, panels, modules, local starters and push buttons shall have prominent engraved identification plates.

b. Local push button stations shall have metal enclosure of die cast aluminium or rolled sheet steel of 1.6mm thickness & shall be of DOP IP55. Push buttons shall be of latch type with mushroom knobs.

c. Where breaker/starter module front serves as compartment cover, suitable blanking covers, one for each size of modules per switchboard shall be supplied for use when carriage is withdrawn.

d. All non-current carrying metal work of boards/panels shall be effectively bonded to earth bus of galvanised steel, extending throughout the switchboard/MCC/DB. Positive earthing shall be maintained for all positions of chassis and breaker frame.

e. Suitable trolley arrangement shall be provided for breaker/starter modules. Two trolleys per switchgear room shall be provided so that top most breaker module of all types, sizes and rating can be withdrawn on trolley and lowered for maintenance purpose.

f. The incoming connection to transformer of more than 1000KVA and inter-connecting Sections between switchboards shall preferably be of bus ducts. The bus duct enclosure shall be made of minimum 3mm thick aluminium alloy. The section of the bus duct should have adequate strength to withstand internal and external forces resulting from the various operating conditions. Aluminium sheet hood shall be provided for outdoor bus duct enclosure joints to provide additional protection against water ingress. The bus duct top shall be sloped to prevent retention of water. The bus duct shall have DOP of IP55.

g. It should be possible to carryout maintenance on a feeder with adjacent feeders alive

2.2.11.3.4 Control, Protection & Metering Requirements

i) Control circuits shall operate at suitable voltage of 110V AC or 220V DC. Necessary control supply transformers having primary and secondary fuses shall be provided for each MCC, 2 x 100% per section. However the breakers shall operate on 220V DC. The auxiliary bus bars for control supply shall be segregated from main bus bars. The control supplies shall be monitored.

ii) Contractor shall fully co-ordinate overload and short circuit tripping of breaker with upstream and downstream breakers/fuses/MCCBs motor starters. Various equipment's shall meet requirement of Type-II class of coordination as per IEC.

iii) All relays and timers shall operate on available DC supply and not have any inbuilt batteries. They shall be provided with hand-reset operation indicator (flags) or LEDs with pushbuttons for resetting.

iv) All equipment's shall have necessary protections. However, following minimum protections shall be provided:

MPCB with Contactor controlled LV motor feeders (Motors rated 18.5kW & below) having intelligent controller

a. Instantaneous short circuit protection
b. Overload protection

v) MCCB with Contactor controlled LV motor feeders (Motors rated above 18.5kW but below 90 kW) having intelligent controller

a. Instantaneous short circuit protection

b. Overload protection

vi) Single phasing protection for motors rated 30 kW and above rating

vii) In Instantaneous short circuit protection on all phases through HRC cartridge type fuses / MCCB rated for 80 kA rms (prospective breaking capacity at 415V).

viii) Thermal overload protection

ix) Single phasing protection for motors protected by fuses.

x) Breaker controlled motors feeders (motors rated above 90kW) Numerical, comprehensive motor protection relay with following minimum facility as indicated below :

a. Instantaneous short circuit protection

b. Overload protection

c. Under voltage protection

d. Locked Rotor protection

e. Earth fault protection

f. Current unbalance.

g. Temperature monitoring (stator, bearing etc.).

h. Phase reversal.

i. Thermal model based with RTD feedback and negative sequence current.

j. Voltage compensated acceleration.

xi) Incomers (ACB):

a. 3 ph IDMT Overcurrent & earth fault protection (51,51N)

b. 3 ph Instantaneous Overcurrent protection (50)

c. Standby earth fault protection for service transformer protection (connected on transformer neutral CT side)

d. Under voltage protection (27) with Timer & Fuse failure protection

e. Neutral dEviation relay

xii) Buscoupler (ACB):

a. 3ph IDMT Overcurrent & earth fault protection (51 & 51N)

b. Sync check relay (25)

xiii) Bus PT:

a. Under voltage protection (27)

b. No voltage protection (27)

c. Fuse failure protection (97)

xiv) ACB outgoing feeders:

3 ph IDMT Overcurrent protection (51, 51N)

xv) Incomer from DG Set.

a) Differential Protection (87) - Three Pole

b) Reverse Power Protection.

c) Overload Alarm on one phase

d) Earth Fault Detection Relay (64)

e) Voltage controlled Overcurrent relay

f) Generator under/over voltage Protection

g) Hand Reset/Lockout Relay with a blue lamp.

h) 3 Phase Energy Meter having accuracy of 1.0 class

Apart form protection relays, each electrically operated breaker shall also be provided with Anti pumping (94), trip annunciation(30), lockout (86). Lockout supervision (95) and trip supervision (74) relays. Lockout relay shall be hand reset type.

2.2.11.3.5 Meters / instruments

I. All meters/ instrument shall be flush mounted on front panel, at least 96 sq.mm. Size with 90 degree linear scales and accuracy class of 2.0.All motors above 7.5 kW shall have directly connected ammeter and Motors above 30kW shall have CT connected Ammeter with ASS. Necessary Current transducers shall be provide for the same. Bus-section shall have bus VT, voltmeter with selector switch, and other relay and timers required for protection. Adequate control and selector switches, push buttons and indicating lamps shall be provided. Thermostatically controlled space heaters with switches shall be provided to prevent condensation.

II. All Incomer feeders shall be provided with MFM, Ammeter with selector switches & with necessary kW transducer, Current transducers etc., Bus PT feeder shall be provided with Voltmeter + VSS & necessary Transducers .All Outgoing supply feeders shall be provided with Ammeters + ASS & necessary transducers.

a. In case of remote controlled breaker panels, following shall be ensured. Each feeder shall have local/remote selector switch. Closing from local shall be possible only in test position whereas closing from remote shall be possible in either service or test position. Tripping from local shall be possible only when local/remote selector switch is in local position. Tripping from remote shall be either breaker in service position or selector switch being in remote position.

b. Control from Remote Necessary hardware shall be provided in the switchgear panel like coupling relays (24V DC, with max. burden of 2.5VA), auxiliary relays, current/voltage transducers (4-20 mA, dual output) etc. to effect interlocks, exchange information / status and exercise control from remote.

2.2.11.3.6 DESIGN AND CONSTRUCTIONAL FEATURES

1) All 415V switch gear motor control centres (MCCs), AC & DC distribution boards (DB s), etc. shall have following features

2) Shall be of metal enclosed, indoor, floor mounted and free standing type.

3) All frames and load bearing members shall be fabricated using mild steel structural sections or pressed and shaped cold rolled sheet steel of thickness not less than 2mm.

4) Frame shall be enclosed in cold rolled sheet steel of thickness not less than 1.6mm. Doors and covers shall also be of cold rolled sheet steel of thickness not less than 1.6 mm. Stiffeners shall be provided wherever necessary. Removable gland plates of thickness 3mm (hot/cold rolled sheet steel) or 4 mm (non-magnetic material) shall be provided for all panels.

5) All switchboards/panels shall be of dust and vermin proof. All cut-outs shall have synthetic rubber gaskets.

6) All switchboards, MCCs and DB s shall have following distinct vertical sections.

   i) Completely enclosed bus bar compartment for horizontal and vertical busbars.

   ii) Completely enclosed switchgear compartments (one for each circuit housing circuit breakers, motor starter or switch-fuse feeder).

   iii) Compartment for cable alley or cable box for power and control cables. In case of cable box, they shall be segregated with complete shrouding for individual feeders at the rear for direct termination of cables.

   iv) For cable connection to circuit breaker a separately enclosed cable compartment shall also be acceptable.

   v) Compartment for relays and other control devices associated with a circuit breaker, wherever necessary.

   vi) The switchboards/MCC/DBs of 1600A & above rating shall be of DOP IP42 & of IP52 for less than 1600A rating.

   vii) All 415V switchgears, MCC's, AC & DC distribution boards etc. shall be painted by powder coating process. Paint shade for complete panels excluding end covers shall be RAL7032 for extreme end covers of all boards.

7) Busbars shall be of high conductivity aluminium alloy or copper.

8) Minimum air clearance in air between phases and phase-earth shall be 25 mm for busbars and cable terminations. For all other components, the Clearances

shall be at least 10mm. wherever above is not possible except for horizontal and vertical busbars, insulation shall be provided by anti-tracking sleeving or barriers. However for horizontal and vertical busbars, clearances specified above shall be maintained even when busbars are insulated/sleeved. In case of DC DBs/ fuse boards, the busbar system shall be insulated or physically segregated with barriers to prevent interpole short circuit.

9) Minimum air clearance in air between phases and phase-earth shall be 25 mm for busbars and cable terminations. For all other components, the Clearances shall be at least 10mm.Wherever above is not possible except for horizontal and vertical busbars, insulation shall be provided by anti-tracking sleeving or barriers. However for horizontal and vertical busbars, clearances specified above shall be maintained even when busbars are insulated/sleeved. In case of DC DBs/ fuse boards, the busbar system shall be insulated or physically segregated with barriers to prevent interpole short circuit.

10) Busbar insulators shall be of track-resistant high strength non-hygro- scopic, non- combustible type and suitable to withstand stresses due to over-voltages and short circuit current. Insulators and barrier of inflammable material such as Hylam shall not be accepted.

11) All types of relays and timer shall be subject to Purchaser's approval. They shall be flush mounted with connections from inside, and shall have transparent & dust tight cover, removable from front, drawout construction for easy replacement and testing facility. The auxiliary relays and timer may be provided in fixed cases.

12) Maxi terminal /cage clamp type terminal blocks shall be provided for signals to be interfaced with DDCMIS/PLC.

13) The switchgears/MCC shall be designed to offer adequate level of safety to operating/ maintenance personnel. Means shall be provided to prevent access to the live part to avoid accidents during service as well as maintenance period. Bidder shall bring out the safety means provided to achieve above. A detailed instruction plate suitable for wall mounting shall be provided for each switchgear/MCC room discribing various safe operating procedure/safety precautions for safe operation and maintenance of switchgear/MCC.

14) All current and voltage transformers as required for metering & protection specified shall be completely encapsulated, cast resin insulated type. Incomers from transformers shall have CTs for transformer REF protection. All current and voltage transformers as required for metering and protection specified shall be completely encapsulated, cast resin insulated type. Incomers from

transformers shall have CTs for transformer restricted earth fault protection. The accuracy shall be as follows:

15) Other CT particulars like ratio, burden knee-point voltage, excitation current and secondary resistance shall be decided by the Tenderers

16) CT secondary shall be rated for 1 A for metering and either 5 A or 1 A for protection.

17) indicating lamps shall be cluster LED type

18) 20% spare feeders of each type & rating used in the MCC with a minimum one (1) number on each bus section shall be provided.

2.2.11.3.7 ESSENTIAL SERVICE MODULE

During auto changeover of the supply the contactors in the affected bus would have dropped off. Services, which, shall be restarted immediately without time lapse to keep the unit running, are considered essential services. Such auxiliaries shall restart automatically without any action by the operator after an auto changeover. These modules shall have additional hardware like timer (or time delayed closing from DCS), aux. contactors and associated circuitry in the module. Such essential services shall be identified during the detailed engineering stage and suitable module/scheme shall be provided.

The modules of some of the critical application motors like barring gear motor, air heater motor, lube oil pump, jacking oil pump etc. irrespective of their kW rating shall be provided with a CT, ammeter and a current transducer with remote metering in DCS.

2.2.11.3.8 Type Tests

GENERAL

All equipment's to be supplied shall be of type tested quality. The Contractor shall submit for Purchaser's approval the reports of all the type tests as listed in this specification and carried out within last five years from the zero date of the project. 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 either conducted at an independent laboratory or should have been witnessed by a client.

In case the Contractor is not able to submit report of the type test(s) conducted within last five years from the zero date of the project, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract free of cost to the Purchaser and submit the reports for approval.

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.

The following type test certificates on each type & rating of L.T. Switchgear, MCC panel and distribution boards shall be submitted.

a. Short time withstand test with circuit breaker mounted inside the switchgear panel.
b. Temperature rise test.
c. Type II - Short circuit co-ordination test for any three ratings of MCC module as selected by the Purchaser.
d. Test sequence –1 & combined test sequence shall be carried out on each rating of circuit breaker mounted inside the panel.
e. Degree of protection tests

2.2.11.3.9 ROUTINE TEST

LT SWITCHGEAR

Switchgear shall be subjected to all routine tests as per relevant standards along with following tests:
Temperature rise test on power circuits

a. Short time current tests on power circuits.
b. Mechanical operation test
c. Insulation resistance and 500V DC Megger before/ after 1 minute HV
xvi) test
d. Electrical control, interlock and sequential operation tests
e. Verification of wiring as per approved schematic.

Motors

2.2.12 MOTORS

2.2.12.1 Design Criteria

i. For the purpose of design of equipments /systems, an ambient temperature of 50 °C and relative humidity of 95% shall be considered. The equipment shall operate in a highly polluted environment.

ii. Transient voltage dip on starting of the largest motor with DOL shall be limited to 20% of the nominal system voltage at the voltage terminals.

1. Rating

   i. The motor rating shall be arrived at considering 15% margin over the duty point input or 10% over the maximum demand of the driven equipment, whichever is higher, considering highest system frequency.

   ii. All motors shall be continuously rated (S1 duty). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor.

   iii. Whenever the basis for motor ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings shall be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.

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

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

   For Mill Motors:

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

3. Canopy shall be provided for outdoor motors.

4. Contractor shall provide fully compatible electrical system, equipments, accessories and services.

5. All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations.

6. Voltage and frequency variations:
   i. Frequency : (+) 3% and (-) 5%
   ii. Voltage :
      A) AC:
         a. ± 10% for 11 kV/6.6 kV
         b. ±10% for 415 V

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

   iii. Combined 10 % (absolute sum)

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

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

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

9. Type

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

   ii. DC Motors
      a. Shunt wound

10. Temperature Rise

   i. **Air cooled m**otors - 70°C by resistance method.

   ii. Water cooled - 80° C over inlet cooling water temperature mentioned elsewhere, by resistance Method.

11. Degree of Protection

Degree of protection for various enclosures shall be as follows:

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

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

2.2.12.2 Codes and Standards

1. All motors shall confirm to the latest editions including all applicable amendment of relevant IS, IEC and CBIP standards/Publications. In case any other standard is followed that ensures equal or better quality, may be accepted. However the English version of the Standard adopted shall be submitted.

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

i.	Three phase induction motors	: IS:325, IEC:60034
ii.	Single phase AC motors	: IS:996, IEC:60034
iii.	Crane duty motors	: IS:3177, IEC:60034
iv.	DC motors/generators	: IS:4722
v.	Degree of protection by enclosures for rotating electrical machines	: IS: 4691 , IS: 4728, IS: 6362, IS: 2253
vi.	Noise levels for rotating electrical machines	: IS: 12065
vii.	Mechanical Vibrations for rotating electrical machines	: IS 12075

2.2.12.3 Operational Requirements

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

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

iv. Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.

v. Motors shall be capable of restarting under full load after a momentary loss of voltage with the possibility of 150 % nominal voltage during fast bus transfer.

2. Torque Requirements

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

ii. Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.

2.2.12.4 Design and constructional features

1. Suitable single phase space heaters shall be provided on motors rated 30 kW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided.

2. All motors shall be suitable for direct on line starting through any type of breaker.

3. All motors shall be either totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. However, motors rated 3000KW or above can be Closed air circuit water cooled (CACW). CW motors can be screen protected drip proof (SPDP) type. Motors located in hazardous areas shall have flame proof enclosures conforming to IS: 2148 as detailed below:

a. Fuel oil area : Group - IIB

b. Hydrogen generation plant area : Group - IIC

4. Winding and Insulation

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

	The coil inter-turn insulation shall be suitable for 0.3/3 micro sec. surge of 32 KVp and 12 kVp for 11 kV and 6.6 kV system respectively followed by 1 min power frequency high voltage test of appropriate voltage on inter turn insulation
415V AC & 220V DC	Class 'F' with temperature rise limited to class 'B'

5. Motors rated above 1000 kW shall have insulated bearings to prevent flow of shaft currents.

6. Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature.

7. Noise level and vibration shall be limited within the limits prescribed in IS: 12065 & IS: 12075 respectively. Motors shall withstand vibrations produced by driven equipment.

8. In MV/HV motors, 12 nos. simplex or 6 nos. duplex RTDs (two per phase), each having D.C. resistance of 100 ohms at 0°C, embedded in the stator winding at locations where highest temperatures may be expected, shall be provided. The material of the RTD's shall be platinum. Each bearing shall be provided with dial type thermometer with adjustable alarm contact and resistance type temperature detector. All HV motors shall be provided with shaft grounding rings for bearing protection and earthing shaft current.

9. MV/HV motors shall also be capable of satisfactory operation at full load at a supply voltage of 80% of the rated voltage and shall be capable of either two starts in quick succession with third start after 5 minutes in cold condition or two starts at 15 minutes intervals in hot condition, both cases with voltage and frequency variation within specified limits.

10. Locked rotor current of the MV motors shall be limited to 600% (subject to IS tolerance) of the full load current of the motors and for HV motors (like BFP) shall be limited to 450% (inclusive of IS tolerance) of full load current of the motor. Locked rotor current of the LV motor shall not exceed 600% of full load current inclusive of IS tolerance.

11. MV Motors shall be provided with differential protection. These motors shall be provided with star connected stator windings. The 3 nos. current transformers, one for each phase shall be mounted in a separate compartment in the neutral side terminal box. The three phases shall be connected to form the star point after they pass through the CTs. These differential protection CTs for motors on 11/ 6.6 kV switchgear shall be supplied as loose.

12. Motor body shall be grounded at two earthing points on opposite sides with two separate and distinct grounding pads complete with tapped holes, GI bolts and washers.

13. HV motors can be offered with either elastimould termination or dust tight phase separated double walled (metallic as well as insulated barrier) cable boxes. In case elastimould terminations are offered, then protective cover and trifurcating sleeves shall also be provided. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided in case of cable boxes.

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

15. Motors rated 18.5kW and below shall be contactor controlled having MPCB incomers with intelligent controllers. Motors rated 18.5kW and above but below 90 kW shall be contactor controlled having MCCB incomers with intelligent controllers. Motors rated 90 kW and & above up to 200KW shall be ACB controlled with numerical relays. HV & MV Motors rated above 200 KW shall have vacuum breakers. HV motors rated 1000kW and above shall be provided with insulation bearings for avoiding bearing currents. HV Motors rated 1000KW and above shall also have differential protection. Care shall be taken by BTG Bidder to ensure that parameters of the differential CT being supplied along with motors (rated above 1000kW) match with the parameters of the differential CT being supplied by BTG bidder in 11kV Switchgear.

16. The motors shall be suitable for bus transfer schemes provided on the 11 kV, 6.6 Kv and 415V systems without any injurious effect on its life.

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

18. All motors shall be provided with an emergency stop push button near the motor as per the Indian Statutory regulations.

19. The motor terminal box shall be suitable for withstanding the maximum system fault current for a duration of at least 0.25 seconds.

20. Neutral in case of HV motors shall be kept accessible.

21. Motors shall be designed to easy access for drilling holes through motor feed of mounting flange for installation of dowel pins after assembly of the motor and driven equipment.

22. Well spacious working platforms shall be provided around the motor area for carrying out maintenance & testing works. Platform shall be minimum of 300 mm below the level of motor base plate.

23. Flow switches shall be provided for monitoring oil flow of forced lubrication bearings, if used. Alarm switch contact rating shall be minimum 0.5 A at 220 V DC and 10 A at 230 V AC.

24. For bearing temperature measurement, duplex RTDs shall be provided for each bearing and shall be wired up to the terminal box.

25. Lube oil pressure transmitters shall be provided to DCS for remote monitoring. Lube oil pressure very low trip to HV equipment shall be 2 out of 3 logic.

26. Capillary type temperature gauge cum switch shall be provided for DE / NDE of HV Motors.

27. Motors with CACA/CACW heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate the following:

    a) Hot and cold air temperatures of the closed air circuit for CACA motors.
    b) Hot and cold, air and water temperatures for CACW motors.

28. The Alarm switch contact rating shall be minimum 0.5 A at 220 V DC and 10 A at 230 V AC.
29. DIRECTION OF ROTATION

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

30. BEARINGS

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

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

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

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

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

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

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

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

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

31. TERMINAL BOXES

General

i) Motors shall be provided with separate terminal boxes for main, space heaters, embedded temperature detectors, bearing temperature indicators and moisture detectors terminals, Neutral CT terminals. When it is not possible to provide LT motors with separate terminal box for space heater terminals, space heater terminals shall be adequately segregated from the main terminals in the single box. Terminal boxes shall be weatherproof and water-tight 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 Purchaser /Consulting Engineer. All terminal boxes shall be suitable for proper termination cable to be finalized during detailed engineering.

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

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

Main Terminal Box

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

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

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

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

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

a) Min. fault level for 11kV Motors - 50kA
b) Min. fault level for 6.6 kV Motors - 40kA
c) Min. fault level for 415V Motors -50kA

d) Min. fault level for 220V DC Motors -25kA

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

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

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

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

32. TYPE AND SIZE OF CABLES

Space Heaters

i) For LV Motors: Two point five (2.5) 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

For Main Terminals:-

i) LT Motors

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

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

ii) HV & MV Motors

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

33. GROUNDING

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

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

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

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

34. EMBEDDED TEMPERATURE DETECTORS

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

35. BEARINGS TEMPERATURE INDICATORS

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

36. SPACE HEATERS

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

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

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

37. HOT AIR TEMPERATURE DETECTOR

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

38. WATER FLOW INDICATOR

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

39. MOISTURE DETECTORS

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

40. BED PLATE

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

41. Painting

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

42. Local Push Button Stations

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

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

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

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

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

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

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

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

LPB shall be of following types:

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

43. OTHER ACCESSORIES

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

44. NOISE LEVEL

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

2.2.12.5 Documents and Drawings

1. INFORMATION WITH PROPOSAL

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

2. INFORMATION ON AWARD OF CONTRACT

Motor Data Sheet

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

Following characteristics curves:-

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

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

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

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

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

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

vii) Negative phase sequence current withstand characteristics.

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

1. Type tests
   i. No load saturation and loss curves up to approximately 115% of rated voltage.

   ii. Momentary overload test.

   iii. Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp., core temp., coolant flow and its temperature shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose.

iv. Surge withstand test on the sample coil after placing it in stator core at (4U + 5 KV) and with at least five impulse of 1.2/50 micro sec. wave, for HV motors only, where U is the line to line voltage in kV.

v. Surge-withstand test with 0.3/3 micro sec. wave on each type of 6.6/11 kV motor coils with at least five such impulses, followed by one minute power frequency high voltage test on turn to turn insulation, after cutting the coil and bringing out the turns suitably. The power frequency test voltage shall be decided during detailed engineering.

vi. Dimensions (for motors covered by IS 1231:1974 and IS 2223:1983 only).

vii. Measurement of resistance of windings of stator and wound rotor.

viii. Reduced voltage running up test at no load (for squirrel cage motors up to 37kw only).

ix. Full load test to determine efficiency, power factor and slip.

x. Insulation resistance test.

xi. Test for vibration severity of motor.

xii. Test for noise levels of motor.

xiii. Test for degree of protection by enclosure.

xiv. Temperature rise test at limiting values of voltage and frequency variations.

xv. Over speed test.

2. Routine Tests

The following shall constitute the routine tests.

i. Insulation resistance test

ii. Measurement of resistance of windings of stator and wound rotor.

iii. No load test

iv. Locked rotor readings of voltage, current and power input at a suitable reduced voltage

v. Reduced voltage running up test (for squirrel cage motor)

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

vii. High voltage test

2.2.12.7 Inspection and Testing at site

1. Insulation resistance of 415V motors shall be measured between the winding of the machine and its frame by means of a 500/1000V megger. A minimum value of 1 mega ohm for 415V motors shall be considered a safe value. In case of lower I.R. Value, the insulation value shall be brought up by any of the following methods as desired by the Site Engineer.

    i. Blowing hot air in case of big motors.

    ii. Putting the motor in electric oven in case of smaller motors.

    iii. Placing heaters or lamps around and inside in case of small motors after making suitable guarding and covering arrangements so as to conserve the heat.

2. Site Test

    i. Measurement of vibration.

    ii. Measurement of insulation resistance and polarization index.

    iii. Measurement of full load current.

    iv. Test running of the motors, checking the temperature rise and identifying the hot spot etc.

3. 6.6 kV motors shall be tested for insulation by 500/1000V megger and its value should not be less than the safe minimum insulation of ≥ 20 MΩ resistance at 60 deg. C. In case the insulation is low, the following method of drying has to be adopted.

    i. By locking the motor so that it cannot rotate and then applying such a low voltage to the stator terminals that full load current flows in the stator, keeping the stator winding temperature below 90 deg. C. In this a close watch shall be kept for any possible overheating and I.R. Values vs. temperature shall be plotted and heating continued till I.R. Value becomes steady.

    ii. By blasting hot air from external source, Maximum temperature of winding while drying should be 70 deg. C to 80 deg. C. (Thermometer) or 90 deg. C. to 95 deg. C. by resistance method. Heating should be done slowly till steady

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

LV Cables

2.2.16 LV CABLES

2.2.16.1 Codes and Standards

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

IS : 3961	:	Recommended current ratings for cables.
IS : 3975	:	Low carbon galvanised 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	:	Specification for drums for electric cables.
IS : 10810	:	Methods of tests for 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.
IEC-60754 (Part-I)	:	Test on gases evolved during combustion of electric cables.
IEEE-383	:	Standard for type test of Class IE Electric Cables.
IEC -60332	:	Tests on Electric cables under fire conditions.
IS:6380	:	Specification of elastomeric insulation and sheath of electric cables
IS:5608	:	Specification for low frequency wires and cables with PVC insulation and PVC Sheath.

IEC:502	:	Extruded solid dielectric insulated power cables for rated voltages from 1.00 kV upto 30 kV
IEC:287	:	Calculations of the continuous current rating of cables (100% load factor)
IEC:228	:	Conductors for insulated cables
IEC: 60	:	High voltage test techniques
IEC: 230	:	Impulse tests on cables and their accessories
IEC-331	:	Fire resisting characteristics of electric cables
NEMA-WC-5	:	Thermoplastic insulated wires and cables for transmission and distribution of electrical energy.
IEC: 540	:	Test methods for insulations and sheaths of electric cables and cords (elastomeric and thermoplastic compounds)
SS-4241475 classF3	:	Cables - Testing of fire characteristics
NES-715-1	:	Temperature index

2.2.16.2 Tecnical Requirements

1. The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water.

2. Cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses develop under steady state and transient operating conditions as specified elsewhere in this specification.

3. Aluminium conductor used in power cables shall have tensile strength of more than 100 N/ sq.mm. Conductors shall be multi stranded.

4. XLPE insulation shall be suitable for a continuous conductor temperature of 90 deg. C and short circuit conductor temperature of 250°C.

5. 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.

6. For single core armoured cables, armouring shall be of aluminium wires/ formed wires. For multicore armoured cables armouring shall be of galvanised steel as follows :

   Calculated nominal dia Size and Type of armour of cable under armour

   i. Up to 13 mm 1.4mm dia GS wire
   ii. Above 13 & upto 25mm 0.8 mm thick GS formed wire / 1.6 mm dia GS wire
   iii. Above 25 & upto 40 mm 0.8mm thick GS formed wire / 2.0mm dia GS wire
   iv. Above 40 & upto 55mm 1.4 mm thick GS formed wire /2.5mm dia GS wire
   v. Above 55 & upto 70 mm 1.4mm thick GS formed wire / 3.15mm dia GS wire
   vi. Above 70mm 1.4 mm thick GS formed wire / 4.0 mm dia GS wire

7. The aluminium used for armouring shall be of H4 grade as per IS:8130 with maximum resistivity of 0.028264 ohm mm2 per meter at 20 deg C. Aluminium armouring shall be same as indicated above for galvanized steel.

8. The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface of G.S.wire/ formed wire.

9. Cable Identification

   1. Outer sheath shall be of PVC (of suitable grade) & black in colour. In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties.

      a. Oxygen index of min. 21 (As per NES-715-1).
      b. Acid gas emission of max. 20% (As per IEC-60754-I).
      c. Smoke density rating shall not be more than 60% during Smoke Density Test as per ASTMD-2843.

2. Cores of the cables shall be identified by colouring of insulation. Following colour scheme shall be adopted:

    a. 1 core - Red, Black, Yellow or Blue
    b. 2 core - Red & Black
    c. 3 core - Red, Yellow & Blue
    d. 4 core - Red, Yellow, Blue and Black

3. For reduced neutral conductors the core shall be black.

4. In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath.

    a. Cable size and voltage grade - To be embossed.
    b. Word 'FRLS' at every 5 metre - To be embossed.
    c. Sequential marking of length of the cable in metres at every one metre-To be embossed / printed.

    The embossing shall be progressive, automatic, in line and marking shall be legible and indelible.

5. Cores of the cables of upto 5 cores shall be identified by colouring of insulation. Following colour scheme shall be adopted.

    a. 1core - Red, Black, Yellow, Blue
    b. 2 core - Red & Black
    c. 3 core - Red, Yellow & Blue

10. All cables shall meet the fire resistance requirement of IEEE - 383 with cable installations made in accordance with clause “Flammability test” and as per Category-B of IEC 60332 Part -3.

11. Allowable tolerances on the overall diameter of the cables shall be +\-2 mm maximum over the declared value in the technical data sheets.

12. In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc, are not acceptable.

2.2.16.3 Cable selection & sizing

1. Cables shall be sized based on the following considerations:

   i) Rated current of equipment.

   ii) Maximum voltage drop limits under steady state and during starting for motor being fed from 415V switchgear restricted to 5% and 10% respectively.

   iii) Maximum voltage drop limits under steady state for feeder (i.e. Outgoing feeders being fed from 415V switchgear) restricted to 3%.

   iv) For cables to motors and feeders protected by MCCBs the cross section will be chosen according to the tripping time of MCCBs.

2. Derating Factors

   Derating factors for various conditions of installations including the following shall be considered while selecting the cable sizes:

   a. Variation in ambient temperature for cables laid in air.

   b. Grouping of cables.

   c. Variation In ground temperature and soil resistivity for buried cables.

3. Cable lengths shall be considered in such ways that straight through cable joints are avoided.

4. Cables shall be armoured type if laid in switchyard area, coal handling area or directly buried. All LV power cables except trailing cables shall be XLPE insulated FRLS.

5. All control cables shall be 2.5 Sq mm copper cable.

6. Multicore control cables will generally have spare conductor (s) in accordance with the following chart and cores of a single cable will not be split for different auxiliary/ equipment:

Conductors		Required Cables
1 or 2	:	1-3/C
3 or 4	:	1-5/C
5 or 6	:	1-7/C
7 or 8	:	1-10/C
9 or 10	:	1-12/C
11 or 12	:	1-16/C
13 or 14	:	1-18/C
Above 14 core	:	Two or more of above cables

2.2.16.4 Constructional Features

i) 1.1 kV grade Power Cables

1. 1.1 kV grade XLPE power cables shall have compacted aluminium conductor for cables including 10 sq. mm and above and copper conductor for cables below 10 sq.mm, XLPE insulated, PVC inner-sheathed (as applicable), armoured, FRLS PVC outer-sheathed conforming to IS: 7098. (Part-I).

2. 1.1 kV grade Trailing cables shall have tinned copper (class 5) conductor, insulated with heat resistant elastomeric compound based on Ethylene Propylene Rubber (EPR) suitable for withstanding 90°C continuous conductor temperature and 250 deg C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-sheathed with heat resistant, oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968.

ii) 1.1 kV Grade Copper Conductor Fire Survival Power Cables

1. 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.

2. The cables shall be generally manufactured in conformity to IS-9968 Part-1/1988.

3. The cables shall be rated for 3 hours fire rating.

4. Conductor shall be of stranded construction, consisting of high conductivity annealed plain copper wires conforming to Class-II of IS 8130. A suitable heat barrier tape, preferably glass mica tape shall be provided over the Conductor.

5. The insulation shall consist of heat resisting elastomeric material EPR (Ethylene Propylene rubber) and shall conform to Type IE-2 of IS:6380/1984 amended up to Date.

6. The suitable fire retardant material fillers shall be used for filling in the interstices.Two layers of plain glass fiber binder tape shall be applied over the laid up cores.

7. Fire Survival Power & Control cables shall be provided for the following services:

    a. DC emergency lube oil pump.

    b. Turbine lube oil pump/barring gear.

    c. Jacking oil pump.

    d. Scanner air fan.

    e. Incoming & outgoing cables for DC lighting distribution board.

    f. Fire /smoke detection system.

    g. DC seal oil pump.

    h. DC emergency lighting cables for Main Plant Building.

    i. Incomer cables for DG board, emergency board, DC lighting board

    j. Batteries to charger and DC distribution board.

    k. Emergency turbine trip by push button in control room.

    l. Boiler turbine: Generator inter-trip which includes the interconnecting cables between

        1. Boiler master fuel trip and turbine trip relays
        2. Generator trip relays and turbine trip relays
        3. Generator trip relays and 765kV kV circuit breaker
        4. Generator trip relays and generator field breaker.
        5. Generator trip relays and UAT breaker.

iii) 1.1 KV Grade Control Cable

1. Control cable shall be multi core, minimum 2.5 sq.mm cross section, stranded copper conductor, PVC insulated, inner PVC sheathed / galvanized steel wire armored and outer sheath made of FRLS PVC compound. In situation where accuracy of measurement or voltage drop in control circuit, warrant, higher cross sections as required shall be used. 4 sq.mm copper conductors shall be used for CT circuits, all other specification remaining same. In 4 sq.mm conductor impose unacceptable high burden on CTs, higher cross section of conductor shall be used.

2. Voltage Transformer leads shall be checked for voltage drop, which shall be limited to within 1 % for all cases other than tariff metering, for which the voltage drop shall be limited to 0.2 %. In case the voltage drop with 4 sq.mm Cu conductors exceeds this value, higher conductor sizes shall be used.

iv) 1.1kV Copper Conductor Fire Survival Control Cables

1. Conductor shall be of stranded construction, consisting of high conductivity annealed tinned copper conductors conforming to IS 8130/1984 amended up to date.

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

3. The conductor insulation shall consist of heat resisting elastomeric material EPR (Ethylene Propylene rubber) and shall conform to Type IE-2 of IS:6380/1984 amended up to date.

4. 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.

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

6. 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.

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

8. The minimum sizes of L.T. cable to be chosen are as below:
   a. Al – 16 Sq.mm (3 core)
   b. Cu – 2.5 Sq.mm (3 core)

9. In power cables maximum conductor size to be used will be 300 sq. mm & 630 sq.mm for multi core and single core cables. In case of multi core cables not more than 3 runs to be used or otherwise single core cable to be used.

v) Cable Drums

Cables shall be supplied in non returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS: 10418.

2.2.16.5 DRAWINGS, DATA AND MANUALS TO BE FURNISHED FOR APPROVAL

i) Cable datasheets
ii) Cable sizing
iii) QAPs & Test Reports.
iv) Relevant catalogues

2.2.16.6 Tests

i) Type Tests

a. For Conductor

i. Annealing test - For copper conductor only.

ii. Tensile test - For aluminium conductor only.

iii. Wrapping test - For aluminium conductor only.

iv. Resistance test.

b. For Armour Wires/ Formed Wires

i. Measurement of Dimensions.

ii. Tensile Test - For aluminium wires only

iii. Elongation test - For aluminium wires only

iv. Torsion test - For round wires only.

v. Winding test - For Formed wires only.

vi. Resistance test.

vii. Zinc Coating test - For G.S. Formed wires /wires only.

viii. Wrapping test - For Al. Formed wires /wires

c. For XLPE insulation & PVC Sheath

i. Test for thickness.

ii. Tensile strength & elongation tests before ageing and after ageing.

iii. Ageing in air oven.

iv. Loss of mass test - For PVC sheath only.

v. Hot deformation test - For PVC sheath only.

vi. Heat shock test - For PVC sheath only.

vii. Shrinkage test .

viii. Thermal stability test - For PVC sheath only.

ix. Hot set test - For XLPE insulation only.

x. Water absorption test - For XLPE insulation only.

xi. Oxygen index test – For outer sheath only.

xii. Smoke density test - For outer sheath only.

xiii. Acid gas generation test - For outer sheath only.

d. For completed cables

i. Insulation resistance test (Volume resistivity method)

ii. High voltage test

iii. Flammability test as per clause " Flammability test" of IEEE - 383 .

iv. Flammability test as per IEC - 332 Part-3 (Category -B).

v. Test for rodent & termite repulsion property.

ii) Flammaability Test

1. This test shall generally be carried out as per IEEE 383. The cable installation to be tested shall consist of as many cables as are necessary to give atleast 10 kg of organic material per metre run.

2. The following cable installation shall be tested :
Installation with single / multi core cables in touching formation.

3. Size of cables, number of cables, number of layers and laying arrangements for each installation shall be subject to Owner's approval.

4. The size of the cables selected (measured by total cross sectional area of the conductor) shall have maximum organic material per sq. mm of total cross sectional area of all the conductors.

iii) Acceptance Tests

Acceptance tests shall be carried out on each type and size of the cables on the cable drums selected at random as per following sampling plan:

Sl.no	No. of drums in the lot	No. of drums to be taken as sample
	Upto 100	10% (Subject to minimum of 1 drum)
	101 to 300	13
	301 to 500	20
	Above 500	32

The following shall constitute acceptance tests:

1. Item No. 1 to 14, 16, 19, 20, 22, 23, 24, 25 of list of type tests specified in cluase 2.2.15.5.1.

2. Fire resistance test as per SS 4241475 (F3 category).

3. One length per size / lot for surface finish and length measurement.

4. Lay length / sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires, Band marking.

iv) Routine Tests

Routine tests shall be carried out as per relevant standard for each drum of cables of all types and sizes.

SUB-SECTION – IC

SPECIFIC TECHNICAL REQUIREMENTS (C &I)

1x800 MW North Chennai STPP (JOB NO. 423)
DEBRIS FILTER

1.00	**SYSTEM**	**DEBRIS FILTER**
2.00	**COMMON / PER UNIT**	ONE UNIT
3.00	**CONTROL SYSTEM**	DCS (STN C&I)
3.10	**PROCESSOR CONFIGURATION FOR PLC SYSTEM**	NA
4.00	**LOCATION OF CONTROL SYSTEM**	CCR
4.10	**CONTROL SYSTEM SCOPE (BIDDER/ BHEL/ CUSTOMER)**	BHEL
5.00	**HARDWIRED INTERFACE WITH DCS (Y/N)**	NA
5.10	**PURPOSE OF HARDWIRED INTERFACE WITH DCS**	
5.11	***a) COMMAND FROM DCS (Y/N)***	NA
5.12	***b) STATUS FEEDBACK TO DCS (Y/N)***	NA
5.13	***c) GROUP FAULT ALARM TO DCS (Y/N)***	NA
6.00	**SOFTLINK TO DCS (Y/N)**	NA
6.10	**PURPOSE OF SOFTLINK TO DCS**	
6.11	***a) COMMAND INTERFACE WITH DCS (Y/N)***	NA
6.12	***b) STATUS MONITORING IN DCS (Y/N)***	NA
7.00	**PROTECTION CLASS FOR PLC / RIO PANEL**	NA
8.00	**CONTROL FROM PB's ON LCP/OWS ON LCP**	CONTROL FROM PB's ON LCP
9.00	**ANNUNCIATION ON LCP (Y/N) -- IF Y, MIN NO. OF HARDWIRED ALARMS / INDICATIONS**	YES BIDDER TO PROPOSE MIN NO OF ALARMS/INDICATIONS
9.10	**MIMIC ON LCP (Y/N)**	Y
10.00	**CONTROL FROM DCS IN CCR (Y/N)**	Y
11.00	**TYPE OF SOFTLINK (TP/OFC)**	NA
11.10	**COMMUNICATION CABLE SCOPE (BIDDER/ PEM/ EDN/ CUSTOMER)**	NA
11.20	**REDUNDANT CABLE (Y/N)**	NA
11.30	**PROTOCOL**	NA
12.00	**RIO / RPU (Y/N)**	NA

1x800 MW North Chennai STPP (JOB NO. 423)
DEBRIS FILTER

13.00	## NO. OF OWS / LAPTOP	NA
13.10	SIZE OF OWS/ CRT OR LCD	NA
14.00	NO. OF PRINTER	NA
14.10	PRINTER SIZE AND TYPE	NA
15.00	$$ POWER SUPPLY AVAILABLE FOR BALL MONITOR (24V DC / 110 V AC UPS / 230 V AC UPS)	NA
15.10	&& POWER SUPPLY AVAILABLE FOR PLC PANEL (3PHASE, 415 V AC/ 1PHASE, 110 V UPS/ 1PHASE, 230 V UPS)	NA
15.20	REDUNDANT FEEDERS (R) / NON-REDUNDANT (NR) FEEDERS FOR POWER SUPPLY	R
15.30	UPS BATTERY CONFIGURATION (1X100% / 2X100%)	NA
15.40	BATTERY TYPE (LEAD ACID/ Ni-Cd)	NA
15.50	BATTERY BACK-UP TIME (in minutes)	NA
16.00	ACTUATOR WITH INTEGRAL STARTER (Y/N)	Y
17.00	PG/ DPG/ PS/ DPS/ PT/ DPT per Debris filter	DPT=2 no. DPG = 1 no (ACROSS EACH FILTER)
18.00	REMARKS	
19.00	PROJECT SPECIFIC INFO	

NOTES:

1.00 OPERATION THROUGH HARDWIRED PUSH BUTTON MOUNTED ON LOCAL CONTROL PANEL SHALL BE PROVIDED.

2.00 BIDDER TO TERMINATE ALL INSTRUMENTATION AND CONTROL ELEMENTS IN JUNCTION BOXES FOR FURTHER CABLING TO DCS BY BHEL/CUSTOMER. BIDDER TO PROVIDE INPUT/OUTPUT LIST, DRIVES LIST, JUNCTION BOX SCHEDULE AND TERMINATION DETAILS, RECOMMENDED CONTROL LOGICS / WRITE-UP ETC. DURING DETAILED ENGINEERING

3.00 ALL THE INSTRUMENTS ALONG WITH NECESSARY FITTINGS, ACCESSORIES AND VALVE MANIFOLD ETC., INSTRUMENT RACK & JUNCTION BOXES, ERECTION HARDWARE SHALL BE IN BIDDER SCOPE OF SUPPLY.

4.00 INSTRUMENT RACK AND JUNCTION BOXES SHALL BE IN BIDDER'S SCOPE OF SUPPLY.

5.00 BIDDER TO FURNISH ELECTRICAL LOAD DATA DURING DETAILED ENGINEERING.

6.00 ALARM FACIA SHALL BE UNDER BIDDER'S SCOPE. NO. OF FACIA SHALL BE DECIDED DURING DETAILED ENGINEERING.

7.00 THE SCOPE OF CABLE SHALL BE REFERRED IN ELECTRICAL SCOPE SPLIT SHEET IN ELECTRICAL PORTION OF THE SPECIFICATION.

Specific Technical Requirements

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

1.2 Drawings/Documents and data to be furnished after award of the contract as per deliverables list.

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

1.4 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.

1.5 Components of instruments, control devices, accessories, piping etc. Which contact with steam, condensate or boiler feed water shall be manufactured from copper free materials which do not react with media at operating parameters.

1.6 All wetted parts of instrument shall be suitable for sea water application (Duplex stainless steel or better).

1.7 Painting of I & C equipment: Epoxy coating required for all I & C equipment.

1.8 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 motorised valves and dampers. The detailed specification of actuator is given in detail as below.

1.9 All motorised valves of 200NB or more than 200NB size shall be provided with integral motorized bypass valves on all process lines.

1.10 DP instruments with min. Capillary length of 15m to be supplied where installation is in pit.

1.11 DPG, DPT & DPS, if applicable across the filters/strainers.

1.12 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).

1.13 All the instruments/equipments/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.

1.14 All primary instruments installed at “Minus level or Floor” shall be with protection class of IP 68.

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

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

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

1.18 All instruments should be supplied with valid calibration and test certificates provided by OEM. All transmitters shall be HART compatible.

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

1.20 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.

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

1.22 For cable scope refer to electrical scope between BHEL and vendor defined in electrical specification.

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

a. F-Type: 2P/4P/8P/12P/24P
b. G-Type: 4P/8P/12P

1.24 Power Supply Requirement:
415 V, 3 phase AC power supply shall be provided by Customer for the local control panel. Further any electrical distribution shall be in bidder's scope. Any other voltage requirement to be arranged/derived by bidder by providing suitable control transformer.

1.25 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 noted by the bidder in the specification, the same will be brought to the notice of BHEL in the form of pre- bid clarification. In absence of any pre-bid clarification, the more stringent requirement as per interpretation of Customer shall prevail without any commercial implication.

The Decanting pumps controls / Status, Oil tanks level transmitters, Tank heating, Drain oil tank level and control & miscellaneous instruments which will be provided by bidder shall be hooked up in the FOPH control panel for monitoring and control

The HFO pumps shall be controlled by VFD.

Remote & local station DP measurement, pressure low, very low switches for auto start & alarm shall be provided for both HFO/HSD (LDO) system. Discharge pressure gauges for individual pump shall be provided at pump house for both HFO & HSD (LDO) system. Common header pressure transmitter at FOPH for both the HSD (LDO) & HFO shall be provided.

Local Control Panel

The local control panel for control and monitoring of the fuel Oil shall be located in the Fuel oil pressurizing pump area and shall house all necessary start/stop push buttons, auxiliary relays, control switches, meters, indicators, status indication lamps etc. to achieve the control philosophy described above. This panel shall also include all the annunciation described below.
For safe and reliable operation control of the Fuel Oil System, Following minimum instruments / control function shall be carried out in addition to process requirement

1) Remote and Local differential pressure across each strainer in HSD (LDO), HFO line at pressurizing pump suction and at heater outlet.
2) Remote and Local differential pressure across strainer at pressurizing pump suction in HSD (LDO) line.
3) Remote and Local pressure at discharge of each HFO pressurizing pump
4) Remote and Local pressure at discharge of each HSD (LDO) pressurizing pump
5) Remote and Local pressure at suction and discharge header of HFO heaters f) Remote and Local pressure at discharge header of HSD (LDO) pressuring pumps
6) Remote and Local temperature of steam & HFO at inlet/outlet of each HFO heater
7) Remote and Local temperature in the connected fuel oil tanks
8) Remote and Local pump suction temperature (for HFO only).
9) Redundant radar type Level Transmitters for each fuel oil tank.

Lay out of Control Room

1) Separate battery room and UPS room shall be provided
2) The control room shall be Air conditioned
3) The control room shall be provided with pantry room, Locker room, Toilet etc.

iv) On Load Tube Cleaning System

The On Load Tube Cleaning System & Debris Filter system shall be designed for fully automatic / manual operation from Plant DDCMIS Local operation shall also be provided.

Open and Close limit switch feed backs of valves are to be connected to DDCMIS for remote viewing and for interlocks and protection.

Remote and local indications of various parameters to the process requirement shall be provided. (The same can be decided during detailed engineering)

The OLCs and CLCS philosophy shall be as per the chapter 4 of this volume.

a) Condenser On Load Tube Cleaning System (COLTCS)

1. COLTCS shall be of sponge rubber ball type designed for continuous and trouble free operation. Provision of abrasive coated balls shall be made for cleaning in case of hard deposits inside tubes.

2. The system shall consist of non-clog type ball recirculation pump, ball injection nozzles, ball collecting vessel, ball monitoring system, necessary instruments, pipings and accessories etc.

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

4. Ball monitoring system shall include ball circulation monitor, oversize monitor and ball sorter.

5. The ball collecting strainer shall have differential pressure transmitter with back-washing system.

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

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

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

b) Debris Filters

1. Two number debris filters shall be provided on the circulating water pipelines upstream of the condenser for online filtering of cooling water.

2. Each debris filter shall comprise of perforated stainless steel screen, butterfly valves, turbulence flap, debris flushing valve, drain plug valve, motor actuators for the valves, differential pressure gauge and control and instrumentation etc.

3. The materials of construction of various components shall be of proven type as per quality of water to be handled by the debris filters. Inside surface of the debris filters shall be coated with anti-corrosive paint to ensure long life.

4. The filters shall be capable of removing solids, suspended matter and fibrous material up to 5 mm size.

5. The removed debris shall be suitably disposed off. The operation of the debris filters shall be of automatic type with facility provided for remote manual operation also.

6. The maximum allowable pressure drop under clean screen condition shall be limited to 0.5 mwc, and under 50% choked screen condition the pressure drop shall not exceed 1.0 mwc. The filter shall be designed for pressure of 5 kg/cm2 (g) and vacuum of 0.1 kg/cm2 (abs).

7. Differential pressure indicators & Differential pressure Transmitters across Debris filter shall be provided with independent impulse & isolation valves.

8. Following Instruments/control functions shall be provided at CW debris filter in addition to instruments provided as per process requirement

9. Remote & Local indication DP transmitters & gauges across debris filters and self-cleaning strainer.

10. Auto start /stop of Cleaning devices for debris filters for high DP and Low DP

v) HP&LP Dosing System

HP & LP dosing complete system shall be controlled from the DDCMIS including stroke adjustment, Local controller for this stroke arrangement are not allowed. Remote / local operation of all pumps and stirrer etc., are to be provided.

The NaOH dosing system for pH correction in DMCW system shall also be controlled from the DDCMIS including stroke adjustment, Remote / local operation of all pumps and stirrer etc., shall be provided.

Open and Close limit switch feed backs of valves are to be connected to DDCMIS for remote viewing and for interlocks and protection.

Remote and local indications of various parameters to the process requirement shall be provided. (The same can be decided during detailed engineering)

The OLCs and CLCS philosophy shall be as per the section V of this volume.

LIST OF DOCUMENTS/DELIVERABLES

C&I DELIVERABLES LIST

C&I DELIVERABLES LIST FOR DF		
Sl.No.	**DRAWING NO.**	**DRAWING/DOCUMENT TITLE**
INSTRUMENTATION		
1	PE-V9-423-165-I901C	INSTRUMENT DATA SHEETS
2	PE-V9-423-165-I902C	BOQ
3	PE-V9-423-165-I903C	INSTRUMENT QP / CHECK LIST
RELAY BASED LCP		
1	PE-V9-423-165-I950C	LOCAL CONTROL PANEL DATA SHEET
2	PE-V9-423-165-I951C	WIRING DIAGRAM
3	PE-V9-423-165-I952C	PANEL EXTERNAL GA DRAWING (INCLUDING FOUNDATION DETAILS & FLOOR CUT-OUT)
4	PE-V9-423-165-I953C	PANEL INTERNAL GA DRAWING
5	PE-V9-423-165-I954C	PANEL FRONT VIEW DRAWING
7	PE-V9-423-165-I956C	BILL OF MATERIAL
8	PE-V9-423-165-I957C	LOCAL CONTROL PANEL QUALITY PLAN
9	PE-V9-423-165-I958C	RELAY BASED PANEL O & M MANUAL

ACTUATORS

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.: PE-SS-423-145-I007 VOLUME II B SECTION D REV. NO. 01 DATE: 03.03.17 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)
GENERAL*	* PROJECT	1x 800 MW NORTH CHENNAI 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 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY
CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF, IP:68
	MECHANICAL POSITION INDICATOR	TO BE PROVIDED FOR 0-100% TRAVEL
	BEARINGS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.
	GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION	METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.
	SIZING	OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. **FOR INCHING SERVICE - 150 STARTS/HR MINIMUM & FOR REGULATING SERVICE - 600 STARTS/HR MINIMUM.**
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) ☐ .....
	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, 3PH, AC
	@ 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.: PE-SS-423-145-I007 VOLUME II B SECTION D REV. NO. 01 DATE: 03.03.17 SHEET 3 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 ☐ FLAME PROOF	
	@ 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 ☐ 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 / CLOSE PB	■ REQUIRED ☐ NOT REQUIRED	
	STOP PB	■ REQUIRED ☐ NOT REQUIRED	
	INDICATING LAMPS	■ REQUIRED ☐ NOT REQUIRED	
	LOCAL REMOTE S/S	■ REQUIRED ☐ NOT REQUIRED	
	STATUS CONTACTS FOR MONITORING	■ REQUIRED ☐ NOT REQUIRED	
	INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, S/S IN LOCAL or OFF MODE/STOP PB OPTD, TORQUE SWITCH OPTD. MID WAY/MOTOR THERMOSTAT TRIP)	
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) **($$ Refer Notes)**	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN / CLOSE	■1 No. ☐2Nos. / ■1 No. ☐2Nos	
	CONTACT TYPE	2 NO + 2 NC	
	RATING	5A 240V AC AND 0.5A 220V DC	
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE	
	ACCURACY	+3% OF SET VALUE	
LIMIT SWITCH (Not Applicable for Smart Actuator) **($$ Refer Notes)**	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN : INT : CLOSE	☐1 No ■2 Nos. / 2 Nos. (ADJ.) / ☐1 No. ■2Nos.	
	CONTACT TYPE	2 NO + 2 NC	
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC	

FORM NO. PEM-6666-0

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.: PE-SS-423-145-I007 VOLUME II B SECTION D REV. NO. 01 DATE: 03.03.17 SHEET 4 OF 4

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 ☐ NOT REQUIRED	
	MFR & MODEL NO.	BIDDER TO SPECIFY	
	TYPE	☐ ELECTRONIC (2 WIRE) R/I CONVERTER ■ ELECTRONIC (2 WIRE) CONTACTLESS	1
	SUPPLY	■ 24V DC ☐	
	OUTPUT	■ 4-20mA	
	ACCURACY	± 1% FS	
SPACE HEATER	@SPACE HEATER	REQUIRED	
	@ POWER SUPPLY (NON INTEGRAL)	230V AC,1 PH.,50 Hz	
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY	
	@ RATING		
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED	
	ENCL CLASS ACTUATOR/MOTOR T.B.	@■ IP 68 @☐.....	
	@ EARTHING TERMINAL	REQUIRED	
	PLUG & SOCKET(9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT)	■ REQUIRED ☐ NOT REQUIRED☐ ☐ 2 NOS. ☐ ----------	1
CABLE GLANDS	@ POWER CABLE GLAND	SIZE: suitable for 3Cx2.5sq mm for motor rating 3.7 kW, 3Cx10 sq mm fr motor from 3.7 kW to 5.5 kW.	
	@ SPACE HEATER CABLE GLAND	SIZE:-Space heater cable gland to be derived internally.	
	OTHER CONTROL CABLE GLANDS-2	QUANTITY & SIZE :-------- (8Px0.5 sq mm)	
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.
8. 2 No. OF EARTHING TERMINALS SHALL BE PROVIDED FOR THE MOTOR BODY EARTHING. 1
9. IN ADDITION TO ABOVE, 2 No. OF CABLE GLANDS (NPT) SHALL BE PROVIDED.
10. LOCAL DIGITAL POSITION INDICATOR SHALL BE PROVIDED FOR INCHING DUTY DRIVES.

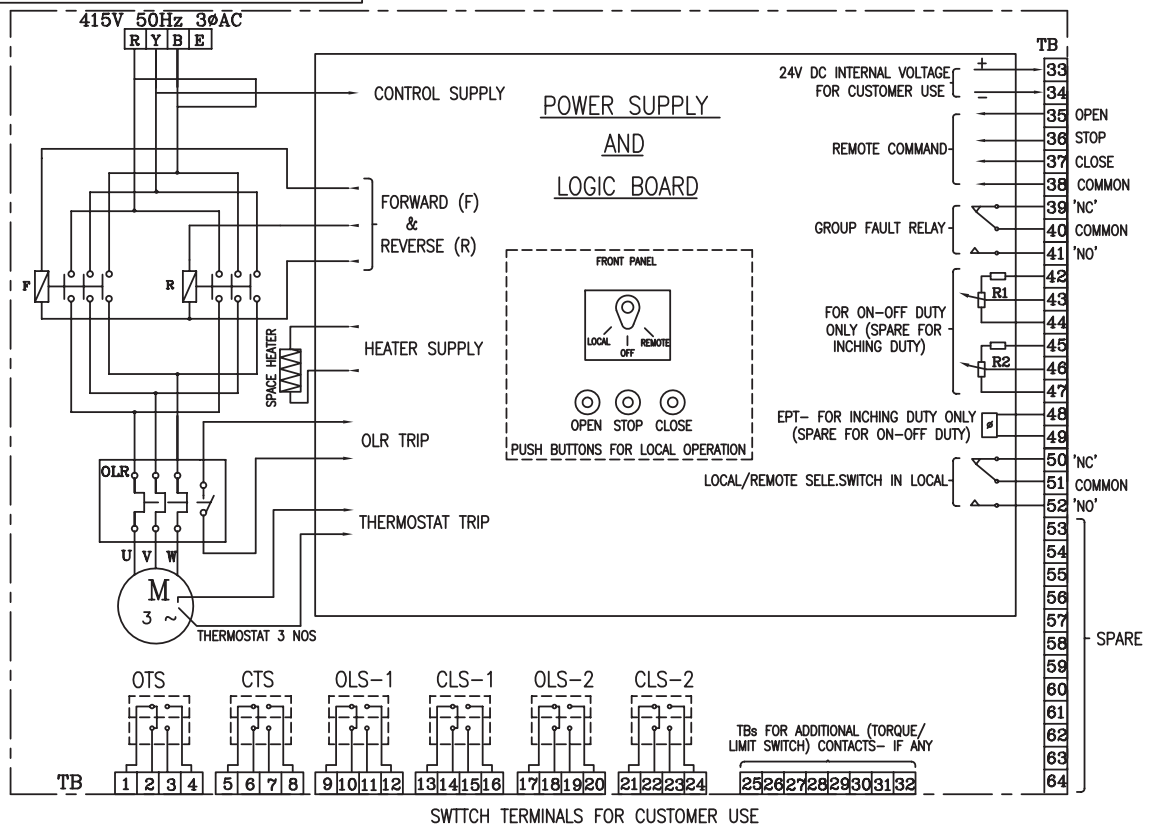
$$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE.

EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.

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-24227



SWTTCH TERMINALS FOR CUSTOMER USE

CONTACT DEVELOPMENT DIAGRAM

OTS	1-2	OPEN AT OVER TORQUE DURING OPENING TRAVEL
	3-4	CLOSE AT OVER TORQUE DURING OPENING TRAVEL
CTS	5-6	OPEN AT OVER TORQUE DURING CLOSING TRAVEL
	7-8	CLOSE AT OVER TORQUE DURING CLOSING TRAVEL
OLS-1	9-10	
	11-12	
CLS-1	13-14	
	15-16	
OLS-2	17-18	
	19-20	
CLS-2	21-22	
	23-24	

SWITCH	TERMINAL NO.	FULL OPEN	a	INTERMEDIATE	b	FULL CLOSE
		VALVE POSITION				

INDICATES CONTACT CLOSED

INDICATES CONTACT OPEN

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

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

VALVES	OPEN		CLOSE	
	MAIN	BACK UP	MAIN	BACK UP
GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS *	CLS	CTS
ALL OTHER GATE & GLOBE VALVES	OLS	OTS *	CTS	#

- CLS NOT TO BE CONNECTED IN TRIP CIRCUIT

* - BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)

NOTE:-

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

REV	DATE	ALTERED
		CHD & APPD

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS (DRAWN FOR INTERMEDIATE POSITION OF VALVES)

BHARAT HEAVY ELECTRICALS LTD.,
UNIT: HIGH PRESSURE BOILER PLANT.
TIRUCHIRAPALLI-620014.
365-121

	NAME	SIGN	DATE
DRN	N.P.ESWAR	N.P	07.10.04
CHD	D.DINAKARAN	D.D	07.10.04
APPD	K.ARUNACHALAM	K.A	07.10.04

NO.OF VAR.

DEPT	SCALE	WEIGHT (KG).	REFERENCE INFORMATIONS	NO. OF ITEMS
VL				
CODE				

TITLE: WIRING DIAGRAM (TERMINAL PLAN) FOR ACTUATOR WITH INTEGRAL STARTER

CARD CODE: U 01

DRAWING NO.: 3-V-MISC-24227

REV: 0

Size A3

2.2.13 ACTUATORS

2.2.13.1 SCOPE

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

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

2.2.13.2 CODES & STANDARDS

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

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

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

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

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

2.2.13.3 General

a) The Actuators shall be integral starters along with overload relays with built in SPP (Single Phase Preventer) with provision for operation from Control room, Local and by wireless set.

b) The actuator motors shall be suitable for use on 415 Volt 3 phase 50Hz power supply. The actuator comprising motor, integral reversing starter, local control facilities and terminals for remote control and indication shall be housed within a self contained, sealed enclosure.

c) Actuator working platforms shall be provided for maintenance purpose.

d) Commissioning tools shall not form an integral part of the actuator and must be removable for secure storage/authorized release. In addition, provision shall be made for the protection of configured actuator settings by a means independent access to the commissioning tool.

e) For some specific applications, integral starter shall also be separately mountable

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

2.2.13.4 Actuator Sizing

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

2.2.13.5 Environmental

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

2.2.13.6 Enclosure

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

2.2.13.7 SPECIFIC REQUIREMENT

i) The actuator shall essentially comprise the drive motor, torque/ Position limit switches, gear train, clutch, hand wheel, position indicator and transmitter, inbuilt thermostat for overload protection,space heater and internal wiring. Actuator shall be integral type. Integral starters shall have facility to hook-up with plant DCS for positioning of limit and torque switches.

ii) The actuator enclosure shall be totally enclosed, dust tight, weather proof (NEMA-6/IP-68) suitable for outdoor use without necessity of any canopy.

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

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

v) A lockable local/remote selector switch shall also be provided for selecting mode of operation.

vi) Gear Train:-Metal (Fibre gears are not acceptable) self-locking to prevent drift under torque switch (where ever applicable) spring pressure when motor is de-energised.

vii) Manual Wheel:- Shall disengage automatically during motor operation.

viii) Duty cycle of actuators shall suit the system requirement. The actuators shall be capable of giving the required torque at the output shaft. The actuators shall be designed to take the full thrust

ix) The integral starter which shall have sophisticated electronic controls with field programming feature. It shall be designed for remote control from DCS/Respective control system. Required interposing relays for receiving open/close/stop command from DCS/Respective control system shall be provided. Potential free contacts and transducers shall be provided to provide status indication at remote DCS/Respective control system.

x) A three position selector switch (marked as LOCAL-OFF-REMOTE) and push buttons OPEN-STOP-CLOSE (for local operation) with indication lamps for running OPEN and running CLOSE shall be provided.

xi) The Remote command signal (OPEN-STOP-CLOSE) from DCS/Respective control system/Control panel shall be isolated from control electronics through opto-isolator.

xii) The following individual status annunciation LED's (Colour-Green) shall be provided locally (Integral to actuator) to annunciate the following for easy local monitoring.

1. Actuator in local mode
2. Actuator in remote mode
3. Actuator running in OPEN direction
4. Actuator running in CLOSE direction
5. Actuator in inching mode.
6. Actuator in self-retaining mode
7. Limit switch OPEN trip
8. Limit switch CLOSE trip
9. Control voltage availability

xiii) The following individual fault annunciation LED's (Colour-Red) shall be provided locally. (Integral to Actuator)

1. Torque switch OPEN
2. Torque switch CLOSE
3. Thermo switch trip
4. Electronic overload relay trip
5. Motor single phasing
6. Common fault (Inclusive of any one or combination of above fault)

xiv) View port shall be provided on integral starter unit to monitor the above status annunciation and fault annunciation.

xv) Electronic overload relay shall be provided to trip actuator in case of overload.Plug in connections/design shall be provided between:-

1. Integral starter unit and basic actuator
2. Between external customer connections and actuator

xvi) OPEN-CLOSE indication /LED shall be provided for indication of full open/close position.

xvii) Automatic phase correction facility and potential free contact for annunciation of power failure shall be provided.

2.2.13.8 Motor

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

i) The squirrel cage induction motor shall be designed for full voltage direct-on-line start, with starting current limited to 6 times full-load current. The motor shall be capable of starting at 85% of rated voltage and running at 80% of rated voltage at rated torque and also at 85% of rated voltage at 33% excess rated torque for a period of 5 minutes each. The motors shall otherwise generally confirm with technical specification for motors mentioned elsewhere in this specification.

ii) The actuators shall be sized so as to open or close valves/ dampers at rated speed enclosure shall not be more than 70 degree 'C' over ambient temp. of 70 deg.C as these are subjected to higher ambient conditions due to their vicinity to operate fluid on continuous load operation. The actuators shall be suitable for a relative humidity of 95%. Class of insulation shall be class-F and type of enclosure shall be IP-615.0

iii) Insulation:- The motor winding shall be insulated with class-F insulation having temperature rise limited to Class-B.

iv) Performance:-The motor shall be capable of:

a) Starting at 85% of rated voltage

b) Running at 80% of rated voltage at rated torque for 5 minutes

c) Running at 85% rated voltage at 33% excess rated torque for 5 minutes.

v) Maximum continuous motor rating shall be atleast 10% above the maximum load derived of the driven equipment under entire operating range including voltage & frequency variation.

Vi) Bearing

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

vii) Earthing

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

2.2.13.9 Motor Protection

Protection shall be provided for the motor as follows:

i. The motor shall be de-energized in the event of a stall when attempting to unseat a jammed valve.

ii. Motor temperature shall be sensed by a thermostat de-energising the motor in case of overheating.

iii. Lost phase protection.

iv. Overload protection.

v. Short circuit protection by suitably rated long acting fuse.

2.2.13.10 Gearing

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

2.2.13.11 Hand Operation

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

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

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

2.2.13.12 Drive Bushing

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

2.2.13.13 Limit Switches

a) Each motor actuator shall have Six (6) rotary drum position limit switches with two for open each with 2 NO + 2NC contacts and two for close each with 2 NO + 2 NC contacts positions, each with adjustable setting between fully open and fully closed positions. Each rotary drum limit switch shall have two (2) limit switches for intermediate open position each with 2 NO + 2 NC contacts. The limit switches shall have capacity of 5A at 240V AC or 0.5A at 220V DC.

b) Each motor actuator shall also have two (2) torque limit switches with two (2) normally opened and two (2) normally closed contacts each.

c) The torque switches shall have a minimum accuracy of 3% of set value. The torque switches shall be provided with calibrated knobs for setting desired torque and separate knobs shall be provided for open and close torque switches. The torque and position limit switches shall be housed in a separate enclosure with protection class as that of actuator.

d) The motor operators/actuators shall be capable of meeting 150 percent of unseating torque at specified voltage.

e) The motor actuators shall have 2 nos. potentiometric type transmitters of 100 ohm rating.

f) Torque switches shall function to stop the motor on closing/opening. Upon actuation by the torque clutch it is restricted its attempt to open or close, thereby causing an overloading torque. Torque switches shall be self-resetting type only (i.e.) once a particular direction torque switch operates, it shall get resetted only when the equipment is operated in other direction.

g) All six (6) limit switches shall be changeover type and adjustable besides having the snap facility. All limit switches, contacts shall be wired up independently upto the terminal block.

2.2.13.14 Remote Valve Position/Actuator Status Indication

iv. Four contacts shall be provided which can be selected to indicate any position of the valve. Provision shall be made for the selection of a normally closed or open contact form. Contacts shall maintain and update position indication during hand wheel operation when all external power to the actuator is isolated.

v. The contacts shall be rated at 5A for 240V AC, 0.5A for 220V DC.

vi. As an alternative to providing valve position any of the four above contacts shall be selectable to signal one of the following:

a. Valve opening, closing or moving
b. Thermostat tripped, lost phase
c. Motor tripped on torque in mid travel, motor stalled
d. Remote selected
e. Actuator being operated by hand wheel

vii. Position feedback has to be provided for all inching type applications. These shall be interfaced with plant DDCMIS.

viii. Actuator local and remote inditions shall be grouped and taken seperatly

2.2.13.15 Local Position Indication

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

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

2.2.13.16 Integral Starter and Transformer

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

i. Energization of the contactor coils.

ii. DC output where required for remote controls.

iii. Supply for all the internal electrical circuits.

2.2.13.17 Integral Local Control and Control Mode Selector

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

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

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

2.2.13.18 Control Facilities

i. The necessary wiring and terminals shall be provided in the actuator for the following control functions:

ii. Open and close external interlocks to inhibit local and remote valve opening and/or closing control. Provision shall be made to configure the interlocks to be active in remote control only.

iii. Remote controls fed from an internal 24V DC supply and/or from an external supply rated 110V AC to be suitable for any one or more of the following methods of control:

Open, close and stop control :

a. Open and close maintained or 'push to run" (inching) control

b. Overriding Emergency Shut-down to Close (or Open) valve from a normally closed or open contact .

iv. The following individual potential free relay contacts shall be provided in the actuator for remote annunciation to facilitate continuous monitoring of the actuator.

a. Actuator in local mode
b. Actuator in remote mode
c. Actuator (valve) running in OPEN direction.

d. Actuator (valve) running in CLOSE direction.
e. Limit switch OPEN trip
f. Limit switch CLOSE trip
g. Actuator in local mode.
h. Actuator in inching mode.
i. Actuator in self-retaining mode.
j. Actuator power switched off /single phasing.
k. Torque switch trip, thermo switch trip and overload relay trip (or close)

v. Automatic phase correction facility and potential free contact for annunciation of power failure shall be provided.

vi. It shall be possible to reverse valve travel without the necessity of stopping the actuator. The starter contactors shall be protected from excessive current surges during travel reversal by an automatic time delay on energization of the contactor coils.

2.2.13.19 Monitoring Facilities

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

i. Monitor (availability) relay, having one changeover contact, the relay being energised from the control transformer only when the Local/Off/Remote selector is in the Remote position to indicate that the actuator is available for remote (control room) operation.

ii. Where required, it shall be possible to provide indication of Thermostat trip and Remote selected as discreet signals. The actuator shall include a diagnostic module, which will store and enable download of historical actuator operation and torque data to permit analysis of actuator and valve in-service performance. Data download shall be carried out without removing any covers and all shall be available locally to the actuator or remotely via telecom data transfer.

iii. Diagnostic and configuration software shall be made available in a Lap Top PC for user.

2.2.13.20 Wiring and Terminals

i. Internal wiring shall be tropical grade PVC insulated stranded cable of appropriate size for the control and 3-phase power. Each wire shall be clearly identified at each end.

ii. The terminals shall be embedded in a terminal block of high tracking resistance compound.

iii. The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight sea land shall be provided with a minimum of 3 threaded cable entries with provision for a minimum of 4.

iv. All wiring supplied as part of the actuator to be contained within the main enclosure for physical and environmental protection. External conduit connections between components are not acceptable.

v. A durable terminal identification card showing plan of terminals shall be provided attached to the inside of the terminal box cover indicating:

a. Serial number
b. External voltage values
c. Wiring diagram number
d. Terminal layout

vi. This must be suitable for the contractor to inscribe cable core identification along side terminal numbers.

2.2.13.21 Startup Kit

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

2.2.13.22 Performance Test Certificate

i. Each actuator must be performance tested and individual test certificates shall be supplied free of charge. The test equipment should simulate a typical valve load, and the following parameters should be recorded:

a. Current at maximum torque setting
b. Torque at max. torque setting
c. Flash test voltage
d. Actuator output speed or operating time

ii. In addition, the test certificate should record details of specification such as gear ratios for both manual and automatic and second stage gearing if provided, drive closing direction, wiring diagram number.

2.2.13.23 The following minimum tests/ checks shall be conducted at site. Any other tests/ checks as per the manufacturer's recommendation shall also be carried out.

a. Measurement of insulation resistance.
b. Measurement of full load current.

c. Test running of the motors.

2.2.13.24 Drawing and Manuals

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

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

FIELD & MEASURING INSTRUMENTS

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

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

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

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

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

2.3.3.2 Transmitters, Switches, Gauges and Panel Mounted Instruments

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

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

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

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

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

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

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

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

Following minimum accessories shall be provided with each set:-

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

For flanged remote seal diaphragm:

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

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

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

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

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

S.No	Features	Essential / Minimum Requirements
1	Applicable Standards	IS:3602-1966, IS/3624, ASME B 40.1
2	**Type / construction**	
	760 mm to 1.0Kg/cm2	Bellows/Diaphragm
	Above1.0Kg/cm2	Bourdon Tube
	Suction side of pumps	Compound gauge
3	**Materials**	
	Bellows	316SS
	Bourdon tube	316SS
	Movement	316SS
	Case Enclosure	SS 316 / Die-cast aluminium with stoved enamel black finish. Epoxy coating shall be provided for corrosive atmosphere.
4	End connection	½" NPT (M)
5	Protective Diaphragm	Teflon
6	Dial Size	150mm with shatter proof glass

S.No	Features	Essential / Minimum Requirements
7	Scale Details	Graduations in black lines on white dial, on white dial, 270 Deg. pointer deflection scale provided with glass cover. Smallest scale division shall be one (1) percent of full scale value or smaller. Pointer stop for all gauges.
8	Range Selection	Cover 125% of max. of scale
9	Accuracy	± One (1) percent or better
10	Instrument process connection	½" NPT Male (Back Entry)
11	Mounting Type	Local / 1/2 inch NPT Male (Back entry) mounted on local gauge board.
12	Protection Class	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)
13	**Accessories**	
	3 way needle valve / manifolds	For all gauges
	Self cleaning type	Pump and compressor discharge (Pulsation dampener / Snubbers (S316) lines
	Syphon	For all steam lines
	Protective separating	For fuel oil and corrosive liquid lines
14	**Other Particulars**	
	External Zero adjustment / Safety device	For all gauges
	Ranges 5 to 20 Kg/cm2	Rubber blow out disc with open front construction.
	Ranges above 20 Kg/cm2	Neoprene safety diaphragm at the back with solid front construction.
16	Over range protection	One Fifty (150) percent of full scale
17	Over Range Test	Test pr. For the assembly shall be 1.5 to the max. Design pr. At 38°C
18	**Other Requirements**	Movement mechanism shall be glycerine filled for oil services & vibration prone area.
		For Fuel oil & corrosive liquid lines diaphragm type sensors required. Armoured capillary of 10 M for Fuel oil & Corrosive liquid service.
		Contact type pressure gauges are not acceptable for interlock & protection.
		For condensate storage tank the pressure gauge in terms of0-10000 mmwcl or suitable range having **dial size of 300mm or bigger size** shall be provided.
19	IBR Requirement	For high pressure service, Process tapping and root valves are as per IBR rules and regulations

2.3.3.3 Temperature Related Instruments

a) Temperature Transmitters (TT)

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

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

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

2.3.3.34 Push Button for Control DESK

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

2.3.3.35 Push Button for Sequence Start/Release

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

2.3.3.36 Push buttons for annunciation

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

2.3.3.37 Hydrogen Gas System Instruments / Analysis

i) Hydrogen Gas Hygrometer

S.No.	Features	Essential/Minimum Requirements
A	Performance	

l) At CW & ACW pump discharge headers flow transmitters shall be provided (Non Contact ultrasonic Type are preferable). In addition flow measurement shall also be provided for CW water used anywhere except condenser service.

m) Flow transmitters for general applications shall be of the differential pressure type

n) Flow switches for OLCS / Alarms / Interlocks / Protection.

o) Lubricating oil Flow transmitter/meter with switch shall be provided for Bearing systems of APH, FD, PA, etc.,

p) Sight glasses flapper indication type shall be provided on lube oil cooling water piping as required to ensure indication of fluid flow.

q) On line Fuel flow & velocity measurement facility in each Pulverized Fuel (PF) pipe for each coal pulveriser shall be provided by bidder for accurate, absolute and simultaneous measurement of coal velocity, coal density, coal mass flow rate and air-to-fuel ratio. The equipments shall compromise of sensors working on micro wave technology.

r) In addition to the conventional triple DP measurement techniques involving venturi/Aerofoil for secondary air flow measurement, One number Flow measurement system each on Left side and Right side shall be provided as redundant/checking measurement for secondary air flow which could be used in the optimization package.

s) On line secondary air flow & velocity measurement facility in each on left side & right side shall be provided by bidder for accurate, absolute and simultaneous measurement of air velocity & flow rate. The equipments shall compromise of sensors working on tribo-electric (Correlation technique) technology.

t) Any other flow element/meter required for system shall be finalised as per system requirement and as per approved drawings/documents by owner.

5. Process Connections

a) The type of instrument source connection shall depend upon the process parameters and the tapping size. The source connection drawings shall be finalised during the engineering stage.

b) Size of tapping point stub, number and size of root valves for different types of measurements are as follows:

S.No.	Quantity of root valves	Size of stub and root valve	Service Condition
Pressure and Differential Pressure Measurement			
(i)	2	25NB	≥ 40 bar (g) OR 425^{0}C
(ii)	1	15NB	< 40 bar (g) AND 425^{0}C.
Level Measurement			
(a)	**Level Gauge & Switch**		
(i)	2	25NB	≥ 40 bar(g) OR 425^{0}C
(ii)	1	25NB	< 40 bar(g) AND 425^{0}C
(b)	**Level transmitter (displacement type)**		
(i)	2	40NB	>40 bar(g) OR 425^{0}C
(ii)	1	40NB	<40 bar(g) AND 425^{0}C
(c)	**Stand pipe for level measuring instrument**		
(i)	2	80 NB	≥40 bar(g) OR 425^{0}C
(ii)	1	80 NB	< 40 bar(g) AND 425^{0}C
Flow Measurement			
(i)	2	25NB	≥ 40bar(g) OR 425^{0}C
(ii)	1	25NB	< 40 bar(g) AND 425^{0}C
Sampling system measurement (Steam and Water Service)			
(i)	2	25 NB	≥40 bar(g) OR 425^{0}C
(ii)	1	25 NB	< 40 bar(g) AND 425^{0}C

LOCAL PANEL

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Doors shall be provided with neoprene / polyurethane gasket only.

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

a) Operator Control Desk

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

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

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

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

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

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

2. To achieve durable & water resistant finish, a sheet of “plastic PVC membrane" on the surface of control desks shall be provided. Final paint finish with proper smoothening is to be ensured. Final finish of CD should be in line with relevant International standards. For more durability, the membrane sheet of the Control desk should extend 200 mm more into the underside of the desk. The cabling / wiring between OWS & CPU’s, power supply cables etc. shall be aesthetically routed and concealed from view.

3. All the control desk shall be equipped with Anti vibration pad of min. 15 mm size. Cable gland plate thickness shall be 3 mm.

4. Doors shall be provided with neoprene / polyurethane gasket only.

b) Surface Preparation and Painting

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

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

a. Exterior - RAL 7032 / RAL 7035.

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

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

c) Panel Wiring

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Following Wire size shall be utilized for internal wiring:

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

S.No	Nature of signals	Wire size
4	Size of Power supply cables shall be as below:-	
	i. 1 to 16 Amp.	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

d) Instruments Mounting

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

e) Panel Illumination

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

f) Fuse Blocks

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

g) Fuses & MCB

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

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

h) Moulded Case Circuit Breakers

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

i) Grounding

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

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

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

j) Terminal Blocks

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

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

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

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

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

k) Name Plates and Labels

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

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

l) Markings / Labels

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

2.3.6.6 Local Instrument Racks & Enclosure

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

i) Closed Type Instruments / Transmitter Racks

a) Required number of Instruments / transmitter racks shall be furnished to house transmitters, switches and converters by grouping them suitably, area wise / function-wise.

b) The transmitter enclosure shall be constructed of 3 mm thick steel plate. The enclosures shall preferably be of modular construction and with two end plate assembly bolted to the frame.

c) The enclosure shall approximately be 1200 millimetres wide, 1000 millimetres deep and 2200 millimetres high to allow easy access to the internals. Racks shall be reinforced as required to ensure true surfaces and to provide adequate support for instruments and equipment mounted therein. Double interlocking doors with three point locking arrangement shall be provided and shall be arranged for maximum possible access to the interior. Centre posts or any member which would reduce access shall not be provided.

b) Since nowadays the reliability and availability of control system is enhanced due to the redundancy path, backup panel with mosaic and vertical type (not L type) is to be provided with as minimum as possible for safe guarding the main equipments BTG and auxiliaries.

c) Hence in addition to the LVS and OWS, a limited operation from backup unit control vertical panel with mosaic is envisaged for emergency operation and to provide safe shut down of plant/equipments. The backup Unit control vertical panel with mosaic shall be housed Conventional Push-button (ILPB) stations, Console inserts (SG & TG), Trip Push Buttons, Ammeters, CCTV for Furnace Flame, chartless recorders & digital display units for Boiler, Turbine & Generator Process/electrical parameters. Also bidder to refer details in Chapter 6.

d) Back up panel system shall be designed for handling the situation in clause 2.3.2.17 for failure of HMI.

e) For electrical layout, complete backup panel with mosaic shall have to be provided for complete on/off operations with necessary meters, DDUs, synchronoscope etc. as specified elsewhere in specification.

2.3.2.11.1 Unit Control And Monitoring Philosophy

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

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

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

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

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

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

b) Distribution boxes, junction boxes, cold junction compensation boxes, terminal boxes and all other field mounted equipment to be furnished as per this specification shall have weather protection conforming to IP 65.

c) The design of panels, cabinets, enclosures and packaging density of components mounted therein shall be such that the temperature rise does not exceed 10 deg. C above the ambient under the worst conditions.

d) The panels housing electronic hardware shall be provided with flame and smoke detectors by bidder.

e) Enclosures for peripheral equipments like printers, etc. shall take care of noise and shall ensure minimum possible noise disturb to the working personnel.

f) For Hazardous areas the protection class shall be in accordance with the requirements of the relevant NEC code for the location.

g) ~~Workstations, OWS, EWS, Servers, Network Switches, Printers, and other peripherals, maximum temperature limit shall be 40 deg. C. For LVS the same shall be around 30 deg. C.~~

h) ~~For remote I/O cabinets mounted in non-AC areas, panel redundant AC shall be provided~~.

i) Specific requirements due to corrosive applications and corrosive environment at project site shall also be considered by bidder.

j) Delivery of all electronic panels from the manufacturer's works are subject to readiness of respective work fronts or readiness of fully covered stores.

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

2.3.2.13 System Documentation

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

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

QUALITY ASSURANCE PLAN

QUALITY ASSURANCE AND TESTING AND GUARANTEES

2.5 Quality Assurance Plan

2.5.3 General Requirement

All equipment furnished under this specification shall be subject to test by authorized quality assurance personnel of the Bidder, representatives of the Owner during manufacture, erection and on completion. Bidder'' quality assurance personnel for these shop and site tests shall be identified in advance and shall be acceptable to the Owner. The approval of the Owner or passing of such inspection of tests will not, however, prejudice the right of the owner to reject the equipment if it does not comply with the specifications when erected or fails to give complete satisfaction in service.

The Bidder shall furnish details of shop and site tests proposed to be conducted by him at various stages to meet the specification requirements for each type of instrument/system along with his proposal. Bidder shall also furnish details of his proposed shop and site quality assurance organization for this contract. Bidder shall prepare a detailed shop and site 'Quality Assurance Programme' to meet the requirements of these specifications for Owner's approval. This document shall also contain the formats for reports and maintenance of test records specification of test equipment to be used for site tests.

All equipment and systems furnished under this specification shall be subjected to shop & site tests in accordance with the Quality Assurance Program approved by the Owner and shall be adequate to ensure full compliance with these specification, all applicable codes & standards and detailed engineering drawings and documents approved by the Owner.

The Bidder shall provide all required test equipment and simulation devices for performing all shop and site tests. All tests equipment shall be of reputed make, required accuracy class and shall be recently calibrated. The record of calibration of test equipment shall be made available to the Owner on demand.

The cost of all tests as per the requirements of this specification and approved quality assurance programme shall be included in Bidder's lump sum price for this package and no extra price shall be payable by the Owner for conducting any test as per the intent and requirements of this specification.

All approval/Inspection are to be carried out by the Owner only.

2.5.3.1 Testing Method

i) Shop Test

Shop tests shall include all tests to be carried out at Bidder's works at of this sub-bidder and at works where raw materials used for manufacture of equipment is produced.

Individual components, instruments and devices furnished in accordance with specification sheets, and I&C device list enclosed with these specifications shall be shop tested by manufacturer prior to shipment. The manufacturer shall conduct these tests for certifying compliance with published specifications for the equipment and provide test results to the Owner in writing. These tests and test certificates shall be in accordance with the agreed 'QA' programme for major systems/equipments. However, manufacturer's standard methods shall be followed if details of tests for any equipment are not covered under this agreed 'QA Programme'. Whenever tested quality material is specified and wherever called upon by Indian Boilers Regulations or by the design code, the test pieces are to be prepared and tested to Owner's satisfaction.

In the event of Owner being furnished with certified particulars of tests, which have been carried out by the suppliers of material, the Owner may, at his discretion, dispense with these tests.

ii) Material Tests

Whenever tested quality material specified and whenever called upon by Indian Boilers Regulations or by design code, the test pieces, are to be prepared and tested to Owner's satisfaction.

In the event of Owner being furnished with certified particulars of tests, which have been carried out by the suppliers of material, the Owner may, at his discretion, dispense with these tests.

iii) Test at Manufacturer's Works

Works tests are to include electrical, mechanical performance and hydraulic tests in accordance with relevant IS, IBR or any other approved standard or any other tests called for by the Owner under these specifications to ensure that the equipment being supplied fulfils the requirements of these specifications. For equipments not covered by any IS or other approved standards, the tests to be carried out shall be in accordance with Bidders' quality assurance programme approved by the Owner.

Control systems, monitoring systems, control panels instrument enclosures, and power supply systems shall be shop tested according to unique requirements specified in the applicable section of these specifications for each item and quality assurance program approved by the owner.

All shop tests shall be performed prior to shipment and the Owner shall be given the opportunity to witness these tests. The Bidder shall notify the Owner regarding readiness for shop test at least 10 days before the scheduled date if the tests to be conducted within Indian and at least 60 days before the schedule date if the test is to be conducted abroad.

iv) Factory Tests

2.5.3.6 Calibration of Instruments

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

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

2.5.3.7 Tests to be performed for Field Instruments

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

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

S.No	Tests to be performed
	Hydro test, IBR Certificate
28.	**Sampling racks :**
	Hydro test, IBR Certificate for tubes and fittings.
29.	**SO2 / 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 Block Valves**
	a) IBR certificate form III C b) Hydrostatic test : ANSI B 16.34 c) Seat leakage test : As per ANSI B 16-104 d) CV test: As per ISA procedure e) Magnetic particle test ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 Deg.C) f) Liquid penetration test: ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 Deg.C) g) Radiography test: ANSI B 16.34 special class h) Calibration and Hysteresis test i) Actuator leakage test
36.	**Pressure Regulating Valve**
	a) IBR certificate form III C b) Hydrostatic test : ANSI B 16.34 c) Seat leakage test : As per ANSI B 16-104 d) CV test: As per ISA procedure e) Magnetic particle test ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 Deg.C) f) Liquid penetration test: ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 Deg.C) g) Radiography test: ANSI B 16.34 special class h) Calibration and Hysteresis test i) Actuator leakage test
37.	**Local Panels :**
	Visual inspection, wiring & continuity check, H.V. and I.R. tests on panels, checking of bill of materials, functional tests.
38	**Wiring Termination & Accessories**

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

i) Testing Types

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

1) Out of these test listed, the bidder / sub vendor / manufacturer is required to conduct certain type test specifically for this contract (and witnessed by employer or his authorized representative). Even if the same have been conducted earlier as clearly indicated subsequently such tests.

2) For the rest, submission of type test, results, and certificates shall be acceptable provided following points

   a) The same have been carried out by the bidder/ sub vendor on exactly the same model/rating of equipment. (For control valves this shall be same size, type & design).
   b) There has been no change in the components from the offered equipments and tested equipments.
   c) The test has been carried out as per the latest standards along with amendments as on the date of bid opening.

3) In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the bidder/sub-vendor within the quoted price and no extra cost will be payable by the owner on this account.

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

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

ii) Special Requirements for Solid State Equipments /Systems

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

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

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

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

iii) Type Test Requirements for C&I Systems

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

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

Note:

VENDOR LIST

PEM REGISTERED VENDOR

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

145-45000-A	INSTRUMENT FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI-MAHARASHTRA-INDIA Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
145-45000-A	INSTRUMENT FITTINGS	FLUIDFIT ENGINEERS PVT. LTD.	Mr. Abbas Bhola Potia Building No. 2, Office No. 3,292, Bellasis Road,Mumbai Central (East) Mumbai-Maharashtra-India Phone- 9920044113 Pincode : 400008 Email : ab@fluidfitengg.com
145-38000-A	INSTRUMENTS PIPE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI-MAHARASHTRA-INDIA Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
145-38000-A	INSTRUMENTS PIPE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI-DELHI-INDIA Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
145-38000-A	INSTRUMENTS PIPE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI-MAHARASHTRA-INDIA Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
145-38000-A	INSTRUMENTS PIPE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA-UTTAR PRADESH-INDIA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
145-32000-A	INSTRUMENTS TUBE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA-UTTAR PRADESH-INDIA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
145-32000-A	INSTRUMENTS TUBE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI-MAHARASHTRA-INDIA Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
145-32000-A	INSTRUMENTS TUBE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI-DELHI-INDIA Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com

145-32000-A	INSTRUMENTS TUBE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI-MAHARASHTRA-INDIA Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
145-25000-A	JUNCTION BOX	FLEXPRO ELECTRICALS PVT. LTD.	Mr. Dineshbhai Zaveri C-1/ 27&37, GIDC, Kabilpore, Navsari-Gujarat-India Phone- 02637-265140,265003 Pincode : 396424 Email : flexpro@flexproltd.com
145-25000-A	JUNCTION BOX	AJMERA INDUSTRIAL & ENGINEERING WORKS	JIGNESH MAHENDRA AJMERA DENA BANK BLDG.,SHREE NAGESH INDL. ESTATE,STATION ROAD, MUMBAI-MAHARASHTRA-INDIA Phone-022 67973578 Pincode : 400 088 Email : ajmera@ajmera.net, jmajmera@yahoo.com
145-25000-A	JUNCTION BOX	K.S.INSTRUMENTS PVT.LTD.	S Raghavan No. 72, 3rd Main, 1st Stage Industrial Suburb, Yeshwanthpur Bangalore-Karnataka-India Phone- 9880385770 Pincode : 560022 Email : sales1@ksinstruments.net
145-25000-A	JUNCTION BOX	SUCHITRA INDUSTRIES	NO-2,OPP-27 AECS LAYOUT 2ND STG REJAMAHALVILAS EXTN 2ND STG BANGALORE - - Phone- Pincode : Email : suchitra.industriesblr@gmail.com
145-25000-A	JUNCTION BOX	Shrenik & Company,	Mr. Mitesh Shah/Mr. Pulin Shah 39 A/3 ,Panchratna Industrial Estate, Sarkhej-Bavla Road Ahmedabad-Gujarat-India Phone-9825024921 Pincode : 382213 Email : sales@pustron.com, pulin@sumip.com
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI-Maharashtra-INDIA Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai,-Maharashtra,-India, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,

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

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

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

PEM REGISTERED VENDOR

Package Code	Package Name	Vendor Name	Vendor Address
145-24000-A	LOCAL CONTROL PANELS	PYROTECH ELECTRONICS PVT. LTD.	E-329, ROAD NO.12, MIA, UDAIPUR-RAJSTHAN-INDIA Phone- 2492122,31,34 Pincode : 313003 Email : pyrotech@pyrotechindia.com
145-24000-A	LOCAL CONTROL PANELS	PROCON INSTRUMENTATION PVT. LTD.	1H, SHAKTI TOWERS, 766, ANNA SALAI, CHENNAI-TAMIL NADU-INDIA Phone- 28266041,2824142 Pincode : 600022 Email : procond1@nda.vsnl.net.in
145-24000-A	LOCAL CONTROL PANELS	INDUSTRIAL CONTROLS & APPLIANCES PVT LTD	47, CHAKALA ROAD, ANDHERI(EAST), MUMBAI-MAHARASHTRA-INDIA Phone- 28344494,28221532 Pincode : 400099 Email : indconapp@vsnl.com
145-24000-A	LOCAL CONTROL PANELS	C and S ELECTRIC LTD.	222, OKHLA INDUSTRIAL ESTATE, PHASE-II, NEW DELHI-DELHI-INDIA Phone- 9871799447 Pincode : 110020 Email : panel.marketing@cselectric.co.in

Notes:-

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

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

INSTRUMENT INSTALLATION DRAWING

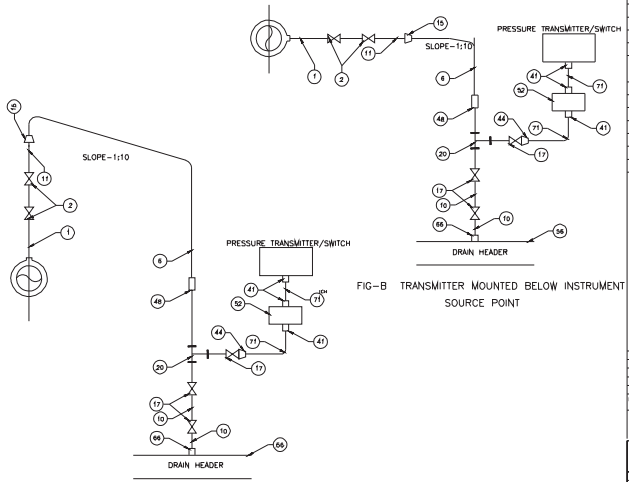


FIG-A TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT

FIG-B TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT

NOTE

TAG NO.	DESCRIPTION	QTY. A	QTY. B
71	1/2"OD IMPULSE TUBE, SS-316	AS REQ.	
66	1/2"GI SOCKET	1	1
56	5/3/2"NB GI DRAIN	AS REQ.	
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"SW X1/2"OD TUBE COMPRESSION FITTINGS, SS-316	1	1
41	1/2"NPT(M) X 1/2"OD TUBE COMPRESSION FITTINGS,SS-316	3	3
1	1/2"/ 3/4"/ CS/AS NIPPLE OF MTL. SAME AS THAT OF MAIN PIPE(AS PRE PROCESS REQ.)	AS REQ.	
20	1/2"SW,EQUAL TEES, CS	1	1
17	1/2" SW, CS GLOBE VALVE / NEEDLE VAVLE	3	3
15	1 TO 1/2"SW REDUCER	1	1
11	1"NPS SCH-80/160 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 REQ.	
2	1/2"/ 3/4"/1" ROOT VALVE	2	2

NOTE:-

1. FOR HIGH TEMPERATURE SERVICE (MORE THAN 80 DEG.C) A 'U'TUBE / SYPHON SHALL BE PROVIDED BETWEEN MANIFOLD AND THE TRANSMITTER / SWITCH
2. FOR HIGH PRESSURE (MORE THAN 40 KG/CM2) ONE ISOLATING VALVE IS PROVIDED IN EACH LINE BETWEEN MANIFOLD AND 1/2"SW EQUAL TEE AND 2 NOS DRAIN VALVE ARE ALSO PROVIDED

REV No.	DATE	MECH.	CIVIL	ELEC.	C&I	DESCRIPTION
		CHECKED				
A	XX.XX.2015	XXX	XXX	XXX	XXX	PRELIMINARY ISSUE

TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED

LAHMEYER INDIA — LAHMEYER INTERNATIONAL (INDIA) PVT. LTD.
CONSULTING ENGINEERS, GURGAON, INDIA

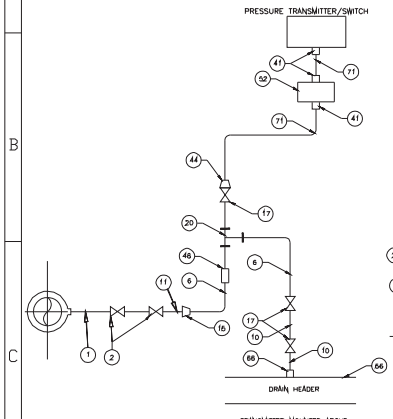
CONTRACT NO :		
PREPARED	NAME	DATE
DRAWN BY	--	--
DESIGNED BY	--	--
CHECKED BY	--	--
APPROVED BY	--	--
SHEET SIZE	A4	
SCALE	N.T.	

PROJECT : 1 X 800MW - NCTPP - STAGE - III
ENNORE & PUZHUDHIVAKKAM VILLAGE, CHENNAI, TAMILNADU

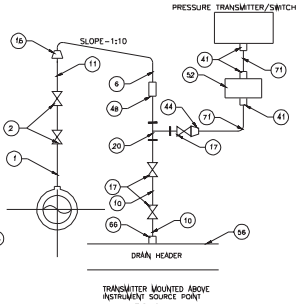
DRAWING TITLE : INSTRUMENT DRAWING FOR PRESSURE/DP TRANSMITTER/SWITCH IN STEAM/LIQUID SERVICE

DRAWING NO : LH-CCOC150068-I--A5786-020 | REV. 00 | SHEET 1 OF 2

Projection meet EN 34 - 1 - C



TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT
FIG-D



TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT
FIG-C

NOTE

TAG NO.	DESCRIPTION	QTY. A	QTY. B
71	1/2"OD IMPULSE TUBE, SS-316	AS REQ.	
66	1/2"GI SOCKET	1	1
56	5/3/2"NB GI DRAIN	AS REQ.	
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"SW X1/2"OD TUBE COMPRESSION FITTINGS, SS-316	1	1
41	1/2"NPT(M) X 1/2"OD TUBE COMPRESSION FITTINGS,SS-316	3	3
1	1/2"/ 3/4"/ CS/AS NIPPLE OF MTL. SAME AS THAT OF MAIN PIPE(AS PRE PROCESS REQ.)	AS REQ.	
20	1/2"SW,EQUAL TEES, CS	1	1
17	1/2" SW, CS GLOBE VALVE / NEEDLE VAVLE	3	3
15	1 TO 1/2"SW REDUCER	1	1
11	1"NPS SCH-80/160 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 REQ.	
2	1/2"/ 3/4"/1" ROOT VALVE	2	2

NOTE:-

1. FOR HIGH TEMPERATURE SERVICE (MORE THAN 80 DEG.C) A 'U'TUBE / SYPHON SHALL BE PROVIDED BETWEEN MANIFOLD AND THE TRANSMITTER / SWITCH
2. FOR HIGH PRESSURE (MORE THAN 40 KG/CM2) ONE ISOLATING VALVE IS PROVIDED IN EACH LINE BETWEEN MANIFOLD AND 1/2"SW EQUAL TEE AND 2 NOS DRAIN VALVE ARE ALSO PROVIDED

REV No.	DATE	MECH.	CIVIL	ELEC.	C&I	DESCRIPTION
		CHECKED				
A	XX.XX.2015	XXX	XXX	XXX	XXX	PRELIMINARY ISSUE

TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED

LAHMEYER INDIA — LAHMEYER INTERNATIONAL (INDIA) PVT. LTD.
CONSULTING ENGINEERS, GURGAON, INDIA

CONTRACT NO :		
PREPARED	NAME	DATE
DRAWN BY	--	--
DESIGNED BY	--	--
CHECKED BY	--	--
APPROVED BY	--	--
SHEET SIZE	A4	
SCALE	N.T.	

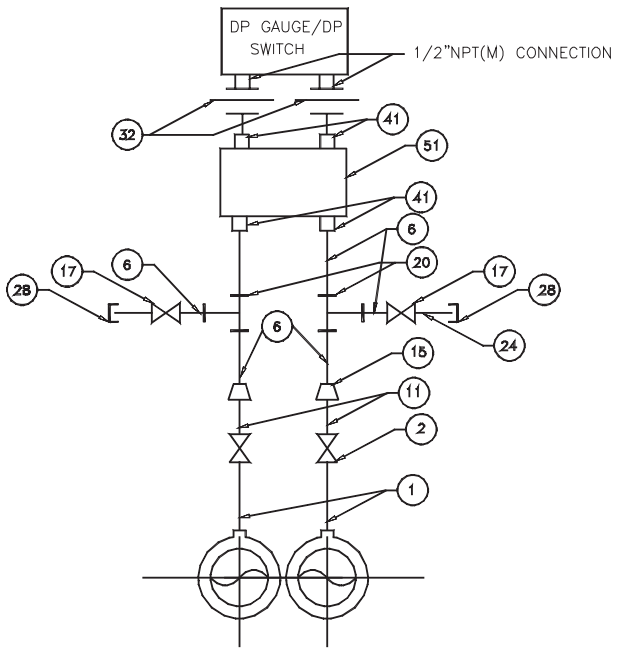
PROJECT : 1 X 800MW - NCTPP - STAGE - III
ENNORE & PUZHUDHIVAKKAM VILLAGE, CHENNAI, TAMILNADU

DRAWING TITLE : INSTRUMENT DRAWING FOR PRESSURE/DP TRANSMITTER/SWITCH IN STEAM/LIQUID SERVICE

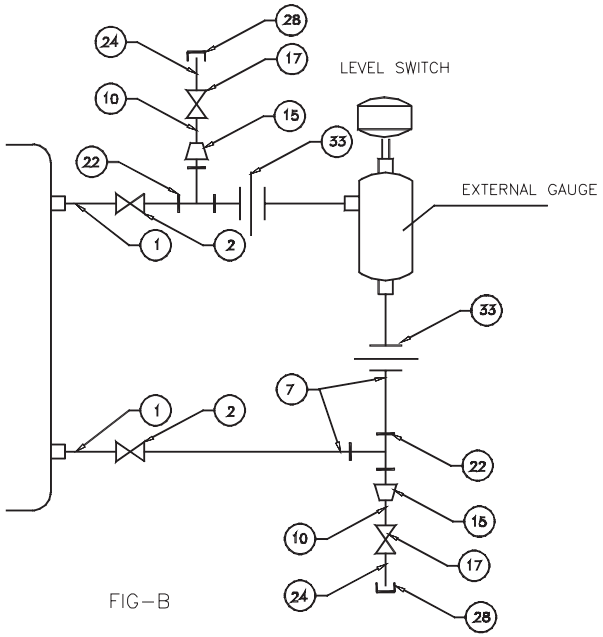
DRAWING NO : LH-CCOC150068-I--A5786-020 | REV. 00 | SHEET 2 OF 2

Projection meet EN 34 - 1 - C

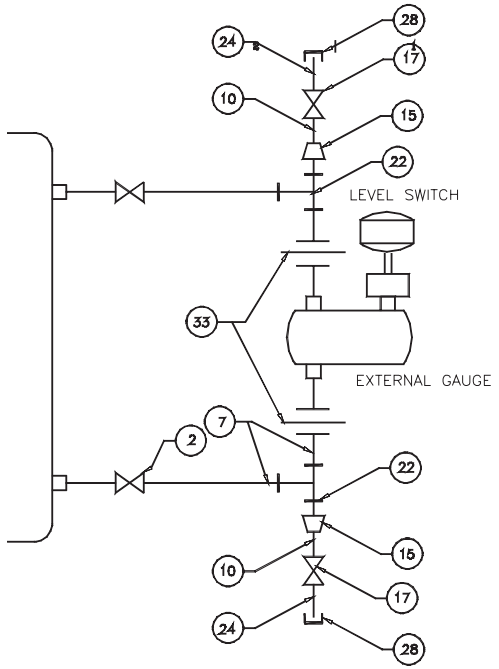
Copying of this drawings, and giving it to others and the use or communication of the contents thereof, are forbidden without express written authority. Offenders are liable to the payment of damages. All rights are reserved in the event of the grant of a patent or the registration of a utility model or design.



FIG–A



FIG–B



FIG–C

NOTE

TAG NO.	DESCRIPTION	QTY. A	B	C
78	1/2"NPT(F)X1/2"NPT(M) SNUBBER/ PULSATION DAMPER	1	–	–
38	3–WAY GAUGE VALVE WITH 1/2" NB SW	1	–	–
32	1/2"NPS, 3 PIECE PIPE UNION WITH 1/2"NPT(F) SCREWED	1	–	–
28	1/2"NPT (f) CS CAP	1	2	2
24	1/2"NPS, SCH–80/160 X 1/2"NPT(M0 CS/AS NIPPLE	1	2	2
20	1/2"SW EQUAL TEE, CS/AS	1	–	–
17	1/2"SW CS/AS GLOBE VALVE	1	2	2
1	1/2"/ 3/4"/ CS/AS NIPPLE OF MTL. SAME AS THAT OF MAIN PIPE(AS PRE PROCESS REQ.)	AS REQ.		
15	1"TO 1/2"SW REDUCER	1	2	2
11	1"NPS SCH–80/160 CS/AS PIPE	1	–	–
6	1/2"NPS. SCH–80/160 CS/AS PIPE	AS REQ.		
2	1/2"/3/4"/1"ROOT VALVE – SW GLOBE VALVE	2	2	2
33	1"SW EQUAL PIPE UNION	–	2	2
22	1"SW EQUAL TEE CS/AS	–	1	2
10	1/2"NPS, SCH 80/160 CS/AS NIPPLE	–	2	2
7	1"NPS, SCH 80/160 CS / AS PIPE	AS REQ.		
33	1"SW EQUAL PIPE UNION	2	2	2

NOTE:–
WITH VALVE SIZE 1/2"SW NIPPLE PIECE IS NOT REQUIRED

REV. No.	DATE	MECH.	CIVIL	ELEC.	C&I	DESCRIPTION
		CHECKED				
X	XX.XX.2015	XXX	XXX	XXX	XXX	PRELIMINARY ISSUE

TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED

LAHMEYER INDIA

LAHMEYER INTERNATIONAL (INDIA) PVT. LTD.
CONSULTING ENGINEERS, GURGAON, INDIA

CONTRACT NO :		
PREPARED	NAME	DATE
DRAWN BY	--	--
DESIGNED BY	--	--
CHECKED BY	--	--
APPROVED BY	--	--
SHEET SIZE	A4	
SCALE	1:1	

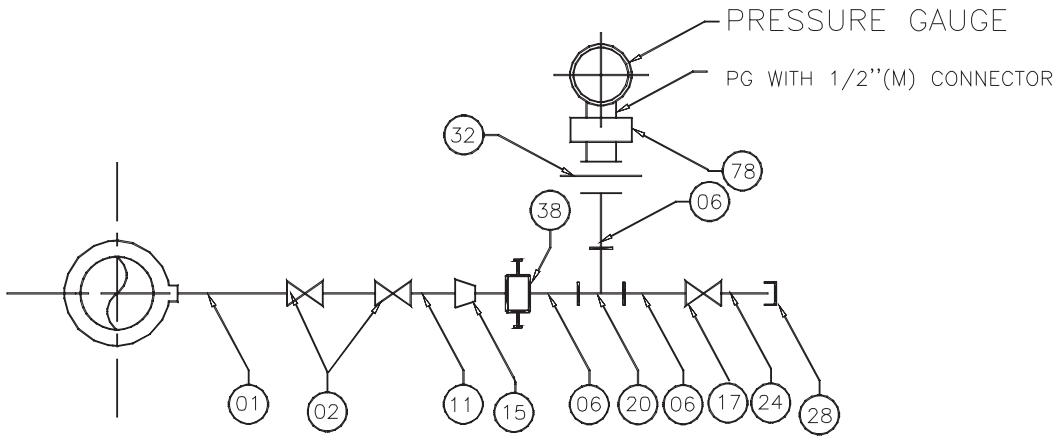
PROJECT : 1 X 800MW - NCTPP - STAGE - III
ENNORE & PUZHUDHIVAKKAM VILLAGE, CHENNAI, TAMILNADU

DRAWING TITLE : INSTRUMENT DRAWING FOR DP GAUGE/ SWITCH & LEVEL SWITCH

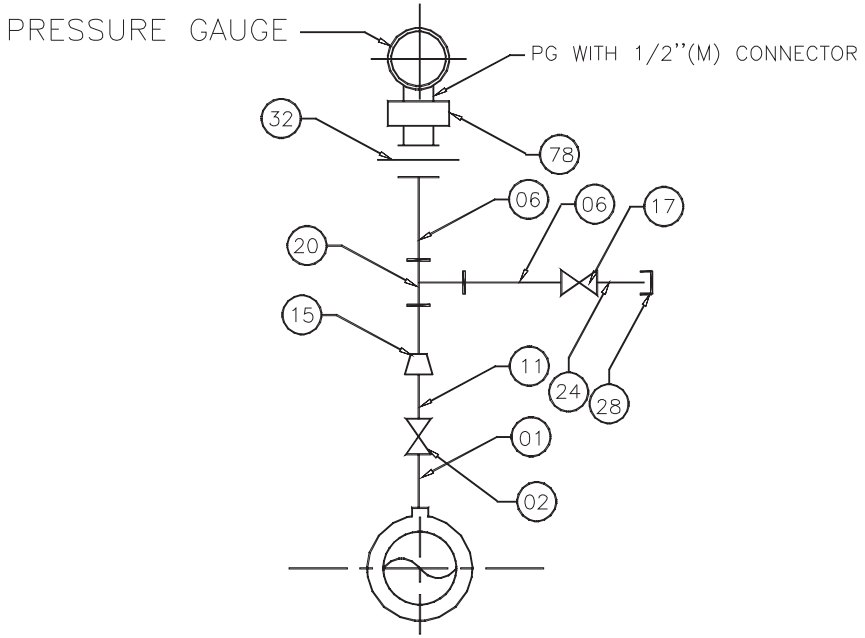
DRAWING NO : LII–GEOE15066–I–45786–013

REV. 00

SHEET 1 OF 1



FIG–A STEAM/LIQUID SERVICE



FIG–B AIR SERVICE

NOTE

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

REV. No.	DATE	MECH.	CIVIL	ELEC.	C&I	DESCRIPTION
		CHECKED				
X	XX.XX.2015	XXX	XXX	XXX	XXX	PRELIMINARY ISSUE

TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED

LAHMEYER INDIA

LAHMEYER INTERNATIONAL (INDIA) PVT. LTD.
CONSULTING ENGINEERS, GURGAON, INDIA

CONTRACT NO :		
PREPARED	NAME	DATE
DRAWN BY	--	--
DESIGNED BY	--	--
CHECKED BY	--	--
APPROVED BY	--	--
SHEET SIZE	A4	
SCALE	1:1	

PROJECT : 1 X 800MW - NCTPP - STAGE - III
ENNORE & PUZHUDHIVAKKAM VILLAGE, CHENNAI, TAMILNADU

DRAWING TITLE : INSTRUMENT DRAWING FOR PRESSURE GAUGE FOR STEAM/LIQUID/AIR SERVICE

DRAWING NO : LII–GEOE15066–I–45786–004 | REV. 00 | SHEET 1 OF 1

Protection mark DIN 34 – 1 – E:

SUB-SECTION – ID

DATASHEET-A

	DATA SHEET - A		SPECIFICATION NO.: PE-TS-423-165-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: 1X800 MW NORTH CHENNAI TPP STAGE III BTG**
1.00	**GENERAL**		
1.1	No. of Strainers/ Filters required for station	Nos.	Total 2 Sets viz. (1 Working + 1 Standby)
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
2.7	Differential pressure measuring system set pressure		

	DATA SHEET - A		SPECIFICATION NO.: PE-TS-423-165-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: 1X800 MW NORTH CHENNAI TPP STAGE III BTG**
	• 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		Duplex SS (UNS 32205/31803) (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)
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)

	DATA SHEET - A		SPECIFICATION NO.: PE-TS-423-165-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: 1X800 MW NORTH CHENNAI TPP STAGE III BTG**
	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)
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

	DATA SHEET - A		SPECIFICATION NO.: PE-TS-423-165-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: 1X800 MW NORTH CHENNAI TPP STAGE III BTG**
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
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

	DATA SHEET - A		SPECIFICATION NO.: PE-TS-423-165-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: 1X800 MW NORTH CHENNAI TPP STAGE III BTG**
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 –**		
15.1	ACTUATOR ALONG WITH MOTORS	Set	1
15.2	DEBRIS DISCHARGE VALVE	Set	1
15.3	**415 V Motor**		
15.3.1	Terminal plates	Nos.	10 Nos. each for small motors upto 30 kW
15.3.2	Heaters	Set	2 Sets
15.3.3	Greasing arrangements	Set	4 sets each type of motor
15.3.4	Motor of each type and rating	Nos.	10% of the Installed quantity or min. 1 No .
15.3.5	Bearings (DE and NDE) for each type and rating of motor	Set	4 Sets

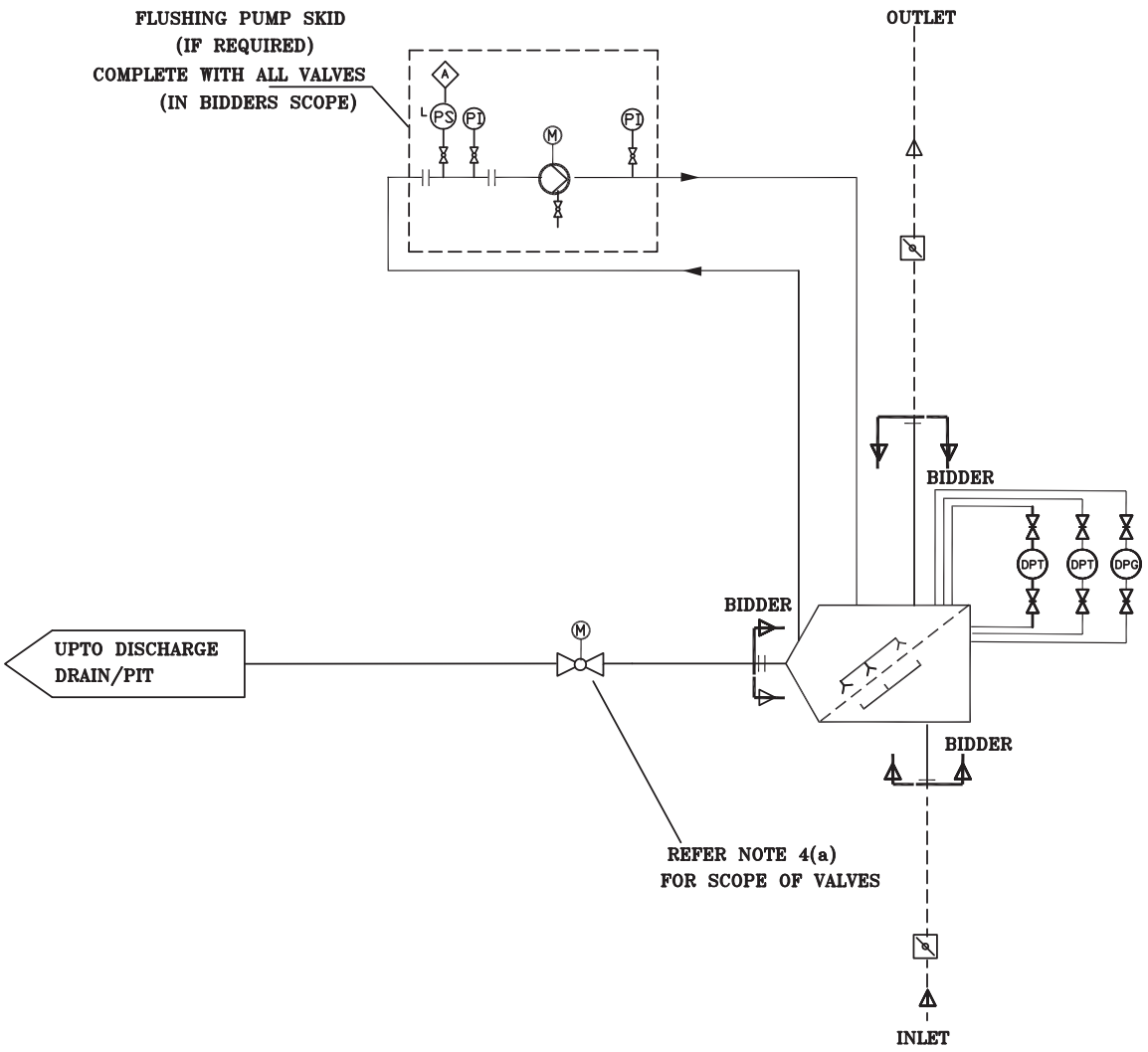
	DATA SHEET - A		SPECIFICATION NO.: PE-TS-423-165-N003
	DEBRIS FILTER (DF)		REV. NO.: 00; DATE : 25.05.2017
	FOR SEA WATER APPLICATION		SECTION : I SUB-SECTION : ID
SL NO	**DESCRIPTION**	**UNITS**	**PROJECT: 1X800 MW NORTH CHENNAI TPP STAGE III BTG**
15.4	**C&I Spares**		
15.4.1	Each type of lamps, PBs, ILPBs, fuse, MCB, MCCB used in the equipment/system.	Nos.	20% of installed quantity of each type
15.4.2	Measuring Instruments - Indicators,Recorders, Electrical Metering and Skid Mounted Instruments		
15.4.2.1	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 for the project or minimum one No. for each type & model, whichever is more
15.4.2.2	Skid mounted instruments (if any)	Nos.	10% of installed of each type & model for the project or minimum one No. for each type & model, whichever is more
15.4.3	Temperature Transmitters and Electronic Transmitters (For Pressure, DP, Temp, Flow, Level), Temperature, Pressure, Flow & LevelSwitch, safety switches, Gauges, meters,Transducer or any other instrument etc.	Nos.	10% of total number of Instruments/transducers offered for each model and type for the project or a minimum of one number, whichever is more.
15.4.4	Relay based Control Panels		
15.4.4.1	LEDs for indicating lights	Nos.	10% of qty installed.
15.4.4.2	Control circuit fuses/MCB/MCCB	Nos.	300% of installed of each type, current rating.
15.4.4.3	Relays modules & contactors.	Nos.	20% spare of qty Installed of each type & rating.
15.4.5	Alarm Annunciation System		
15.4.5.1	Logic modules, group card modules, power supply modules, Hooters and any other electronic module.	Nos.	20% spares of each type installed
15.4.5.2	Un-engraved window boxes complete with LED etc.	Nos.	5% spares of each type installed
15.4.5.3	LEDs for annunciation facia windows and LEDs box assemblies offered for the project	Nos.	20% of qty installed
15.4.5.4	Annunciator hooter	Nos.	One (1) No. of each type
15.4.6	Erection Hardware		
15.4.6.1	Instrument valves, manifolds	Nos.	Ten (10) percent of each type & Size installed

	DATA SHEET - A		SPECIFICATION NO.: PE-TS-423-165-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: 1X800 MW NORTH CHENNAI TPP STAGE III BTG**
15.4.6.2	Condensate pots of each type & Size installed	Nos.	Ten (10) percent of total number of Installed or four numbers whichever is higher .
15.4.6.3	Fittings	Nos.	Ten (10) percent of each type & Size installed

Notes for Mandatory Spares:

1	For C&I Mandatory Spare not covered above: Bidder to supply 10% or 1 no. (whichever is more) of each type of sensor/instrument, analyzers /special instruments/Electronic card, instrumentation/mechanical fittings etc for any other electronic system, feeder control cabinets, hydrastep (EWLI), Vibration Monitoring System, 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 etc.
2	Spares not applicable for the Package to be specifically quoted as “NOT APPLICABLE”.
3	In case if such items of spares indicated as “not applicable” by bidder in its offer, are found applicable at a later date during execution of the project, such items of spares are to be supplied within the ordered cost of the mandatory spares.
4	Wherever % is indicated for the mandatory spares, the quantity shall be calculated for % of supply for total quantity for station, unless otherwise specified. The quantity to be reckoned for % indicated shall be rounded off to the next higher whole number. For example if the % arrived is 0.2 the quantity to be supplied shall be 1 and if the % arrived is 5.1 the quantity to be supplied shall be 6.
5	In respect of quantity mentioned as 'Set' means the total quantity of all the components/items used in particular equipment unless otherwise specified.

ANNEXURE–I



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

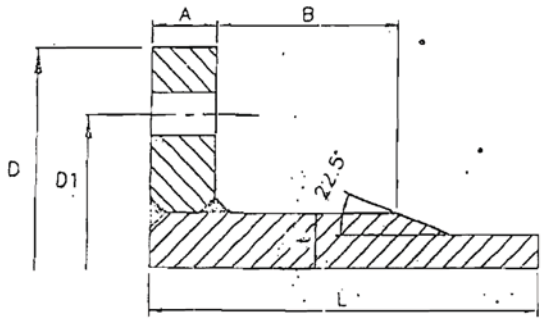
FLOW DIAGRAM FOR
DEBRIS FILTER

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	1920	60	32	80	220	110
1800	14-16	2115	2020	70	32	90	250	120
2200	18	2550	2420	80	36	100	300	140
2300	20			90	38	110	325	150
2500	20			90	38	110	325	150
2700	20			90	38	110	325	150

— TENTATIVE

DRAWING FOR BAL. SEPARATOR COUNTER FLANGE

REV.	DATE	ALTD	CHD	APPD

JOB NO. 999

STATUS -

DISTRIBUTION

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

DEPT CODE		NAME	SIGN	DATE
	DRN	PR		25.06.07
	DSGN	PM		25.06.07
	CHD	SPV		25.06.07
	APPD	SM		25.06.07

TITLE
COUNTER FLANGE DETAILS

DRAWING NO.
PE-DG-999-141-M017

SHEET 01 OF 01

REV 00

SEA WATER ANALYSIS

S.No.	Parameter	Unit	Value (Range)
1	**General**		
a)	pH		7.94-8
b)	Conductivity	millisiemens/cm	43.8-44.1
c)	Temperature	Deg C	25-32
d)	Turbidity	NTU	20-40
e)	Total Organic carbon (total/ dissolved)	PPM of C	2.4-2.84
f)	CO_2	Mg/l	<2
g)	TDS	Mg/l	39600-39740
h)	BOD	Mg/l	10-20
i)	COD	Mg/l	88-96
j)	Oil & Grease	Mg/l	<10
k)	Phenols	Mg/l	0.08-0.09
l)	Free Residual Chlorine	Mg/l	<0.2
2	**Cations**		
a)	Cacium	Mg/l	459-478
b)	Magnesium	Mg/l	1510-1516
c)	Sodium	Mg/l	10100-12000
d)	Potassium	Mg/l	358-450
e)	Ammonia	Mg/l	4.43-5.42
f)	Stontium	Mg/l	12.9-12.4
g)	Barium	Mg/l	1.55-1.58
h)	Aluminum Total	Mg/l	1-1.8
i)	Aluminum Dossolved	Mg/l	0.8-1.0
j)	Manganese Total	Micro g/l	0.2-0.6
k)	Manganese Dissolved	Micro g/l	0.1-0.2
l)	Iron total	Micro g/l	220-260
m)	Iron Dissolved	Micro g/l	Below detectable limit (detectable Limit : 10)
3	**Anions**		
a)	Chloride	Mg/l	18994-19194
b)	Sulphate	Mg/l	3710-3949
c)	Nitrate	Mg/l	136-152
d)	Nitrite	Mg/l	0.46-0.62
e)	Bicarbonate	Mg/l	144-148
f)	Carbonate	Mg/l	Nil
g)	Fluoride	Mg/l	2.64-2.8

h)	Boron	Mg/l	0.14-0.17
i)	Phosphate	Micro g/l	240-380
j)	Sulphide	Micro g/l	Below detectable limit (detectable Limit : 100)
k)	Silica Dissolved	Micro g/l as SiO_2	200-250
4	**Heavy Metals**		
a)	Arsenic	Micro g/l	Below detectable limit (detectable Limit : 2)
b)	Mercury	Micro g/l	Below detectable limit (detectable Limit : 1)
c)	Cadmium	Micro g/l	120-130
d)	Copper	Micro g/l	200-220
e)	Nickel	Micro g/l	470-490
f)	Molybdenum	Micro g/l	Below detectable limit (detectable Limit : 100)
5	**Suspended Particle Size Range**		
a)	10 micron & above	Mg/l	Below detectable limit (detectable Limit : 10)
b)	5 micron to 10 micron	Mg/l	Below detectable limit (detectable Limit : 10)
c)	1 micron to 5 micron	Mg/l	Below detectable limit (detectable Limit : 10)
d)	0.1 micron to 1 micron	Mg/l	20-26
6	**Colloidal Particle Size Range**		
a)	SDI (10 Minutes)	-	10-20
b)	SDI (5 Minutes)	-	20-40
7	**Density of sea water**	Kg/ cum	1030

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

* 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
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	

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
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	

Manufacturer / Sub-Contractor	Contractor	**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	Name & Sign. Of approving authority & Seal
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	

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		
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

* 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
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	

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
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

* 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	
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

* Records indentified with "STAR" shall be essentially included by contractor in QA Documentation.

** M :Manufacturer / Manufacturer's Sub-contractor
C : Contractor O : Owner

Indicate : "P" - Perform, "W" - Witness and "V" - Verification

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

* 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	
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.

	TITLE	SPECIFICATION NO.
	LV MOTOR	VOLUME II B
	DATA SHEET - C	SECTION D
		REV NO. 00 DATE
		SHEET 1 OF 2

S. No.	Description	Data to be filled by successful bidder
A.	**General**	
1	Manufacturer & country of origin	
2	Motor type	
3	Type of starting	
4	Name of the equipment driven by motor & Quantity	
5	Maximum Power requirement of driven equipment	
6	Rated speed of Driven Equipment	
7	Design ambient temperature	
B.	**Design and Performance Data**	
1	Frame size & type designation	
2	Type of duty	
3	Rated Voltage	
4	Permissible variation for	
5	a Voltage	
6	b Frequency	
7	c) Combined voltage & frequency	
8	Rated output at design ambient temp (by resistance method)	
9	Synchronous speed & Rated slip	
10	Minimum permissible starting voltage	
11	Starting time in sec with mechanism coupled	
12	a) At rated voltage	
13	b) At min starting voltage	
14	Locked rotor current as percentage of FLC (including IS tolerance)	
15	Torque	
	a) Starting	
	b) Maximum	
16	Permissible temp rise at rated output over ambient temp & method	
17	Noise level at 1.0 m (dB	
18	Amplitude of vibration	
19	Efficiency & P.F. at rated voltage & frequency	
	a) At 100% load	
	c) At 75% load	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

S. No.	Description		Data to be filled by successful bidder
	c) At starting		
C.	**Constructional Features**		
1	Method of connection of motor driven equipment		
2	Applicable Standard		
3	DOP of Enclosure		
4	Method of cooling		
5	Class of insulation		
6	Main terminal box		
	a) Type		
	b) Power Cable details (Conductor, size, armour/unarmour)		
	c) Cable Gland & lugs details (Size, type & material)		
	d) Permissible Fault level (kArms & duration in sec)		
7	Space heater details (Voltage & watts)		
8	Flame proof motor details (if applicable)		
	a) Enclosure		
	b) suitability for hazardous area		
	i	Zone	O / I / II
	ii	Group	IIA / IIB / IIC
9	No. of Stator winding		
10	Winding connection		
11	Kind of rotor winding		
12	Kind of bearings		
13	Direction of rotation when viewed from NDE		
14	Paint Shade & type		
15	Net weight of motor		
16	Outline mounting drawing No (To be enclosed as annexure)		
D.	**Characteristic curves/ drawings** (To be enclosed for motors of rating ≥ 55KW)		
	a) Torque speed characteristic		
	b) Thermal withstand characteristic		
	c) Current vs time		
	d) Speed vs time		

	QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION : 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 P	AGENCY W	AGENCY V	REMARKS
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									

	QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION : 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	AGENCY W	AGENCY 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)

1.0 SCOPE

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

2.0 CODES AND STANDARDS

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

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

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

3.0 TECHNICAL REQUIREMENTS

3.1 Panel Construction

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

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

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

3.1.4 The salient features of construction shall be:

Sheet material: Cold rolled sheet steel
Frame thickness: Not less than 3.0mm
Enclosure thickness: Not less than 2.5 mm for load bearing sections (Mounted with instruments)
1.6 mm for doors and Not less than 2.0 mm for others
Panel Height: As Required
Gland plate thickness: 3.0mm
Base channel: ISMC 100 with anti-vibration mounting & foundation bolts.

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

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

3.1.7 The class of protection shall be in accordance with IP-42 unless otherwise specified in the data sheet – A (No. PES-145-54A-DS1-0).

3.1.8 All steel surfaces shall be cleaned by sand / pellet blasting, treated for pickling, degreasing and phosphating etc. by seven tank method. The panel shall have a high quality finish and appearance. The panel shall be painted with two coats of primer followed by two coats of epoxy / synthetic enamel based final paint of color shade and finish as given in data sheet-A (No. PES-145A-DS1-0). Minimum thickness of the paint shall be 85 microns for external paint and 70 microns for internal paint.

3.1.9 The cable glands of the required size and type as given in data sheet-A (No. PES-145A-DS1-0) shall be supplied alongwith the Panel.

3.1.10 All operable and indicating devices shall be mounted on the front of the panel while aux. Relays / timers MCBs etc. required for realization of control logics shall be mounted on a mounting plate inside the panel. Auxiliary relays and timers etc. shall be grouped according to the control function.
No operable or indicating devices shall be mounted below 750 mm and above 1800 mm (w.r.t. finished ground level). The devices shall be located in such a way so as to ensure easy access for operation / maintenance.

3.1.11 Single / dual control power supply feeders of voltage class as specified in data sheet-A (No. PES-145A-DS1-0) shall be provided by the purchaser. In case redundant power supply feeders are provided then auto changeover unit shall be mounted on the panel are in the panel supplier's scope. Where DC control power supply is specified an additional 240V, 50 Hz AC supply feeder for powering of space heater and lighting shall be provided by the purchaser. Suitable arrangement shall be provided inside the panel to receive and terminate the power supply feeder(s). For this purpose MCBs of suitable current rating shall be provided by the vendor. A supervisory relay along with a pilot lamp to indicate control supply 'ON' shall be provided on the panel. Any other power supply required for the operation of the devices mounted in the panel shall be arranged by the vendor.

3.1.12 The internal wiring shall be carried out with 1100 volt grade PVC insulated copper multi strand wire / flexible of 1.5mm2 size. AC & DC wires shall be kept separate from each other. Separate coloured wires to be used for AC and DC circuits. All wires shall be properly numbered and identified with ferrules as per the Control scheme / wiring diagram. Wires shall be routed and run through PVC troughs.

3.1.13 Terminal blocks shall be clip on type, 1100 volts grade. Separate terminal blocks shall be used for AC & DC circuits. The terminals shall be suitable for terminating 0.5 mm2 to 2.5mm2 external cables. The TB points in terminal block shall be cage clamp type / screw type. The terminal for ammeters shall be provided with removable links for shorting CTs. Each terminal strip shall be provided with identification strip. The terminal shall not be mounted below 250 mm height from finished floor. The panel shall have ten (20) percent spare terminal.

3.1.14 The interior of each panel shall be suitably illuminated through fluorescent lamps / tube lights with shrouded cover of minimum 15W operable on 240V 50 Hz AC power supply through panel door switch. A 15 Amp. 3-pin Power receptacle shall be provided.

3.1.15 Suitable space heaters operable on 240 Volts 50 Hz AC power system shall be provided at the panel bottom. These shall be designed to maintain the panel temperature five (5) deg. C above the ambient temperature during maintenance shutdown. Suitable isolating and control devices comprising of MCB, thermostat etc. shall be provided for the space heater.

3.1.16 The panel shall be provided with a copper earth bus of 25 x 6 mm size running throughout the width of the panel. It shall be terminated internally with 10 mm bolts at extreme ends for connection to; main station earth. The panel mounted equipments / devices shall be connected to earth bus through green coloured PVC insulated stranded copper conductor of 2.5 mm2 size.

3.1.17 Local Panel shall be provided with main name plate of 150 mm x 40 mm size having inscription of 20 mm height. The individual devices on the panels shall be as provided with separate name plate with inscription of 3 mm height. The instrument / devices shall be provided with stick on label plates inside the panel. The material of the main and individual labels shall be three (3) ply 3 mm thick Traffolyte

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

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

3.2 Hazardous Area Panel Requirement

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

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

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

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

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

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

3.3 Control & Monitoring devices

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

3.3.2 Alarm Annunciator System

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

3.3.3 Relays

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

3.3.4 Timers

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

3.3.5 Control / Selector Switches

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

3.3.6 Push Buttons / Indicating Lights

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

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

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

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

3.3.7 Ammeters

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

3.3.8 Miniature Circuit Breaker (MCB)

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

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

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

4.0 TESTING AND INSPECTION

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

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

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

4.3.1 Routine Tests

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

4.3.2 Type Tests

1. Enclosure Class Test

5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

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

5.2. Mandatory Spares

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

5.3. Recommended Spares

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

6.0 DRAWINGS AND DOCUMENTS

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

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

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

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

7.0 MARKING AND PACKING

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

8.0 APPLICABLE DATA SHEET FORMS

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

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

BHEL	**DATA SHEET FOR LOCAL PANELS**	SPECIFICATION NO.: PE-SS-999-145-054A
		VOLUME
		SECTION
		REV. NO. 02 / DATE: 16.09.2013
		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 (As per requirement EDN)	
	ENCLOSURE SHEET THICKNESS	FRONT	☐2.0 mm	
		OTHER	☐ 2.0 mm	
		DOOR	☐ 1.6 mm	
		HEIGHT	☐ 2365 mm for stand alone panels. ☐ Other ……	
		OTHER	☐ Load bearing sheet front shall have 3mm thickness	
TECHNICAL	INPUT POWER SUPPLY * (ANY OTHER POWER REQUIREMENT TO BE DERIVED FROM THIS SUPPLY ONLY)		☐ 240V 50 Hz AC ☐ 220V DC ☐ 415V 3 PHASE 3W ☐ 415V 3 PHASE 4W	
	NO. OF FEEDERS		☐ ONE ☐ TWO	
	STARTER WITH MCC (CHECK WITH MAUX/ELEC)		☐ REQUIRED ☐ NOT REQUIRED	
	IPR POSITION		☐ MCC ☐ RELAY PANEL	
	CONTACT RATING OF RELAY		☐ 5 Amp, 230 V AC ☐ 0.25 Amp, 220V DC	
	CONTROL SUPPLY		☐ 110V AC ☐ 220V AC ☐ 220V DC ☐ Other. (As per requirement)	
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)		_____NOS. (AS REQUIRED)	
	TEMP SCANNER (IF REQUIRED –NO. OF CHANNELS TO BE SPECIFIED UNDER SEC-C)		☐ REQUIRED ☐ NOT REQUIRED	
	PAINT TYPE		☐ EPOXY ENAMEL ☐ EPOXY POWDER COATED	
	MIMIC (TYPE OF MIMIC- MATERAIL, THICKNESS TO BE SPECIFIED DURING DETAILED ENGG.)		☐ REQUIRED ☐ NOT REQUIRED	
	PANEL COLOUR (EXTERNAL)		☐ LIGHT GREY (Shade 631 IS-5) ☐ OPALINE GREEN (Shade 275) .	
	FINISH (EXTERNAL)		☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY	
	PANEL COLOUR (INTERNAL)		☐ WHITE ☐ CREAM ☐ OFF WHITE	
	FINISH (INTERNAL)		☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY	
	CLASS OF PROTECTION		☐ IP-42 (FOR INDOOR SERVICE) ☐ IP-55 (FOR OUTDOOR SERVICE) ☐ ANY OTHER	
	CONTROL HARDWARE		☐ RELAY BASED	

	DATA SHEET FOR LOCAL PANELS	SPECIFICATION NO.: PE-SS-999-145-054A	
		VOLUME	
		SECTION	
		REV. NO. 02	DATE: 16.09.2013
		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)
	FOUNDATION ARRANGEMENT	☐ FOUNDATION BOLTS ☐ ANCHOR FASTENERS	
	WEIGHT OF PANEL (Kg.)	……..(Vendor to specify)	
	PANEL TYPE	☐ PRESSURISED ☐ UNPRESSURISED As per Requirement	
	CABLE GLAND	☐ DOUBLE COMPRESSION	
	AMMETER (TYPE OF INPUT) *	☐ 1 Amp CT ☐ 4-20 mA	
	SCOPE OF SUPERVISION FOR ERECTION & COMMISSIONING	☐ APPLICABLE ☐ NA	
	* TO BE CO-ORDINATED WITH PEM ELECTRICAL		

	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL
NAME	AANCHAL CHOUDHARY	SACHIN SRIVASTAVA	MA MANSOORI	NAME:
DESIGNATION	SR.ENGR	DY.MNGR	D. GM	
SIGNATURE				SIGNATURE:
DATE	16.09.2013	16.09.2013	16.09.2013	DATE:

FORM NO. PEM-6666-0

BHEL	**DATA SHEET FOR LOCAL PANELS**	SPECIFICATION NO.: PE-SS-999-145-054A
		VOLUME
		SECTION
		REV. NO. 02 / DATE: 16.09.2013
		SHEET 3 OF 3

TAG No. ……. Qty..... Data Sheet No.: **PES-145A-DS1-0**

Data Sheet C

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

GENERAL	MANUFACTURER			
	CONSTRUCTION		☐ FOLDED ☐ WELDED (As per requirement EDN)	
	ENCLOSURE SHEET THICKNESS	FRONT		
		OTHER		
		DOOR		
		HEIGHT		
		OTHER		
TECHNICAL	INPUT POWER SUPPLY			
	NO. OF FEEDERS			
	CONTACT RATING OF RELAY			
	TEMP SCANNER			
	CONTROL SUPPLY			
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)			
	PAINT TYPE			
	PANEL COLOUR (EXTERNAL)			
	FINISH (EXTERNAL)			
	TYPE OF MIMIC MATERIAL OF MIMC THICKNESS OF MIMIC			
	PANEL COLOUR (INTERNAL)			
	FINISH (INTERNAL)			
	CLASS OF PROTECTION			
	CONTROL HARDWARE			
	FOUNDATION ARRANGEMENT			
	WEIGHT OF PANEL (Kg.)			
	PANEL TYPE			
	CABLE GLAND			
	AMMETER (TYPE OF INPUT)			
	SCOPE OF SUPERVISION			

	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL
NAME	AANCHAL CHOUDHARY	SACHIN SRIVASTYAVA	MA MANSOORI	NAME:
SIGNATURE				SIGNATURE:
DATE	16.09.2013	16.09.2013	16.09.2013	DATE:

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR TRANSMITTER

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECKS FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	VISUAL.						
	MODEL/TAG No						
2	PROCESS CONNECTION			P	W	V	
3	ACCURACY			P	W	V	
4	REPEATABILITY			P	W	V	
5	HYSTERESIS			P	W	V	
6	EFFECT OF TEMP VARIATION ON ACCURACY			P	W	V	
7	SPAN / ZERO ADJUSTMENT	ONE / TYPE		P	W	V	
8	EFFECT OF SUPPLY VOLTAGE VARIATION			P	W	V	
9	EFFECT OF LOADING (500 OHM METERS)			P	W	V	
10	HIGH PRESSURE TEST	SEE NOTE-1 BELOW		P	W	V	
11	BURN-IN TEST	ONE / TYPE		P	W	V	
12	DEGREE OF PROTECTION			P	W	V	
13	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

** 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. When material corelation are not available manufacturer's compliance to be provided.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR PRESSURE & DP GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	SENSOR TYPE						
	DIAL SIZE						
	MODEL NO/TAG NO						
	RANGE/SCALE						
	SWITCH CONTACT RATING & NOS.						
	END CONNECTION						
2	CALIBRATION			P	W	V	
	ACCURACY						
	REPEATABILITY						
	SET POINT ADJUSTMENT						
3	OVER PRESSURE & LEAK TEST			P	W	V	
4	OPERATION OF PRESSURE. RELIEF DEVICE	ONE		P	W	V	
5	REVIEW OF TC FOR	FOR LOT		V	V	V	
	MATERIALS OF SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. When material corelation is not available, MFR's compliance to be provided
5. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR PRESSURE SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	V	V	
	1.1 MODEL NO/TAG NO						
	1.2 RANGE						
	1.3 END CONN						
	1.4 NO. OF CONTACT						
2	CALIBRATION			P	V	V	
	2.1 REPEATABILITY						
	2.2 SET POINT ADJUSTMENT						
	2.3 DIFFERENTIAL						
3	OVER PR & LEAK TEST			P	V	V	
4	ELECT. INSULATION/HV TEST	ONE		P	V	V	
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT		V	V	V	
	5.1 SENSOR						
	5.2 MOVEMENT						
	5.3 PROCESS CONNECTION						
	5.4 HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	REVIEW OF TC OF MICROSWITCH	FOR LOT		V	V	V	

** 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 carry out ROUTINE TEST on 100 %.
3. Contractor to provide compliance certificate for tests/checks verifid by contractor and the same alongwith test certificates to be verified by BHEL

PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	1 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
	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 $			Remarks
									P	W	V	
		3. Conductor a) Resistance b) Size c) Sheet colour	 MA MA MA	 Electrical Measurement Visual	 100% 100% 100%	 BHEL Spec. and IS:1554 or IS:694	 BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	3	---	2	
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type	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

$ 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	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
$ 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	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 $			Remarks
									P	W	V	
10.	Panel Wiring	1. Wiring Layout	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		2. Wiring Termination (Crimped Lugs)	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		3. Ferrule numbers	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		4. Colour of wiring	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
		5. Size of Conductor	MA	Measurement	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
11.	Component Mounting	1. Correct components	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
		2. Fixing	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
	FINAL											
12.	Final Inspection	1. Workmanship	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.
		2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		3. Components identification Marking / Name plates	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	

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	6 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
		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	

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	7 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	
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	

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

SECTION III

DOCUMENTS TO BE SUBMITTED BY BIDDER

	TITLE : SCHEDULE OF PERFORMANCE GUARANTEES FOR DEBRIS FILTER (DF)	SPEC. NO. PE-TS- 423-165-N003
		SECTION : III
		SUB SECTION : IIIA
		Sheet 1 of 1 Date- 25.05.2017

S.NO.	DESCRIPTION	UNITS	PROJECT NAME: 1X800 MW NORTH CHENNAI TPP STAGE III 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
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
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					
Revision Number	**0**	**1**	**2**	**3**	**4**
Signature of Bidder/ Vendor Authorised Representative					
Date :					

	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
2. Items which deviate from Specification shall be marked with an asterisk (*)

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					
Revision Number	**0**	**1**	**2**	**3**	**4**
Signature of Bidder/ Vendor Authorised Representative					
Date :					

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
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		

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
	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		

Name of Bidder/ Vendor					
Revision Number	**0**	**1**	**2**	**3**	**4**
Signature of Bidder/ Vendor Authorised Representative					
Date :					

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
	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		

	Title	SPECIFICATION NO.
	DATA SHEET - B **DEBRIS FILTER** **(BACKWASH TYPE)**	PE-TS-XXX-165-N003
		SECTION: **C** SUB-SECTION: **IIIC**
		SHEET 7 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
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 :		

Name of Bidder/ Vendor					
Revision Number	**0**	**1**	**2**	**3**	**4**
Signature of Bidder/ Vendor Authorised Representative					
Date :					

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
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	

Name of Bidder/ Vendor					
Revision Number	**0**	**1**	**2**	**3**	**4**
Signature of Bidder/ Vendor Authorised Representative					
Date :					

	Title	SPECIFICATION NO.
	DATA SHEET - B **DEBRIS FILTER** **(BACKWASH TYPE)**	PE-TS-XXX-165-N003
		SECTION: **C** SUB-SECTION: **IIIC**
		SHEET 9 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
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)		

G:\MSE\ASH\DS-DF.RTF

Name of Bidder/ Vendor					
Revision Number	**0**	**1**	**2**	**3**	**4**
Signature of Bidder/ Vendor Authorised Representative					
Date :					