MAHAGENCO
1X660 MW BHUSAWAL TPS UNIT-6

TECHNICAL SPECIFICATION
FOR
SUMP PUMPS

Specification No.: PE-TS-415-100-N002 (Rev-00)

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA-201301

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Notes:

1) In case there is conflict in different clauses of specification, most stringent clause (as decided by BHEL / end customer) shall be followed, if no specific deviation is taken by bidder and accepted by BHEL during tender stage in that regard.

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 SCOPE:

This enquiry covers the design, manufacture, assembly, inspection and testing at manufacturer's and/or his sub-contractors works, proper packing for delivery and installation checks at site and mandatory spares (if applicable) complete with all accessories as per the requirements specified in this specification and any other services, etc. if called for in the succeeding sections of the specification.

1X660 MW BHUSAWAL TPS UNIT-6

Evaluation of sump pumps as indicated in technical specification shall be as per NIT.

Note:

a) The bidder shall include complete supplies for the project in his scope, part supplies offered for project shall disqualify the offer.
b) Sump pumps details viz. quantity, Capacity, Head, Materials of construction, Mandatory spares and other particulars are detailed in Data Sheet-A at Section-ID of the specification.

2.0 SCOPE OF SUPPLY:

2.1.1 Scope of supply includes Pumps, motors with standard/special accessories which shall necessarily be the part of the pump bidder scope.

2.1.2 The pumps shall be complete with following standard/ special accessories- as applicable.

2.2.1 Standard accessories to be supplied with each pump.

a) Electric motor drive with cable glands.
b) Self-contained lubrication system.
c) Erection & commissioning spares, as required.
d) Supply of first fill of lubricants including second fill/ replenishment as necessary after commissioning and handing over of equipment.

2.2.2 Special accessories included in Bidder's scope of supply:

The following accessories besides those stipulated in Data Sheet-A shall be in bidder's scope.

a). For Type A (Fixed Vertical wet pit type sump pumps)

For each of these pumps a supply feeder upto starter cum control panel shall be made available by BHEL. The following to be included in pump bidder scope.

- One No. wall mounted local control panel (IP-65 protection) for each set of two (2) Nos. of pumps per unit. The common LCP shall also house starter panel of 2 Nos. submersible sump pumps. For details of panels and control interlocks- refer Clause No. 7.1 in succeeding paras of this Section.

  Control system for projects shall be relay based.

- Power & control cable for each pump of lengths as per data sheet A with suitable connection arrangement to wall mounted starter cum control panel. Separate Cables shall be provided by Bidder for power and control purpose and these cables shall not be bunched together. Minimum size of power cables shall not be less than 2.5 mm

square. Cable shall be flexible copper conductor PVC insulated, armored and overall hard grade PVC sheathed. In case where power and control cables are combined, the paired screened cable shall be provided.

- Flanges, nuts and bolts & matching counter-flange with nuts, bolts and gaskets for connecting with pump discharge at one end & discharge pipe works of purchaser at other end.
- Delivery bends and discharge piping upto pump mounting level with associated flange/ counterflange.
- Suction strainer as applicable.
- Accessories as per data sheet.
- Level switches as per control interlock requirement as detailed in Clause No. 7.1 herein. Each level switch shall be provided with accessories like Probe , Perforated enclosing MS pipe for probe a/w mounting flange , matching flange with fixing nuts and bolts
- Pressure gauge at discharge of each pump with 3-way isolating root valve as per datasheet.
- Pumps shall be wet pit type, vertical shaft, centrifugal, vertical submerged suction, non-clog volute type complete with enclosed shaft, discharge pipe, head assembly thrust bearing & drive assembly, cover plates etc.
- Any other standard accessory required for safe and trouble free operation of Pumps to be provided by Bidder.

b). For TYPE B (Portable trolley mounted Submersible type sump pumps):

For these pumps 63 amps. Welding socket shall be made available by BHEL for power supply. The following shall be included in pump bidder scope:

- Wheel trolley for carrying pump and drive unit along with starter cum control panel. Trolley shall have swiveling front wheel and have adequate fixing arrangement for pump motor set with a base frame along with all below accessories, for operation without any undue vibration and with facility for being handled by a single operator.

  The trolley shall be provided with “Hose Reeling Drum” & “Cable Reeling Drum”.

  The pump motors set shall be suitably mounted on trolley with solid rubber type wheels, the trolley shall be of robust construction. The portable pump with its drives shall be secured to the trolley such that there is no unbalance when the trolley is moved from one location to another or when the pump is working. The number of wheel trolleys shall be one (1) per pump.
- One starter cum control panel (IP-65 protection) for each pump complete with necessary auto selector switches, start/stop buttons, switch/contactor fuse, red & green indication lamp, over load relays, L/L reset push buttons, A/O/M switch, control transformer. The starter cum control panel shall be mounted on the wheel trolley. The starter cum control panel shall be suitable for outdoor duty and to be provided with protection canopy.

  Control system shall be relay based.
- Power cable connected to starter panel at one end and with plug compatible to 63 amp. Socket at the other end (Details shall be furnished during contract stage.) for connecting purchaser’s power supply to starter panel.

- Hose pipe with hose nipple, flanges, nuts and bolts & matching counter-flange with nuts, bolts and gaskets for connecting with pump discharge at one end & discharge pipe works of purchaser at other end. Arrangement of connecting hose with pump discharge and connecting with discharge pipe works of purchaser shall be as per clause no. 2.2.4 below.
- Two (2) nos. 30m long discharge hose (canvas) having female hose coupling at both ends & of size to suit pump discharge shall be provided for each pump.
- One (1) no. male type hose coupling, one end of which is suitable to couple with the discharge hose and the other end is flanged, matching with the above mentioned 500 mm long pipe piece end and connected therewith by necessary bolts, nuts & gaskets.
- One (1) no. 25 meters long submersible type power cable with a hermetically sealed (waterproof) cable gland for connection with the pump drive- motor.
- Cables for connecting the starter panel with the nearest power supply source (cable length – 25M)
- Skirt base with suction strainer as applicable.
- Suitable lugs and other attachments on the pump motor assembly frame for hoisting and lowering of the pump motor set from and to the sump with chain (Chain length: 15 M).
- Level switches as per control interlock requirement as detailed in Clause No. 7.2 herein.
- Lifting chains.
- Other accessories as mentioned in Datasheet-A.
- Any other standard accessory required for safe and trouble free operation of Pumps to be provided by Bidder.

2.2.3 Rust inhibiter paint at Manufacturer's works.

2.2.4 Arrangement of connecting hose with pump discharge & discharge pipe of purchaser (if required).

One end of the discharge flange of the pump shall be connected to the delivery bend of suitable size.

Suitable sized expander/ reducer if required shall be connected with necessary flanges at both ends (bidder scope).

In case expander / reducer is not required, delivery bend shall be connected with hose nipple. Hose pipe shall be connected to hose nipple with necessary clamping arrangement.

In case expander / reducer is required, flange connected with hose nipple shall be connected to reducer / expander. Hose pipe shall be connected to hose nipple with necessary clamping arrangement.

The other end of hose to be connected to pipe work of purchaser shall be provided with suitable flanged piece with counter flanges, nuts and bolts.

2.2.5 One set of special tools & tackles for maintenance of equipment for each project shall be in bidder's scope.

2.2.6 Bidder shall provide various drawings, data, calculations, test reports/ certificates

operation & maintenance manuals including As Built drawings, etc. as specified and as necessary for the project.

2.2.7 Adequate nos of properly designed bearings shall be furnished. Bearings for pumps shall be antifriction type and lubricated by grease. Line shaft bearings of vertical pumps shall also be grease lubricated. All necessary grease gun, grease cup and tubing shall be included.

3.0 Works excluded from Bidder's scope. The following/ services shall be provided by purchaser.

a) Civil foundation
b) Power supply

4.0 The pumps will be subjected to mechanical running at works and site by the purchaser. If the site performance is found not meeting the requirements including vibration and noise as specified, then the equipment shall be rectified or replaced by the vendor, at no extra cost to the purchaser.

5.0 High, reliability of the pumps is an essential requirement. It is therefore essential that the bidder chooses a standard proven model from the range of pumps manufactured. A comprehensive list of similar installations shall be submitted along with the bid.

6.0 OTHER REQUIREMENTS:

6.1 The submersible Sump pumps shall meet the technical requirements of Section-I as well as Section-II.

6.2 The Quality Plans enclosed in the specification are for bidder's guidance only. The bidder shall comply with these and other minimum requirements specified in the specification and shall furnish their own quality plan in the event of order based upon guidance given therein, for approval of BHEL/Customer as applicable to respective project.

7.0 Operational philosophy:

7.1 Controls for **Type A** (**Fixed Vertical wet pit type sump pumps):**

Vertical wet pit type sump pumps shall be controlled through a wall mounted starter cum control panel (in bidder's scope) for each set of Two (2) pumps.

The local control panel shall be Relay based. The starter cum control panel shall be suitable for outdoor duty and to be provided with protection canopy

The following controls/interlocks shall be provided in the local control panel.

Normally one pump will be running and the other an auto standby, however, in the event of very high level both pumps shall run.

(a) Start/stop facility.

(b) If any of the working sump pumps trips due to electric fault etc. the standby sump pump will come into operation automatically.

(c) Selector switch for main/standby selection.

(d) One number level switch (high level) provided in the sump shall start one number sump pump in the event of high water level in the sump.

(e) One number level switch (high level) provided in the sump shall start second sump pump in the event of very high water level in the sump.

(f) One number level switch (low level) provided in the sump shall trip the running pumps in the event of very low water level in the sump.

(g) Sump pump status indication (ON/Off/Trip).

(h) Indication for failure of any sump pump.

(i) Indication for Low voltage, low level, high level and overload.

(j) Ammeter shall be provided in LCP if motor rating is 30 KW or above.

(k) Power and Control circuits shall be with MCCB.

(l) Alarm shall be annunciated in the event of low water level in the sump.

Important note: In order to make equal running of pumps, provision for duty standby selection of pumps shall be provided by bidder.

7.2 Controls for **TYPE B (Portable Submersible pumps):**

Each submersible pump shall be provided with integral float type level switch mounted on pump frame for tripping the pump at low water level. The additional instruments/ interlocks required for pump - motor safety shall also be provided.

Each Portable type Sump pump shall be provided with starter cum local control panel as indicated above at S.No. 2.2.2 (b).

The start/ stop P.B. for pumps shall be provided in the panel being supplied by the bidder. Power and Control circuits shall be with MCCB. Any additional feature Specified in Data Sheet-A shall be provided.

The following controls / interlocks shall be provided in the local control panel.

a. Start / stop facility.
b. One number level switch (very low level) provided along with the pump shall trip the pump in the event of very low water level in the sump
c. Sump pump status indication (on / off / trip).
d. Indication for failure sump pump.
e. Indication for low voltage, low level and overload.

8.0 No external water supply shall be available for the cooling/sealing of sump pumps. The portable type sump pumps shall be oil filled type.

9.0 The materials of construction for various components specified are the minimum requirements and materials of construction for other components not specified shall be similarly selected by the bidder for the intended duty.

10.0 The makes of various Bought-Out-Items of bidder shall be subject to Purchaser's approval.

11.0 It is mandatory for the bidder 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, notwithstanding anything else stated elsewhere in bidder's offer, data sheets etc. The bidder's deviations or implied/ indirect deviations in data sheets, etc. shall not be binding on the purchaser.

12.0 The bidder shall guarantee the performance of pump- motor units along with accessories for rated, performance duties, including the acoustical/ vibrational aspects for the stipulated limits specified elsewhere in the specification.

NOTE: The discharge rate of sump pump is very much uncontrolled. As such pump should be capable to operate even under a condition of as low as 25% of specified total head.

13.0 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 of pump and motor
- GA drawings of pumps,
- Control philosophy & GA drawing of control panel.
- Quality Plan.
- O & M Manual.

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

PACKAGE	BHEL DRG NO	DRG TITLE
Sump Pumps/ Submersible pumps	PE-V8-415-100-N001	TDS AND PERFORMACE CURVES OF SUMP PUMPS
	PE-V8-415-100-N002	GENERAL ARRANGEMENT AND CROSS SECTIONAL -SUMP PUMPS
	PE-V8-415-100-N003	TDS AND CURVES FOR MOTORS (IF APPLICABLE) OF SUMP PUMPS
	PE-V8-415-100-N004	C&I Doc. -WRITE UP, WIRING DIAGRAM & GA OF CONTROL PANEL FOR SUMP PUMPS
	PE-V8-415-100-N005	QP- SUMP PUMPS
	PE-V8-415-100-N006	O&M MANUAL-SUMP PUMPS

14.0 Sub-Vendor List shall be furnished during detailed engineering. In case, Bidder offer makes other than the given list, the same shall be subject to approval of Customer/BHEL.

15.0 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.***

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

a) Compliance certificate duly signed and stamped.

b) GA drawings of pumps with motors (shall be only for reference purpose, same shall not be reviewed/commented by purchaser at this stage and shall be subject to approval only during contract).

Apart from above no other drgs./docs./data sheets etc. are required to be submitted at bid stage and even if furnished shall not be taken cognizance of.

In case of any deviation from this technical specification, the same shall be indicated in the schedule of deviations as per Section-IIIC or NIT. In the absence of duly filled schedules it will be assumed that the bid strictly conforms to the specification.

17.0 Sump pumps/submersible pumps 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.

17.1 Preparation for Packing:

- After testing, operation, all fluids e.g. water etc., shall be completely drained from all 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 pumps shall be placed on a strong wooden base & bolted to the wooden base using the foundation holes for further transportation up to site.

17.2 Protection of parts:

- Pumps shall be packed in properly in high grade bubble plastic wrap for transportation, and long storage at site.
- Sump pumps items 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 sump pumps shall be closed properly by suitably covering to prevent foreign material entering in opened space.
- 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.

17.3 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.

17.4 Additional Dispatch Requirements

MDCC after final inspection shall be provided to vendor on the basis of following: -

i) List of items packed in each box with description & quantity.

ii) Photograph of each sump pump, control panel, hose pipe and each box in open & closed condition.

iii) Bidder to include handling instructions in engineering drg/doc and packing to be done in such a way to avoid damage of items in transit and long storage at site and same shall be approved in contract stage by BHEL/Customer

18.0 BIDDER TO COMPLY FOLLOWING AFTER PLACEMENT OF PO:

i. Supplier to submit detailed ' Bill of Material ' (BOM) at the time of drawing /document submission after placement of PO. Each item of the BOM to be uniquely identified with item code no. or item serial no.

ii. Supplier to ensure that all items which will find separate mention in the packing list are covered in this detailed BOM.

iii. Supplier to also give the following undertaking in the BOM:

"The BOM provided herewith completes the scope (in content and intent) of material supply under PO No. ……., dated …….
Any additional material which may become necessary for the intended application of the supplied item(s)/package will be supplied free of cost in most reasonable time."

SUB-SECTION – IB

SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)

MAHARASHTRA STATE POWER GENERATION CORPORATION LIMITED

1x660 MW BHUSAWAL THERMAL POWER STATION UNIT-6

SUMP PUMP
TECHNICAL SPECIFICATION
(ELECTRICAL PORTION)

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT,
NOIDA, U.P., INDIA

CONTENTS

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 SUMP PUMP.
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 SUMP PUMP" 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) Electrical mandatory spares (As per spec.)

PACKAGE : SUMP PUMPS
SCOPE OF VENDOR: SUPPLY
PROJECT : 1X660MW BHUSAWAL THERMAL POWER STATION, UNIT-6

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
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	
5	Any special type of cable like compensating, co-axial, prefab, MICC, fibre Optic cables etc.	Vendor	BHEL	
6	Cabling material (Cable trays, accessories ,cable tray supporting system, conduits etc.)	BHEL	BHEL	
7	Cable glands ,lugs, and bimetallic strip for equipment supplied by Vendor	Vendor	BHEL	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power and control cables.
8	Equipment grounding & Lightning protection	BHEL	BHEL	
9	Below grade grounding	BHEL	BHEL	
10	Motors alongwith fixing accessories	Vendor	-	Makes shall be subject to customer/ BHEL approval at contract stage.

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 without any commercial implication.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.

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.	415	ORIGINATING AGENCY		PEM (ELECTRICAL)
	PROJECT TITLE	1X660 MW BHUSAWAL TPS	NAME		DATA FILLED UP ON
	SYSTEM	SUMP PUMP	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 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 of the LT Motors is subjected to BHEL/Customer approval, during contract stage, without any commercial implication

	TITLE	SPECIFICATION NO.
	LV MOTORS **DATA SHEET-A**	VOLUME II B SECTION D
	1X660 MW BHUSAWAL TPP	REV NO. 00 DATE 28.01.2019 SHEET 1 OF 1

1.0	Design ambient temperature	:	50 ^{o}C
2.0	Maximum acceptable kW rating of LV motor	:	160KW
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Details of supply system		
	a) Rated voltage (with variation)	:	415V $\pm$ 10%
	b) Rated frequency (with variation)	:	50 Hz (+5% and -5%)
	c) Combined voltage & freq. variation	:	10% (sum of absolute values)
	d) System fault level at rated voltage	:	50 kA for 1 sec
	e) Short time rating for terminal boxes		
	o 90 kW and upto 160kW (Breaker controlled)	:	50 KA for 1 sec.
	o Below 90 kW (SFU + Contactor controlled)	:	50 KA protected by fuse for 0.2 sec
	f) LV System grounding	:	Effectively grounded
5.0	Class of insulation	:	Class ‘F’, with temp rise limited to class B.
6.0	Minimum voltage for starting (As percentage of rated voltage)	:	80% of rated voltage
7.0	Power cables data	:	Shall be given during Detailed engg
8.0	Earth Conductor Size & Material	:	Shall be given during Detailed engg
9.0	Space heater supply	:	240 V, 1¢ , 50 Hz
10.0	Rating up to which Single phase motor	:	Acceptable below 0.20 kW
11.0	Additional tests	:	As per QP and customer motor spec
12.0	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
13.0	Makes	:	As per ANNEXURE-I
14.0	Paint shade	:	RAL 7032
15.0	Degree of Protection of enclosure (motors):		INDOOR IP-55 OUTDOOR IPW-55
16.0	Energy efficiency	:	IE3 as per IS:12615: 2011

- **Also detail Customer spec. for Motors to be referred as enclosed with spec.**

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				REV.	
			SEAL		
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		

NAME OF VENDOR				
			REV.	
NAME	SIGNATURE	DATE	SEAL	

Motors

1.0 SCOPE

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

1.2 Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification.

1.3 In case of any discrepancy, the driven equipment specification shall govern etc.

2.0 STANDARDS

2.1 All motors shall conform to the latest applicable IS, IEC and CBIP Standards/ Publications except when otherwise stated herein or in the driven equipment specification.

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

(a) IS-325

(b) IS-12615

(c) IEC-34

3.0 SERVICE CONDITIONS

3.1 The motors will be installed in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash canopy to be provided to all outdoor install motors.

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

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

4.0 TYPE AND RATING

4.1 A.C. MOTORS

4.1.1 Motors shall be general purpose, constant speed, squirrel cage, three phase, induction type.

4.1.2 All motors shall be rated for continuous duty. They shall also be suitable for long period of inactivity.

4.1.3 The motor name-plate rating at 50°C shall have at least 10% margin over the input power requirement of the driven HT equipment at rated duty point unless stated otherwise in driven equipment specification or in general electrical specification.

4.1.4 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service.

4.1.5 All LT motors used in this project are proposed to be energy efficient type suitable for EFF1 efficiency rating.

4.1.6 The motor name plate rating shall have at least 10% margin over the input power requirement of the HT driven equipment and 15% for LT driven equipments at rated duty point.

4.1.7 Motors located in hazardous area shall be flame proof type.

4.2 D.C. MOTORS

4.2.1 D.C. Motor provided for emergency service shall be shunt/compound wound type.

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

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

4.3 For equipment installed outdoor and exposed to direct sun rays, the effect of solar heat shall be considered in determining the design ambient temperature.

5.0 PERFORMANCE

5.1 RUNNING REQUIREMENTS

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

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

5.1.3 The motor shall be designed to withstand momentary overload of 60% of full load torque for 15 second without any damage.

5.1.4 Motor shall not be stalled if the supply voltage drops to 70% of the rated voltage for 2 seconds duration.

5.2 STARTING REQUIREMENTS

Motor shall be designed for direct online starting at full voltage. Starting current shall not exceed 6 times full load current for all auxiliaries except boiler feed pump where the starting current shall be limited to 4.5 times. No further tolerances are applicable on starting current specified above for HT motors

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

5.2.2 Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminal except BFP motor. In case of BFP motor, it shall

be 75% rated voltage. Minimum starting requirement for mill motor (double cage) shall be 85% rated voltage at motor terminals.

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

Cranking motor shall be capable of six equally spread starts per hour, three starts in quick succession from cold condition and one restart from hot condition. The coal conveyor and crusher motors shall be suitable for 3 consecutive hot starts with maximum 20 starts per day.

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

5.2.4 HT pump motors shall be suitable to start with forward rotation.

5.2.5 The motors shall be designed to withstand 120% of rated speed for 2 minutes without any mechanical damage

5.3 STRESS DURING BUS TRANSFER.

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

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

5.4 LOCKED ROTOR WITHSTAND TIME

5.4.1 The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 2.5 seconds for motors up to 20 seconds starting time and by 5 seconds for motor with more than 20 seconds starting time.

5.4.2 Starting time mentioned above is at minimum permissible voltage of 80% rated voltage.

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

6.0 SPECIFIC REQUIREMENTS

6.1 ENCLOSURE

6.1.1 All indoor motor enclosures shall conform to the degree of protection IP-55 unless otherwise specified and outdoor motor enclosure shall confirm to degree of IPW-55.Motor for outdoor or semi-outdoor service shall be of weather-proof construction.

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

6.2 COOLING

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

6.2.2 In case water cooling is required for very large motors, prior approval of the customer is to be obtained before proceeding ahead with design & manufacture.

6.3 WINDING AND INSULATION

6.3.1 All insulated winding shall be of copper.

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

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

6.4 TROPICAL PROTECTION

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

6.4.2 All fittings and hardwares shall be corrosion resistant.

6.5 BEARINGS

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

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

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

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

6.5.5 Grease lubricated bearings shall be prelubricated and shall have provisions for in-service positive lubrication with drains to guard against over lubrication.

6.5.6 Oiled bearing shall have an integral self cooled oil reservoir with oil ring inspection ports, oil sight glass with oil level marked for standstill and running conditions and oil fill and drain plugs.

6.5.7 Forced lubricated or water cooled bearing shall not be used without prior approval of Owner.

6.5.8 Lubricant shall not deteriorate under all service conditions. The lubricant shall be limited to normally available types with IOC equivalent.

6.5.9 Bearings shall be insulated as required to prevent shaft current and resultant bearing damage.

6.6 NOISE & VIBRATION

6.6.1 The noise level shall be as per statutory acceptance (IS/IEC).

6.6.2 The peak amplitude of the vibration shall be within IS/IEC specified limits.

6.7 MOTOR TERMINAL BOX

6.7.1 Motor terminal box shall be phase segregated (PSTB) type and located in accordance with Indian Standards clearing the motor base- plate/ foundation.

6.7.2 Terminal box shall be capable of being turned 360 Deg. in steps of 180 Deg. For HT motors and 90 Deg. for LT motors unless otherwise approved.

6.7.3 The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor.

6.7.4 The terminal box shall have sufficient space inside for termination/connection of XLPE insulated armoured aluminium cables.

6.7.5 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.

6.7.6 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.

6.7.7 The terminal box shall be capable of withstanding maximum system fault current for duration of 0.25 sec.

6.7.8 For 11kV and 3.3kV motor, the terminal box shall be phase-segregated type. The neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type) with shorting links for star connection.

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

6.7.10 The gland plate for single core cable shall be non-magnetic type.

6.7.11 Due to any reason, if the terminal box is found to be not suitable for the approved cable size for either HT/LT motors, then the bidder shall arrange necessary adopter box to facilitate the termination of cables. The adopter box shall be of the same short circuit rating and specifications as the main terminal box. The adopter box shall be located as near as possible to the main terminal box. The interconnecting cabling between adopter box and main terminal box along with providing suitable cable glands and termination kits as applicable shall also be done by the bidder.

6.8 GROUNDING

6.8.1 The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GS bolts and washer

6.8.2 The grounding connection shall be suitable for accommodation of ground conductors as follows :

Motor above 90 kW	:	75 x 10 mm GS Flat
Motor above 30 kW up to 90 kW	:	50 x 6 mm GS Flat
Motor above 5 kW up to 30 kW	:	25 x 6 mm GS Flat
Motor up to 5 kW	:	8 SWG GS Wire

6.8.3 The cable terminal box shall have a separate grounding pad

6.9 RATING PLATE

In addition to the minimum information required by IS, the following information shall be shown on motor rating plate:

(a) Temperature rise in Deg.C under rated condition and method of measurement.

(b) Degree of protection.

(c) Bearing identification no. and recommended lubricant.

(d) Location of insulated bearings.

6.10 CONSTRUCTION

6.10.1 Stator Core

The Stator Core Lamination shall be made of high-grade silicon/magnetic steel sheet varnished on both sides and pressed to form rigid core.

6.10.2 Rotor

The rotor construction shall be such that in case of dislodging of the rotor bar from the end ring, it should not come out and hit the stator core/stator winding and damage.

7.0 ACCESSORIES

7.1 GENERAL

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

7.2 SPACE HEATER

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

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

7.3 TEMPERATURE DETECTORS

7.3.1 All 11kV and 3.3kV motors shall be provided with twelve (12) nos. Simplex type winding temperature detectors, four (4) nos. per phase.

7.3.2 11kV and 3.3kV motor bearing shall be provided with duplex type temperature detectors.

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

7.3.4 Leads of all simplex type motor winding RTDS and motor bearing RTDS shall be wired up to respective switchgear metering & protection compartment. From which one set of RTDS will be connected to numerical protection relay and another set shall be kept free for DCS connectivity.

7.3.5 Five numbers of Temperature detectors / thermisters shall be provided for L.T. Motors above 90 kW (3 nos. Winding temperatures & 2 nos. bearing temperatures).

7.4 INDICATOR/SWITCH

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

(a) 11kV and 3.3kV motor bearing temperature

(b) Hot and cold air temperature of the closed air circuit for CACA and CACW motor

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

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

7.5 CURRENT TRANSFORMER FOR DIFFERENTIAL PROTECTION

7.5.1 Motor 1000 KW and above shall be provided with three differential current transformers mounted over the neutral leads within the enclosure. Loose 3 nos. CT for mounting on switchgear side shall be in bidder's scope.

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

7.6 ACCESSORY TERMINAL BOX

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

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

7.7 DRAIN PLUG

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

7.8 LIFTING PROVISIONS

Motor weighing 25 Kg. or more shall be provided with eyebolt or other adequate provision of lifting.

7.9 DOWEL PINS

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

7.10 PAINTING

Motor including fan shall be painted with corrosion proof paints of colour shade (RAL-7032).

8.0 TESTS

8.1 ROUTINE AND TYPE TEST:

Tests are to be conducted for HT and LT motors 60kW and above in presence of Mahagenco representative and contractor as per IS: 325 and required copies of test certificates are to be furnished for approval and despatch clearance. In addition, following tests shall have to be carried out on the motors in presence of MAHAGENCO representative & contractor on LT & HT motors. For Motors below 60kW type and routine test conducted as per IS325 shall be witnessed by contractor and test certificate shall be submitted for review of Mahagenco & Dispatch clearance

8.1.1 FOR HT MOTORS:

(a) Impulse test by 1.2 / 50 micro sec. On sample coil of Stator winding insulation as type test as per IEC-671/IS 14422,1995 test voltages as under

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

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

(c) Polarization Index Test as per IS:7816 as routine test

(d) Tan delta measurement on coils

(e) Surge withstand test for inter turn insulation.

(f) Test to diagnose rotor bar failure during manufacture.

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

8.1.2 FOR HT & LT MOTORS:

(a) Test for suitability of IP55/ IPW– 55 as per IS 4691 as type test. Type test certificate for first numeral shall be acceptable in lieu to test,

provided the test motor is identical to motor being supplied. Second numeral test shall be carried out on one motor of each type and rating.

(b) Fault Withstand Test for main terminal box as type test. Type test certificate shall be acceptable, if the test is conducted on exactly identical terminal box within last three years.

(c) Test for noise level as routine test.

(d) Test for vibration as routine test.

(e) Overspeed test as type test.

8.2 TEST WITNESS:

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

LV Cables

1.0 SCOPE OF SUPPLY

1.1 The cables shall be supplied, installed and commissioned in accordance with the following specification and the details given in data sheets and annexures mentioned below :-

1.1.1 Datasheet – A1 to A6 of section IV Volume IV-B

1.1.2 Annexure-A of section IV of Volume IV-B.

1.1.3 Annexure - D section I of Volume IV-A.

1.1.4 Section IX of Volume IV-B

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

1.2 Cable shall be furnished in accordance with this specification and the following Datasheet-A (A1 to A6)

2.0 CODES & STANDARDS

2.1 All cables and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) ASTM, IEEE, SS, IEC etc. except where modified and/ or supplemented by this specification.

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

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

3.0 DESIGN CRITERIA

3.1 Cables will be generally laid on ladder type trays, perforated type cable trays or drawn through rigid steel conduits.

3.2 For continuous operation at specified rating, maximum conductor temperature shall be limited to the permissible value as per relevant standard and/or this specification which one is more stringent.

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

3.4 Armouring shall be single round wire of galvanized steel for multicore cables and aluminum for single core cable for power and control cables. For fire survival control cable, the armouring over inner sheath shall consist of single layer of wire / round galvanized steel wire as per IS 3975 amended upto date. For Fire survival power cable, Single core cables to be used in A.C. system, the armouring over inner sheath shall consist of single layer of round copper wire, for multi-core cables to be used in A.C. system and single/two core cables in D.C. System, the armouring over inner sheath shall consist of single layer of round galvanized steel wire.

3.5 The inner & outer sheath shall have flame retardant low smoke halogen evolution (FRLSH) characteristics or fire survival characteristics as applicable and shall meet the requirements of additional tests specified for the purpose.

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

3.7 HT cables shall be manufactured by triple extrusion dry cured (CCV) process using pressurized nitrogen.

4.0 SPECIFIC REQUIREMENTS

4.1 GENERAL DESCRIPTION

All Cables shall be furnished in strict compliance with ratings and requirements and sizes as given in Datasheet-A & Annexures to this Specification.

4.2 DRUM LENGTH AND TOLERANCE

The 11kV & 3.3kV power cables shall be supplied on steel drums. Wooden drums shall be used for 1100V power and control cables. Each drum shall contain~~ing~~ minimum 500 meters single length for larger sizes of cable unless specifically asked for. For smaller sizes of cables, each drum shall contain minimum 1000 meters single length of cable. Allowable tolerance on individual drum length is ±5%.Empty Steel drums except mandatory spare cables shall be returnable and wooden drums shall be non returnable.

4.3 NON-STANDARD LENGTH

Owner/Purchaser may accept total non-standard lengths upto 5% of the total ordered quantity. However the Contractor will be required to obtain Owner's/ Purchaser's approval before packing the Cables on drums. Non-standard lengths shall not be less than 100 metres in any case.

4.4 CABLE IDENTIFICATION

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

(a) MSPGCL

(b) Manufacturer's name or trade mark

(c) Voltage grade

(d) Year of manufacture

(e) Type of insulation, e.g. XLPE/PVC/HR85 /IE2 etc.

(f) No. of core and size of cables.

(g) Type of improved fire performance, e.g. FR/FR-LSH/FS

(h) IS number

(i) ISI mark

Note: Non erasable sequential cable length marking at an interval of 1 (one) meter throughout the Drum length, shall be provided on all cables

4.5 PACKING

Cables shall be supplied on drums. The drums shall be of heavy construction. All wooden parts shall be manufactured from seasoned wood. All ferrous parts used shall be treated with suitable rust preventive finish or coating to avoid rusting during transit or storage. Wooden cable drum shall be treated by immersing in copper-nitrate solution. Drum number shall be indicated on each cable drum.

4.5.1 Cable shall be wound and packed on drums in such a manner that it will be properly sealed and firmly secured to the drum. The ends of each length shall be sealed before shipment. Heat Shrinkable seal shall be used for this cable ends.

4.5.2 The cable drums should carry the following details in printed form:

(a) MSPGCL

(b) Manufacturer's name or trade make

(c) Type of cable & voltage grade

(d) Year of manufacture

(e) Type of insulation e.g. XLPE/HRPVC/IE2

(f) No. of core and size of cables

(g) Cable code e.g. FRLS/FS

(h) Single length of cable on drum

(i) Direction of rotation, by arrow

(j) Approx. gross mass.

(k) IS/IEC number and ISI mark

4.5.3 Joints and Terminations

Materials of construction for a joint/termination shall perfectly match with the dielectric chemical and physical characteristics of the associated cables. The material and design concepts shall incorporate a high degree of operating compatibility between the cable and joints. The protective outer covering (jacket) used on the joints/terminations shall have the same qualities as that of the cable outer sheath in terms of ambient/operating temperature withstand capability and resistance to hazardous environments and corrosive elements. Straight through joints and terminations for HT cables shall be heat shrinkable type.

4.6 SELECTION CRITERIA

4.6.1 (a) HT and LT power cables shall be selected on the basis of current carrying capacity, short circuit current rating and permissible voltage drop. The fault level, refer Design Data Volume IV-A General Electrical Description.

(b) Cables from PCC to MCC/ACDB shall be sized for selected busbar rating of MCC/ACDB and steady state voltage drop shall be calculated with selected busbar rating.

(c) While sizing power cables, following derating aspects shall be reckoned:

(i) Ground/Ambient Air temperature

(ii) Depth of Laying.

(iii) Power Cables touching each other.

(d) Cables, for circuit breaker controlled outgoing feeders for motors and transformer shall withstand the short circuit current for the fault clearing time of 0.2 Sec. and 1.0 Sec. for tie feeders & Incomers of 11kV, 3.3kV and 415 volt system. Also Outgoing feeders where only IDMT protection is provided 1.0 sec shall be considered as fault clearing time for cable sizing.

(e) The Cables shall be capable of continuous satisfactory operation under a power supply system frequency variation of (±) 5%, voltage variation of (±) 10% and combined frequency and voltage variation of ±10% (absolute sum)

(f) For fuse protected circuits the conductor size shall depend upon full load current subject to voltage drop limited to 3% at load terminal during running of all feeders and 15 % during starting for motor feeders with rigid coupling. For motors with fluid coupling the starting voltage drop can be considered as 20%. In addition, transformer regulation shall also be considered for loads.

(g) For loads fed from local panels, the total running voltage drop in cable from 415V PCC to local panel and from local panel to individual motor shall be limited to 3% at full load motor current while the same during starting shall be limited to 15%.

(h) Current rating capacity of cables should be 110 % of full load current, after considering the derating factors.

(i) For welding receptacle, 3% running drop shall only be considered.

The minimum sizes of L.T cable to be chosen are as below:

AL - 16 mm^2 (3 core), Cu - 2.5 mm^2 (3 core)

4.6.2 Apart from above, consideration shall also be given to limit the cable to some standard sizes instead of using too many types.

4.6.3 The standard cable sizes, amp capacities, derating factors. as given in IS/IEC will be generally followed.

4.6.4 (a) For breaker protected circuits minimum size of the cable shall be as follows:

1100V Power	:	240 mm² XLPE
11000V & 3300 Power	:	240 mm² XLPE

(b) For motor circuits the selection of size will be made ensuring that the cable shall withstand a short circuit fault directly following a second hot start.

4.6.5 For fuse protected circuit, the conductor size will depend on full load current subject to voltage drop not exceeding 3%. For practical purposes, the minimum size chosen is as below:

(a) Aluminum : 16 mm²

(b) Copper : 2.5 mm²

(c) Recommended cable sizes for various motor ratings

Motor rating		Cable size
(i)	0-5.5kW	3C-2.5/4/6/10 mm² Cu as per voltage drop
(ii)	5.6-11kW	3C-16 mm² Al
(iii)	11.1-22kW	3C-35 mm² Al
(iv)	22.1-45kW	3C-95 mm² Al
(v)	45.1-75kW	3C-185 mm² Al
(vi)	75.1-below 90kW	2x3C-185 mm² Al

Note:

220V DC incomer supply to HT & LT switchgear and protection panels minimum size of 220V dc supply F.S cable shall be 10 mm² & 6 mm² respectively.

4.6.6 All control cables shall be 2.5 mm² copper cables.

4.6.7 Multicore control cables will generally have spare conductor (s) in accordance with the following chart :

	Conductors required		Cables
(a)	1 or 2	:	1-3/C
(b)	3 or 4	:	1-5/C
(c)	5 or 6	:	1-7/C
(d)	7 or 8	:	1-9/C
(e)	9 or 10	:	1-12/C
(f)	Above 10	:	Two or more of above cables

4.6.8 Separate cables for each type of following services/functions as applicable shall be used for each feeder. Same multicore cable using different services shall not be acceptable.

(a) Power.

(b) Control, interlock and indication.

(c) Metering and measuring.

(d) Alarm and annunciation.

(e) C.T. Cables.

(f) V.T. Cables.

4.7 Selected sizes of power and control cables are given in Annexure-A.

4.8 Fire Survival Cables shall be used for important auxiliaries / area as recommended by Standard Technical Specification and CEA as below for the following:

Fire Survival Power & Control Cables shall be used for important auxiliaries/areas like:

(a) DC emergency lube oil pump

(b) DC hydrogen seal pump

(c) Turbine lube oil pump/barring gear

(d) DC emergency lighting for main building and service building

(e) DC cables for battery to charger & DC distribution boards, also cables from DCDB to DCFB

(f) Jacking oil pump

(g) Emergency turbine trip in control room

(h) Boiler Turbine: Generator inter trip which include the interconnection between

(i) Boiler master fuel trip and turbine trip relays

(ii) Generator trip relays & turbine trip relays

(iii) Generator trip relays & generator breaker

(iv) Generator trip relays & field breaker

(v) Generator trip relays & unit auxiliary transformer breaker

(i) Incomer cables for DG board, emergency board, DC lighting board etc.

(j) Scanner air fan & fire/smoke detector system

(k) Complete 220V DC, 24V DC & UPS control, protection & supply of cables downstream of DCDB/ACDB shall be with minimum cable size of 2Cx6 sqmm Cu

5.0 TESTS

5.1 SHOP TESTS

The Cables shall be subject to shop tests in accordance relevant IS/IEC/ASTM/IEEE/SS standards and QAP approved by purchaser to prove the design and general qualities of the Cables as below:

5.1.1 Routine tests shall be carried out on each drum of cables.

5.1.2 Acceptance Tests shall be carried out on 1 drum out of every 10 or less number drums chosen at random for acceptance of the lot for every type & size of cable.

5.1.3 Type test as per relevant IS, on each type and size of cable, inclusive of measurement of armour DC resistance of power cables shall be carried out on one sample drum selected on random basis in each lot. Size of cable shall be read in sq. mm. in conjunction with number of cores. Type of cable shall mean voltage grade, XLPE, HRPVC, FRLS, FS etc

5.2 ADDITIONAL TESTS

Following additional Type & acceptance tests shall also be performed on each type of cables having inner & outer sheath with improved fire performance (Type FRLSH, FS).The quantum of check shall be as elaborated above for additional type and acceptance test.

5.2.1 Oxygen index test

The Oxygen index shall not be less than 29.

5.2.2 Temperature Index Test

The measured value of temperature index shall be 21 at a temperature of 250°C for FRLS cables and 350°C for FS cables

5.2.3 Flame Retardance test on single cable and on bunched cables

After the test, there should be no visible damages on the test specimen within 300mm from its upper end.

After burning has ceased, the cables should be wiped clean and the charred or affected portion should not have reached a height exceeding 2.5 meter above the bottom edge of the burner, measured at the front and rear of the cable assembly. 3 Hours fire rating test shall be carried out for FS cable as per IEC331

5.2.4 Halogen acid gas evolution test

The level of HCL evolved shall not exceed 20 per cent by weight. HCL evolved shall not exceed 2% for FS cable.

5.2.5 Smoke density test

The cables shall meet the requirements of light transmission of minimum 40% after the test. Minimum transmission shall be 80% for FS cable.

5.2.6 Test for specific optical density of smoke

The cables shall meet the requirements of IS/IEC.

5.2.7 Test for rodent & termite repulsion property

5.2.8 The test shall be carried out to note the presence of rodent and termite repelling chemical in PVC compound. Normal procedure is that a few chippings of the PVC compound are slowly ignited in a porcelain dish or crucible in a muffle furnace at about 600°C. The resulting ignited ash is boiled with a little ammonium acetate solution (10%). A drop of aqueous sodium sulphide solution is placed on a thick filter paper and it is allowed to

soak. The spot is touched with a drop of above extract. A black spot indicates the presence of anti-termite & rodent compound.

5.2.9 Flammability test shall be carried on finished cables as per following standards:

(a) Swedish Chimney test – SS:424-14-75

(b) IEEE std.383 – 1974 latest

(c) IEC std. 332-1 and IEC 331

5.3 TEST WITNESS

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

5.4 TEST CERTIFICATES

5.4.1 Certified reports of all the tests carried out at the works shall be furnished for approval of the Owner/Purchaser.

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

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

H.V. POWER CABLE

DATA SHEET – A1

SR. NO.	ITEM		
1.0	**11 kV & 3.3 kV POWER CABLE**		
1.1	11kV & 3.8/6.6kV grade 90° C continuous rating under normal condition and 250° C rating under short circuit condition heavy duty XLPE power cable suitable for use in 11kV & 3.3kV non-effectively earthed (UE) system conforming to following requirement and in line with IS-7098, IS-8130, IS-5831 & IS-3975, manufactured by Triple Extrusion Dry Cure(CCV) process using pressurized Nitrogen		
1.1.1	Conductor		Stranded and compacted circular aluminium conductor of grade H2 & class 2 for all sizes, generally conforming to IS:8130
1.1.2	Conductor Screen		Extruded semi-conducting compound
1.1.3	Insulation		Extruded cross linked polyethylene (XLPE) conforming to IS7098 (Part-2)
1.1.4	Insulation Screen		Extruded semi-conducting compound in combination with a layer of lapped copper tape of thickness is not less than 0.1mm.
1.1.5	Core Identification		By coloured strips applied on (For three core cables) cores or by numerals.

SR. NO.	ITEM		
1.1.6	Inner Sheath		Extruded HRPVC/FRLS compound conforming to type ST2 of IS: 5831 for three core cables. Single core cables shall also have inner sheath. Filler material shall also be of type ST2 PVC.
1.1.7	Armour		Galvanised single round steel wire armour for twin and multicore cables
			Non-magnetic hard drawn aluminum single round wire conforming to H4 of IS-8130 latest for single core cables.
1.1.8	Overall Sheath		Extruded FRLSH HRPVC compound conforming to type ST2 of IS: 5831.
1.1.9	Drum		Steel Drum

L.V. POWER CABLE (XLPE TYPE)

DATA SHEET – A2

SR. NO.	ITEM		
1.0	415V LT POWER CABLES		
1.1	Rating: 1.1 kV grade, 90° C continuous rating under normal condition and 250°C under short circuit condition rating, XLPE heavy duty, power cable conforming to following requirement and in line with IS 7098 Part-I. IS 8130 & IS 5831 and IS 3975.		
1.1.1	Conductor		Stranded and compacted plain aluminium of grade H2 and stranded, high conductivity annealed plain copper as applicable conforming to IS:8130. Class 2
1.1.2	Insulation		Extruded cross-linked polyethelene (XLPE) conforming to IS:7098 (Part-1)
1.1.3	Core Identification		By color-coding.
1.1.4	Inner Sheath		Extruded HRPVC FRLS compound conforming to type ST2 of IS: 5831 for multicore cable. Single core cables shall have no inner sheath. Filler shall be of same material as of inner sheath i.e. ST2
1.1.5	Armour		Galvanized single round steel wire armour for twin and multicore cables.

SR. NO.	ITEM		
1.1.6			Non-magnetic hard drawn aluminum single round wire conforming to H4 of IS-8130 latest for single core cables.
1.1.7	Overall Sheath		Extruded FRLSH HRPVC compound conforming to type ST2 of IS: 5831.
1.1.8	Drum		Conforming to IS-10418 (Wooden drum)

CONTROL CABLE

DATA SHEET – A3

SR. NO.	ITEM		
1.0	**CONTROL CABLES**		
1.1	Rating : 1.1kV grade 85° C continuous rating under normal condition and 160°C under short circuit condition rating HRPVC Control cable (YWY) conforming to following requirement and in line with IS:1554, IS:8130, IS:5831 and IS:3975.		
1.1.1	Conductor		Stranded, non-compacted & circular, high conductivity annealed plain copper, generally conforming to IS: 8130.
1.1.2	Insulation		Extruded HRPVC type-C compound conforming to IS: 5831. The minimum volume resistivity of insulation shall be 3.5×10^{14} ohm-cm at 27°C and 3.5×10^{11} OHM-CM at 85°C.
1.1.3	Core Identification		By color coding and numbering at interval of 100mm or less.
1.1.4	Inner Sheath		Extruded HRPVC compound conforming to type ST2 FRLS of IS: 5831 for multicore cables. Single core cables shall have no inner sheath. Filler shall be of same material as of inner sheath i.e. ST2.
1.1.5	Armour		Galvanised single round steel wire for twin and multicore cables.

SR. NO.	ITEM		
1.1.6	Overall Sheath		Extruded FRLSH HRPVC compound conforming to type ST2 of IS: 5831.
1.1.7	Drum		Conforming to IS: 10418 (Wooden drum).

1.1 K V GRADE COPPER CONDUCTOR FIRE SURVIVAL POWER CABLE

DATA SHEET – A4

SR. NO.	ITEM		
1.0	These cables shall be 90 deg C rating under normal condition and 250 deg C under short circuit condition generally confirmed to IS 9968Part I latest with 3 hr fire rating		
1.1	Conductor		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
1.2	Insulation		The insulation shall consist of heat resisting electrometric material EPR (Ethylene Propylene rubber) and shall conform to Type IE-2 of IS: 6380 / 1984 amended up to date.

SR. NO.	ITEM		
1.3	Laying up of cores (For multicore cables only)		The core shall be suitably identified in accordance with IS: 9968 (Part-I). The suitable fire retardant material fillers shall be used for filling in the interstices. Two layers of plain glass fibre binder tape shall be applied over the laid up cores.
1.4	Inner Sheath		An inner sheath of extruded special low smoke and very low halogen content (acid gas generation shall be less than 2% by weight) elastomeric (HOFR) compound of black colour conforming to Type SE-3 of IS – 6380/1984, ammended up to date, shall be provided over the laid up cores. This shall be provided even for single core cables after providing two layers of plain glass fibre tape over the insulation.

SR. NO.	ITEM		
1.5	Armour		For Single core cables to be used in A.C. system, the armouring over inner sheath shall consist of single layer of round copper wire. For multi-core cables to be used in A.C. system and single/two core cables in D.C. System, the armouring over inner sheath shall consist of single layer of round galvanised steel wire.
1.6	Overall Sheath		The extruded outer sheath shall be of special low smoke and very low halogen content (acid gas generation shall be less than 2% by weight) elastomeric HOFR compound comprising of synthetic rubber and shall generally conform to the type SE-3 of IS:6380 latest revision. Minimum value of 'Tensile Strength' and 'Percentage elongation ratrupture' shall be 8 Newton/sq.mm. and 250% respectively. The colour of outer sheath shall be black or any other colour agreed mutually between Owner & supplier.

1.1 kV GRADE COPPER CONDUCTOR FIRE SURVIVAL CONTROL CABLE

DATA SHEET – A5

SR. NO.	ITEM	UNIT	
1.0	These cables shall be 90 deg C rating under normal condition and 250 deg C under short circuit condition generally confirmed to IS 9968Part I latest with 3 hr fire rating		
1.1	Conductor		It shall be of stranded construction, consisting of high conductivity annealed tinned copper conductors conforming to IS: 8130 / 1984 amended upto date. A suitable heat barrier tape, preferably glass mica tape shall be provided over conductor.
1.2	Insulation		The conductor insulation shall consist of heat resisting elastomeric material EPR (Ethelene Propylene rubber) and shall conform to type IE-2 of IS 6380/1984 latest revision.

SR. NO.	ITEM	UNIT	
1.3	Laying up of cores (For multicore cables only)		The core shall be suitably identified in accordance with IS:9968 (Part-I) 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.
1.4	Inner Sheath		An inner sheath of extruded very low halogen (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 SE3 of IS 6380 / 1984 amended upto date shall be provided over the laid up cores.
1.5	Armour		The armouring over inner sheath shall consist of single layer of wire / round galvanised steel wire as per IS 3975 amended upto date.

SR. NO.	ITEM	UNIT	
1.6	Overall Sheath		The outer sheath shall be of special low smoke and very low halogen content (acid gas generation shall be less than 2% by weight) elastomeric HOFR compound comprising of synthetic rubber and shall generally conform to the type SE-3 of IS: 6380 latest revision. The colour of outer sheath shall be black or any other natural colour with prior approval of the Owner.

FLEXIBLE TRAILING CABLE

DATA SHEET – A6

SR. NO.	ITEM		
1.1	3300V Unearthed Grade		Flexible trailing cable, annealed plain copper conductor, Class-5 of IS-8130, insulated with EPR, conductor and Insulation shielded with EPR, cores screened with ATC wire braiding, cores laid up, HD CSP inner sheathed, proof cotton taped and FRLSH HD CSP sheathed overall, confirming to IS:9968. Alternatively PCP sheathing may be acceptable.
1.2	1100V Grade		1100V Grade trailing cable shall be plain copper of Class-5 of IS-8130, heat resistant elastomeric compound based on EPR insulation, inner sheath of heat resistant elastomeric compound PCP sheath, nylon cord reinforcement and heat resistant, oil resistant and flame retardant heavy duty elastomeric compound FRLSH CSP outer sheath.

CABLE SIZES

ANNEXURE – A

SR. NO.	CABLE SIZE	CONDUCTOR	INSULATION
1.0	**H. V. CABLES**		
1.1	1 core 630 Sq.mm	Al.	XLPE (FRLSH)
1.2	1 core 500 Sq.mm	Al.	XLPE (FRLSH)
1.3	3 core 240 Sq.mm	Al.	XLPE (FRLSH)
1.4	3 core 300 Sq.mm	Al.	XLPE (FRLSH)
1.5	1 core 70 Sq.mm	Al.	XLPE (FRLSH)
2.0	**L. V. POWER CABLES**		
2.1	3 core 2.5/4/6/10 Sq.mm	Cu.	XLPE (FRLSH)
2.2	2 core 16 Sq.mm	Al.	XLPE (FRLSH)
2.3	3 core 16 Sq.mm	Al.	XLPE (FRLSH)
2.4	4 core 16 Sq.mm	Al.	XLPE (FRLSH)
2.5	2 core 35 Sq.mm	Al.	XLPE (FRLSH)
2.6	3 core 35 Sq.mm	Al.	XLPE (FRLSH)
2.7	4 core 35 Sq.mm	Al.	XLPE (FRLSH)
2.8	3 core 95 Sq.mm	Al.	XLPE (FRLSH)
2.9	3.1/2 core 95 Sq.mm	Al.	XLPE (FRLSH)
2.10	3 core 185 Sq.mm	Al.	XLPE (FRLSH)
2.11	3.1/2 core 185 Sq.mm	Al.	XLPE (FRLSH)

SR. NO.	CABLE SIZE	CONDUCTOR	INSULATION
2.12	3 core 240 Sq.mm	Al.	XLPE (FRLSH)
2.13	3.1/2 core 240 Sq.mm	Al.	XLPE (FRLSH)
2.14	3 core 300 Sq.mm	Al.	XLPE (FRLSH)
2.15	3.1/2 core 300 Sq.mm	Al.	XLPE (FRLS)H
2.16	1 core 630 Sq.mm	Al.	XLPE (FRLSH)
3.0	**CONTROL CABLE**		
3.1	2 core 2.5 Sq.mm	Cu.	HRPVC (FRLSH)
3.2	3 core 2.5 Sq.mm	Cu.	HRPVC (FRLSH)
3.3	5 core 2.5 Sq.mm	Cu.	HRPVC (FRLSH)
3.4	7 core 2.5 Sq.mm	Cu.	HRPVC (FRLSH)
3.5	9 core 2.5 Sq.mm	Cu.	HRPVC (FRLSH)
3.6	12 core 2.5 Sq.mm	Cu.	HRPVC (FRLSH)
3.7	20 core 2.5 Sq.mm	Cu.	HRPVC (FRLSH)
4.0	**FS POWER CABLES**		
4.1	3 core 2.5 Sq.mm	Cu.	EPR
4.2	4 core 2.5 Sq.mm	Cu.	EPR
4.3	2 core 6 Sq.mm	Cu.	EPR
4.4	2 core 16 Sq.mm	Cu.	EPR
4.5	3 core 16 Sq.mm	Cu.	EPR
4.6	4 core 16 Sq.mm	Cu.	EPR
4.7	2 core 35 Sq.mm	Cu.	EPR

SR. NO.	CABLE SIZE	CONDUCTOR	INSULATION
4.8	3 core 35 Sq.mm	Cu.	EPR
4.9	4 core 35 Sq.mm	Cu.	EPR
4.10	3 core 95 Sq.mm	Cu.	EPR
4.11	3.1/2 core 95 Sq.mm	Cu.	EPR
4.12	1 core 630 Sq.mm	Cu.	EPR
5.0	**FS CONTROL CABLE**		
5.1	2 core 2.5 Sq.mm	Cu.	EPR
5.2	2 core 6 Sq.mm	Cu.	EPR
5.3	3 core 2.5 Sq.mm	Cu.	EPR
5.4	5 core 2.5 Sq.mm	Cu.	EPR
5.5	6 core 2.5 Sq.mm	Cu.	EPR
5.6	7 core 2.5 Sq.mm	Cu.	EPR
5.7	9 core 2.5 Sq.mm	Cu.	EPR
5.8	10 core 2.5 Sq.mm	Cu.	EPR
5.9	12 core 2.5 Sq.mm	Cu.	EPR
5.10	16 core 2.5 Sq.mm	Cu.	EPR

SUB-SECTION – IC

SPECIFIC TECHNICAL REQUIREMENTS (C &I)

CONTROL AND INSTRUMENTATION SPECIFICATION FOR SUMP PUMPS

TABLE OF CONTENTS

GENERAL & SPECIFIC TECHNICAL REQUIREMENT

GENERAL REQUIREMENT

1.0 Bidder shall provide complete and independent control & instrumentation system with all accessories, auxiliaries and associated equipments for the safe, efficient and reliable operation of auxiliary systems.

2.0. The quantity of instruments for auxiliary system shall be as per tender P &ID, wherever provided, for the respective system as a minimum for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe &reliable operation of plant, bidder shall supply the same without any price implication.

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

4.0 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/ erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments; sensors, switches etc for external connection including spare contacts shall be wired out to suitably located junction boxes.

5.0 The customer specification attached as Specific Technical Requirement will supercede the Data sheets, if there is any mismatch.

6.0 All instruments shall be suitable for chemical applications.

Specific Technical Requirements (C&I):

1) The control of all Sump pumps (submersible sump pump (permanent duty type) and portable submersible sump pump) for respective locations shall be through Relay based Local Control Panels. Operation and control of sump pumps, location and quantity of Control Panels etc. shall be as per design philosophy given elsewhere in the specification.

2) All electrical actuators shall be integral type.

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

4) Three (3) nos. electrode type capacitance level switches per sump; one for low level, the second for high level and the third for very high level, along with necessary junction box, local control panel, control cables etc. to achieve automatic startings/stopping of the sump pumps, and also ON/OFF indication for sump pump shall be monitored at DCS. The entire assembly being mounted on the same base frame. The control panel shall also be equipped with start/stop push button for starting/stopping individual sump pumps manually.

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

6) Scope of Instrumentation cables (Screened Control Cables), Fibre Optic cable & Control cables shall be as per Electrical Cable scope matrix in Electrical portion of specification. Any cable in Bidder's scope shall be as per specification.

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

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

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

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

11) The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by bidder without any technical, commercial and delivery implication to BHEL.

12) Two nos. feeders of 415 V AC shall be provided for LCPs of submersible sump pumps (permanent duty type) and portable submersible sump pumps. Necessary power supply for panel, instruments etc and any other supply like 24 V DC, 110 V AC etc. for alarm

annunciator, lamps etc. shall be derived from these two feeders by the bidder. The necessary hardware for the same shall be in Bidder's scope. Suitable Automatic changeover arrangement of the input feeders shall also be provided by the bidder in the LCP. Minimum 10% spare windows to be provided in each LCP.

13) Double root valve shall be provided for all pressure tappings where the pressure exceeds 40 kg/cm2.

C&I DELIVERABLES LIST

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT						
1X660 MW BHUSAWAL TPP						
Sl.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CUSTOMER	FROM	USER	REMARKS
INSTRUMENTATION						
1	PE-V9-415-XXX-I901	INSTRUMENT DATA SHEETS	-	VENDOR	C&I	
2	PE-V9-415-XXX-I902	INSTRUMENT SCHEDULE	-	VENDOR	C&I	
3	PE-V9-415-XXX-I903	INSTRUMENT INSTALLATION/ HOOK UP DIAGRAMS	-	VENDOR	C&I	
5	PE-V9-415-XXX-I905	INSTRUMENT QP/CHECK LIST	-	VENDOR	C&I	
LOCAL CONTROL PANEL						
1	PE-V9-415-XXX-I950	LOCAL CONTROL PANEL DATASHEET	A	VENDOR	C&I	
2	PE-V9-415-XXX-I951	WIRING DIAGRAM	-	VENDOR	C&I	
3	PE-V9-415-XXX-I952	PANEL GA DRAWINGS	-	VENDOR	C&I	
8	PE-V9-415-XXX-I956	BILL OF MATERIAL	-	VENDOR	C&I	
13	PE-V9-415-XXX-I957	LOCAL CONTROL PANEL QUALITY PLAN	`	VENDOR	C&I	
14	PE-V9-415-XXX-I958	LOCAL CONTROL PANEL O&M MANUAL	-	VENDOR	C&I	
19	PE-V9-415-XXX-I925	MANDATORY SPARES BILL OF MATERIAL	A	VENDOR	C&I	
	Notes:	415 - Project No.				
		XXX -MAX Package Code				
		$$ -Approval by BHEL if Vendor BBU Item. Approval by Customer if Customer BBU Item				

SPECIFICATION FOR MOTORISED VALVE ACTUATOR

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.: PE-ID-415-145-I902 VOLUME II B SECTION D REV. NO. 00 DATE: 18.02.19 SHEET 1 OF 3

Data Sheet A & B

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

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GENERAL*	* PROJECT		
	OFFER REFERENCE		
	* TAG NO. SERVICE		
	* DUTY	☐ 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% IN HOT HUMID AND TROPICAL ATMOSPHERE AND HIGHLY POLLUTED AT PLACES OF COAL DUST AND FLY DUST.	
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY	
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY	
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY	
CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF,DUST TIGHT SUITABLE FOR OUTDOOR USE WITHOUT CANOPY 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	

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.: PE-ID-415-145-I902 VOLUME II B SECTION D REV. NO. 00 DATE: 18.02.19 SHEET 2 OF 3

Data Sheet A & B

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

408

	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY	
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY	
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC	
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ☐ 230 V ■ 110 V	
	@ ENCLOSURE CLASS OF MOTOR	■ IP 68 ☐ FLAME PROOF	
	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B	
	@ WINDING TEMP PROTECTION	■ THERMOSTAT (3 Nos.,1 IN EACH PHASE) ■ ---THERMOSTAT- 1 NO+1 NC CONTACT ----------	
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED(THERMISTOR PTC)	
INTEGRAL STARTER	INTEGRAL STARTER	■ REQUIRED ☐ NOT REQUIRED	
	TYPE OF SWITCHING DEVICE	■ CONTACTORS ☐ THYRISTORS	
	TYPE	■ CONVENTIONAL ☐ SMART (NON-INTRUSIVE)	
	STEP DOWN CONT. TRANSFORMER	■ REQUIRED	
	OPEN / CLOSE PB	■ REQUIRED ☐ NOT REQUIRED	
	STOP PB	■ REQUIRED ☐ NOT REQUIRED	
	INDICATING LAMPS(POWER SUPPLY ON/OPEN /CLOSE)	■ REQUIRED ☐ NOT REQUIRED	
	LOCAL REMOTE OFF S/S	■REQUIRED ☐ NOT REQUIRED	
	STATUS CONTACTS FOR MONITORING	■ REQUIRED ☐ NOT REQUIRED	
	INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (THERMAL O/L RELAY OPERATED, MOTOR THERMOSTAT TRIP,CONT./POWER SUPPLY FAILED, LOCAL/OFF/REMOTE S/S IN LOCAL or OFF MODE , TORQUE OPEN/CLOSE CUT OFF,VALVE JAMMED)	
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(Total:-06 nos.)	☐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	

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.: PE-ID-415-145-I902 VOLUME II B SECTION D REV. NO. 00 DATE: 18.02.19 SHEET 3 OF 3

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	
	SUPPLY	■ 24V DC ☐ ……	
	OUTPUT	■ 4-20mA	
	ACCURACY	± 1% FS	
SPACE HEATER	@SPACE HEATER	REQUIRED	
	@ POWER SUPPLY (NON INTEGRAL)	240V AC,1 PH.,50 Hz	
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY	
	@ RATING	decided as per load data received tender stage	
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED	
	ENCL CLASS ACTUATOR/MOTOR T.B.	@■ IP 68 @☐……	
	@ EARTHING TERMINAL	REQUIRED	
	PLUG & SOCKET(9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT)	☐ REQUIRED ■ NOT REQUIRED☐ ☐ 2 NOS. ☐ ----------	
CABLE GLANDS	@ POWER CABLE GLAND	SIZE: decided as per load data received tender stage	
	@ SPACE HEATER CABLE GLAND	SIZE: decided as per load data received tender stage	
	OTHER CONTROL CABLE GLANDS	QUANTITY & SIZE: Cable glands suitable for 8Px0.5 sq mm & 2P x 0.5 sq mm cable.	
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 & TINNED COPPER LUGS 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% 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 CAPABLE OF STARTING AT 85 PERCENT OF RATED VOLTAGE AND RUNNING AT 80 PERCENT OF RATED VOLTAGE AT RATED TORQUE AND 85 PERCENT RATED VOLTAGE AT 33 PERCENT EXCESS RATED TORQUE FOR A PERIOD OF 5 MINUTES EACH.
8. THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.
9. COMMANDS SHALL BE LATCHED AT INTEGRAL STARTER END.
10. SS TAG NAME PLATE SHALL BE PROVIDED.
11. CANOPY FOR OUTDOOR SERVICES SHALL BE PROVIDED.
12. CONTROL WIRING SHALL BE OF SUITABLE VOLTAGE GRADE COPPER WIRE 1.5 SQ.MM.
13. THE TERMINAL IN TERMINAL BOX SHALL BE SUITABLE FOR CONNECTION 2.5 SQ.MM COPPER CONDUCTOR.
14. ATTAIN FULL SPEED OPERATION BEFORE VALVE LOAD IS ENCOUNTERED AND IMPART AN UNSEATING BLOW TO START THE VALVE IN MOTION (HAMMER BLOW EFFECT).
15. ALL ELECTRICAL EQUIPMENT,ACCESSORIES AND WIRING SHALL BE PROVIDED WITH TROPICAL FINISH TO PREVENT FUNGUS GROWTH.

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

EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.

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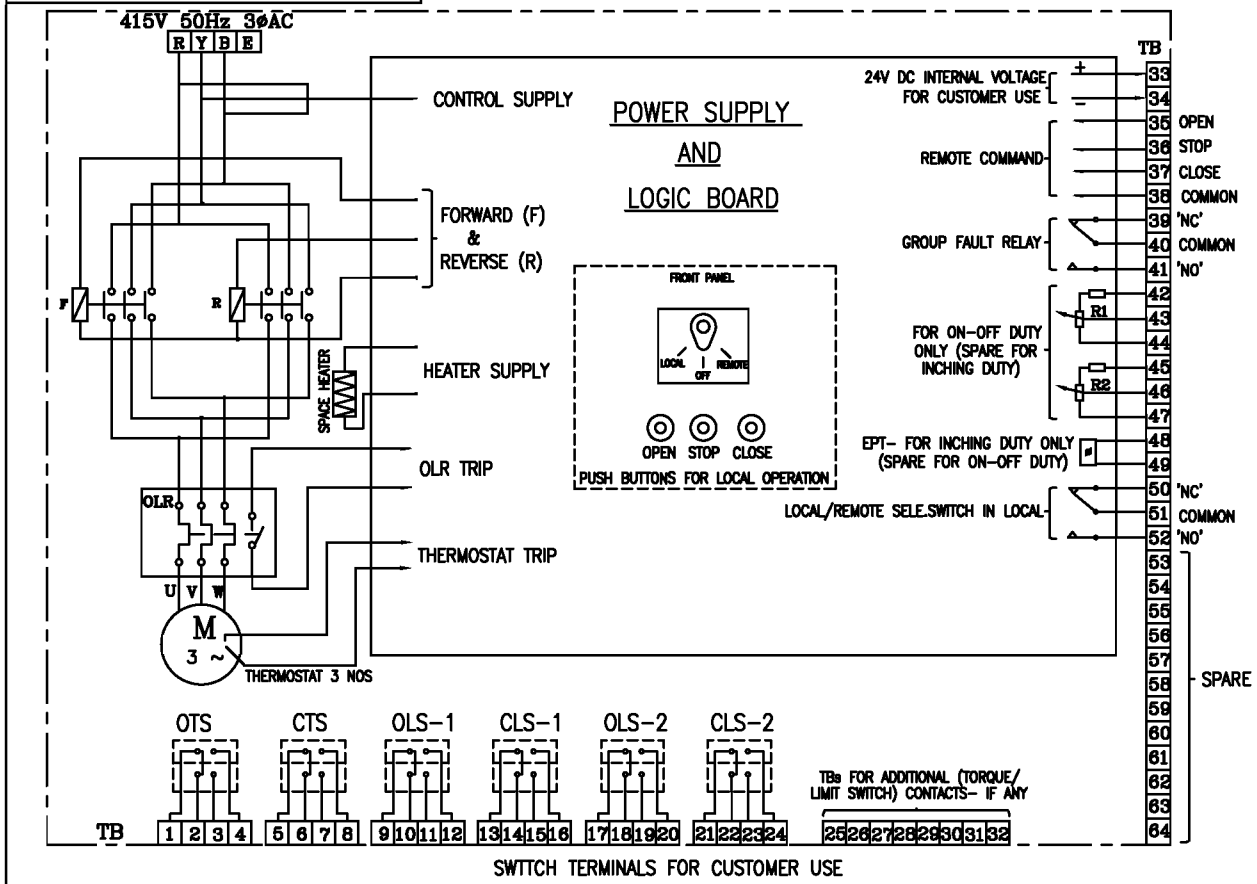
	PREPARED BY	CHECKED BY	APPROVED BY	VENDOR COMPANY SEAL
NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

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



SWITCH 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	

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	NO.OF VAR.
DRN	N.P.ESWAR	N.P	07.10.04	
CHD	D.DINAKARAN	D.D	07.10.04	
APPD	K.ARUNACHALAM	K.A	07.10.04	

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

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

CARD CODE: U 01

DRAWING NO.: 3-V-MISC-24227

REV: 0

Size A3

SPECIFICATION FOR FIELD INSTRUMENTS

SR. NO.	ITEM	DESCRIPTION
		engineering units or 0-100%
1.6.10	Output	2 off isolated 4-20mA DC output
1.6.11	Load	< 750 ohms.
1.6.12	Power supply	240V AC, 50 Hz.
1.6.13	Turn Down	100:1.
1.6.14	Accuracy	± 0.2 % of measured value.
1.6.15	Enclosure	NEMA4X (IP67) aluminum, Epoxy coated
1.6.16	Nameplate	Tag number, service engraved in stainless steel tag plate.
	Notes:	
1.	The above on-line flow meter shall not create any obstruction on flow.	
2.	Users' list shall be submitted to support on proven satisfactory performance for similar process applications.	
1.7	PRESSURE GAUGE AND DIFFERENTIAL PRESSURE GAUGE	
1.7.1	Type	Bourdon / Bellows / Diaphragm.
1.7.2	Sensing & Socket	AISI-316 SS.
1.7.3	Movement Material	AISI-304 SS.
1.7.4	Case Material	Stainless steel, IP-65.
1.7.5	Dial Size	Generally 150 mm.
1.7.6	Scale	Black lettering on white in 270 ^{o} arc.

SR. NO.	ITEM	DESCRIPTION
1.7.7	Window	Shatterproof glass.
1.7.8	Range Selection	Normal process pressure: 50~70% of range.
1.7.9	Over-range Protection	125% of maximum range by internal stop. External stop at zero.
1.7.10	Adjustment	Micrometer screw for zero. Internal micrometer screw for range.
1.7.11	Element Connection	Argon welding.
1.7.12	Process Connection	1/2" NPT(M) Bottom for local, back for panel mounting.
1.7.13	Performance	Accuracy of ± 1.0 % of span or better.
1.7.14	Operating ambient	0 - 50 °C.
1.7.15	Safety Feature	Blow out disc /diaphragm at the back.
1.7.16	Accessories	(a) Snubbers and Glycerin filled for pulsating fluid applications and at pump discharge.
		(b) Stainless steel Diaphragm seals for viscous fluids
		(c) 3-Way SS316 Gauge cock for pressure gauges.
		(d) 5-valve SS316 manifold from barstock for differential pressure gauge.
		(e) Siphons for steam and hot water services.

SR. NO.	ITEM	DESCRIPTION
1.7.17	Applicable standard	IS-3624 / 1996.
1.7.18	Nameplate	Tag number, service engraved in stainless steel tag plate.
1.8	TEMPERATURE GAUGE	
1.8.1	Type	Mercury or gas filled.
1.8.2	Sensing Element Material	Bourdon - AISI-316 SS.
1.8.3	Capillary Armoring	Stainless steel flexible.
1.8.4	Movement Material	AISI 304 SS.
1.8.5	Bulb / Stem Diameter	12 mm.
1.8.6	Bulb / Stem Material	AISI 316.
1.8.7	Capillary	Stainless Steel.
1.8.8	Connection to well	½" NPT.
1.8.9	Case Material	Stainless steel.
1.8.10	Dial Size	150 mm in general.
1.8.11	Scale	Black lettering on white in 270 ^{0} arc.
1.8.12	Mounting	Surface/Panel.
1.8.13	Over range Protection	125 % of range or more.
1.8.14	Instrument connection	Bottom for local and back for panel mounting.
1.8.15	Range	Normal temperature – 50~70% of range.
1.8.16	Zero adjuster	Micrometer screw adjustable from front.

SR. NO.	ITEM	DESCRIPTION
		(c) Adapter flanges with nuts, bolts and gaskets for instrument and process side.
1.13	LEVEL SWITCH	
1.13.1	Type	External cage float operated. Magnetically coupled.
1.13.2	Float Material	AISI-316 stainless steel or better.
1.13.3	Other wetted parts	AISI-316 stainless steel or better.
1.13.4	External Cage	Carbon steel/Stainless steel as per process requirements, welded type/ flanged construction. Cage pressure rating shall equal or exceed the rating of the main vessel.
1.13.5	External cage mounting	Side-Side.
1.13.6	External cage connection	25 NB socket welded.
1.13.7	Switch housing	Epoxy coated die-cast aluminium alloy with neoprene gasket conforming to IP-65.
1.13.8	Type of switch configuration	2 SPDT (two nos.).
1.13.9	Contact rating	5A, 240V/AC, 0.25A, 220V DC.
1.13.10	Accessories	(a) Counter flange, nuts & bolts, suitable gasket etc.
		(b) Steel globe type drain valve.
		(c) ½"NPT cable gland.
		(d) Stainless steel nameplate with

SR. NO.	ITEM	DESCRIPTION
		alpha-numeric engraved for service and tag.
1.13.11	Preferred feature	Switch operating point marked on cage.
1.13.12	Mounting	On standpipe.
1.14	CONDUCTIVITY TYPE LEVEL SWITCH	
1.14.1	Type	Conductivity discrimination.
1.14.2	Application	Drain pots viz. on CRH line.
1.14.3	Mounting	Flanged – on external cage.
1.14.4	Probe MOC	Stainless steel with high purity ceramic.
1.14.5	Probe rating	> Maximum design pressure of vessel.
1.14.6	Input	Four independent channel with selectable switching threshold for water conductivity.
1.14.7	Relay Output	Four isolated output relays for Hi, Lo, Hi-Hi, Lo-Lo.
1.14.8	Contact type & rating	2 SPDT or 1 DPDT @ 5A 30V DC.
1.14.9	Local Display	Coloured LEDs for Hi, Lo, Hi-Hi, Lo-Lo, Power & fault.
1.14.10	Power supply	Dual 240V AC, 50 Hz, 1Ph.
1.14.11	Enclosure	IP–65, corrosion resistant & wall mounting type (Explosion proof for NEC Class-1, Division-1 area).

SR. NO.	ITEM	DESCRIPTION
1.14.12	Accessories	(a) PTFE cable from probe to electronics.
		(b) Mounting accessories.
		(c) External cage.
		(d) Washer & gasket.
1.14.13	Test pressure	(e) Two times rated pressure.
1.14.14	Cable connection	(f) ½" NPT with cable gland.
1.15	CONDUCTIVITY TYPE ELECTRONIC LEVEL INDICATOR	
1.15.1	Type	Conductivity discrimination.
1.15.2	Application	HP heater level.
1.15.3	No. of Probes	10
1.15.4	Probe Mounting	Flanged – on standpipe.
1.15.5	Probe MOC	Stainless steel with high purity ceramic.
1.15.6	Probe rating	> Maximum design pressure of vessel.
1.15.7	Input	Independent channel with selectable switching threshold for water conductivity.
1.15.8	Relay Output	Four isolated output relays for Hi, Lo, Hi-Hi, Lo-Lo.
1.15.9	Contact type & rating	2 SPDT or 1 DPDT @ 5A 30V DC.

SR. NO.	ITEM	DESCRIPTION
1.27.12	Hysteresis	Fully adjustable preferred
1.27.13	Output contacts	2 SPDT Potential free changeover contacts @ 240V, 5A AC/220V, 0.5A DC.
1.27.14	Accuracy & Repeatability	0.25% of span or better
1.27.15	Resolution	0.1% of span
1.27.16	Operating Temperature	Transmitter- 50 ºC and Sensor – 80 ºC
1.27.17	MOC Sensor	Body- PVC and Face – Polyurethane
1.27.18	Humidity	1% to 95% non condensing.
1.27.19	Enclosure	IP-65 Epoxy painted die cast aluminium or Polycarbonate housing.
1.27.20	Cable connection	3/4" ET
1.27.21	Mounting	2" for sensor and Transmitter on panel.
1.27.22	Accessories	Cable gland, prefab cable, mounting accessories.
1.28	CAPACITANCE TYPE LEVEL SWITCH	
1.28.1	Type	Capacitance type
1.28.2	Probe	(i) Rod or suspended electrode
		(ii) Rope type probes may be used only where required probe length is greater than 3 meters.
1.28.3	Probe Mounting	Stainless steel 1½" ANSI RF Flange / ¾" NPT (M)

SR. NO.	ITEM	DESCRIPTION
1.28.4	Material of construction	316 SS
1.28.5	Insulation	PTFE Part/ Full as per service.
1.28.6	Enclosure	Powder/Epoxy coated Die cast aluminium with neoprene gasket conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
1.28.7	Ambient temperature	0-60 °C.
1.28.8	Mounting	On Tap
1.28.9	Supply voltage	240V AC, 50Hz /24V DC
1.28.10	Relay output	2 SPDT
1.28.11	Contact rating	240V, 5A AC/220V, 0.5A DC.
1.28.12	Response time	100 mSec or better
1.28.13	Cable connection	¾" ET
1.28.14	Accessories	Counter flange, Cable gland, prefab cable and stainless steel name plate engraved with alpha-numeric.
1.29	TEMPERATURE SWITCH	
1.29.1	Type	Mercury filled-in.
1.29.2	Sensing Element Material	Bellow / Bourdon AISI SS-316.
1.29.3	Bulb Material	AISI SS-316.
1.29.4	Capillary	Stainless steel armoured.
1.29.5	Movement Material	AISI SS-304.
1.29.6	Case material	Epoxy coated steel plate or die-cast aluminium alloy with neoprene gasket

SR. NO.	ITEM	DESCRIPTION
		(b) Local indication for power.
1.38	SIGHT GLASS	
1.38.1	Type	Flap-type.
1.38.2	End connection	Screwed / Flanged.
1.38.3	Material	
(a)	Body	CS/SS as per process medium.
(b)	Indicator	Stainless steel.
1.38.4	Sight Glass	Toughened Borosilicate.
1.38.5	Gasket	Neoprene.
1.38.6	Bolts & Nuts	High tensile steel.
1.38.7	Hydraulic Test Pressure	1.5 times maximum working pressure.
1.38.8	Accessories	As required.
1.39	LEVEL GAUGE (FLOAT & TAPE)	
1.39.1	Type	Float and Tape
1.39.2	Float & Tape MOC	AISI 316
1.39.3	Pulley material	Aluminium
1.39.4	Guide wire	SS 316 Stainless steel
1.39.5	Accuracy	± 2 mm
1.39.6	Indication	On circular or vertical dial
1.39.7	Rating	Twice the design pressure

SR. NO.	ITEM	DESCRIPTION
	(q) Accessories	Special cables, electronics, cabinets etc. as required to make the system complete, with bar/chain.
	(r) Range	Application dependent.
	(s) Range increment	0.1% of this selected range.
	(t) Operating temperature	0 -70 ^{0}C
	(u) Accuracy	± 0.5% FS range
2.0	**CONTROL PANELS/DESK MOUNTED INSTRUMENTS AND ELECTRICAL SYSTEM ACCESSORIES**	
2.1	COUPLING RELAY	
2.1.1	Type	Octal base plug-in type/ DIN rail Mounting.
2.1.2	Coil voltage	24 V D.C. in general / other as required.
2.1.3	Contact	2 NO & 2 NC (Minimum).
2.1.4	Contact rating	250 V/5A (A.C)/220V/2A (D.C).
2.1.5	Operating range	70 to 110% of rated voltage.
2.1.6	Insulation	2 kV for 1 minutes between terminal & earth.
2.1.7	Mechanical life	20 million operations.
2.1.8	Coil protection	Diode.
2.1.9	Indication	Coil on LED.

SR. NO.	ITEM	DESCRIPTION
2.1.10	Enclosure	Transparent cover.
2.1.11	Connection	Screw terminals.
2.1.12	Mounting	Projection mounting inside panel / DIN rail mounting.
2.2	DISTRIBUTION BOARDS	
2.2.1	Type	Fixed, Modular.
2.2.2	Power distribution	Through MCCB.
2.2.3	Enclosure	Sheet Steel, IP54.
2.2.4	Mounting	Free standing (Can be attended from both front & back).
2.3	RECEIVER RECORDER	
2.3.1	Type	Microprocessor Based continuous video chart type. (Paper less)
2.3.2	Display type	320 x 240 pixels high resolution coloured LCD graphics.
2.3.3	Number of pen	2/4 as applicable.
2.3.4	Input	4-20mA DC/1-5 Volt/ RTD/ Thermocouple.
2.3.5	Display span rate	1, 5, 10, 20, 30 and 60 min / div. Selectable.
2.3.6	Digital indication	Measured values with engineering unit.
2.3.7	Trends	Coloured display on screen.

SR. NO.	ITEM	DESCRIPTION
2.3.8	Colour of trends	Selectable.
2.3.9	Performance	
(a)	Accuracy	±0.1% of span or better. (Indication & Recording)
(b)	Updation rate	1 Sec or better.
2.3.10	Input open circuit	Up/Down Scale. (selectable)
2.3.11	Reference Junction Compensation	Built-in cold junction compensation for thermocouple inputs.
2.3.12	Power Supply	240 Volt, 1 Ph, 50 Hz A.C.
2.3.13	Operating ambient temperature range	0-50 ^{O} C. (maximum)
2.3.14	Face Dimension	144 mm (W) x 144 mm (H).
2.3.15	Depth	300 mm (typical).
2.3.16	Construction	Case - drawn steel, Bezel- Polycarbonate.
2.3.17	Readable distance	3 meters (minimum)
2.3.18	Mounting	Flush panel.
2.3.19	Accessories	Engraved phenolic nameplate affixed to front flange to identify each recorder by tag number and each pen by color and measured variable. Shunt resistors, Ethernet port, RS232/422a/ 485 port.
2.3.20	Features	(i) Hi, Hi-Hi, Lo and Lo-Lo contacts each channel.

SR. NO.	ITEM	DESCRIPTION
2.3.21		(ii) 2 MB memory for Data acquisition and 100 MB Zip disk.
		(iii) 3 ½" Floppy disk.
		(iv) Computation functions like linear scaling, square root, differential and engineering unit and all other mathematical functions.
		(v) Memory status display, LCD backlight saver.
		(vi) Event sampling typically 125, 250, 500 msec.
2.4	MULTIPOINT RECORDER	
2.4.1	Type	Microprocessor Based continuous video chart type. (Paper less)
2.4.2	Number of Points	6,12 or 24. (as required)
2.4.3	Input	4-20 mA/1-5V/Thermocouple/RTD.
2.4.4	Recording	Channel number or dot with different color for each channel.
2.4.5	Point Selection	Programmable for any combination of points by selection.
2.4.6	Readable Distance	3 meters. (minimum)
2.4.7	Data Display	Channel number, alarm status, measured data and engineering data (or Programming Display) in green LEDs.

SR. NO.	ITEM	DESCRIPTION
2.4.8	Face Dimension	(i) 144 x 144 mm (approx.) for 6 point.
		(ii) 252 x 206 mm (approx.) for 12 point.
		(iii) 305 x 380 mm (approx.) for 24 point.
2.4.9	Reference Junction Compensation	Built-in.
2.4.10	Mounting	Flush Panel.
2.4.11	Performance	
(a)	Accuracy	± 0.5% of span or better.
(b)	Ambient Temperature effect	± 0.3% of span for 10 ^{O}C variation or better.
(c)	Supply voltage variation effect	± 0.2% of span for 10% variation in supply voltage or better.
(d)	Frequency variation effect	± 0.1% of span for 2 Hz variation in frequency or better.
(e)	Operating Position effect	± 0.1% of span for 0-30 Deg. inclined or better.
2.4.12	Input Open Circuit	Up/Down Scale.
2.4.13	Power Supply	240 Volt, 1 Phase, 50 Hz AC.
2.4.14	Operating Conditions :-	
(a)	Temperature	0-50 ^{O} C.
(b)	Relative Humidity	25%-90%.

SR. NO.	ITEM	DESCRIPTION
(c)	Supply Voltage	-15% to +10%.
2.4.15	Accessories	Engraved phenolic nameplate affixed to front flange to identify each recorder by tag number and each pen by color and measured variable. Shunt resistors, Ethernet port, RS232/422a/485 port.
2.4.16	Preferred Features	(i) Hi, Hi-Hi, Lo and Lo-Lo contacts for each channel.
		(ii) 2 MB memory for Data acquisition and 100 MB Zip disk.
		(iii) 3 ½" Floppy disk.
		(iv) Computation functions like linear scaling, square root, differential and engineering unit and all other mathematical functions.
		(v) Memory status display, LCD backlight saver.
		(vi) Event sampling typically 125, 250, 500msec.
2.5	BAR GRAPH INDICATOR	
2.5.1	Type	Bar graph.
2.5.2	Number of channels	One/Two (as required)
2.5.3	Input	4-20 mA/1-5 V/Thermocouple/RTD.
2.5.4	Indication	Green LED / LCD.

SR. NO.	ITEM	DESCRIPTION
2.5.5	Scale	100 mm vertical one for each channel graduated in engineering unit. (linear scale)
2.5.6	Readable Distance	3 meters. (minimum)
2.5.7	Mounting	Flush panel.
2.5.8	Face Dimension	36(W) x 144(H) mm (approx) / 72 x 144 (H) mm.
2.5.9	Resolution	1% of scale or better.
2.5.10	Power Supply	240V, 1 Phase, 50 Hz AC.
2.5.11	Operating Conditions :-	
(a)	Temperature	0-50 ^{O} C.
(b)	Relative Humidity	5%-95%.
(c)	Supply Voltage	-15% to +10%.
2.5.12	Connection between Indicator and Tray	Prefab Cable.
2.5.13	Accessories	(i) Mounting Tray.
		(ii) Engraved phenolic nameplate affixed to front flange to identify each indicator by tag number and each point by measured variables.
2.5.14	Alarm Facility	1 HI and 1 LO for each channel independently adjustable over span. Voltage free outputs.
2.5.15	Reference Junction Compensation	Built-in cold junction compensation for

SR. NO.	ITEM	DESCRIPTION
		thermocouple inputs.
2.5.16	Feature	(i) Alarm level indication by flashing Cursor.
		(ii) Green Digital display of parameter value in front panel with a 3.1/2 digit display.
2.6	VALVE POSITION INDICATOR	
2.6.1	Input	4-20 mA DC/1-5 Volts DC.
2.6.2	Indication	Pointer and Scale. Moving Coil Meter.
2.6.3	Readable Distance	3 meters (minimum)
2.6.4	Pointer Deflection	90 Deg Sector or linear.
2.6.5	Mounting	Flush Panel (Horizontal/vertical)
2.6.6	Accuracy	±1% or better.
2.6.7	Protection Class	IP-42.
2.6.8	Operating Ambient Temp.	0-50 °C.
2.6.9	Scale	0-100%.
2.6.10	Bezel Size	DIN Standard.
2.7	DIGITAL INDICATOR	
2.7.1	Type	Four and half digit LED seven-segment display with sign.
2.7.2	Face Dimension	72 x 144 mm / 48 x 96 mm. (as applicable)
2.7.3	Display Character	13.8 mm, Green. (LED)

SR. NO.	ITEM	DESCRIPTION
2.7.4	Accuracy	0.1% of reading, ±2 digit.
2.7.5	Input	4-20Ma DC/1-5 V DC/ RTD/ Thermocouple.
2.7.6	Mounting	Flush Panel.
2.7.7	Power Supply	240V ±10%, 50 ±2.5 Hz.
2.7.8	Output Contact	2 nos SPDT, contact rating 5A at 240V AC/ 0.25A at 220V DC.
2.7.9	Power/Signal Connection	Screwed.
	Large Display (150x300 mm) indicators shall be provided for MW, MVAR and frequency indications.	
2.8	TOTALIZER / COUNTER	
2.8.1	Type	Electronic.
2.8.2	Number of digits and digit size	Six, 9 mm high.
2.8.3	Input	4-20mA DC.
2.8.4	Reset	Manual.
2.8.5	Readable distance	3 meters. (minimum)
2.8.6	Mounting	Flush.
2.8.7	Performance	
(a)	Accuracy	± 0.5% of span.
2.8.8	Operating ambient temp.	0 - 50 °C.
2.8.9	Accessories	Engraved phenolic nameplate affixed to front flange to identify tag number and measured variable.

SR. NO.	ITEM	DESCRIPTION
2.8.10	Preferred Features	Power supply on/failure LED visible from front.
2.9	PUSH BUTTON	
2.9.1	Type	Shrouded square format.
2.9.2	Face Dimension	32 x 32 mm (maximum)
2.9.3	Contact Configuration	2 NO + 2 NC.
2.9.4	Contact Addition	Add-on block up to 4 each with 2 pairs of contacts.
2.9.5	Contact Material	Hard Silver Alloy.
2.9.6	Contact Rating	500V / 10 A.
2.9.7	Utilization Category	AC11 / DC11.
2.9.8	Insulation Voltage	2 kV for 1 minute between terminals and earth.
2.9.9	Mechanical Life	1 million operation.
2.9.10	Construction	Aluminium shrouding with plastic lens.
2.9.11	Colours	Red, Green, Yellow, Black, etc.
2.9.12	Connection	Screw terminals.
2.9.13	Enclosure Class	IP-52.
2.9.14	Legend	Engraving.
2.10	ILLUMINATED PUSH BUTTON	
2.10.1	Type	Square format.
2.10.2	Face Dimension	32 x 32 mm. (maximum)

SR. NO.	ITEM	DESCRIPTION
2.10.3	Contact Configuration	2 NO + 2 NC. (minimum)
2.10.4	Contact Addition	Add-on-Block up to 4 each with 2 pairs of contacts.
2.10.5	Contact Material	Hard Silver Alloy.
2.10.6	Contact Rating	500 V/ 10A.
2.10.7	Utilization Category	A C11 / DC11.
2.10.8	Insulation Voltage	2 kV for 1 minute between terminals and earth.
2.10.9	Mechanical Life	1 Million Operation.
2.10.10	Lamp	LED with built-in resistors as required.
2.10.11	Lamp Rating :	
(a)	Voltage	240 V AC.
(b)	Watt	2 Watt (approx.)
2.10.12	Lamp and Lens Replacement	From front.
2.10.13	Construction	Transparent Plastic Lens.
2.10.14	Colour	Red, Green, Amber, Yellow etc.
2.10.15	Connection	Screw terminals.
2.10.16	Enclosure Class	IP-52.
2.10.17	Legend	Engraving.
2.11	SELECTOR SWITCH	
2.11.1	Type	2/3/4 position stay put type with rotary lever actuator.

SR. NO.	ITEM	DESCRIPTION
2.11.2	Face Dimension	32 x 32 mm. (maximum)
2.11.3	Contact Configuration	4 pair of contacts.
2.11.4	Contact Addition	Add-on-Block up to 4 each with 2 pairs of contact.
2.11.5	Contact Material	Hard silver Alloy.
2.11.6	Contact Rating	500 V/10 A.
2.11.7	Utilization Category	AC11 / DC11.
2.11.8	Insulation Voltage	2 kV for 1 minute between terminals and earth.
2.11.9	Mechanical Life	1 million operation.
2.11.10	Construction	Aluminium shrouding.
2.11.11	Connection	Screw terminals.
2.11.12	Enclosure Class	IP-52.
2.12	INDICATING LAMP	
2.12.1	Type	LED with built-in resistor.
2.12.2	Face Dimension	32 x 32 mm. (maximum)
2.12.3	Voltage	240 V AC.
2.12.4	Watt	2.5 Watt (approximate).
2.12.5	Lamp and Lens Replacement	From front.
2.12.6	Construction	Transparent Plastic lens.
2.12.7	Colour	Red, Green, Amber, Yellow etc.
2.12.8	Connection	Screw terminals.

SR. NO.	ITEM	DESCRIPTION
2.12.9	Legend	Engraving.
2.13	INDICATING METERS (A.C)	
2.13.1	Type	Rectifier type.
2.13.2	Face Dimension	96 x 96 mm.
2.13.3	Scale	Radial arc of 240 Deg.
2.13.4	Accuracy	1.5% of full scale. ± 0.5 Hz for frequency meter.
2.13.5	Input	0-1/0-5A for current measurement, 0-240V, 50 ± 2.5 Hz for voltage/ frequency measurement.
2.13.6	Zero Adjustment	Screw on meter face.
2.13.7	Enclosure	Shielded Case.
2.13.8	Mounting	Flush Panel.
2.13.9	End Scale Suppression	6 times the measuring range only for motor ammeters.
2.14	INDICATING METERS (D.C)	
2.14.1	Type	Taut band moving coil.
2.14.2	Face Dimension	96 x 96 mm.
2.14.3	Scale	Radial arc of 240 Deg.
2.14.4	Accuracy	1.5% of full scale.
2.14.5	Input	0-75 mA for current measurement. Direct reading for voltage measurement.

SR. NO.	ITEM	DESCRIPTION
2.14.6	Zero Adjustment	Screw on meter face.
2.14.7	Enclosure	Shielded case.
2.14.8	Mounting	Flush Panel.
2.14.9	End Scale Suppression	2 times the measuring range only for motor ammeters.
	For electrical system's meter and for synchronization, Bidder shall refer to electrical volume of the specification.	
2.15	AUXILIARY RELAY	
2.15.1	Type	Electromagnetic.
2.15.2	Coil voltage	240 V A.C / 220V DC. For any other voltage bidder to make his own arrangement.
2.15.3	Contact Configuration	2 NO & 2 NC (Minimum), additional contacts as per requirement with provision for additional contact block expansion.
2.15.4	Contact rating	250V/5A. (A.C/D.C.)
2.15.5	Operating range	80 to 110% of rated voltage.
2.15.6	Insulation	2 kV for 1 minute between terminals & earth.
2.15.7	Mechanical life	20 million operations.
2.15.8	Coil protection	Diode/surge suppressor.
2.15.9	Connection	Screw terminals.
2.15.10	Mounting	Projection mounting inside panel.

SR. NO.	ITEM	DESCRIPTION
2.16	ELECTRICAL TRANSDUCER	
	Transducers shall be provided for conversion of AC electrical quantities such as voltage, frequency, current and power. Transducer shall be suitable for 220V DC auxiliary supply. Transducers shall be of low burden type having 4 – 20 mA DC linear galvanically isolated output compatible with secondary indicating instrument. Transducer shall be dual channel type. Accuracy class of Transducers shall be as per IS14570:1998 or IEC688 :992.	
2.17	SYNCHROSCOPE	
	Synchroscope shall be designed to provide an illuminate and indication of phase and frequency difference between bus voltage and Generator voltage. It shall denote the actual frequency difference corresponding to the inverse of time taken for one rotation of the illuminated vector spot. The instrument shall be designed for industrial applications, which require precise, reliable and robust instruments for the display range and indication. Synchroscope shall be designed as per the DIN/IEC/BS standards.	
2.18	ANNUNCIATION	
2.18.1	PLC based system alarm annunciation system shall be solid state/ microprocessor based and shall include all required logic sequence. Display part of the system shall have panel mounted facia LED array assemblies, sets of alarm accept, reset, mute and test push buttons and panel mounted audible devices.	
2.18.2	The system shall be immune to variations in the power supply and shall not generate spurious alarm when the system power is switched on (power-on-reset)	
2.18.3	Controller of the PLC/Microprocessor based control system shall be used for configuring the alarm	
2.18.4	10% wired spare channels & facia shall be provided in all cases	

SR. NO.	ITEM	DESCRIPTION
2.18.5	ANNUNCIATOR LOGIC	
	(a) The circuit components for individual windows shall be mounted on plug -in circuit cards.	
	(b) Input shall be provided with contact bounce filtering. The filter shall delay contact inputs for 15 milliseconds to protect against input device bounce and electrical noise on input lines.	
	(c) Critical alarms shall be hardwired to the input card of annunciator controller.	
2.18.6	OTHER TECHNICAL PARTICULARS	
	(a) Type of contact	NO or NC configurable
	(b) Contact interrogation voltage	24 V DC
	(c) Window drivers.	Electronically short circuit protected, current limiting with automatic recovery
	(d) Facia dimension	75 mm (W) X 50 mm (H)
	(e) LED per facia	8 nos./Window
	(f) Flash rate	Adjustable (slow, fast, intermittent)
	(g) Inscription Type	Etched on photo film (sandwiched)
	(h) Inscription letter height	5 mm (min.)
	(i) No. of row of inscription/ facia	4 (max.)
	(j) No. of letters/row	14 (max.)

SR. NO.	ITEM	DESCRIPTION
	(k) Colour of letters	Black (for white windows)
	(l) Facia front cover	Hi-impact polystyrene
	(m) Facia rear plate	Translucent plastic
	(n) Colour of background	Milk white and red for critical / trip.
	(o) Fascia block plate	Cold rolled sheet steel epoxy painted.
	(p) Audible alarm	Cone type speaker
	(q) Tone generator	Electronic with adjustable tone, amplitude and frequency
	(r) Preferred sequence	(i) Ordinary Channel : ISA-S-18.1-1979-R
		(ii) First-up channel : ISA-S-16.1-1979- F3M3

NOTE:

1. Instruments which are open to atmosphere should be covered with proper canopy.

3.0 CONTROL VALVES, ACTUATORS & ACCESSORIES

General Technical Guidelines for the Control Valves shall be as follows :

(a) Bidder shall exercise caution in selecting severe service control valves like BFP recirculation valves, HP & LP bypass valves, superheater & reheater attemperator valves, PRDS valves for Boiler & Turbine, Soot blower steam pressure control valve, control valves whose down stream are connected to vacuum such as HP/LP heater emergency level control, condenser make up water control valve, separator level control and CEP minimum flow control valve. For such critical applications, Bidder shall offer valves which are proven

4.0 CONTROL DESK / PANELS / RACKS

(a) Convenient and logical approach to operational interfaces and aesthetics in the overall view of the panel /desk shall be considered.

(b) For items susceptible to vibration, suitable anti-vibration padding shall be provided to prevent damage or malfunction.

(c) All items inside the panels/cabinets shall be neatly arranged with easy access/maintenance approach.

(d) Incoming power supply feeders shall be duplicated . Alarm shall be provided for failure of a power supply feed.

(e) Desk/panel shall be provided with interior illumination, utility receptacles with plug and cooling fan.

(f) Panel/Desk shall have gland plate at cable entry to panel. Thickness of gland plate shall not be less than 3 mm.

(g) Wire shall be routed/laid through covered trough.

(h) Crating of the panels and desks shall be suitable for protection against shock, vibration, inappropriate handling and inclement weather conditions during transportation and warehousing. Mounted equipment shall have adequate protection against damage during handling, transit and storage. Suitable desiccant shall be used inside the packing case.

(i) Nameplate

(i) Nameplate shall be provided for instrument or device mounted on the panel.
(ii) Nameplates for panels shall be provided both in front and rear.

(j) All local control panels shall be housed in air condition environment.

4.1 CONTROL DESK

4.1.1 Devices mounted on the desk shall be flush type. Devices shall be so mounted that their removal and replacement can be accomplished without interruption of services to others.

4.1.2 Desk shall be ergonomically designed to suit working on a 24 X 7 basis. Aesthetics, ergonomics and illumination shall be considered while positioning of the desk, large video screen and panels in control room.

4.1.3 Control desk shall be free standing floor mounting type of table-top design with compartments for locating the hardware. Desk shall be constructed from aluminum extrusion with high pressure laminate MDF board for work surface of approved colour. Aluminium structure shall be anodized or powder coated paint finish. Thickness of sheet shall not be less than 3 mm.

4.1.4 Monitors with retractable keyboard, emergency push buttons shall be provided on the desk. Desk shall be arranged in arc-like shape without any sharp edges. Edges shall be extruded PVC or rounded post-formed laminate.

4.1.5 Desk shall be of modular, scalable and industrially ruggedized design and shall have Telephones and Intercom connections.

4.1.6 Desk shall have concealed cable trays for wire dressing.

4.1.7 Design shall include Earthing bolts.

4.1.8 Back installed items shall be suitably concealed from front view.

4.2 BACK UP PANEL

4.2.1 Construction shall be from sheet steel of thickness not less than 3 mm.

4.2.2 Electrical upright Panel construction & design shall be similar to back up panel. Control switches, meters, indicators, synchronizer, excitation control switch, annunciation window etc. along with associated mimic diagram, as recommended, shall be provided for manual synchronization of generator.

4.2.3	Cabinets/Enclosure/Panels		
(a)	Material of construction	:	Cold rolled steel sheet.
(b)	Thickness of Sheet	:	(i) 2.0 mm for faces supporting instruments / terminals.
(c)	Construction	:	Welded throughout as per approved National Standards.
(d)	Panel height	:	2300 mm. (approx)
(e)	(i) Corners	:	7 mm inner radius.
	(ii) Dimensional	:	a. In height & length - 3 mm.
	(iii) Tolerances	:	b. In height between adjacent sections - 2 mm.
		:	c. Total for a group - 6 mm.
(f)	Doors	:	Double, recessed, turned back edges.
	(i) Thickness of Sheet	:	2 mm.
	(ii) Hinges	:	Stainless steel.
	(iii) Door latches	:	Three point type.
	(iv) Door gaskets	:	Neoprene rubber on fixed frame to result dust proof/weatherproof enclosure.
	(v) Opening of the doors	:	Outward.
	(vi) Louvers	:	With removable wire mesh to ensure dust and vermin proof.
(g)	Color of interior	:	Brilliant white.
(h)	Colour external	:	RAL 7032.

(i)	Painting	:	Epoxy powder coated or better.
(j)	Gland plates	:	Removable 3 mm thick. (bottom)
(k)	Cable entry	:	Bottom.
(l)	Hardware	:	(i) Anti vibration pad- 15 mm.
		:	(ii) Predrilled base channel ISMC - 10 or equivalent for all sides.
		:	(iii) Stainless steel buff- finished 2 mm thick kick plate for all sides.
		:	(iv) Stainless steel scratch strips along desk edges fixed with pan-head recessed screws.
		:	(v) Rubber strips to ensure air tightness between kick plate and finished floor.
		:	(vi) Lifting hook / Eye bolt.
		:	(vii) Drawing pocket.
		:	(viii) Door switch, lamps, thermostat, heaters and fans.
(m)	Enclosure Protection	:	As per environment condition of the area of installation. Refer section-1 of this vol.

4.3 LOCAL INSTRUMENT RACKS & ENCLOSURE

4.3.1 General Requirements

(a) Devices located in the field shall be grouped and installed in the enclosure (Closed Rack) in outdoor areas such as Boiler area etc. and in Open Type Rack in covered areas such as TG Building.

shall be of 2" NB ASTM A 106, Sch-80 Gr. C installed at a slope of 1:25 and extended beyond the rack for connection to plant drain header.

4.3.4 Junction Box

Junction boxes of metallic construction.

(a) Junction box shall be provided at a dry compartment at one side of the enclosure/rack with front opening type door. Junction box shall be of sheet steel construction with thickness not less than 2 mm. Earth stud shall be furnished at rack for safety grounding.

(b) Terminals shall be screwless cageclamp type of reputed make and 20% spare terminals shall be furnished in the junction box.

5.0 DISTRIBUTED CONTROL SYSTEM (DCS)

5.1 SYSTEM FUNCTIONAL DESCRIPTION

5.1.1 Integrated functionally & geographically distributed and hierarchically structured real time control (both binary and modulating), Data acquisition, Man machine interface, Historization units and Management Information System (MIS) system synthesized from one general family of identical interchangeable multifunction hardware has been envisaged.

5.1.2 System shall be highly reliable with the availability of not less than 99.7% with adequate redundancy and fault tolerant configuration.

5.1.3 The system shall be unitized and connectivity with other plant control system & Plant wide network has been envisaged.

5.1.4 Remote input output stations as a data concentrator for acquisition and monitoring of non critical parameters like Boiler metal temperature and Generator winding temperature etc, are foreseen. RIO shall be industrially ruggedized and shall be provided with integral air conditioner considering the harsh environment.

5.1.5 For Power supply to DCS system refer Volume V , Section-10.

(v) Conductor material & sheath color for thermocouple cable as per ANSI MC 96.1.

CABLE TYPE	OVERALL SHEATH COLOR	WIRE	SHEATH COLOR	CONDUCTOR MATERIAL
KX	Yellow	Positive	Yellow	Nickel / Chromium
		Negative	Red	Nickel / Aluminum
JX	Black	Positive	White	Iron
		Negative	Red	Constantan
RX	Green	Positive	Black	Copper
		Negative	Red	Copper Nickel Alloy

(w) Durable printed or embossed numbering at regular interval of 50mm shall be provided for identification of pairs.

10.5 INSTRUMENTATION MULTI PAIRED SIGNAL CABLE

(a)	Conductor type	:	Stranded (7) annealed tinned copper.
(b)	Conductor size	:	0.5/1.0/1.5 Sq.mm. (as required)
(c)	Conductor resistance	:	39 Ω/Km/18 Ω/Km/12 Ω/Km.
(d)	Conductor Insulation	:	HR PVC Type-C (IS-5831,1984) 0.6 mm thick.
(e)	Operating Voltage	:	300/500V RMS. (Core to earth/core to core)
(f)	Twisting	:	Twin twisted with lay of 60 mm.

(g)	Twisting Direction	:	All pairs in the same direction. Lapped to form bunch with mylar tape.
(h)	Screen (Pair & Overall)	:	Aluminium mylar tape with a thickness of 28 µm (min.) for individual pair screen and 60 µm (min.) for overall screen with 100% coverage and 25% overlapped edges. Over the individual pair screening tape two laps of 0.05 mm thick (min.) polyester tape shall be applied with minimum overlap of 25%. Metallic side of the screen shall be in contact with drain wire. (i) Analog signals- Individual pair & overall shield to be considered. (ii) Binary signals- overall shield to be considered.
(i)	Drain wire	:	Annealed tinned copper wire, stranded. Size 0.5 Sq. mm. (No. of strands / size:- 7 / 0.3mm)
(j)	Inner Sheath	:	Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties) HR PVC Type ST2 of IS-5831,1984 Thickness as per IS-1554, Part-I 1976
(k)	Rip Cord	:	Non metallic under sheath.
(l)	Armouring	:	GI wire/strip as per IS 3975
(m)	Outer Sheath	:	Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties).

HR PVC Type ST2 of IS-5831,1984.

Thickness as per IS-1554, Part-I 1976.

(n)	Filler	:	Non hygroscopic with FRLS property.
(o)	Temperature Range	:	85 °C.
(p)	Insulation at 20 Deg.C	:	100 MOhms/Km [Min]
(q)	Capacitance at 800 Hz	:	120 nf/km
(r)	Cross talk	:	60 dB.
(s)	Attenuation	:	1.2 dB/Km.
(t)	Codes & Standards	:	(i) IPCEA-S-61-402. (ii) BS 5308. (iii) IEC 332-1. (iv) ASTM-B-33. (v) IS-8130-1984. (vi) IS 1554 Part-1. (vii) IS 10810.
(u)	Sheath color	:	Inner- Black and Outer- Gray.
(v)	Tests		(i) Oxygen Index: Min.29 at room temp. (ASTM-D-2863). (ii) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I. (iii) Temp Index: Min 250 ° C at 21Oxy. Ind. (ASTM-D-2863).

(iv) Smoke Density Rating: Max.60% (ASTM-D-2843).

(v) Flammability Test : as per IEC 332 Part-I.

(vi) Swedish Chimney Test-SS-424-1475 F3.

(vii) Insulation Resistance 100 M Ohm / Km Min.

(viii) High voltage test

Core to core- 1.5 kV for 1 min.

Core to screen- 1.0 kV for 1 min.

(ix) Rodent & Termite repulsion test (Presence of lead shall be confirmed).

(w) Colour of core for Instrumentation Cable (As per IS-9938)

PAIR	CORE	COLOR
1st	1st	Blue
1st	2nd	Red
2nd	1st	Gray
2nd	2nd	Yellow
3rd	1st	Green
3rd	2nd	Brown
4th	1st	White
4th	2nd	Black

Above 4 Pairs, 4 Pairs making a unit shall have indelible printed colour coded bands like Pink for 1st unit, Orange for 2nd unit and Violet for 3rd unit and so on. In addition band marking, for example single band for 1st. unit, double band for 2nd. unit and so on, shall be provided on each conductor for identification of unit. Band marking on individual core shall be provided at regular intervals not exceeding 50 mm.

10.6 Cables near high temperature zone shall be capable of withstanding high temperature and terminated in junction box / panel in normal temperature zone. Teflon insulated and sheathed thermocouple extension cables and copper conductor cables shall be used in high temperature zone. Conductor and sheath shall be extruded FEP (Teflon) as per VDE 0207 Part 6 and ASTMD 2116. These cables shall be pair, multipair, triad, multitriad and twisted & shielded.

10.7 CONTROL & POWER CABLE

Bidder shall refer to Volume IVB of the electrical specification for detail.

11.0 ERECTION HARDWARE

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

11.1 ELECTRICAL ACCESSORIES

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

(a) Rigid Steel Conduit

(i) Conduits up to and including 25 mm shall be of 16 SWG and conduits above 25 mm shall be of 14 SWG. Minimum size of conduits shall be 19 mm.

(ii) Each piece of conduit shall be straight, free from blister and other defects and covered with capped bushing at both ends.

(iii) All rigid conduit couplings and elbows shall be hot dip galvanized rigid mild steel in accordance with ANSI C 80.1 and UL6. The conduit interior and exterior surfaces shall have a continuous zinc coating with an over coat of transparent enamel or zinc chromate. Conduits shall be furnished in standard length of 3 meters, threaded at both ends.

(iv) All conduit fittings shall conform to the requirements of ANSI C 80.4 and UL-514 where these standards apply.

(b) Flexible Conduit

(i) Flexible conduit shall be of three-layer construction of very high quality of lead coated steel. Outside and inside layer shall be reinforced with heat resistant material.

(ii) Lead coating outside and inside of the conduit steel surface shall provide a non-corrosive characteristic particularly in acidic atmosphere. Besides flexibility, this shall be strong enough to stay at the desired profile without support and shall be durable and strong so as to offer sufficient mechanical protection. It shall also be fully liquid dust and air tight and shall withstand a continuous hydraulic pressure up to 2 Kg/ Sq. cm and temperature up to 200 °C.

(c) Special Fittings

(i) Conduit sealing and fittings shall be provided as required and shall be consistent with the area and equipment with which they are installed.

(ii) Double locknuts shall be provided on all conduit terminations not provided with threaded lugs and couplings. Locknuts shall be designed to securely bond the conduit to the enclosure when tightened. Locknuts shall not loosen due to vibration.

11.1.1 Electrical Junction Box

(a)	Type of Enclosure	:	Dust tight & weatherproof conforming to IP 65.
(b)	Material	:	3 mm sheet steel
(c)	Type of Cover	:	Solid unhinged with retention chain.
(d)	Paint	:	External - RAL 7032, Internal – Brilliant White.
(e)	Mounting	:	Surface
(f)	Cable Entry	:	3 mm (min) Gland plate
(g)	Gasket	:	Neoprene
(h)	Grounding	:	Brass earth lug with green screw head External-2 nos , Internal-1no.M6.
(i)	Number of Drain Holes	:	Two at bottom capped.
(j)	Identification	:	Label for JB and Tags for cable.
(k)	Accessories	:	(i) Rail mounted cage clamp type screwless terminals with markers.
		:	(ii) Cable gland
		:	(iii) Ferrules
		:	(iv) Canopy at top

11.1.2 Cable Gland

(a)	Type	:	Double compression
(b)	Entry Thread	:	NPT

(c)	Material	:	Brass
(d)	Finish	:	Cadmium Plated
(e)	Protection	:	IP 54 or better
(f)	Accessories	:	Neoprene gasket, locknuts, reducers etc.

11.1.3 Cable Tray

(a)	Material	:	Mild steel, slotted
(b)	Thickness	:	not less than 2.0 mm
(c)	Finish	:	Hot dip galvanized
(d)	Perforation	:	As per MFR standard
(e)	Cover	:	Suitable for tray

11.2 PROCESS HOOK UP ACCESSORIES & SPECIFICATION

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

11.2.1 Seamless Stainless Steel Pipe

(a)	Reference	:	ASTM A-312 TP 316
(b)	Material Grade	:	TP 316
(c)	Type	:	Seamless /Plain end
(d)	Size	:	½" NB
(e)	Schedule	:	40
(f)	Standard Length	:	5 meter

11.2.2 Stainless Steel Pipe Fittings

(a)	Reference	:	ASTM A-182 F 316 / ANSI B16.11
(b)	Type	:	Forged
(c)	Rating	:	3000 lbs / 6000 lbs / 9000 lbs
(d)	Size	:	½" NB
(e)	End connection	:	Generally socket weld
(f)	Type of Fittings	:	Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

11.2.3 Seamless Stainless Steel Tube

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

± 15 % for wall thickness.

(h) Standard Length : 5 meter

(i) Test : Flare, Hardness, Ball and Bubble Test.

11.2.4 Stainless Steel Tube Fittings

(a) Reference : ASTM-A-182

(b) Type : Double ferrule double compression.

(c) Material : 316 Stainless steel forged.

(d) Ferrule : 316 Stainless Steel.

(e) Type of Fittings : Male/female connector, elbow, cross /equal tee, straight connector, bulkhead union, ferrule etc. as required to suit installation.

(f) Size : To suit SS tubing and NPT end connection.

11.2.5 C.S. Pipe

(a) C.S. Pipe : ASTM-A 106 Gr. C

(b) Material : Cold drawn seamless black C.S

(c) Type : Seamless/Plain ends.

(d) Size : ½" NB

(e) Schedule : 80, 160, XXS as required.

(f) Standard Length : 6 meter

11.2.6 C.S. Pipe Fittings

(a)	Reference	:	ASTM-A 105/ANSI B16.11
(b)	Type	:	Forged
(c)	Rating	:	3000 lbs/6000 lbs/9000 lbs
(d)	Size	:	½" NB
(e)	End connection	:	Generally socket weld.
(f)	Type of Fittings	:	Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

11.2.7 A.S. Pipe

(a)	Reference	:	ASTM-A 335 P22 AS PER ANSI B 36.10
(b)	Material	:	Cold drawn seamless A.S
(c)	Type	:	Seamless / Plain ends
(d)	Size	:	½" NB
(e)	Schedule	:	XXS
(f)	Standard Length	:	5 meter

11.2.8 A.S. Pipe Fittings

(a)	Reference	:	ASTM-A 182 F22 AS PER ANSI B 16.11
(b)	Type	:	Forged
(c)	Rating	:	9000 lbs
(d)	Size	:	½" NB

	(e)	End connection	:	Generally socket weld
	(f)	Type of Fittings	:	Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.
11.2.9	Carbon Steel Globe Valve			
	(a)	Reference	:	ASTM A-105
	(b)	Type	:	Globe
	(c)	Construction	:	Forged Body Cadmium Plated.
	(d)	End Connection	:	½" Socket Weld
	(e)	Rating	:	Cl. 800 / CL. 2500
	(f)	Material	:	Body - Carbon steel Stem - Hardened Steel Plug - AISI 316 SS Seat- Stainless steel stellited
	(g)	Packing	:	Teflon / Grafoil as required
	(h)	Yoke	:	ASTM A105
	(i)	Handwheel	:	Carbon steel
	(j)	Design standard	:	As per ANSI B 16.34
11.2.10	Stainless Steel Globe Valve			
	(a)	Reference	:	ASTM A-182 F316
	(b)	Type	:	Globe
	(c)	Construction	:	Forged Body
	(d)	End Connection	:	Socket Weld
	(e)	Proof Pressure	:	400 Kg/Cm2
	(f)	Material	:	Body - Stainless steel

				Stem - Hardened Steel Plug - AISI 316 SS Seat- Stainless steel stellited
	(g)	Packing	:	Teflon as required
	(h)	Yoke	:	ASTM A182 F316
	(i)	Handwheel	:	Carbon steel
	(j)	Design standard	:	As per ANSI B 16.34
11.2.11	Alloy Steel Globe Valve			
	(a)	Reference	:	ASTM A-182 F22
	(b)	Type	:	Globe
	(c)	Construction	:	Forged Body
	(d)	End Connection	:	½" Socket Weld
	(e)	Rating	:	CL. 2500
	(f)	Material	:	Body - Alloy steel Stem - Hardened Steel Plug - AISI 316 SS Seat- Stainless steel stellited
	(g)	Packing	:	Grafoil as required
	(h)	Yoke	:	ASTM A182 F22
	(i)	Handwheel	:	Carbon steel
	(j)	Design standard	:	As per ANSI B 16.34
11.2.12	Condensate Pot			
	(a)	Reference	:	ASTM A182 F22 /ASTM A105
	(b)	Material	:	Alloy steel/carbon steel as per applicatio

	(c)	Construction	:	Drilled from bar stock
	(d)	End connection	:	3 nos. ½" socket weld end
	(e)	Accessories	:	Vent valves
11.2.13	Instrument Valve Manifold			
	(f)	Type	:	(i) Two valve manifold
			:	(ii) Five valve manifold
	(g)	Mounting	:	Remote 2" Pipe Mounting
	(h)	Construction	:	Single block (bar stock)
	(i)	Material	:	Forged body and bonnet AISI 316 stainless steel.
	(j)	Ports	:	1/2 " NPT (F)
	(k)	Rating	:	420 Kg/Sq. cm at ambient
	(l)	Operating Temperature	:	(-) 30 to (+) 170 Deg C
	(m)	Packing	:	PTFE Wafer
	(n)	Seat & Stem	:	AISI 316 SS
	(o)	Plug	:	AISI 316 SS free to turn on stem/17-4 PH.
	(p)	Handle Bar	:	AISI 316 SS
	(q)	Connection	:	Straight
	(r)	Accessories	:	(i) Plugs for all ports.
			:	(ii) Mounting Bracket , bolts , nuts.

11.3 PNEUMATIC HOOK UP ACCESSORIES

11.3.1 Air Header :

(a)	Technical Particulars	:	For Panel	For Field
(b)	Material of Construction	:	Stainless steel	Stainless steel
(c)	Inlet Connection	:	2" NPT (M)	1" NPT (M)
(d)	Header Take-off	:	Stainless steel	Stainless steel
(e)	Take off connection	:	1 / 2" NPT (M	1/ 2" NPT (M
(f)	Tube Take-off	:	Tube adapter on valve	Tube adapter on valve
(g)	Drain	:	SS drain valve at lowest point	SS drain valves at lowest poin

11.3.2 Seamless Stainless Steel Tube

(a)	Reference	ASTM A-269 TP 316
(b)	Material Grade	TP 316
(c)	Size	¼" OD X 0.049" wall thickness.
(d)	Type	Cold drawn annealed, pickled, passivated, de-scaled, ,hydraulically cleaned seamless tube.
(e)	Properties	The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80.
(f)	Test Pressure	400 Kg/Sq. cm

(g)	Tolerance	± 0.13 mm for outside diameter ± 15 % for wall thickness
(h)	Standard Length	5 meter
(i)	Test	Flare, Hardness, Ball and Bubble Test

12.0 SPECIAL TOOLS & TACKLE AND TEST EQUIPMENT FOR DCS/PLC AND OTHER SYSTEMS

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

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

12.3 Bidder shall furnish list of tools & tackle and test equipment proposed to be supplied along with the bid.

CONTROL PANELS SPECIFICATION

Unless otherwise specified cable entry for panels/desks/cabinets shall be through bottom via glanding plate. Fireproof seal shall be used to seal the bottom to prevent entry of dust.

(b) Panels and cabinets shall be constructed from steel sheet reinforced as required to provide true surface and adequate support for devices mounted thereon. Thickness of the steel plate shall conform to the requirements of UL 50 or equivalent standard. Panels and cabinets shall be of adequate strength to support mounted components during shipment and to support a concentrated load of 100 Kilograms on their top after erection.

(c) Panel/cabinet shall have eyebolt on top for lifting.

7.10.2 Surface Preparation and Painting

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

(a) Suitable filler shall be applied to all pits, blemishes and voids in the surface. The filler shall be sanded so that surfaces are level and flat; corners are smooth and even. Exposed raw metal edges shall be ground burr-free.

The entire surface shall be blast clean to remove rust and scale. Oil, grease and salts etc. shall be removed from by one or more solvent cleaning methods prior to blasting.

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

(i) Exterior – RAL 7032.

(ii) Interior - Brilliant White.

(c) Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections shall not be acceptable.

7.10.3 Wiring

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

(a) All spare contacts of relays, switches and push buttons shall be wired up to the terminal blocks.

(b) Each wire shall be identified at both ends with wire designation as per approved wiring diagram. Heat shrinkable type ferrules with indelible computerized print shall be used with cross- identification.

(c) Wire termination shall be made with insulated sleeve and crimping type lugs. All external connections shall be made with one wire per terminal. Wire shall not be spliced or tapped between terminals. Open-ended terminal lugs shall not be used.

(d) Internal wiring should be terminated uniformly on one side of the terminal block leaving the other side available for termination of outgoing cables.

(e) Thermocouple lead wires, analyzer measuring lead wires, or any other lead wires carrying measuring signal of the order of low milli volt or micro volt shall be electrically and physically isolated from other AC and DC wiring.

(f) All low-level signal cables shall be separately bundled from control cable.

(g) Wires shall be dressed and run in troughs with clamp-on type covers. Wirings shall be neatly bunched in groups by non-metallic cleats or bands. Each group shall be adequately supported along its run to prevent sagging or strain on termination.

(h) Shield wires shall be terminated on separately.

(i) Common connections shall be limited to two wires per terminal.

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

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

(l) Panel internal wiring shall follow distinct colour-coding to segregate different voltage levels viz. 24V DC, 48V, 110V AC, 240V AC, 220V DC etc.

(m) Panels/cabinets /desks shall be provided with removable gasketted cable gland plates and cable glands. Split type grommets shall be used for prefab cables.

(n) Wire shall be multistranded annealed flexible high purity copper conductor with heat resistant FRLS PVC insulation and shall pass vertical flame test per IPCEAS-1981.

(o) Wire sizes used for internal wiring shall not be lower than the followings:

(i)	Control wiring (switches, pushbuttons etc.)	:	1.5 Sq.mm
(ii)	Power supply/receptacle /illumination wiring	:	2.5 sq. mm or higher as per load/
(iii)	4-20mA DC current and low voltage signal upto 24V DC	:	0.5 Sq. mm

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

7.10.4 Grounding

(a) System cabinet AC and DC ground shall be electrically isolated from each other and also electrically isolated from the Instrumentation signal ground. All the above ground shall be individually connected to the single point on the ground pit. Dedicated redundant earth pit shall be provided which shall be away from the HV equipment. This earth pit shall not be shared with other electrical equipment ground and shall also be insulated from other electrical system ground to ensure single point grounding of the system. Grounding resistance shall be better than 1.0 ohm. IEEE guideline shall be followed while designing the grounding system.

(b) Panels and cabinets shall be provided with a continuous tinned copper ground bus bar of minimum 25 mm x 6 mm cross section, extending along the entire length of the panel/desk/cabinet assembly. The ground bus shall be bolted to the panel structure and effectively ground the entire structure.

(c) The panel/desk/enclosure /JB ground shall have two (2) bolt drilling with GI bolts and nuts at each end to connect to GI/ copper flat ground riser by means of insulated copper ground cable of required cross section with lug.

(d) Circuits requiring grounding shall be individually and directly connected to the panel ground bus.

(e) For electronic system cabinets, the electronic system ground bus shall be similar but insulated from the cabinet and shall be separately connected to the system ground. Signal cable shields shall be grounded at the panel end only and shall not be left open. The ground in between panels of a shipping section shall be firmly looped.

(f) Electrical meters, relays, transmitters and switching devices, operating at a voltage less than 50V may be grounded through the steel structure.

7.10.5 Panel/Cabinet/ Desk/Enclosures Environ mental Protections

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

SR. NO.	LOCATION	ENCLOSURE TYPE
(i)	Indoor type non- ventilated enclosure in non-hazardous area	IP-54.
(ii)	Indoor type ventilated enclosure in non-hazardous area	IP -42.
(iii)	Enclosure in Air conditioned area	IP-22 with suitable canopy at top to prevent ingress of dripping water.
(iv)	Outdoor type in non-hazardous areas	IP-55.
(v)	Outdoor in hazardous areas	As per requirements of the NEC Code for the location.

7.10.6 Terminal Blocks

(a) Terminals shall be chromated galvanized DIN rail mounted screw less cage clamp type. Terminals shall have screwed connection for conductor cross-section above 2.5 mm². Terminal blocks shall conform to IEC 947-7-1.

(b) The characteristics of the terminal blocks shall be as follows:

(i) High contact force, independent of conductor cross-section and large contact surface area.

(ii) Self-loosening protection.

(iii) Resistant to thermal aging and vibration.

(iv) Low and constant voltage drop.

(c) Tension spring shall be made of high quality, non-rusting, acid-resistant steel. The current bar shall be of tin-lead plated copper or brass.

(d) Terminals shall be of non flammable suitable thermoplastic material such as polyamide.

(e) Terminal blocks shall be mounted vertically in panels and cubicles with clearance for at least 100 mm between two sets and between wall and terminal block.

(f) Terminal blocks shall be provided with white marking strips/self-adhesive marker cards. Power terminals shall have protection covers.

(g) At least 20 percent spare unwired terminals shall be provided for all panels/cabinets /desks /junction box etc. This shall be in addition to 20% spare wired terminals of spare IO channels and 10% wired spare modules.

(h) Bottom of the terminal block shall be at least 200 mm above the cable gland plate for bottom entry type panels.

(i) For extending 24 V DC supply to panels, the size of the terminals shall be decided based on voltage drop and not based on current.

(j) Other requirements of the terminal blocks are as follows:

(i) The last block in a rail-mounted assembly shall be closed with an end plate and end bracket.

(ii) For visual and electrical separation of terminal groups, partition plates shall be provided, which can be push fitted after forming an assembly.

(iii) Design shall permit testing of incoming and outgoing signals by using suitable test plug and socket without disconnecting the cable connections.

(iv) It shall be possible to use jumper plugs through the test plug socket to connect adjacent terminals.

(v) Where more than one connection to a terminal block is required, two tier terminals shall be used.

(vi) Terminal blocks shall be of different colours depending on voltage levels.

7.10.7 Nameplates and Labels

(a) Each item shall have permanently attached to it, in a prominent position, a rating plate of non-corrosive material upon which is to be engraved the manufacturer's name, equipment, type/model number, range, serial number, together with details of the loading conditions under which the item of plant in question has been designed to operate.

(b) Such nameplates or labels are to be of white non-hygroscopic material with engraved black lettering, or alternatively of transparent plastic material with suitably colour lettering engraved on the back.

(c) The nameplates shall be held by self-tapping screws. The size of nameplate shall be approximately 20 mm x 75 mm for equipment and 40 mm x 150 mm for the panels.

(d) Items of plant such as valves, which are subject to handling, are to be provided with an engraved chromium plated nameplate or label with engraving filled with enamel, suitably mounted or affixed with strong rustproof chain

(e) All such nameplates, instruction plates, lubrication charts etc. shall be with English inscriptions. exemption

8.0 METERING BASES AND CHART UNITS

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

(a)	Pressure	:	Kg/cm^2.
(b)	Differential Pressure	:	mm of H_2O column/Kg/cm^2.
(c)	Draught	:	mm of H_2O column.
(d)	Vacuum	:	Kg/cm^2 (abs)/mm of Hg column.
(e)	Temperature	:	Degree Celsius (°C).
(f)	Flow (Steam, Water)	:	Tonnes/hr, M^3/Hr.
(g)	Flow (Oil)	:	M^3/Hr, Litter/Hr.
(h)	Flow Air	:	Tonnes/hr/M^3/Hr.
(i)	Density	:	gms/c.c.
(j)	Level	:	mm/%.
(k)	Conductivity	:	Siemens/cm.
(l)	Gas Analyzer	:	Percentage by weight or as specified in respective case.
(m)	Dissolved Oxygen/Silica /Sodium	:	ppm /ppb.

	SPECIFICATION FOR LOCAL PANELS	SPECIFICATION NO.: PE-SS –999- 145 –054A	
		VOLUME II B	
		SECTION D	
		REV. NO. 03	DATE : 16-09-2013
		SHEET 1	OF 6

1.0 SCOPE

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

2.0 CODES AND STANDARDS

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

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

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

3.0 TECHNICAL REQUIREMENTS

3.1 Panel Construction

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

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

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

3.1.4 The salient features of construction shall be:

Sheet material: Cold rolled sheet steel
Frame thickness: Not less than 3.0mm
Enclosure thickness: Not less than 3.0 mm for load bearing sections (Mounted with instruments)
2.0 mm for doors and Not less than 2.0 mm for others
Panel Height: Not less than 2365 mm (Refer data sheet-A (No. PES-145A-DS1-0)
Gland plate thickness: 3.0mm
Base channel: ISMC 100 with anti-vibration mounting & foundation bolts.

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

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

3.1.7 The class of protection shall be in accordance with IP-55 unless otherwise specified in the data sheet – A (No. PES-145-54A-DS1-0).

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

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

3.1.10 All operable and indicating devices shall be mounted on the front of the panel while aux. Relays / timers MCBs etc. required for realization of control logics shall be mounted on a mounting plate inside the panel. Auxiliary relays and timers etc. shall be grouped according to the control function.

No operable or indicating devices shall be mounted below 750 mm and above 1800 mm (w.r.t. finished ground level). The devices shall be located in such a way so as to ensure easy access for operation / maintenance.

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

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

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

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

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

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

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

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

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

3.2 Hazardous Area Panel Requirement

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

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

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

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

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

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

3.3 Control & Monitoring devices

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

3.3.2 Alarm Annunciator System

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

3.3.3 Relays

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

3.3.4 Timers

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

3.3.5 Control / Selector Switches

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

3.3.6 Push Buttons / Indicating Lights

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

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

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

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

3.3.7 Ammeters

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

3.3.8 Miniature Circuit Breaker (MCB)

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

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

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

4.0 TESTING AND INSPECTION

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

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

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

4.3.1 Routine Tests

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

4.3.2 Type Tests

1. Enclosure Class Test

5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

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

5.2. Mandatory Spares

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

5.3. Recommended Spares

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

6.0 DRAWINGS AND DOCUMENTS

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

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

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

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

7.0 MARKING AND PACKING

7.1 Panel with all instruments / devices mounted on it shall be suitably packed & protected for the entire period of despatch, storage and erection against impact, abrasion, corrossion, incidental damage due

to vermin, sunlight, high temperature, rain moisture, humidity, dust, sea-water spray (where applicable) as well as rough handling and delays in Transit and storage in open.

8.0 APPLICABLE DATA SHEET FORMS

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

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

APPLICABLE CODES AND STANDARDS

The required quantities of cable accessories shall be similarly estimated on the basis of number of terminations and proposed routing of the cables and shall be included in the offer allowing a positive allowance of at least 30% for each accessory. The exact quantity of different accessories shall be specified in the offer. Any shortfall in the quantity of accessories observed during actual laying shall be compensated at no extra cost.

5.0 PROVEN PRODUCT

5.1 The offered model of DCS, Microprocessor based control system must have been successfully supplied, erected, tested and commissioned as complete station Control & Instrumentation system for at least two units of capacity not less than 600 MW supercritical Thermal Power Station(s) with reheat type pulverized coal fired boiler. Further, these units should be in successful operation for a minimum period of two (2) years.

5.2 Similarly, all other C&I equipment/PLC/systems/sub-systems/ instruments and accessories in the power cycle shall also be of make and model whose guaranteed and trouble-free performance has been proven at least for two (2) years in not less than two (2) different reheat type pulverized coal fired units of unit size not less than 500 MW.

5.3 Bidder shall furnish required information to fully satisfy Owner regarding successful operation and high reliability of products/systems furnished.

6.0 CODES AND STANDARDS

6.1 Items such as thermowells, control valves, flow elements and other in line devices in high and medium pressure steam, feed water and similar services, which fall under the purview of Indian Boiler Regulation Act shall be either certified by IBR or shall be certified by authorities acceptable to IBR. It shall be responsibility of Bidder to obtain the necessary approval of the concerned Authority/Chief Inspector of Boiler for the design and design calculations, manufacturing and erection procedure as called for under the IBR Act for all items requiring such certification.

6.2 Generally, the following latest edition of codes and standards prevailing at the time of award of contract shall be applicable.

6.2.1 Temperature Measurement

(a) Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974).

(b) Temperature Measurement - Thermocouples - ANSI - MC 96.1 - 1982.

(c) Temperature Measurement by electrical resistance thermometers - IS: 2806.

(d) Thermometer-element-Platinum resistance - IS: 2848 / DIN 43760.

6.2.2 Pressure Measurement

(a) Instrument and apparatus for pressure measurement - ASME PTC 19.2 (1964).

(b) Bourdon tube pressure and vacuum gauges - IS: 3624/1996.

6.2.3 Flow Measurement

(a) Instruments and apparatus for flow measurement - ASME PTC 19.5 (1972) Interim supplement, Part-II.

(b) Measurements of fluid flow in closed conduit - BS 1042.

6.2.4 Electronic Measuring Instruments and Control Hardware

(a) Automatic null balancing electrical measuring instruments -ANSI C 39.4 (Rev. 1973), IS 9319.

(b) Safety requirements for electrical and electronic measuring and controlling instrumentation - ANSI C 39.5/1974.

(c) Compatibility of analog signals for electronic industrial process instruments - ISA-S 50.1: ANSI MC 12.1/1975.

(d) Dynamic response testing of process control instrumentation - ANSI MC 4.1 (1975) - ISA -S26 (1968).

(e) Surge withstand capability (SWC) tests - ANSI C 37.90A (1989), IEC-255.4.

(f) Printed circuit boards - IPC TM-650, IEC 326C.

(g) General requirements and tests for printed wiring boards - IS-7405 (Part-I)/1973.

(h) Edge socket connectors - IEC 130-11.

(i) Requirements and methods of testing of wire wrap terminations- DIN 41611 Part-2.

(j) Dimensions of attachment plugs and receptacles- ANSI C73-1973. (Supplement ANSI C73a – 1980.

6.2.5 Instrument Switches and Contacts

(a) Contact Rating - AC services NEMA ICS Part-2 125, A-600.

(b) Contact Rating - DC services NEMA ICS Part-2 125, N-600.

6.2.6 Enclosures

(a) Enclosures for Industrial Controls and Systems–NEMA ICS-6-110.15 through 110.22.

(b) Racks, panels and associated equipment -EIA: RS-310-B-1983 (ANSI C83.9 - 1972).

6.2.7 Apparatus, Enclosures and Installation Practices in Hazardous Area

(a) Classification of hazardous area - NEMA Article 500, Volume-6, 1978.

(b) Electrical Instruments in hazardous dust locations - ISA-RP 12.11.

(c) Intrinsically safe apparatus - NFPA Article 493 Volume-4 1978.

(d) Purged and pressurized enclosure for electrical equipment in hazardous location - NFPA Article 496 Volume-4, 1978.

6.2.8 Sampling System

(a) Stainless Steel material of tubing and valves, for sampling system - ASTM A 269-79 GRTO-316.

(b) Submerged helical coil heat exchangers for sample coolers - ASTM D11-98.

6.2.9 Annunciator

(a) Specifications and guides for the use of general-purpose annunciators - ISA RP 18.1.

(b) Surge withstand capability tests -ANSI C37.90 a -1971 and IEEE Standard 472-1974.

6.2.10 Interlocks, Protections

(a) Relays and relay system associated with electric power apparatus - IEEE Standards 3.13.

(b) Surge withstand capability tests - ANSI C37.90 a - 1971 and IEEE Standard 472-1974.

(c) General requirements and tests for switching devices for control and auxiliary circuits including contactor relays - IS-6875 (Part-I)/ 1973.

(d) Turbine water damage prevention - ASME-TDP-1-1980.

(e) Boiler safety interlocks - NFPA Section 85B, 85D, 85E, 85F, 85G.

6.2.11 UPS System

(a) Practice and requirements for semi-conductor power rectifiers - ANSI C34.2.

(b) Relays and relay systems associated with electrical power apparatus IEEE Standard - 3.13.

(c) Surge withstand capability tests - ANSI C 70.90 A/1971, IEC-255.4.

(d) Recommended practice for sizing large lead storage batteries for generating stations and sub-stations - -IEEE-485.

(e) Battery: IEEE Std. 1106/IS, 10918, BS 6920-II: 1984, IS 1652, IEC 896-1987.

(f) For Lead acid plante type battery selection & sizing : IEEE Std. 485:1997

6.2.12 Control Valves

(a) Control valve sizing (Incompressible fluids) - ISA-S39.2 / 1972.

(b) Control valve sizing (Compressible fluids) - ISA-S39.4 / 1972.

(c) Control Valve seat leakage – ANSI / FCI 70.2.

(d) Face to face dimensions of Control Valves - ANSI B16.10.

(e) Control Valve Capacity Test Procedure – ISA – S75.02.

6.2.13 Instrument Tubing

(a) Seamless Carbon Steel Pipe - ASTM-A-106.

(b) Forged carbon steel fittings - ASTM-A-105.

(c) Dimensions of fittings - ANSI-B16.11.

(d) Code for pressure piping, welding, hydrostatic testing - ANSI-B 31.1.

(e) Nomenclature for instrument tube fittings - ISA-RP 42.1 / 1982.

(f) Seamless Stainless Steel Tube ASTM A-213 TP 316 / ASTM A-269 TP 316.

(g) Seamless Alloy Steel Pipe ASTM A 335 P22.

(h) Seamless Stainless Steel Pipe ASTM A-312 TP 316.

6.2.14 Cables

(a) Thermocouple extension wires/cables - ANSI MC96.1.

(b) Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy-IPCEA S-61-402.

(c) Guide for design and installation of cable system in power generating station (insulation, jacket materials) -IEEE Standard 422.

(d) Requirements of vertical tray flame test - IEEE 383.

(e) Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B33.

6.2.15 Electronic Cards, Subassemblies and Components

(a) Unpackaged.

(i) Vibration : IEC-68.2.6

(ii) Shock : IEC-68.2.27

(iii) Drop & Topple : IEC-68.2.31

(b) Packaged

Vibration, Drop & Static Compression – NSTA.

(c) Electromagnetic Compatibility

(i) Electrical Fast Transient : IEC-801.4

(ii) Surge Withstand : IEC-255.4

(iii) Radiated Electromagnetic Field : IEC-801.3

(iv) Electrostatic Discharge : IEC-801.2

(v) Electromagnetic Emissions : VDE 0871, Class-B

6.2.16 Cable Trays, Conduits

(a) Guide for the design and installation of cable system in power generating station (cable trays, support systems, conduits)- IEEE Standard 422, NEMA VE-1, NEC-1981. Test Standards NEMA VE-1-1979.

(b) Galvanizing of carbon steel cable trays - ASTM A-386.

7.0 DESIGN CRITERIA

This section lays down the general design criteria to be adapted in designing the instrumentation and control system of the plant.

7.1 GENERAL REQUIREMENTS

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

(a) Stable in spite of temperature fluctuations.

(b) Able to withstand high humidity.

(c) Weather proof.

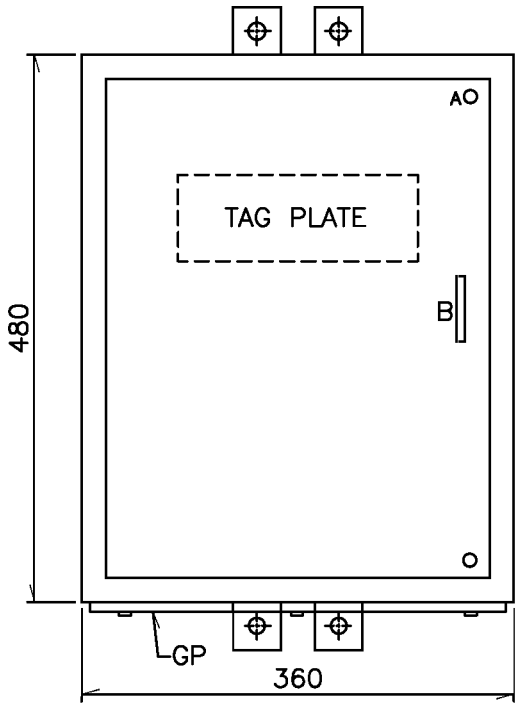
(d) Dust proof.

(e) Corrosion resistant.

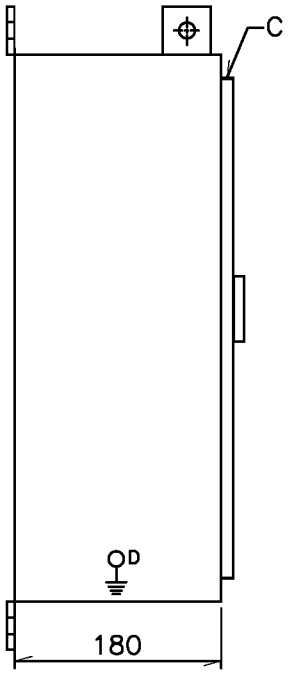
(f) Erosion resistant.

(g) Able to withstand high vibration.

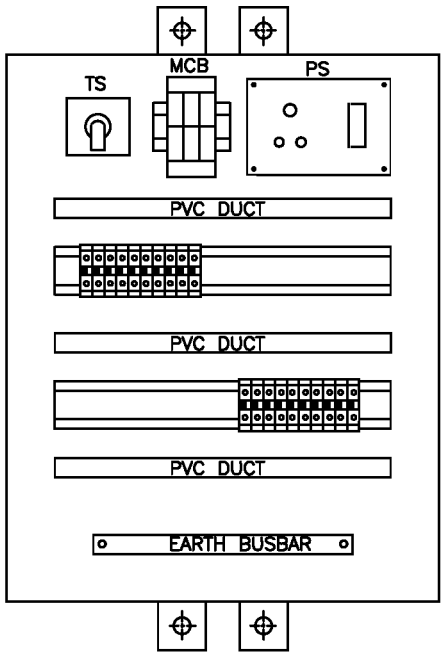
DRAWINGS



FRONT VIEW



SIDE VIEW



INTERNAL FRONT VIEW

LEGEND:

A – DOOR LOCK
B – DOOR HANDLE
C – HINGES
D – EARTH STUD
GP – GLAND PLATE
PS – POWER SOCKET
TS – TOGGLE SWITCH
TBS – TERMINAL BLOCKS

NOTES:

1. JB WILL BE MADE OUT OF 2.0 mm CRCA SHEET.
2. PROTECTION CLASS IP–65.
3. COLOR: EXT.–RAL 7032, INT.–BRILLIANT WHITE.
4. NUTS FOR MOUNTING THE JUNCTION BOX SHALL BE PROVIDED.
5. 3 mm THICK CRCA GLAND PLATE (GP) AT BOTTOM SHALL BE PROVIDED.
6. SCREWLESS CAGE CLAMP TERMINALS SHALL BE USED.
7. EARTH BUS BAR SHALL BE OF 25x6 TINNED COPPER.
8. INSTRUMENT TAG VIS–A–VIS SERVICE AND TERMINAL DETAILS SHALL BE PRINTED ON PHENOLIC BOARD MOUNTED ON BACK SIDE OF DOOR.
9. COLOR CODE FOR POWER SUPPLY: PHASE–RED, NEUTRAL–BLACK & EARTH – GREEN.
10. CABLE FOR PANEL LIGHTING SHALL BE 1.5 SQ.mm, 1100V GRADE.
11. SIGNAL WIRING SHALL BE 4Px0.5 SQ.mm TINNED COPPER, TWISTED PAIR, OVERALL SHIELDED 500V GRADE, FRLS PVC.
12. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.

FOR BID PURPOSE ONLY

ISSUE	BY	CH	DATE

PROCON ENGINEERS
(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT. LTD.)

CLIENT : MAHARASHTRA STATE POWER GENERATION CO.LTD.

PROJECT : BHUSAWAL T.P.S. UNIT–6 : 1 X 660 MW PROJECT

DO NOT SCALE | DATE : 23–08–2011

G.A. OF JB LOCAL INSTRUMENT RACK

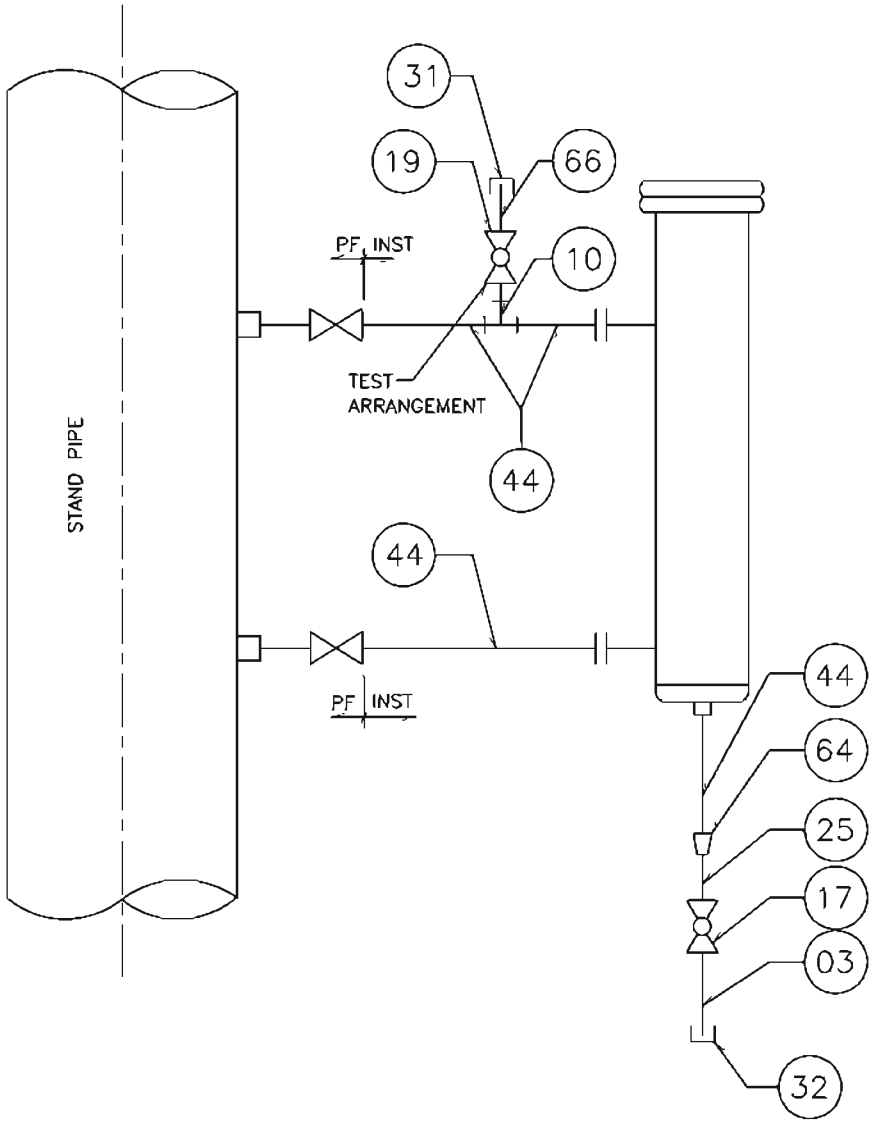
SCALE ~ | APPROVED

DIV INST.
DR P.N.Z.
CH D.J.P.

DWG.NO.PE–189–IN–SK–8004 (SH. 5 OF 10) | P0

TITLE: TYPICAL INSTRUMENT INSTALLATION DIAGRAM
DWG.NO. PE-189-IN-SK-8003 (SH. 10 OF 20)

FLOAT OPERATED LEVEL SWITCH



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
17	1	GLOBE VALVES 1/2" SW 800lbs, CS/AS
25	0.5 MTRS.	IMPULSE PIPE 15 NB SCH 80, CS/AS
32	1	PLUG 1/2" NPT(M) 3000lbs, CS/AS
10	2	EQUAL TEE (FEMALE) 1" SW 3000lbs, CS/AS
44	2 MTRS.	IMPULSE PIPE 25 NB SCH 80, CS/AS
64	1	REDUCER 1" SW x 1/2" SW 3000lbs, CS/AS
19	1	GLOBE VALVES 1" SW 800lbs, CS/AS
31	1	PLUG 1" NPT(F) 3000lbs, CS/AS
66	1	1" NB SCH 80 SW x 1" NPT(M) SEAMLESS NIPPLE 3000 lbs, CS/AS
03	1	15 NB SCH 80 SW x 1/2" NPT(M) SEAMLESS NIPPLE 3000lbs, CS/AS

SERVICE : CONDENSATE.

FOR BID PURPOSE ONLY

DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED CHEM	CIVIL	ELEC	I&C	MECH	APPD	DATE

FOR RO ISSUE ONLY		
CLEARED		
DEPT	SIGNATURE	DATE
CHEM		
CIVIL		
ELEC		
I&C		
MECH		

"A" (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION / FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSE ONLY AS INDICATED IN THE SHELL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.
CONSTRUCTION / FABRICATION WORK IS PERMITTED ON "B" (UNCLEARED) ISSUES ONLY.
INFORMATION CONTAINED WITHIN "HOLD" IS NOT RELEASED FOR CONSTRUCTION / FABRICATION. FIELD MUST GO DESIGN OFFICE TO CLEAR "HOLDS" IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION / FABRICATION WORK RELATED TO "HOLDS".
DRAWINGS SIGNED BY PROCON ENGINEERS' AUTHORISED REPRESENTATIVE ONLY ARE CONSIDERED VALID DRAWINGS.

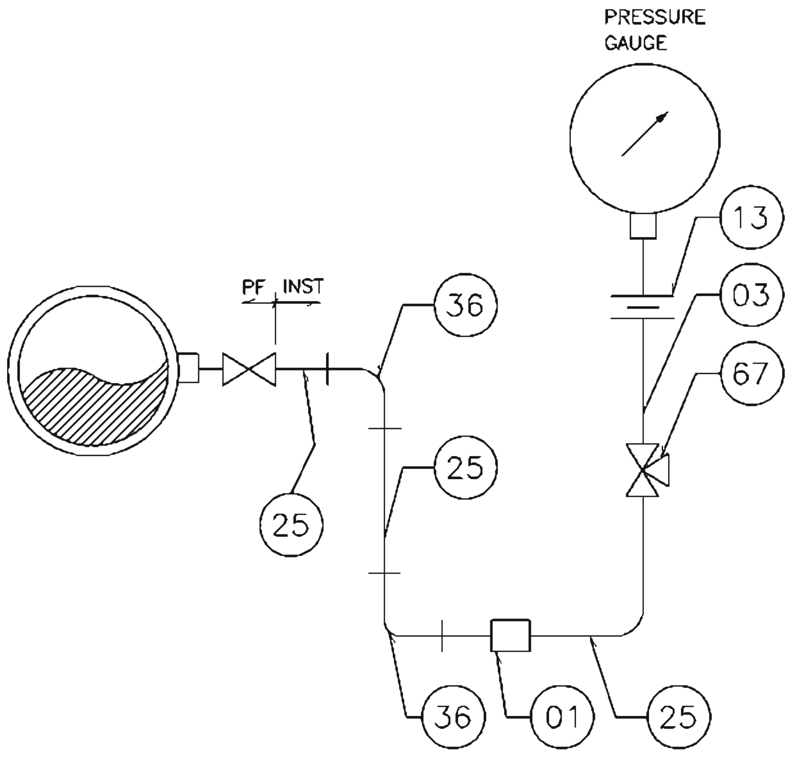
MAHAGENCO

MAHARASHTRA STATE POWER GENERATION CO.LTD.
BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

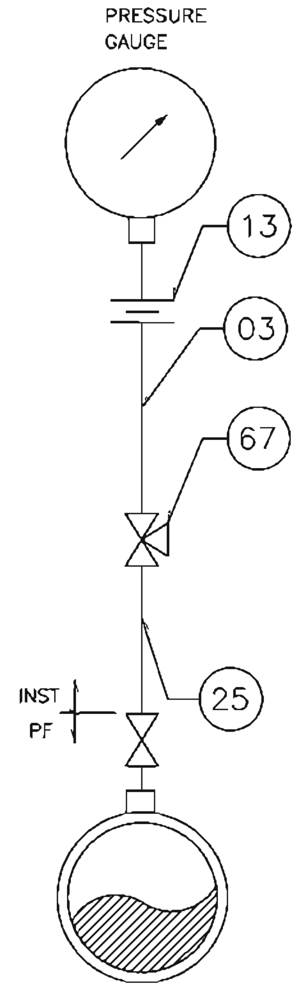
TYPICAL INSTRUMENT INSTALLATION DIAGRAM

PROCON ENGINEERS
(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)

SCALE	~	DATE(RO ISSUE)
DSN.	INST.	APPROVED
DR.	P.N.Z.	DATE(CURRENT ISSUE) 23-08-2011
CH.	D.J.P.	DWG.NO. PE-189-IN-SK-8003 (SH. 10 OF 20) ISSUE PQ



HORIZONTAL TAPPING



VERTICAL TAPPING

BILL OF MATERIAL

ITEM NO.	QTY./ INST	DESCRIPTION
25	15 MTRS.	IMPULSE PIPE 15 NB SCH 80, CS/AS
01	1	FULL COUPLING 1/2'' SW 3000lbs, CS/AS
36	2	90° ELBOW 1/2'' SW 3000lbs, CS/AS
03	1	1/2'' NPT(M) x 1/2'' PE, 4'' LONG NIPPLE, CS/AS
13	1	NUT & TAIL FITTING WITH CU WASHER 1/2'' NPT(F) x 1/2'' PE
67	1	3 WAY GAUGE COCK 1/2'' SW 3000lbs, CS/AS

SERVICE : WATER, CONDENSATE ETC.

FOR BID PURPOSE ONLY

DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED: CHEM	CIVIL	ELEC	I&C	MECH	APPD	DATE

FOR RO ISSUE ONLY

DEPT	CLEARED SIGNATURE	DATE
CHEM		
CIVIL		
ELEC		
I&C		
MECH		

MAHAGENCO

MAHARASHTRA STATE POWER GENERATION CO.LTD.
BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

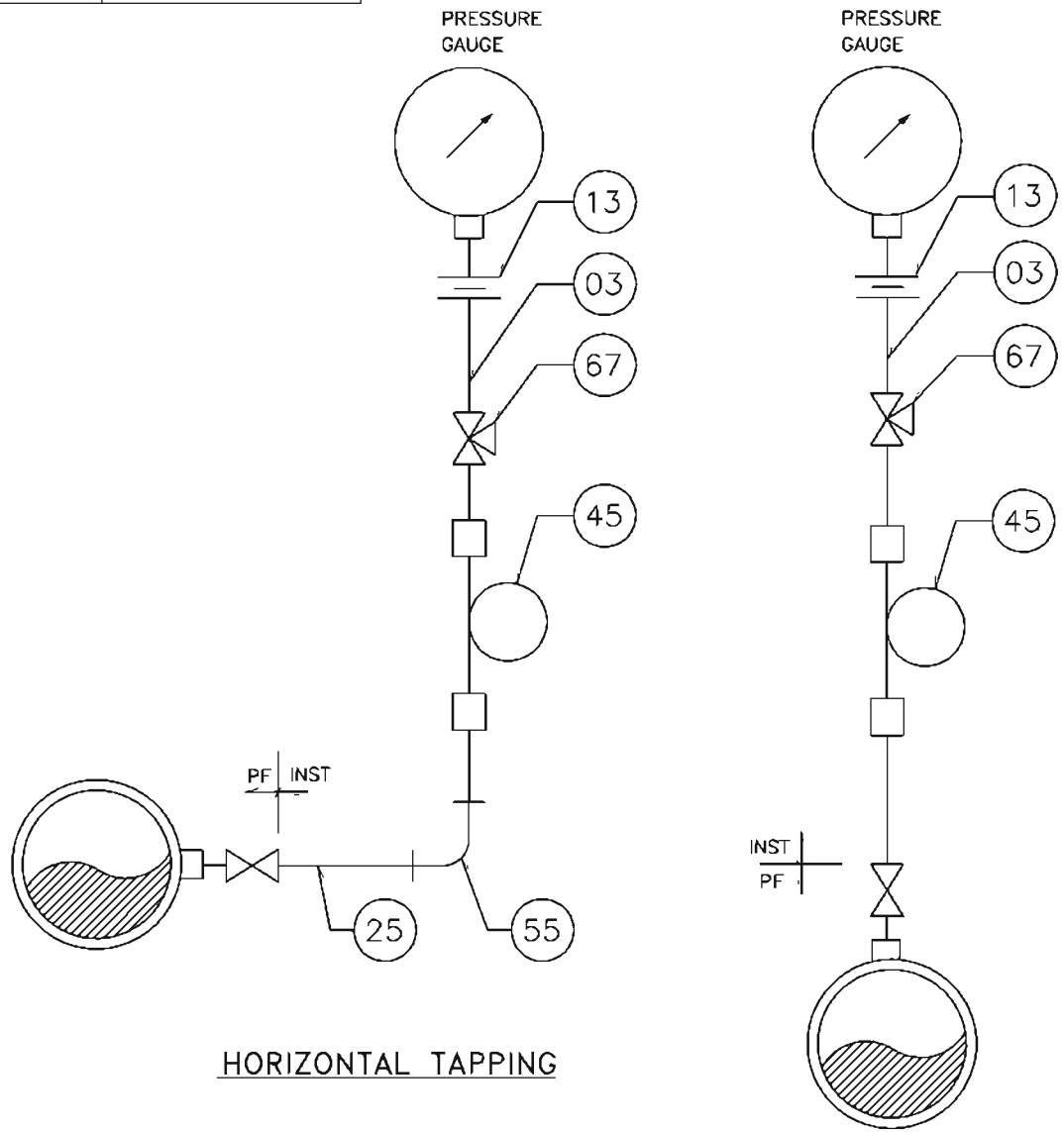
PROCON ENGINEERS
(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)

SCALE ~ | APPROVED | DATE(RO ISSUE)
DIV. INST.
DR. P.N.Z.
CH. D.J.P.
DATE(CURRENT ISSUE) 23-08-2011
DWG.NO. PE-189-IN-SK-B003 (SH. 11 OF 20) ISSUE P0

TITLE: TYPICAL INSTRUMENT INSTALLATION DIAGRAM | DWG.NO. PE-189-IN-SK-B003 (SH. 11 OF 20)

TITLE: TYPICAL INSTRUMENT INSTALLATION DIAGRAM

DWG.NO. PE-189-IN-SK-8003 (SH. 12 OF 20)



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
25	15 MTRS.	IMPULSE PIPE 15 NB SCH 80, CS/AS
55	1	90° ELBOW 1/2" SW 6000lbs, CS/AS
03	1	1/2" NPT(M) x 1/2" PE 4" LONG NIPPLE, CS/AS
13	1	NUT & TAIL FITTING WITH SS WASHER 1/2" NPT(F) x 1/2" PE
45	1	SYPHON 1/2" OD SCH. 80, CS/AS
67	1	3 WAY GAUGE COCK 1/2" SW 3000lbs, CS/AS

SERVICE : STEAM, FEED WATER.

FOR BID PURPOSE ONLY

DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED CHEM	CIVIL	ELEC	I&C	MECH	APPD	DATE

FOR RO ISSUE ONLY CLEARED		
DEPT	SIGNATURE	DATE
CHEM		
CIVIL		
ELEC		
I&C		
MECH		

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CONSTRUCTION / FABRICATION WORK IS PERMITTED ON 'B' (RELEASED) ISSUES ONLY.

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DRAWINGS SIGNED BY PROCON ENGINEERS' AUTHORISED REPRESENTATIVE ONLY ARE CONSIDERED VALID DRAWINGS.

MAHAGENCO

MAHARASHTRA STATE POWER GENERATION CO.LTD.
BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

PROCON ENGINEERS
(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)

SCALE	~	APPROVED	DATE(RO ISSUE)
DIV.	INST.		
DR.	P.N.Z.		DATE(CURRENT ISSUE) 23-08-2011
CH.	D.J.P.	DWG.NO. PE-189-IN-SK-8003(SH. 12 OF 20)	ISSUE P0

4.0 LIST OF APPROVED VENDORS – CONTROL & INSTRUMENTATION

SR. NO.	NAME OF EQUIPMENT / ITEM		APPROVED VENDORS
1.0	**FIELD / PRIMARY INSTRUMENTS:**		
1.1	RTD & THERMOCOUPLES	(a)	PYRO ELECTRIC INSTRUMENTS GOA PVT. LTD.
		(b)	GENERAL INSTRUMENTS CONSORTIUM, MUMBAI
		(c)	DETRIVE, MUMBAI
		(d)	TEMSENS INSTRUMENTS(I) PVT. LTD, UDAIPU
1.2	SMART ELECTRONIC TRANSMITTERS (PRESSURE, DIFF. PRESSURE)	(a)	EMERSON PROCESS MANAGEMENT (I) LTD
		(b)	FUJI, JAPAN
		(c)	YOKOGAWA, JAPAN/ YOKOGAWA INDIA
		(d)	ABB, GERMANY / FARIDABAD
		(e)	HONEYWELL, USA / PUNE
1.3	DISPLACER TYPE LEVEL TRANSMITTER	(a)	CHEMTROL MIL
		(b)	DRESSER, COIMBTORE
		(c)	V-AUTOMAT, DELHI
		(d)	ECKARDT, GERMANY
1.4	LEVEL TRANSMITTERS (DISPLACEMENT TYPE)	(a)	DRESSER MASONIELAN, FRANCE (DRESSER VALVES INDIA LTD. COIMBATORE)
		(b)	CHEMTROLS, MUMBAI (ECKARDT, GERMANY)
		(c)	ECKARDT, GERMANY

SR. NO.	NAME OF EQUIPMENT / ITEM		APPROVED VENDORS
1.5	LEVEL TRANSMITTERS (ULTRASONIC TYPE)	(d)	ENDRESS+HAUSER, GERMANY/INDIA
		(e)	KROHNE, FRANCE
		(f)	PEPPERL+FUCHS, GERMANY/INDIA
		(g)	VEGA, GERMANY
		(h)	KAB INSTRUMENTS LTD.
1.6	RADAR TYPE LEVEL TRANSMITTERS	(a)	SIEMENS MILLTRONICS
		(b)	ENDRESS & HAUSER
		(c)	SBEM
		(d)	EMERSON
		(e)	AMETEKEDREXELBRROK (CHEMTROLS)
1.7	TEMPERATURE TRANSMITTERS	(a)	EMERSON PROCESS (FORMERLY FISHER ROSEMOUNT), USA/DAMAN
		(b)	ABB, GERMANY / FARIDABAD
		(c)	FUJI, JAPAN
		(d)	HONEYWELL, USA / PUNE
		(e)	YOKOGAWA, JAPAN/ YOKOGAWA INDIA
		(f)	MOORE, USA
1.8	MAGNETIC LEVEL SWITCHES	(a)	LEVCON INSTRUMENTS PVT. LTD., KOLKATA
		(b)	V.AUTOMAT, NEW DELHI
		(c)	ASIAN INDUSTRIAL VALVES, CHENNAI
1.9	LEVEL SWITCHES CONDUCTIVITY TYPE	(a)	BHARAT HEAVY ELECTRICALS LTD.
		(b)	YARWAY, USA

SR. NO.	NAME OF EQUIPMENT / ITEM		APPROVED VENDORS
		(c)	LEVELSTATE, UK
		(d)	SOLARTON, UK (PRESENTLY CALLED AS MOBREY)
		(e)	CHEMTROL
		(f)	LEVEL STATE (HITECH SYSTEMS)
		(g)	MOBREY
1.10	FLOW SWITCHES	(a)	SWITZER, CHENNAI
		(b)	KRONHE MARSHALL
		(c)	GENERAL INSTRUMENTS MUMBAI
		(d)	CHEMTROL
1.11	BYPASS ROTAMETER	(a)	IEPL, HYDERABAD
		(b)	PLACKA INSTRUMENTS INDIA PVT. LTD., CHENNAI
		(c)	TRAC, HYDERABAD
		(d)	EUREKA, PUNE
1.12	ROTAMETER	(a)	INSTRUMENTATION ENGINEERS PVT. LTD.
		(b)	SIGMA INSTRUMENTS CO.
		(c)	EUREKA INDUSTRIAL EQPT. PVT. LTD.
		(d)	TELACE EQUIPMENT PVT. LTD.
1.13	FLOW INTEGRATOR (ELECTRONIC TYPE)	(a)	ABB, GERMANY / FARIDABAD
		(b)	MASIBUS, GANDHINAGAR
		(c)	YOKOGAWA, JAPAN/ YOKOGAWA INDIA
		(d)	LEKKTROTEK, PUNE
		(e)	EMERSON

SR. NO.	NAME OF EQUIPMENT / ITEM		APPROVED VENDORS
		(f)	ENDRESS & HAUSER
		(g)	FORBES MARSHALL
1.14	GAUGES (PRESSURE, DIFF. PRESSURE)	(a)	A N INSTRUMENTS PVT. LTD., KOLKATA
		(b)	GENERAL INSTRUMENTS CONSORTIUM, GOA/ MUMBAI
		(c)	GOA THERMOSTATIC INSTRUMENTS, GOA
		(d)	FORBES MARSHALL LTD., HYDERABAD
		(e)	WAAREE INDUSTRIES, MUMBAI
		(f)	H.GURU INSTRUMENTS (SOUTH INDIA), BANGALORE
		(g)	WIKA INSTRUMENTS INDIA PVT. LTD., PUNE
		(h)	GOA INSTRUMENTS PVT. LTD.,
		(i)	MONOMETER, MUMBAI
		(j)	BELLS CONTROLS LTD., KOLKATA
		(k)	SWITZER INSTRUMENTS LTD., CHENNAI
		(l)	WIKA ALEXANDER WIEGAND GMBH&CO., GERMANY
		(m)	BUDENBURG GUAGE CO. LTD
		(n)	INSTRUMENTATION PVT. LTD., BANGALORE
		(o)	INDOSONIC INSTRUMENT, MUMBAI
		(p)	PRECISION
		(q)	ASHCROFT

SR. NO.	NAME OF EQUIPMENT / ITEM		APPROVED VENDORS
1.15	TEMPERATURE GAUGE	(a)	GOA THERMOSTATIC INSTRUMENTS, GOA
		(b)	GENERAL INSTRUMENTS CONSORTIUM,
		(c)	A.N. INSTRUMENTS PVT. LTD., KOLKATA
		(d)	H. GURU INSTRUMENTS (SOUTH INDIA), BANGALORE
		(e)	FORBES MARSHALL, HYDERABAD
		(f)	WIKA INSTRUMENTS INDIA PVT. LTD., PUNE
		(g)	WAREE, DADRA GOA INSTRUMENTS PVT. LTD.,
		(h)	BELLS CONTROLS LTD., KOLKATA
		(i)	SWITZER INSTRUMENTS LTD., CHENNAI
		(j)	WIKA ALEXANDER WIEGAND GMBH&CO., GERMANY
		(k)	BUDENBURG GUAGE CO. LTD.
		(l)	INDOSONIC INSTRUMENT, MUMBAI
1.16	SWITCHES (PRESSURE, DIFF. PRESSURE)	(a)	INDFOSS INDUSTRIES LTD., GHAZIABAD
		(b)	SWITZER INSTRUMENTS COMPANY, CHENNAI
		(c)	SOR INC., USA
		(d)	PYROELECTRIC, GOA
		(e)	DRESSER INDUSTRIES INC, USA
		(f)	REGULATEURS GEORGIN, FRANCE

SR. NO.	NAME OF EQUIPMENT / ITEM		APPROVED VENDORS
		(g)	DELTA CONTROLS LTD., U.K.
		(h)	KDG INSTRUMENTS LTD. U.K.
		(i)	ASHCROFT
		(j)	DWAYER, USA
		(k)	GENERAL INSTRUMENTS CONSORTIUM
1.17	TEMPERATURE SWITCH	(a)	INDFOSS INDUSTRIES LTD., GHAZIABAD
		(b)	SWITZER INSTRUMENTS COMPANY, CHENNAI
		(c)	GENERAL INSTRUMENTS CONSORTIUM, MUMBAI
		(d)	SOR INC., USA
		(e)	PYROELECTRIC, GOA DRESSER INDUSTRIES INC, USA
		(f)	REGULATEURS GEORGIN, FRANCE
		(g)	DELTA CONTROLS LTD., U.K.
		(h)	KDG INSTRUMENTS LTD. U.K.
1.18	AIR FILTER REGULATOR	(a)	PLACKA, CHENNAI
		(b)	SHAVO NORGREN, INDIA
1.19	MASS FLOW METER (CORROLIOUS PRINCIPLE)	(a)	EMERSON PROCESS MANAGEMENT (I) LTD
		(b)	ABB
		(c)	YOKOGAWA
		(d)	ENDRESS+ HAUESER
		(e)	GE SENSING & INSPECTION TECHNOLOGIES
		(f)	FORBES MARSHALL

SR. NO.	NAME OF EQUIPMENT / ITEM		APPROVED VENDORS
1.20	I/P CONVERTER	(a)	ECKHARDT, GERMANY
		(b)	MTL, CHENNAI
		(c)	ABB
		(d)	WATSON SMITH (PRESENTLY NORGREN)
		(e)	EMERSON PROCESS MGMT ASIA PACIFIC LTD.
		(f)	MOORE CONTROLS
1.21	FLOW ELEMENTS	(a)	INSTRUMENTATION LTD.
		(b)	MICRO PRECISION PRODUCTS
		(c)	ENGINEERING SPECIALITIES PVT. LTD.
		(d)	GENERAL INSTRUMENTS
1.22	LEVEL GAUGES (FLOAT TYPE)	(a)	SB ELECTRO
		(b)	SIGMA
		(c)	V AUTOMAT
		(d)	LEVCON
		(e)	CHEMTROLS
		(f)	ASIAN INDUSTRIAL VALVES
1.23	ORP TRANSMITTERS	(a)	FORBES MARSHALL
1.24	DENSITY METER (NUCLEONIC TYPE)	(a)	ENDRESS + HAUSER
		(b)	THERMO MEASURE TECH.
		(c)	CHEMTROL (THERMO FISHER)
1.25	DENSITY METER (NON-NUCLEONIC TYPE)	(a)	ENDRESS + HAUSER
		(b)	THERMO MEASURE TECH.
		(c)	CHEMTROL (THERMO FISHER)

SR. NO.	NAME OF EQUIPMENT / ITEM		APPROVED VENDORS
1.26	SOLID MASS FLOW METER	(a)	SIEMENS MILLTRONICS
		(b)	CHEMTROL (THERMO FISHER)
		(c)	SIEMENS INSTRUMENTS, CANADA
1.27	PULL CORD SWITCH	(a)	JAYASHREE ELECTRODEVICES PVT. LTD.
		(b)	A.G. SYSTEM CONTROLS, MUMBAI
1.28	BELT SWAY SWITCH	(a)	JAYASHREE ELECTRODEVICES PVT. LTD.
		(b)	A.G. SYSTEM CONTROLS, MUMBAI
1.29	ZERO SPEED SWITCH	(a)	A.G. ELECTRONICS
		(b)	JAYASHREE ELECTRODEVICES PVT. LTD.
1.30	PROXIMITY SWITCH	(a)	AW
		(b)	JAYASHREE ELECTRODEVICES PVT. LTD.
1.31	LEVEL SWITCH (RF TYPE)	(a)	EIP ENVIRO LEVEL CONTROLS
2.0	**DCS, HMI, MONITORING AND PLC SYSTEMS:**		
2.1	DDCMIS	(a)	ABB.
		(b)	YOKOGAWA
		(c)	SIEMENS.
		(d)	BHEL
		(e)	EMERSON PROCESS MANAGEMENT
		(f)	MHI
2.2	PLC	(a)	ALLEN BRADLEY.
		(b)	SCHNEIDER
		(c)	ROCKWELL

SR. NO.	NAME OF EQUIPMENT / ITEM		APPROVED VENDORS
		(d)	GE FANUC
2.3	MASTER SLAVE CLOCK	(a)	SYMMETRICOM INC., USA
		(b)	HOPF, GERMANY
		(c)	HATHWAY, USA
		(d)	SERTEL ELECTRONICS, CHENNAI
		(e)	ADVANCE MICRONIC
2.4	DOT MATRIX PRINTER	(a)	HP / EPSON / WIPRO / TVS / SAMSUNG
2.5	LASER & COLOUR INKJET PRINTERS	(b)	HP / EPSON / CANON / IBM / XEROX / SAMSUNG
2.6	COMPUTERS FOR OPERATOR / ENGINEER / HISTORY STATION, SHIFT SUPERVISOR, STORIAN, SOFT LINK STATION FOR INTERFACING WITH OTHER SYSTEMS, PERFORMANCE CALCULATION AND SER STATION	(a)	IBM
		(b)	DELL
		(c)	HP/COMPAQ
2.7	TFT MONITOR	(a)	LG / SAMSUNG / HP / COMPAQ / IBM / DELL
2.8	VIBRATION MONITORING SYSTEM & TURBO-SUPERVISORY INSTRUMENTS	(a)	ROCKWELL AUTOMATION, USA
		(b)	BENTLEY NEVADA, USA / INDIA
		(c)	SHINKAWA, JAPAN / FORBES MARSHALL,
		(d)	VIBROMETER, SWITZERLAND
2.9	LARGE VIDEO SCREENS	(a)	BARCO BELGIUM / BARCO, INDIA
		(b)	PLANAR, USA / PYROTECH, INDIA
		(c)	CHRISTIE, USA / CHRISTIE, INDIA

SR. NO.	NAME OF EQUIPMENT / ITEM		APPROVED VENDORS
		(d)	SYNELEC
		(e)	DELTA, THAILAND / DELTA POWER SYSTEMS, INDIA
2.10	HART COMMUNICATOR	(a)	HONEYWELL, USA/PUNE
		(b)	EMERSON PROCESS (FORMERLY FISHER ROSEMOUNT), USA / DAMAN
		(c)	YOKOGAWA, JAPAN / YOKOGAWA, INDIA
		(d)	MERIAM, USA / CHEMTROLS, MUMBAI
		(e)	ABB, GERMANY / INDIA
		(f)	FUJI, JAPAN
2.11	HART MANAGEMENT SYSTEM	(a)	PEPPERL+FUCKS, GERMANY / INDIA
		(b)	MTL, UK / INDIA
		(c)	EMERSON PROCESS, USA / DAMAN
2.12	ALARM ANNUNCIATION SYSTEM	(a)	PROCON, CHENNAI
		(b)	I I C, HYDERABAD
		(c)	MINILEC, PUNE
		(d)	IIC, MUMBAI
		(e)	PIRIE, MUMBAI
		(f)	PECON, VADODARA
		(g)	POSITRONICS
2.13	RMCMS (ROTATING MACHINE CONDITION MONITORING SYSTEM)	(a)	VIBROTECH (M/S MEGITT INDIA PVT. LTD.)
		(b)	M/S SKF INDIA LTD.
2.14	ACOUSTIC PYROMETER	(a)	BONNENBERG + DRESCHER GMBH, GERMANY

SR. NO.	NAME OF EQUIPMENT / ITEM		APPROVED VENDORS
2.15	ACOUSTIC STEAM LEAK DETECTION SYSTEM (ASLD)	(a)	HI-TECH SYSTEM & SERVICES LTD, NEW DELHI (AMI MAKE)
		(b)	SARTECH INTL, CHENNAI (INSTROTECH MAKE INSPECTA FFT
2.16	EPABX SYSTEM	(a)	SIEMENS
		(b)	BPL
2.17	FURNACE TV CAMERA SYSTEM	(c)	HITECH SYSTEM & SERVICES LTD. (M/S LENOX INSTRUMENT COMPANY INC., USA
3.0	**ELECTRICAL & SECONDARY INSTRUMENTS:**		
3.1	DIGITAL INDICATOR	(a)	ABB, GERMANY / FARIDABAD
		(b)	MASSIBUS, GANDHINAGAR PYROTECH, UDAIPUR
		(c)	LEKTROTEK, PUNE
		(d)	GOSSEN / CAMILLE BAUER / METRAWATT YOKOGAWA, JAPAN / INDIA
		(e)	SIEMENS
3.2	BARGRAPH INDICATORS	(a)	ABB, GERMANY / FARIDABAD
		(b)	MASSIBUS, GANDHINAGAR
		(c)	PYROTECH, UDAIPUR
		(d)	LEKTROTEK, PUNE
		(e)	GOSSEN / CAMILLE BAUER / METRAWATT
		(f)	M-SYSTEM, JAPAN (CHINO LAXSONS DAMAN)
		(g)	SIEMENS

SR. NO.	NAME OF EQUIPMENT / ITEM		APPROVED VENDORS
3.3	PEN, POINT AND CHARTLESS RECORDERS	(a)	EUROTHERM, UK
		(b)	TATA HONEYWELL
		(c)	YOKOGAWA, JAPAN (YOKOGAWA, INDIA)
		(d)	CHINO (LAXSON), JAPAN
		(e)	ABB, UK / GERMANY
		(f)	FUJI ELECTRIC, JAPAN
3.4	TRANSDUCERS	(a)	SEIMENS
		(b)	AUTOMATIC ELECTRIC LTD., MUMBAI
		(c)	PYROTECH, UDAIPUR
		(d)	SOUTHERN TRANSDUCERS, CHENNAI
		(e)	ACCORD, PUNE MECO, MUMBAI
		(f)	ABB
		(g)	SITU, MUMBAI
		(h)	RISHABH
		(i)	ADEPT, PUNE
3.5	ELECTRICAL ANALOG (PANEL) METERS	(a)	AUTOMATIC ELECTRIC LTD., MUMBAI
		(b)	MECO, MUMBAI
		(c)	RISHAB, NASIK
3.6	SELECTOR SWITCHES AND CONTROL SWITCHES	(a)	KAYCEE
		(b)	ALSTOM
		(c)	L & T
		(d)	SIEMENS

SR. NO.	NAME OF EQUIPMENT / ITEM		APPROVED VENDORS
3.7	MOSAIC ANALOG (MOVING COIL) INDICATORS	(a)	GOSSEN, GERMANY
		(b)	WEIGEL, GERMANY
3.8	MOSAIC DIGITAL INDICATORS	(a)	GOSSEN, GERMANY
		(b)	WEIGEL, GERMANY
3.9	INTERPOSING RELAYS FOR COMMAND OUTPUT TO MCC	(a)	JYOTI
		(b)	H&B
		(c)	ALSTOM
		(d)	ELASTA
		(e)	OEN SIEMENS
		(f)	ABB
3.10	RELAYS / AUX. CONTACTORS	(a)	TELEMECANIQUE & CTRLS
		(b)	ABB
		(c)	SIEMENS
		(d)	GEC – ALSTOM
		(e)	L & T
3.11	LIMIT SWITCHES	(a)	BHARTIYA CUTLER & HAMMER, FARIDABAD
3.12	MINIATURIZED PUSH BUTTONS / ILPB (24X48MM) MOSAIC GRID COMPATIBLE	(a)	SIEMENS
		(b)	TEW, GERMANY (OLD NAME SUBKLEW)
4.0	**CONTROL DESKS & PANELS:**		
4.1	UNIT CONTROL PANELS (UCP)/ ELECTRICAL CONTROL PANEL (ECP)/ CONTROL DESK (MOSAIC GRID BASED)	(a)	BHEL EDN
		(b)	PYRO TECH, UDAIPUR
		(c)	INSTRUMENTATION LTD. KOTA
		(d)	KHODAY CONTROL SYSTEMS, BANGALORE

SR. NO.	NAME OF EQUIPMENT / ITEM		APPROVED VENDORS
		(e)	CHEMIN CONTROLS, PONDICHERRY
4.2	CRT DESK / OPERATOR DESK	(a)	PYRO TECH, UDAIPUR
		(b)	INSTRUMENTATION LTD. KOTA
		(c)	KHODAY CONTROL SYSTEMS, BANGALORE
		(d)	CHEMIN CONTROLS, PONDICHERRY
4.3	MOSAIC GRID/ MOSAIC TILES & OTHER MOSAIC ITEMS	(a)	SYMO, SWITZERLAND
		(b)	TEW, GERMANY (OLD NAME SUBKLEW)
		(c)	PYROTECH
4.4	LOCAL PANELS / DISTRIBUTION BOARDS	(a)	CONTROL & SCHEMATICS
		(b)	PYROTECH
		(c)	RITTAL
		(d)	L&T
4.5	TERMINAL BLOCKS	(e)	ELMEX
		(f)	PHOENIX
		(g)	WAGO
5.0	**ANALYSERS:**		
5.1	SWAS ANALYSERS	(a)	POLYMETRON / ZELLWEGGER – ANALYTICALS
		(b)	ABB
		(c)	ORION, USA
		(d)	ROSEMOUNT ANALYTICAL-CHEMPURE,
		(e)	HACH ULTRA FRANCE,
		(f)	HACH USA

SR. NO.	NAME OF EQUIPMENT / ITEM		APPROVED VENDORS
		(g)	YOKOGAWA
		(h)	AMETECH
		(i)	FORBES MARSHALL
		(j)	EMERSON
5.2	SWAS (STEAM AND WATER ANALYSIS SYSTEM) PANELS	(a)	ABB KENT, U.K.
		(b)	ABB LTD. FARIDABAD
		(c)	FORBES MARSHAL
		(d)	EMERSON PROCESS MANAGEMENT INSTRUMENTATION LTD., KOTA
		(e)	YOKOGAWA
5.3	CO ANALYSER (IN SITU TYPE)	(a)	AMETEK, USA / SINGAPORE
		(b)	CODEL INTERNATIONAL LTD. UK
		(c)	LAND COMBUSTION UK
5.4	OXYGEN IN FLUE GAS ANALYSER (ZIRCONIA PROBE TYPE)	(a)	AMETEK, USA / SINGAPORE
		(b)	LAND INSTRUMENTS, UK
		(c)	EMERSON PROCESS MANAGEMENT (I) LTD
		(d)	YOKOGAWA, JAPAN
		(e)	ENOTECH, GERMANY
		(f)	ABB, UK
		(g)	TELEDYNE, USA
		(h)	FUJI (AIC)
5.5	SMOKE DENSITY ANALYSER / PARTICULATE EMISSION ANALYSER / OPACITY ANALYSER	(a)	DURAG, GERMANY
		(b)	CODEL, UK
		(c)	LAND COMBUSTION UK

SR. NO.	NAME OF EQUIPMENT / ITEM		APPROVED VENDORS
		(d)	EMERSON
		(e)	ABB
		(f)	FUJI (AIC)
5.6	NOX / SO2 ANALYSER (IN SITU)	(a)	CODEL, UK
		(b)	FORBES MARSHALL
		(c)	LAND COMBUSTION, UK
5.7	OZONE ANALYSER	(a)	BMT MESSTECHNIK, GMBH
5.8	RESIDUAL OZONE ANALYSER	(a)	ECO SENSORS / KAUFFMANN UMWITTECHNIK .EK
5.9	OZONE LEAK DETECTOR	(a)	OTTPL
6.0	**CONTROL VALVES / ACTUATORS / SOLENOID VALVES:**		
6.1	ELECTRICAL ACTUATORS FOR REGULATING & OPEN / CLOSE VALVES	(a)	ROTORK CONTROL (INDIA) LTD.,
		(b)	AUMA (INDIA) LTD.,
		(c)	LIMITORQUE INDIA LTD.
6.2	PNEUMATIC ACTUATORS-REGULATING & OPEN / CLOSE	(d)	INSTRUMENTATION LTD., PALGHAT
		(e)	KELTRON CONTROLS, KERALA
6.3	SH/RH SPRAY CONTROL VALVES SH/RH SPRAY BLOCK VALVES FEED CONTROL VALVES	(a)	MIL CONTROLS LTD.
		(b)	INSTRUMENTATION LTD. PALGHAT
		(c)	FISHER SANMAR LTD.
		(d)	CONTROL COMPONENT INC., USA
		(e)	HORA (HOLTER REGELARMATUREN GMBH & CO.)
6.4	LFO/HFO CONTROL, AND TRIP VALVES, FLOW CONTROL, PRESSURE	(a)	MIL CONTROLS LTD.
		(b)	INSTRUMENTATION LTD. PALGHAT

SR. NO.	NAME OF EQUIPMENT / ITEM		APPROVED VENDORS
	CONTROL, TEMP. CONTROL, AND BURNER TRIP VALVES, BALL VALVES	(c)	FOURESS ENGG (I) LTD, BANGALORE
		(d)	SAMSON CONTROLS , PUNE
6.5	SOOT BLOWER PRESSURE REDUCING VALVE	(a)	MIL CONTROLS LTD.
		(b)	INSTRUMENTATION LTD., PALGHAT
		(c)	FISHER SANMAR LTD.
		(d)	CONTROL COMPONENT INC., USA
		(e)	HORA (HOLTER REGELARMATUREN GMBH & CO.)
6.6	APRDS CONTROL VALVES	(a)	INSTRUMENTATION LTD.
		(b)	CONTROL COMPONENT INC., USA
		(c)	HORA (HOLTER REGELARMATUREN GMBH & CO.)
6.7	CONTROL VALVES- NON CRITICAL	(a)	DEZURIK COPES VULCAN LTD., U.K.
		(b)	CONTROL COMPONENT INC., USA
		(c)	FISHER SANMAR LIMITED
		(d)	INSTRUMENTATION LTD
		(e)	MIL CONTROL LTD.
		(f)	FISHER XOMOS SANMAR LTD.
		(g)	HORA (HOLTER REGELARMATUREN GMBH & CO.)
6.8	SOLENOID VALVE	(a)	ASCO, CHENNAI
		(b)	ROTEX AUTOMATION LTD., GUJRAT
		(c)	AVCON CONTROLS, MUMBAI
6.9	HP/LP BYPASS VALVES	(a)	BOPP & REUTHER SR GMBH CONTROL COMPONENTS INC (CCI)

SR. NO.	NAME OF EQUIPMENT / ITEM		APPROVED VENDORS
6.10	ELECTRO-HYDRAULIC ACTUATOR	(a)	LEONARDO AUTOMATION (INDIA) PVT. LTD.
7.0	**ERECTION HARDWARES:**		
7.1	LOCAL INSTRUMENT RACK (LIR) AND LOCAL INSTRUMENT ENCLOSURES (LIE)	(a)	PYROTECH, UDAIPUR
		(b)	INSTRUMENTATION LTD., KOTA
		(c)	ELECTRONICS CORPORATION OF INDIA LTD., HYDERABAD
		(d)	CHEMIN CONTROLS, PONDICHERRY
		(e)	PRAMMEN INDUSTRIES
7.2	INSTRUMENT VALVES	(a)	EXCEL HYDRO PNEUMATICS PVT. LTD., MUMBAI
		(b)	BHEL
		(c)	METPRESS ENGINEERING WORKS, KOLKATA
		(d)	BALDOTA VALVE & FITTING CO. PVT. LTD., MUMBAI
		(e)	AURA INC., NEW DELHI
		(f)	INSTRUMENTATION LTD. PALGHAT
		(g)	PRECISSION ENGG. INDUSTRIES, MUMBAI
		(h)	VIKAS INDUSTRIAL PRODUCTS, NEW DELHI
7.3	VALVE MANIFOLDS	(a)	EXCEL HYDRO PNEUMATICS PVT. LTD., MUMBAI
		(b)	METPRESS ENGINEERING WORKS, KOLKATA

SR. NO.	NAME OF EQUIPMENT / ITEM		APPROVED VENDORS
		(c)	BALDOTA VALVE & FITTING CO. PVT. LTD., MUMBAI
		(d)	AURA INC., NEW DELHI
		(e)	PRECISSION ENGG. INDUSTRIES, MUMBAI
		(f)	HP VALVES AND FITTINGS, CHENNAI
7.4	COMPRESSION FITTINGS / SOCKET WELD FITTINGS	(a)	SWAGELOCK, USA
		(b)	ASTEC VALVES & FITTINGS PVT. LTD.
		(c)	MET-LOK HYDRO PNEUMATICS PVT. LTD.
7.5	CONDENSATE POTS	(a)	EXCEL HYDRO-PNEUMATICS PVT. LTD., MUMBAI
		(b)	MICROPRECISION, FARIDABAD
		(c)	INSTRUMENTATION LTD. PALGHAT
		(d)	METPRESS ENGINEERING WORKS, KOLKATA
		(e)	BALDOTA VALVES & FITTINGS CO. PVT. LTD., MUMBAI
		(f)	PRECISSION ENGG. INDUSTRIES, MUMBAI
7.6	IMPULSE & SAMPLE PIPINGS	(a)	TPS TECHNITUBE ROHREN WERKE GMBH, GERMANY
		(b)	MAHARASHTRA SEAMLESS LTD.
		(c)	BHEL
		(d)	CHOKSI TUBE COMPANY LTD., INDIA
		(e)	INDIAN SEAMLESS METAL TUBES LTD., INDIA
		(f)	MANNESMANN AG, GERMANY

SR. NO.	NAME OF EQUIPMENT / ITEM		APPROVED VENDORS
		(g)	TOUVAY AND CAUVIN GULF EC, DUBAI
		(h)	JINDAL SAW PIPES LTD., INDIA
		(i)	SUMITOMO CORPORATION, JAPAN / KAWASAKI
		(j)	RATNAMANI METALS & TUBES LTD., AHMEDABAD
7.7	JUNCTION BOX (FRP)	(a)	DEVI POLYMERS, CHENNAI
		(b)	SUCHITRA INDUSTRIES, BANGALORE
		(c)	RITTAL
		(d)	PYROTECH
		(e)	L&T
		(f)	HENSEL ELECTRIC INDIA PVT. LTD., SRIPERUMBUDUR
7.8	AIR CYLINDER	(a)	VELJAN HYDRAIR, HYDERABAD
		(b)	NUCON INDUSTRIES, HYDERABAD
		(c)	PRECISION ENGG. (PREAC), BANAGALORE
		(d)	ASCO, CHENNAI
8.0	**CABLES:**		
8.1	CONTROL CABLES	(a)	DELTON CABLES, FARIDABAD
		(b)	UNIVERSAL CABLES, SATNA
		(c)	NICCO CABLE, KOLKATA
		(d)	POLYCAB, DAMAN
		(e)	GAYOLENE, MUMBAI
		(f)	RELIANCE ENGRS, BANGALORE
		(g)	CORDS CABLES, RAJASTHAN

SR. NO.	NAME OF EQUIPMENT / ITEM		APPROVED VENDORS
		(h)	PARAMOUNT CABLES, ALWAR
		(i)	THERMOCABLES, BANGALORE,
		(j)	KEI INDUSTRIES LTD., CHENNAI
8.2	INSTRUMENTATION CABLE	(a)	DELTON CABLES, FARIDABAD
		(b)	UNIVERSAL CABLES, SATNA
		(c)	NICCO CABLE, KOLKATA
		(d)	POLYCAB, DAMAN
		(e)	GAYOLENE, MUMBAI
		(f)	RELIANCE ENGRS, BANGALORE
		(g)	CORDS CABLES, RAJASTHAN
		(h)	PARAMOUNT CABLES, ALWAR
		(i)	THERMOCABLES, BANGALORE / HYDERABAD
		(j)	KEI INDUSTRIES LTD., CHENNAI
		(k)	CABLE CORPRN OF (I) LTD., CHENNAI
		(l)	RPG CABLES LTD., CHENNAI
		(m)	FORT GLOSTER INDUSTRIES LTD. KOLKATA
		(n)	DECO CABLES, DELHI
		(o)	KRISHNA CABLES, GWALIOR
		(p)	THERMAPADS (P) LTD
		(q)	ELKAY TELELINKS LTD.
		(r)	INCAB INDUSTRIES LTD
		(s)	TORRENT CABLE LTD.
8.3	COMPENSATING CABLES	(a)	DELTON CABLE

SR. NO.	NAME OF EQUIPMENT / ITEM		APPROVED VENDORS
		(b)	TOSHNIWAL, MUMBAI RELIANCE, BANGALORE
		(c)	LAPP INDIA, MUMBAI/ BANGALORE
		(d)	CORDS CABLES, RAJASTHAN
		(e)	PARAMOUNT CABLE
8.4	SPECIAL CABLES (PTFE /FEP INSULATED CABLES)	(a)	TOSHNIWAL CABLE
		(b)	RELIANCE CABLES
		(c)	LAPP INDIA, MUMBAI
		(d)	PARAMOUNT CABLES
		(e)	FINOLEX, PUNE
8.5	POWER CABLES (LT)	(a)	DELTON CABLES, FARIDABAD
		(b)	UNIVERSAL CABLES, SATNA
		(c)	NICCO CABLE, KOLKATA
		(d)	CORDS CABLES, RAJASTHAN
		(e)	FORTGLASTER INDUSTRIES
		(f)	INCAB, PUNE
		(g)	CCIL, BANGALORE
		(h)	KEI INDUSTRIES LTD., CHENNAI
		(i)	POLYCAB, DAMAN PARAMOUNT CABLES, ALWAR
9.0	**UPS / DC SYSTEM:**		
9.1	UPS WITH ACDB	(a)	HI-REL ELECTRONICS
		(b)	EMERSON NETWORK (FORMERLY TATA LIEBERT)
		(c)	DB POWER ELECTRONICS
9.2	24 VDC BATTERY CHARGER	(a)	CALDYNE, KOLKATA

SR. NO.	NAME OF EQUIPMENT / ITEM		APPROVED VENDORS
	WITH DCDB	(b)	AMARARAJA, TIRUPATI
		(c)	CHHABI ELECTRICALS, JALGAON
		(d)	HBL POWER SYSTEMS, HYDERABAD
		(e)	MASS TECH CONTROLS
9.3	BATTERY (TUBULAR/PLANTE) (TUBULAR) (TUBULAR)	(a)	EXIDE, KOLKATA
		(b)	HBL NIFE, HYDERABAD UNION BATTERY (BUI PUNE)
9.4	BATTERY (NICKEL-CADMIUM)	(a)	HBL POWER SYSTEMS, HYDERABAD
		(b)	AMCO, BANGALORE

Laboratory Instruments:

Bidder shall submit the vendor list with credentials for Mahagenco's approval.

NOTE : The vendors indicated in the above list are Mahgenco's approved vendors, however, the product of above vendors proposed for this project shall meet the requirements stipulated in 'Proven Product' Cl. No. 5.0 of Vol. V, Section I of Tender Specification.

SUB-SECTION – ID

DATASHEET-A

	MAHAGENCO - 1X660MW BHUSAWAL TPS UNIT-6						Specification No.:	PE-TS-415-100-N002 Rev-00
	TECHNICAL SPECIFICATION FOR SUMP PUMPS							Section-1D
	DATA SHEET - A (SUMP PUMPS)						Date:	03.06.2021
CL. NO.	**DESCRIPTION**	**UNIT**	**I**	**II**	**III**	**IV**	**V**	**VI**
			Permanent duty Vertical Sump Pumps for CW Pit	**Portable Submersible Sump Pump for CW/ACW P/H Sump**	**Portable Submersible Sump Pump for Raw Water P/H Sump**	**Portable Submersible Sump Pump for Clarified Water P/H (Non DM) Sump.**	**Portable Submersible Sump Pump for Existing Abandoned P/H Sump**	**Portable Submersible Sump Pump for dewatering of various sumps of the plant (Other than CHP / AHP)**
1.0.0	**GENERAL**							
1.1.0	Service /Location of Sump pumps		CW Pit in TG Hall	Sump pits in CW/ACW P/H	Sump pits in Raw Water P/H	Sump pits in Clarified Water P/H (Non DM)	Sump pits in Existing Abandoned P/H	Various sump pits in plant
1.2.0	Equipment name		Sump Pump	Sump Pump	Sump Pump	Sump Pump	Sump Pump	Sump Pump
1.3.0	Pump type		Permanent duty Vertical wet pit sump pumps	Portable Submersible sump pumps	Portable Submersible sump pumps	Portable Submersible sump pumps	Portable Submersible sump pumps	Portable Submersible sump pumps
1.4.0	Duty		Intermittent	Intermittent	Intermittent	Intermittent	Intermittent	Intermittent
1.5.0	Location		Indoor/ Outdoor	Indoor/ Outdoor	Indoor/ Outdoor	Indoor/ Outdoor	Indoor/ Outdoor	Indoor/ Outdoor
1.6.0	Maximum Ambient Temperature	°C	60	60	60	60	60	60
1.7.0	Drive		Motor Driven	Motor Driven	Motor Driven	Motor Driven	Motor Driven	Motor Driven
1.8.0	Motor Rating		Motor rating at 50 deg C selected shall have at least 15% margin over the maximum power required at any condition of the entire characterstic curve of the pump. The discharge rate of sump pump is uncontrolled. As such pump should be capable to operate even under a condition of as low as 25% of specified total head.					
2.0.0	**PUMP PARAMETERS**							
2.1.0	Design capacity	M3/hr	40	100	100	100	40	40
2.2.0	Total head at rated capacity	MWC	20 (Suitable for working in Range 5 to 25)	20 (Suitable for working in Range 5 to 25)	20 (Suitable for working in Range 5 to 25)	20 (Suitable for working in Range 5 to 25)	20 (Suitable for working in Range 5 to 25)	10 (Suitable for working in Range 2.5 to 12.5)
2.3.0	Total no.of pumps installed	Nos.	2	2	1	1	2	2
2.4.0	No. of pumps working / Standby	Nos.	-	-	-	-	-	-
2.5.0	Parallel operation required		YES	-	-	-	-	-
2.6.0	Pump RPM		1500 (Max.)	1500 (Max.)	1500 (Max.)	1500 (Max.)	1500 (Max.)	1500 (Max.)
2.7.0	Range of operation	%	30 to 150 % of the rated flow	30 to 150 % of the rated flow	30 to 150 % of the rated flow	30 to 150 % of the rated flow	30 to 150 % of the rated flow	30 to 150 % of the rated flow
2.8.0	Pump design standard		IS 5120/IS14220/IS1710	IS 5120/IS14220/IS1710	IS 5120/IS14220/IS1710	IS 5120/IS14220/IS1710	IS 5120/IS14220/IS1710	IS 5120/IS14220/IS1710
2.9.0	Max. particle size to be handled	mm	40	40	40	40	40	40
3.0.0	**LIQUID DATA**							
3.1.0	Liquid handled		Water with suspended particles, silica, polluted liquid etc.	Water with solid particles, cotton wastes, silica, mud/sludges, coal particles, ash particles etc.	Water with solid particles, cotton wastes, silica, mud/sludges, coal particles, ash particles etc.	Water with solid particles, cotton wastes, silica, mud/sludges, coal particles, ash particles etc.	Water with solid particles, cotton wastes, silica, mud/sludges, coal particles, ash particles etc.	Water with solid particles, cotton wastes, silica, mud/sludges, coal particles, ash particles etc.
3.2.0	Specific gravity		1.1	1.1	1.1	1.1	1.1	1.1
3.3.0	Temperature (max.)	°C	60	60	60	60	60	60
4.0.0	**DESIGN AND CONSTRUCTION**							
	FEATURES							
4.1.0	Impeller type		Open/Semi-open, Non-clog type	Open/Semi-open, Non-clog type	Open/Semi-open, Non-clog type	Open/Semi-open, Non-clog type	Open/Semi-open, Non-clog type	Open/Semi-open, Non-clog type
4.2.0	Flange drilling standard		ANSI B 16.5	ANSI B 16.5	ANSI B 16.5	ANSI B 16.5	ANSI B 16.5	ANSI B 16.5
4.3.0	Sump pit bottom floor level		EL (-) 6.3M	-	-	-	-	-
4.4.0	Sump pit size L X B X HT. (where pumps to be installed)		2M X 1.5M X 1M	-	-	-	-	-
5.0.0	**MATERIAL OF CONSTRUCTION**							
5.1.0	Casing / Suction bell		2% NiCI to IS 210 Gr. FG 260 (Refer note-2)	2% NiCI to IS 210 Gr. FG 260 (Refer note-2)	2% NiCI to IS 210 Gr. FG 260 (Refer note-2)	2% NiCI to IS 210 Gr. FG 260 (Refer note-2)	2% NiCI to IS 210 Gr. FG 260 (Refer note-2)	2% NiCI to IS 210 Gr. FG 260 (Refer note-2)
5.2.0	Impeller		SS-316	SS-316	SS-316	SS-316	SS-316	SS-316
5.3.0	Pump/Impeller shaft		SS-316	SS-316	SS-316	SS-316	SS-316	SS-316
5.4.0	Wear ring (where applicable)		Austenitic cast iron	Austenitic cast iron	Austenitic cast iron	Austenitic cast iron	Austenitic cast iron	Austenitic cast iron
5.5.0	Shaft sleeve (where applicable)		SS-316 (Hardened)	SS-316 (Hardened)	SS-316 (Hardened)	SS-316 (Hardened)	SS-316 (Hardened)	SS-316 (Hardened)
5.6.0	Shaft coupling		SS AISI-410	SS AISI-410	SS AISI-410	SS AISI-410	SS AISI-410	SS AISI-410
5.7.0	Coulmn Pipe (where applicable)		MS. IS-2062 / Equivalent	-	-	-	-	-
5.8.0	Pump and motor coupling		SS. AISI -410	-	-	-	-	-
5.9.0	Shaft bearing		BUSH GM as per IS-306 Gr.1/ equivalent	BUSH GM as per IS-306 Gr.1/ equivalent	BUSH GM as per IS-306 Gr.1/ equivalent	BUSH GM as per IS-306 Gr.1/ equivalent	BUSH GM as per IS-306 Gr.1/ equivalent	BUSH GM as per IS-306 Gr.1/ equivalent
5.10.0	Fasteners		SS 316	SS 316	SS 316	SS 316	SS 316	SS 316
5.11.0	Gland		C.I, IS-210, FG-260/ Equivalent	C.I, IS-210, FG-260/ Equivalent	C.I, IS-210, FG-260/ Equivalent	C.I, IS-210, FG-260/ Equivalent	C.I, IS-210, FG-260/ Equivalent	C.I, IS-210, FG-260/ Equivalent
5.12.0	Gland Packing		Braided Graphite- free Teflon	Braided Graphite- free Teflon	Braided Graphite- free Teflon	Braided Graphite- free Teflon	Braided Graphite- free Teflon	Braided Graphite- free Teflon
5.13.0	Mechanical seal		As applicable	As applicable	As applicable	As applicable	As applicable	As applicable
5.14.0	Pump Lubrication		SELF/Oil/Grease	SELF/Oil/Grease	SELF/Oil/Grease	SELF/Oil/Grease	SELF/Oil/Grease	SELF/Oil/Grease
5.15.0	Pump line shaft lubrication		-	N/A	N/A	N/A	N/A	N/A
5.16.0	Strainer (Body / Mesh)		Body (2 % NiCI to IS 210 Gr. FG 260)/ Wire Mesh (SS 316)	Body (2 % NiCI to IS 210 Gr. FG 260)/ Wire Mesh (SS 316)	Body (2 % NiCI to IS 210 Gr. FG 260)/ Wire Mesh (SS 316)	Body (2 % NiCI to IS 210 Gr. FG 260)/ Wire Mesh (SS 316)	Body (2 % NiCI to IS 210 Gr. FG 260)/ Wire Mesh (SS 316)	Body (2 % NiCI to IS 210 Gr. FG 260)/ Wire Mesh (SS 316)
5.17.0	Discharge Pipe		MS. IS-1239 / Equivalent	-	-	-	-	-
5.18.0	Hose Pipe		-	Heavy duty rubberised canvas	Heavy duty rubberised canvas	Heavy duty rubberised canvas	Heavy duty rubberised canvas	Heavy duty rubberised canvas
5.19.0	Base Plate/ Cover plate		MS IS-2062/ equivalent	MS IS-2062/ equivalent	MS IS-2062/ equivalent	MS IS-2062/ equivalent	MS IS-2062/ equivalent	MS IS-2062/ equivalent
Note :	**Bidder's may offer alternative materials, if they are superior to that specified above for the indicated service of the pump.**							

	MAHAGENCO - 1X660MW BHUSAWAL TPS UNIT-6						Specification No.:	PE-TS-415-100-N002 Rev-00
	TECHNICAL SPECIFICATION FOR SUMP PUMPS							Section-1D
	DATA SHEET - A (SUMP PUMPS)						Date:	03.06.2021
CL. NO.	**DESCRIPTION**	**UNIT**	**I**	**II**	**III**	**IV**	**V**	**VI**
			Permanent duty Vertical Sump Pumps for CW Pit	**Portable Submersible Sump Pump for CW/ACW P/H Sump**	**Portable Submersible Sump Pump for Raw Water P/H Sump**	**Portable Submersible Sump Pump for Clarified Water P/H (Non DM) Sump.**	**Portable Submersible Sump Pump for Existing Abandoned P/H Sump**	**Portable Submersible Sump Pump for dewatering of various sumps of the plant (Other than CHP / AHP)**
6.0.0	**INSPECTION AND TESTING**		yes at Works	yes at Works	yes at Works	yes at Works	yes at Works	yes at Works
7.0.0	**SUPPLY OF ACCESSORIES AND SERVICE.**							
7.1.0	Counter Flanges with Nuts,Bolts, Gaskets etc.		Yes	Yes	Yes	Yes	Yes	Yes
7.2.0	Elastomer cables for connecting pump with its panel length (M)		30 M	25M	25M	25M	25M	25M
7.3.0	Relay based control panel with integral starter		Yes Wall mounted with IP 65 protection	Yes Trolley mounted for each sump pump with IP 65 protection	Yes Trolley mounted for each sump pump with IP 65 protection	Yes Trolley mounted for each sump pump with IP 65 protection	Yes Trolley mounted for each sump pump with IP 65 protection	Yes Trolley mounted for each sump pump with IP 65 protection
7.4.0	Suction and Discharge pressure gauge with root valve / pump		Discharge pressure guage with 3 way SS isolating valve	-	-	-	-	-
7.5.0	Discharge hose/ Pipe							
	- Hose/ Pipe length per pump		20 M (Pipe) & minimum 4 nos. bends (of 90 degree).	30 M (Heavy duty rubberised canvas)	30 M (Heavy duty rubberised canvas)	30 M (Heavy duty rubberised canvas)	30 M (Heavy duty rubberised canvas)	30 M (Heavy duty rubberised canvas)
	- Hose/Pipe dia		Min. 100 NB or to suit pump discharge	Min. 100 NB or to suit pump discharge	Min. 50 NB or to suit pump discharge	Min. 50 NB or to suit pump discharge	Min. 50 NB or to suit pump discharge	Min. 80 NB or to suit pump discharge
	- No. of Hose pipe per pump		-	Two(2)	Two(2)	Two(2)	Two(2)	Two(2)
7.6.0	Orifice Plate and its arrangement at Pump Discharge (Refer note-3)		1 no. (suitable for 5MWC pressure drop)	1 no. (suitable for 5MWC pressure drop)	1 no. (suitable for 5MWC pressure drop)	1 no. (suitable for 5MWC pressure drop)	-	-
7.7.0	Cables (*) for connecting the starter panel with the power supply source - Length (M) / pump (*)including plug matching with purchaser's 63 Amp welding socket		25 m	25 m	25 m	25 m	25 m	25 m
7.8.0	Chains		Yes(15M)	Yes(15M)	Yes(15M)	Yes(15M)	Yes(15M)	Yes(15M)
7.9.0	Suction Strainers		Yes	Yes	Yes	Yes	Yes	Yes
7.10.0	Pump Stool		Yes	Yes	Yes	Yes	Yes	Yes
7.11.0	Wheel trolley required per pump		No	Yes	Yes	Yes	Yes	Yes
7.12.0	Level switches for		Electrode type capacitance level switches	Float type level probe integral with pump	Float type level probe integral with pump	Float type level probe integral with pump	Float type level probe integral with pump	Float type level probe integral with pump
	- Very Low level		Yes	Yes	Yes	Yes	Yes	Yes
	- High level		Yes	N/A	N/A	N/A	N/A	N/A
	- Very high level		Yes	N/A	N/A	N/A	N/A	N/A
8.0.0	**Levels for installation**							
8.1.0	Pump/Motor Support Elevation		EL 0.0 M	N/A	N/A	N/A	N/A	N/A
8.2.0	Pump sump Invert Level		EL (-) 6.3 M	N/A	N/A	N/A	N/A	N/A
9.0.0	**Special Requirements**							
9.1.0	Male/female hose coupling with accessories for connecting two hose pipes		-	Yes	Yes	Yes	Yes	Yes
10.0.0	**Mandatory Spares**		Yes	Yes	Yes	Yes	Yes	Yes
10.1.0	**C&I Spares**		C&I Spares as per ANNEXURE-1 to DATA SHEET-A	C&I Spares as per ANNEXURE-1 to DATA SHEET-A	C&I Spares as per ANNEXURE-1 to DATA SHEET-A	C&I Spares as per ANNEXURE-1 to DATA SHEET-A	C&I Spares as per ANNEXURE-1 to DATA SHEET-A	C&I Spares as per ANNEXURE-1 to DATA SHEET-A
10.2.0	**415V MOTORS (LT Motors) spares**							
10.2.1	Terminal plates for motors upto 30kw for each rating		1 no. For each type & rating of Motor	-	-	-	-	-
10.2.2	Heaters		1 set For each type & rating of Motor	-	-	-	-	-
10.2.3	Greasing arrangements		1 set For each type & rating of Motor	-	-	-	-	-
10.2.4	Motor of each type and rating		10% of the installed quantity or minimum 1 number whichever is higher	-	-	-	-	-
10.2.5	Bearings (DE and NDE)		1 set For each type & rating of Motor	-	-	-	-	-
10.2.6	End shield cover driving of non driving end		1 set For each type & rating of Motor	-	-	-	-	-
10.2.7	Cooling fan		1 set For each type & rating of Motor	-	-	-	-	-
10.2.8	Motor terminal block		1 set For each type & rating of Motor	-	-	-	-	-
10.2.9	Complete set of coupling		1 set For each type & rating of Motor	-	-	-	-	-

	MAHAGENCO - 1X660MW BHUSAWAL TPS UNIT-6						Specification No.:	PE-TS-415-100-N002 Rev-00
	TECHNICAL SPECIFICATION FOR SUMP PUMPS							Section-1D
	DATA SHEET - A (SUMP PUMPS)						Date:	03.06.2021
CL. NO.	**DESCRIPTION**	**UNIT**	**I**	**II**	**III**	**IV**	**V**	**VI**
			Permanent duty Vertical Sump Pumps for CW Pit	**Portable Submersible Sump Pump for CW/ACW P/H Sump**	**Portable Submersible Sump Pump for Raw Water P/H Sump**	**Portable Submersible Sump Pump for Clarified Water P/H (Non DM) Sump.**	**Portable Submersible Sump Pump for Existing Abandoned P/H Sump**	**Portable Submersible Sump Pump for dewatering of various sumps of the plant (Other than CHP / AHP)**
	Notes for Mandatory spares:-							
	a) Whenever the quantity is indicated as a percentage, it shall mean percentage of total population of that item in the station (project) unless specified otherwise, and the fraction will be rounded off to the next higher whole number. Wherever the requirement has been specified a 'set', it will include the total requirement of the item for a unit, module or the station or as specified. Where it is not specified, a 'set' would mean the requirement for the single equipment/system as the case may be. Also, the 'set' would include all components required to replace the item							
	b) Wherever quantity is specified both as a percentage and a value, the bidder has to supply the higher quantity until and unless specified otherwise							
NOTE:								
1	The clearance between stationary and moving parts should be such as to allow sustained performance without exclusive maintenance.							
2	Alloy CI (min 30 mm thick) BHN 350 min.							
3	Orifice plate shall be installed in the discharge Hose pipe / Pipe. Suitable flanges/counterflanges with nut, bolts and gasket is to be provided by bidder.							

ANNEXURE-1
(To Data sheet-A)

C&I
MANDATORY SPARES

MANDATORY SPARES

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
1.8.4	Pulse input card	10% of total use or 4 nos. of each type and rating whichever is more
1.8.5	LIU unit	10% of total quantity used for each type and model or 2 no. whichever is more
1.8.6	Trans-receiver (optical to UTP converter)	10% of total quantity used for each type and model or 2 no. whichever is more
1.8.7	I/O & processor module chassis (rack)	1no. of each type
1.8.8	Terminal block	10% of total quantity used for each type and rating
1.8.9	Blank CD/DVD	50 no.
1.8.10	Tonner for colour laser printer	10 no. of each colour other than black & 20 no. of black tonner for each type of laser printer model
1.8.11	MCBs	1 no. of each type & rating
1.8.12	Complete set of operator work station	1 no.
1.9	Bus coupler/ interface hardware	10% or 2 nos. of each type and model whichever is more
1.10	Relays interposing relay	10% or 2 nos. of each type and model whichever is more
1.11	PCs	2 no. of each type & model.
1.12	Batteries used for battery backup of RAMs	10% or 2 nos. of each type and model, whichever is more.
1.13	Fuses	100 % of each type and rating

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
1.14	Cooling fans for power supply	10% or 2 nos. of each type and model whichever is more
2.0	**SG RELATED SUB-SYSTEMS**	
2.1	FLAME MONITORING SYSTEM	
2.1.1	Complete flame scanner assembly including scanner head assembly scanner housing & fiber optic cables	20% or 2 nos., whichever is more
2.1.2	Flame scanner lens	50%
2.1.3	Electronic cards for scanners	10% or 2 nos. of each type whichever is more.
2.1.4	Power supply modules	10% or 2 nos. of each type whichever is more.
2.2	COAL FEEDERS	
2.2.1	Calibration motor	10% or 2 nos. whichever is more.
2.2.2	Correction motor	10% or 2 nos. whichever is more
2.2.3	Motion monitor	10% or 2 nos. whichever is more
2.2.4	Speed pick-up	10% or 2 nos. whichever is more
2.2.5	Torque switch	10% or 2 nos. whichever is more
2.2.6	Load cell	10% or 2 nos. whichever is more
2.2.7	Electronic cards & power supply cards	10% or 2 nos. whichever is more
2.2.8	Clutch (if applicable)	10% or 2 nos. whichever is more
2.2.9	Local indication lamps	200 %
2.2.10	Panel meters	10% or 2 nos. whichever is more

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
	measurement used.	
3.0	**MEASURING INSTRUMENTS**	
3.1	ELECTRONIC TRANSMITTERS	
3.1.1	Transmitters of all types, ranges and model no. (for the measurement of Pressure, differential pressure flow, level etc.)	10% or 2 no. of each type and model, whichever is more
3.1.2	Electronic cards / PCB's for each type and model and model of transmitters	10% or 5 nos. of each type, whichever is more
3.2	TEMPERATURE ELEMENTS	
3.2.1	RTDs of each type & length	10% or 2 nos. whichever is more
3.2.2	Thermocouples of each type like K-type, R-type, metal etc and length	10% or 2 nos. whichever is more
3.2.3	Thermowell for T/C & RTDs	10% or 1 no. of each type, rating, length used in the system whichever is more
3.2.4	Process actuated switch devices Including all types of pressure, differential pressure, flow, temperature, differential temperature, level switch devices	10% or 1 no. of each type and model whichever is more
3.3	INDICATORS/RECORDERS	
3.3.1	Digital Indicators of each model, type & range (including relevant digital indicators of electrical system)	10% or 2 nos. min. whichever is more

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
3.3.2	Vertical Indicators of each type & model	5% or 1 no. of each model whichever is more
3.3.3	Recorders for each type and model	5% or 1 no. whichever is more.
3.3.4	Consumables for continuous recorders Charts Ink capsules	25 rolls per recorder/ 25 nos per recorder/ 20 nos. per recorder / Ink Pads /Pens.
3.3.5	Consumables for multi point recorders	
(a)	Charts	5 nos. per recorder
(b)	Ink pads	5 nos. per recorder
(c)	Print mechanism/ print head assembly	10% or 5 nos. of each type whichever is more
3.3.6	Level transmitters (displacer type)	
(a)	Electronic cards / PCB's of level transmitters	10% of total quantity used or 1 for each type/rating whichever is more
(b)	Level transmitters	10% of total quantity used or 1 for each type/rating whichever is more
(c)	Electronic water level indicator	10% or 2 nos. min. whichever is more
3.3.7	PD type flow transmitters	10% of total quantity used or 1 for each type/rating whichever is more
3.4	SWITCHES	
3.4.1	Switches (Pressure, DP, Level, Flow, Temperature etc)	10% of each type of total nos. used in the system or minimum 1 no. of each type, model & range whichever is more

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
4.17	Rubber gloves	1 no.
4.18	Voltmeter for measuring cell voltage (centre zero type)	1 no.
4.19	Thermometer	1 no.
4.20	Insulated socket spanner with handle	1 no.
5.0	**PROCESS CONNECTION PIPING** (for impulse piping /tubing, sampling piping/ tubing and air supply piping as applicable)	
5.1	Valves of all types and models	10% or 2 no. of each type, class, size and model whichever is more.
5.2	2 way, 3way, 5way valve manifolds	10% or 2 no. of each type, class size and model whichever is more.
5.3	Fittings	10 nos. of each type
5.4	Purge meters	10 % of each model or 2 Nos. whichever is more
5.5	Filter regulators	10% of each model or 2 Nos. whichever is more
5.6	Impulse pipe & tubing of all type	20 mtrs each type & size
5.7	Impulse line root valve	10% of total quantity used or 4 no. whichever is more for each type and rating of each size
5.8	SS tube	40 mtrs of each type/size
5.9	Fitting for SS tube	40 nos. of each type/size

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
6.0	**INSTRUMENTATION CABLE, INTERNAL WIRING AND ELECTRICAL FIELD**	
6.1	Pre fabricated cable of each type	10% of installed quantity
6.2	Pre fabricated cable connector	10% or1no.of each type and model, whichever is more.
6.3	Other cables	10% of each type, pair and size of actual installed quantity
7.0	**ELECTRICAL ACTUATORS**	
7.1	Actuators	10% or 1 no. of each type, model and rating, whichever is more.
7.2	Power unit for modulating actuator	10% or 2 nos. of each type, whichever is more.
7.3	DC-DC unit/power pack units	10% or 2 nos. of each type, whichever is more.
7.4	Electronic cards	10% or 5 nos. of each type, whichever is more
7.5	Brake assembly	10% or 2 nos. of each type, whichever is more..
7.6	Brake coils	10% or 2 nos. of each type whichever is more.
7.7	Position feed back transmitters	10% or 2 nos. of each type whichever is more.
7.8	Control unit	10% or 2 nos. of each type whichever is more
7.9	Torque and limit switch assembly of each unit	10% or 2 nos. of each type, whichever is more.
7.10	O-ring	1 set of each size

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
7.11	Motor	1 no. of each type & rating
7.12	Auxiliary contact	10% of total quantity used or 2 nos. whichever is more for each type and rating of each size
7.13	Seal kit	1 set of each type & size
8.0	PLC CONTROL SYSTEM FOR PLANT AUXILIARIES & OFF-SITE PLANTS	
8.1	CPU Card	10% of total quantity of each type used in all systems.
8.2	Communication Processor Module	10% of total quantity of each type used in all systems.
8.3	Binary Input Card	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.
8.4	Pulse Input Card	10% of total nos. used in the system or minimum 2(two) nos. whichever is more.
8.5	Analog Input Card (4 to 20 mA type)	10% of total nos. used in the system or minimum 2(two) nos. whichever is more.
8.6	Analog Input Card (RTD input type)	10% of total nos. used in the system or minimum 2(two) nos. whichever is more.
8.7	Binary Output Card for contact	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
8.8	Binary Output Card for Voltage (24VDC)	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.
8.9	Analog Output Card (4 to 20 mA type)	10% of total nos. used in the system or minimum 2(two) nos. whichever is more.
8.10	Interposing Relay	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.
8.11	Output Relay modules/ Relay Board & Auxiliary Relay	10% of total quantity of each type used in the system or minimum 4(four) nos. of each type whichever is more.
8.12	Prefab-cable with connector for CPU, Communication Card and I/O racks	2 No. for each type
8.13	Networking Modules/ Components/ Switch with Power supply module	1No. for each type
8.14	Power Supply Unit for CPU, Communication Card and I/O racks	10% of total nos. used in the system or minimum 2 (two) nos. whichever is more for each type and rating.
8.15	I/O & Processor module chassis	1 (one) no. of each type
8.16	RAM Backup Battery	2 (two) nos. for each type and rating for each system.
8.17	Communication Modules of various types	1No. for each type
8.18	Special Fuse for the Cards	Each type/ rating of fuse, 25% of total nos. used in the system or minimum 25 nos. whichever is more for each system.

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
8.19	Terminal Block	10% of total quantity used in systems for each type and rating
8.20	HMI UNIT	
8.20.1	24" Colour TFT Monitor with Power and signal cable	2 (two) no.s complete set
8.20.2	Key Board	2No.
8.20.3	Mouse/ Trackball	2No.
8.20.4	Complete set of Operators station	2 (two) no.s complete set
8.20.5	Hard Disk Drive for the workstation	2 (two) no.s complete set
8.20.6	UPS for PLC system	1 (one) no.s complete set
8.20.7	Memory Module/ EEPROM chip	10% of total quantity used in the systems or minimum 4 (four) no. whichever is more.
8.20.8	DVD Dual layer Read/ Write type Writer	2 (two) no.s complete set
8.20.9	Blank CD/ DVD	50 (fifty) no.s
8.21	Dot Matrix Printer	2 (two) no.s complete unit
8.22	Dot Matrix Printer's Cartridge	25 (twenty five) no.s
8.23	Toner for Colour Laser Printer	10 (ten) no.s of each colour other than black, and 20 no.s of black toner for each type of laser printer model
8.24	Micro PLC system (i.e. integrated CPU & I/O system, where above mentioned components are not applicable)	One Complete Set
8.25	PLC Network Tap	10% of total quantity for each System

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
8.26	PLC Network End connector	10% of total quantity for each System
8.27	MCB	1 no. of each type and rating.
9.0	STEAM AND WATER ANALYSIS SYSTEM (SWAS)	
9.1	CONDUCTIVITY	
9.1.1	Conductivity Sensor/cell for each type of Cell Constant	20% of the total no. used in the system or minimum 2(two) nos. whichever is higher.
9.1.2	Conductivity Transmitter Complete Set	20% of the total no. used in the system or minimum 2(two) nos. whichever is higher.
9.2	pH	
9.2.1	pH Sensor	20% of the total no. used in the system or minimum 2(two) nos. whichever is higher.
9.2.2	pH Transmitter Complete Set	20% of the total no. used in the system or minimum 2(two) nos. whichever is higher.
9.2.3	Sensor recharger	20% of the total no. used in the system or minimum 2(two) nos. whichever is higher.
9.3	SODIUM ANALYSER	
9.3.1	Sodium Analyser Electrode	1 (one) no.
9.3.2	Critical Electronic spare part for Sodium Analyser Analyser/Monitor	1 (one) no. each type
9.3.3	Reagent container	1 no.
9.3.4	Refurbishment kit for sodium analyser	1 no.

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
9.6.2	Dissolve Oxygen Analyser Complete Set	1(one) no.
9.7	PHOSPHATE ANALYSER	
9.7.1	Electrode	1(one) no.
9.7.2	Critical Electronic Spare Parts for Phosphate analyser/monitor	1(one) no. each MPC
9.7.3	Consumable kit/Chemical Reagent for Phosphate Analyser	For maintaining the system for 1(one) year continious operation
9.8	OTHER HARDWARE	
9.8.1	Stainer each type	2(two) nos.
9.8.2	Sample Cooler	2(two) nos.
9.8.3	High Pressure Reducing Valve	5(five) nos.
9.8.4	Cation column	5(five) nos.
9.8.5	Pressure Gauge, Pressure Switch, Temperature Gauge, Temperature Switch, Isolating Valve, Solenoid Valve, Rota Meter etc.	10% of total quantity of each item and type/rating used in the system or minimum 1(one) no. whichever is higher.
9.8.6	Annunciation System	
(a)	Each type of PCB	1(one) No. each
(b)	Lamp Box with Facia & Lamps (LED type)	5(five)Nos.
(c)	Hooter	1(one) No.
9.8.7	Auxiliary/Power Contactor, Push Button, Indicating Lamp, Fuse etc. for Chiller Unit	10% of total quantity of each type of items used in the system or minimum 2(two) nos. whichever is more.

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
17.0	CONTROL PANEL AND LOCAL/ REMOTE CONTROL DESK (AS APPLICABLE)	
17.1	Recorder	1(one) No. each type and model
17.2	Bar graph indicator	10% of total quantity used in the system or minimum 1(one) no. whichever is more for each type and model.
17.3	Digital indicator	10% of total quantity used in the system or minimum 1(one) no. whichever is more for each type and model.
17.4	Mosaic/Conventional Type Push button Station	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.
17.5	Mosaic Type Push button Station with LED Indication	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.
17.6	Mosaic Type LED Indication Station	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.
17.7	Simaphore Indicator	2(two)Nos. each type
17.8	ANNUNCIATION SYSTEM (For offsite / Auxiliary Plants)	
17.8.1	Each type of PCB (for non-PLC driven system)	1(one) No. each

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
17.8.2	Lamp Box with Facia & Lamps (LED type)	10% with minimum 2 nos.
17.8.3	Hooter	1(one) No.
18.0	**UPS**	
18.1	Fuse	3 (Three) times of total quantity of each type of fuses used in the system.
18.2	SCR	10% of total quantity of each type used in the system or minimum 2 (two) nos. whichever is more.
18.3	Diode	10% of total quantity of each type used in the system or minimum 2 (two) nos. whichever is more.
18.4	IGBT	2 (two) nos.
18.5	ELECTRONIC MODULE/ PCB	
18.5.1	Static Switch	10% of each type of Electronic Card/ PCB/ modules used in the system
18.5.2	Inverter	10% of each type of Electronic Card/ PCB/ modules used in the system
18.5.3	Static voltage Regulator	10% of each type of Electronic Card/ PCB/ modules used in the system
18.5.4	Charger	10% of each type of Electronic Card/ PCB/ modules used in the system
18.5.5	UPS of 2 KVA rating or below.	One Complete set.
18.5.6	Selector Switch	10% of each type
18.5.7	Digital Voltage/ Current Indicator (LCD type)	10% of each type
18.5.8	Indication Lamp- Complete assembly (Red/ Green colour)	10% of each type

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
18.5.9	Cooling Fan - 240 VAC supply	10% of population or min. 2 Nos. whichever max.
18.5.10	Current transformer of each rating	2 Nos.
18.6	UPS BATTERY	
18.6.1	Inter connecting cell strips	10 nos.
18.6.2	Rubber gloves	1 pair
18.6.3	Voltmeter for measuring cell voltage (Center zero type)	1 no.
18.6.4	Appron & Goggles	1 set
18.6.5	Cell lifting puller	1 no.
18.6.6	Insulated socket spanner with handle	1 no.
18.6.7	Terminal screw with bellaville washer	10% of total quantity used
18.6.8	Thermometer	1 no.
18.6.9	Battery cell (Uncharged/dry)	7 nos. for main UPS & 10% of total quantity used for each UPS
18.6.10	Vent plug	10% of total quantity used or minimum 2 no. of each type whichever is more
18.6.11	Hydrometer	1 no.
18.6.12	Funnel	1 no.
18.6.13	Plastic filling bottle	1 no.
18.7	Filtering capacitor used in the output circuit	2 sets

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
26.0	Vacuum transmitter for AHP	4 nos.
27.0	Gauges of all types	10% of total quantity used or 1 nos. whichever is max. for each type/rating
28.0	Master clock system	
28.1	Each type of card	10% of total quantity used or 1 nos. whichever is max.
28.2	Slave clock	4 no. with necessary cables & connector
29.0	Power cylinder	
29.1	Actuator Seal Kit	2(two) nos. for each type of Power Cylinder
29.2	Gasket	2(two) nos. for each type of Power Cylinder
29.3	Complete Set of Power Cylinder	1(one) no. each type for all application
29.4	Position Transmitter complete set	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.
29.5	Power Cylinder Positioner complete Set	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.
29.6	Complete Set of Solenoid Valve for Power Cylinder	2Nos. for each type & ratings

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
29.7	Solenoid Coil for Pneumatic type Power Cylinder	5Nos. for each type & ratings
29.8	Position Limit Switch for Pneumatictype Power Cylinder	10Nos. for each type & ratings
29.9	Air Lock Relay	10Nos. for each type
29.10	Signal Air Booster Unit	2Nos. for each type
30.0	**MANDATORY SPARES NOT COVERED ABOVE**	Bidder to supply 10% electronic modules/ cards or any other electronic components required for system such as annunciation system for offsite/auxiliary plant, online condensate tube cleaning system, ambient air monitoring system, plant simulator.

SUB-SECTION - IIA

STANDARD TECHNICAL SPECIFICATION (MECHANICAL)

1.00.00 GENERAL

1.01.00 This specification covers the design, performance requirement, constructional features, material requirements, manufacture, inspection and testing at the manufacturer's and/or his sub-contractor's works and painting requirements for delivery of Sump Pump/submersible pumps complete with all accessories as specified hereinafter.

1.02.00 The design, performance, major constructional features, materials of construction etc., of the Sump Pumps/submersible pumps shall be guided by Data Sheet-A. The requirements of this specification shall also be taken care of.

2.00.00 Codes and Standards

2.01.00 The design, performance requirement, material requirements, manufacture, inspection and testing of the Sump Pumps shall generally comply with the requirements of all applicable Indian/British/American/DIN standards, in particular the following :

IS 8034	:	Technical requirements for submersible pump sets
IS 5600	:	Technical requirements for rotodynamic pumps for handling sewage and drainage.
IS 1710	:	Vertical turbine pumps for clear, cold and fresh water.
IS 5120	:	Technical requirements - Rotodynamic special purpose pumps
IS 5600	:	Sewage and drainage pumps
IS 5639	:	Pumps for handling chemical and corrosive mixed flow and axial flow pumps
IS 9137	:	Code for acceptance for centrifugal, mixed flow and axial flow pumps
BS 5316	:	Acceptance tests for centrifugal, mixed flow and axial flow pumps
Hydraulic Institute Standards of USA		
API 610	:	Centrifugal pumps general refinery services

2.02.00 In case of any contradiction between the above standards and this specifiation, the

stipulations in this specification shall prevail and shall be binding on the bidder.

3.00.00 General Description

3.01.00 Sump pumps/submersible pumps specified hereinafter shall be used to dewater various sump pits in the power house and other plant area where gravity draining is not envisaged to ensure general housekeeping.

Type of Sump Pumps required under this specification are described in Section-ID/Data Sheet-A, the following requirements shall be taken care, as applicable.

3.01.01 Fixed Type Sump Pumps

Fixed type Sump pumps shall be electric motor driven permanently installed and shall be vertical wet pit bottom suction volute type and will handle drainage water, containing solid particles with sludges, polluted liquid etc. from the area where they are installed. These pumps will run continuously by the use of high and low level switches in the sump. Particle size expected in the water may be of the order of 30mm.

3.01.02 Fixed Duty Type Submersible Pumps

Fixed duty type submersible pumps shall be electric motor driven permanently installed and the motor shall be integral part of the pumps and the pump & motor shall be single unit i.e. monoblock type which be submerged in the water. Submersible pump will handle drainage water, containing solid particles with sludges, polluted liquid etc. from the area where they are installed. These pumps will run continuously by the use of high and low level switches in the sump. Particle size expected in the water may be of the order of 30mm.

3.01.03 Trolley Mounted portable sump pumps

These pumps shall be horizontal centrifugal, either electric motor driven or Diesel engine driven as specified in Data Sheet-A and shall be portable type. Each pump set alongwith drive, control panel etc., shall be mounted on a trolley for ease of transportation. These pumps shall be suitable for handling drainage water containing hard solid particles, sludge, polluted liquid with expected particle size of 30mm.

3.01.04 Trolley Mounted Vertical Submersible portable type pump

These pumps shall be vertical submersible portable type pump motor sets with suitable arrangement for carrying to any place and for lowering to and raising from various water reservoirs and pits. The pump motor set shall be monoblock type and shall be mounted on trolley and shall be suitable for handling water containing mud/sludge, solid particles, cotton waste, silica, ash particles, coal particles, polluted liquid etc. The particle size expected in water may be 30mm.

4.00.00 GENERAL PERFORMANCE REQUIREMENT

4.01.00 The pumps shall be designed to have best efficiency at the specified duty point. The pump set shall be suitable for continuous operation at any point within the "Range of Operation".

4.02.00 Pumps shall have a continuously rising head capacity characteristics from the specified duty point towards shut off point, the maximum head being at shut off.

4.03.00 Permanently installed vertical sump pumps/submersible pumps, wherever specified, shall be suitable for parallel operation. The head vs capacity, the bhp capacity characteristics etc. shall match to ensure equal load sharing and trouble free operation throughout the range. Drive motor shall not be overloaded when pump discharge is more than rated.

4.04.00 The static head requirement of portable type sump pumps may have a considerably wide range of variation depending upon the depth of pit being dewatered. While the pump shall have adequate capacity at the maximum head, its drive shall be sufficiently rated to cater for any overloading during the pump operation at its minimum possible head, i.e. maximum discharge.

4.05.00 Pump with its drive unit shall run smooth without undue noise and vibration. Acceptable peak to peak vibration limits shall generally be guided by Hydraulic Institute Standards (latest edition)/as per applicable IS standard.

5.00.00 GENERAL

5.01.00 Pumps as described in Section-IA/ID (DataSheet-A) shall be complete with their drives, couplings and other accessories as also those needed to make the pump sets complete in all respect, for proper operation and maintenance.

6.00.00 DESIGN AND CONSTRUCTION

6.01.00 The design, construction testing and other details of the sump pumps and related accessories shall be in line with the stipulations and data in this section and as per data sheet-A.

6.02.00 Each sump pump shall be equipped and coupled with a drive motor with rating so selected as to have atleast 25% margin over the maximum power required by the pump, throughout its range of operation.

The discharge rate of sump pump is very much uncontrolled. As such pump should be capable to operate even under a condition of as low as 25% of specified total head.

6.03.00 All integral piping shall be as per IS-1239 of heavy grade (as suited for the maximum operating pressure) and shall be either galvanised or painted with approved rust inhibiting paint.

6.04.00 All valves shall be steel body type as per applicable IS/BA/ANSI standard, with pressure class compatible with the maximum working pressure.

6.05.00 All hoses shall be of steel wire reinforced type. Pump suction hose shall be suitable for working under vacuum. Pump discharge hose shall be suitable to withstand the maximum pressure that it may be subject to in all working conditions, including hydrostatic testing of the sump pump discharge line.

6.06.00 Pump suctions strainer (applicable only for Portable Horizontal Sump Pumps) shall have openings large enough just to permit the entry of solids having maximum size as stipulated in the specification.

6.07.00 Pressure gauges shall be of Bourdon type, with sealing diaphragm to prevent ingress of the work fluid. Selected range of pressure gauge shall be such that the entire range of working pressure covers about 1/3rd to 2/3rd to its range. Accuracy of measurement shall be within ± 1% of scale range. The suction pressure gauge shall be compound type. Pressure gauge dial size shall be 100mm or more.

6.08.00 Pumps

6.08.01 Fixed type Sump Pumps shall be wet pit type, vertical shaft, centrifugal, vertical submerged suction, non-clog volute type complete with enclosed shaft, discharge pipe, head assembly thrust bearing and drive assembly, cover plates etc.

6.08.02 Fixed duty type Submersible pumps shall be monoblock type in which electric motor shall be integral part of the pump and this monoblock of pump & motor set shall be submerged in the water. The pump shall be single stage and non-clog design.

6.08.03 Trolley mounted portable sump pumps shall be of horizontal shaft, single stage, end suction, radially split casing, centrifugal, non-clog design complete with common base plate, drive assembly etc. These pumps shall be trolley mounted portable type.

6.08.04 Vertical Submersible Portable type pumps shall be submersible pump motor type, single stage and non-clog design and shall be portable type.

6.08.04 Casing

a) Casing shall be so designed to allow free passage of specified maximum size of solid.

b) Casing shall be designed to withstand the maximum shut off pressure developed by the pump.

c) The casings shall be cast, free from blow holes, sand holes, other detrimental defects. The casing shall be complete with suction and discharge connections.

d) For submersible type sump pumps adequate seal arrangement shall be made to keep leakage of liquid from casing to column assembly to minimum and adequate drain shall be provided in column assembly to permit escape of the leakage flow. The casing shall also include the bearing housing of the bottom pump shaft

bearing.

e) Trolley mounted portable sump pumps shall be provided with vent connections and drain connections with valves. These pumps shall be manually primed.

6.08.05 Impeller

a) The impeller shall be non-clog type, cast in one piece and specially designed to pass large solids or unscreened liquids. The clearance between stationary and moving parts should be such as to allow sustained performance without excessive maintenance.

b) Impellers of Fixed type sump pumps shall have provision for adjustment from an accessible location.

6.08.06 Pump shaft

a) Shaft size selected shall be such that critical speed is at least 20% away from the operating speed and the runway speed.

b) The shaft shall be ground and polished to final dimension and of ample size to withstand all stresses resulting from rotor weight, hydraulic loads and across the line starting. Shaft shall be provided with renewable sleeves particularly under stuffing boxes and other locations as recommended by pump manufacturers.

c) The coupling between shafts shall be so designed that they become tight during pump operation.

6.08.07 Column Pipe for fixed type sump pumps (As applicable for vertical sump pumps)

The discharge pipe shaft assembly shall be flanged or screwed as per manufacturer's standard and standard length of each piece of column pipe shall be in conformity to the shaft piece lengths from consideration of easy handling.

6.08.08 Bearings

a) Adequate nos. of properly designed bearings shall be furnished. Bearings for fixed type Sump Pumps shall be Oil lubricated and Bearings for trolley mounted Horizontal pumps shall be antifriction type and lubricated by oil/grease. All necessary grease gun, grease cup and tubing shall be included.

b) Thrust bearing of adequate design shall be furnished for taking the entire pump thrust arising from all probable conditions of continuous operation through out its "range of operation" and also the shut off condition life of thrust bearing shall be 20,000 working hour minimum for the load corresponding to the duty point. The bearings shall be lubricated by grease or oil from a location conveniently accessible. Design shall be such that the lubricant can not contaminate the

handling liquid.

6.08.09 Wearing Ring/Liner Plate

Renewable wearing rings/liner plates shall be provided either on impeller or on the casing or on both impeller and casing.

6.08.10 **Stuffing Box**

Stuffing box of Fixed type sump pumps shall be of mechanical packing type. Trolley mounted portable sump pumps shall have mechanical seal of reliable design.

6.08.11 **Coupling**

Pump and motor shall be connected with a suitable flexible coupling. Coupling shall be provided with coupling guard.

6.08.12 Fixed type sump pumps shall be provided with a suitable mounting plate. The mounting plate shall be adequately sized to accommodate the level switches, discharge pipe, oil cups etc. Trolley mounted portable sump pumps and drives shall be mounted on one base plate. Base plate shall be of rigid construction properly ribbed as needed. Suitable drain with valve, vent with valve and drain funnel shall be furnished by the Bidder.

The necessary supporting plate, mounting frame, base plate, etc., as required shall be supplied under this specification alongwith anchor bolts, foundation bolts, pipe, sleeves etc. Lifting lug, eye bolts etc., as required for the proper handling of each pump set shall be furnished.

6.08.13 **Suction Bell**

Fixed type sump pumps and vertical submersible portable type pumps shall be complete with adequately dimensioned suction bell to guide and streamline intake fluid.

7.00.00 INSPECTION AND TESTING

The contractor shall carry out the following minimum specific tests & inspections to ensure that the equipment furnished lies in strict conformance with the specification & in accordance with codes/standards and good engineering practice.

a) Material identification and testing shall include but shall not be limited to the following components:

   i) Impeller & wearing rings.

ii) Shafts & shaft sleeves.

iii) Couplings

iv) Bearings

v) Coloumn pipes

vi) Discharge head

b) Tests shall also include but shall not be limited to the following :

i) The entire surface of the impeller castings shall be subjected to D.P. test as per ASTM-E-165.

ii) Shaft shall be subject to D.P. & Ultrasonic test.

iii) Wearing rings shall be subject to D.P. test.

iv) Witnessing of NDT/review of NDT reports.

v) Static balance test for impeller & dynamic balance of complete rotating parts as per ISO-1940.

vi) Complete inspection of assembled pump

c) Hydrostatic test shall be done for the following components (as minimum) at 150% of the shut-off pressure. Pressure shall be maintained for a period of not less than one (1) hour.

i) Bowls/suction bells
ii) Column pipe
iii) Discharge head
iv) Any other applicable pressure parts.

d) Performance tests at shop

i) Each pump shall have to be tested to determine performance curves of the pumps. These tests are to be conducted in the presence of Owner's representative as per the requirements of the Standards of Hydraulic Institute of USA (ASME-Power Test Code PTC 8.2/BS-599) or any other equivalent standard but the tolerences on Head, Discharge & Power shall be specified in HIS, USA.

ii) Performance tests are to be conducted to cover the entire range of operation of the pumps. These shall be carried out to span 130% of rated capacity upto pump shut-off condition. A minimum of five combinations of head & capacity are to be achieved during testing to establish the performance curves, including the design capacity point, shut-off point and the two extremities of the range of operation as specified in the annexures. After completion of performance test, all pumps shall be stripped down for inspection of internals.

iii) Tests shall be conducted with actual drive motors being furnished

iv) The Bidder shall submit in his proposal the facilities available at his works to conduct performance testing.

v) NPSH tests are to be conducted on one pump of each type at 3% head drop conditions, if specified in the pump Annexures.

vi) All rotating components of the pumps shall be subjected to static and dynamic balancing tests. The assembled rotor will be subjected to dynamic balancing tests.

vii) Mechanical run test shall be carried out on all pumps to determine the vibration levels, noise levels etc. This test shall be conducted at site also. However, test value at site shall be used for the acceptance of the equipment.

7.01.00 The pump integral accessories like thrust bearing, pump motor coupling etc., shall be subject to tests as per manufacturer's standard.

7.02.00 Test on motors, control panels, starter panels, cables shall be conducted as per the requirement of this specification.

7.03.00 After erection at site, pumps shall be operated to prove satisfactory and trouble free performance.

7.04.00 A typical quality plan is enclosed for bidder's guidance, the bidder shall furnish detailed Quality Plan based on same for Purchaser's approval, in the event of order.

8.00.00 Drawings, data, curves and information

8.01.00 Following drawings, data and information for the equipments are required to be submitted by the bidder alongwith his formal proposal.

8.01.01 General Arrangement drawings of the pumps showing various dimensions, suction and discharge locations.

8.01.02 Typical cross-section drawings of the pumps, seal rings, etc., and materials of construction for all items.

8.01.03 Characteristic curves of pumps showing effective head, pump input power, efficiency, submergence and NPSH, against capacity ranging from shut off condition to 150% of rated capacity.

8.01.04 Speed vs. torque curve of the pump corresponding to recommended mode of pump starting, super-imposed on speed vs. torque of the motor, corresponding to 80% and 100% rated voltage.

8.01.05 Diagram showing the type of lubrication system etc.

8.01.06 Completely filled up schedules enclosed under Vol.III of this specification.

8.01.07 GA drawing of Control Panel.

8.01.08 A write up describing clearly the procedure for installing the pump and also for overhauling the fixed type pumps. A procedure for lowering and raising the vertical submersible portable type pumps shall also be given.

8.02.00 Drawings, data, curves and information to be submitted by the successful tenderer after placement of order.

8.02.01 The drawings/data asked against clause nos.8.01.00 to 8.01.07 above shall also be furnished in a finalised form by the successful tenderer for the approval of the purchaser/his consultant. In addition following documents shall also be submitted for Purchaser's/consultant's approval.

8.02.02 Pump foundation details with static and dynamic loads.

8.02.03 Pump and drive sealing, bearing lubrication and cooling arrangement drawing.

8.02.04 Drive data

8.02.05 Reports on shop tests and test certificates.

8.02.06 All other drawings/documents and data as specified and deemed necessary.

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-TS-XXX-100-N002	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-100-N005, Rev-02	DATE: 6-May-2020
	PROJECT:		PO NO.:	DATE:
	ITEM: Sump Pump/Submersible Pump	SYSTEM: Plant Water/Common	SECTION: II	SHEET Page 1 of 3

S. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY				REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/ N				D	M	C	N	
1.0 RAW MATERIAL														
1.1a	Pump Casing	Mechanical and Chemical properties	CR	Mechanical and Chemical Analysis	1 / Heat / Batch	1 / Heat / Batch	Approved Drawing/ Data sheet	Relevant Material specification	Lab Report/ MTC	√	P	V	V	
1.1b	Impeller	Mechanical and Chemical properties	CR	Mechanical and Chemical Analysis	1 / Heat / Batch	1 / Heat / Batch	Approved Drawing/ Data sheet	Relevant Material specification	Lab Report/ MTC	√	P	V	V	
1.2	Heat treatment of Stainless Steel Castings	Heat Cycle	MA	Verification of HT chart	All Batches	All Batches	Relevant Material specification	Relevant Material specification	Correlated HT charts	√	P	V	V	
1.3	Bars / forgings for pump and motor shafts	Mechanical and Chemical Properties	CR	Mechanical and Chemical Analysis	1 / Bar	1 / Bar	Approved Drawing/ Data sheet	Relevant Material specification	Lab Report/ MTC	√	P	V	V	
		Dimensions	MA	Measurement	100%	100%	Manufacturers Drawing	Manufacturers Drawing	IR	√	P	V	V	
		Internal defects for 40 mm and above diameter	CR	UT	100%	100%	ASTM A-388	Refer Note 2	IR	√	P	V	V	
1.4	Cable Type: PVC insulated, multi core, copper conductor	Routine TC and acceptance TC as per IS 694/Is1554, Length and size	MA	Measurement	100%	100%	Approved Datasheet / IS 694/IS1554	Approved Datasheet / IS 694/IS1555	IR & TC	√	P	V	V	Compliance certificate to be submitted by Vendor
1.5	Bearings	Make, Bearing No., Surface finish	MA	Visual Examination	100%	100%	Manufacturers Std	Manufacturers Std	IR	√	P	V	-	
2.0 INPROCESS CONTROL														
2.1	All Components	Visual Defects	MA	Visual	100%	100%	Manufacturers Drawing	No harmful defects	Log book / IR	√	P	V	V	
		Dimensions	MA	Measurement	100%	100%	Manufacturers Drawing	Manufacturers Drawing	Log book / IR	√	P	V	V	
2.2	Pump discharge casing	Leak tightness	CR	Hydro test (Duration 30 minutes min.)	100%	100%	Refer Remark.	No leakage	IR	√	P	W	V	Test Pressure=2 times duty point pressure OR 1.5 times pump shut off head, whichever is higher

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	4/9/2020	Girish Chandra	Checked by:	04.09.2020	Mohit Kumar		
Reviewed by:	4/9/2020	Vishal Kumar Yadav	Reviewed by:	04/9/2020	Ritesh Kumar Jaiswal		

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

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-TS-XXX-100-N002	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-100-N005, Rev-02	DATE: 6-May-2020
	PROJECT:		PO NO.:	DATE:
	ITEM: Sump Pump/Submersible Pump	SYSTEM: Plant Water/Common	SECTION: II	SHEET Page 2 of 3

S. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY **			REMARKS
1	2	3	4	5	6		7	8	9					
					M	C/ N				D	M	C	N	
	Motor Housing	Leak tightness	CR	Air test (Duration 30 Minutes min)	100%	100%	Air test at 0.5 kg/cm2 (gauge pressure)	No leakage	IR	√	P	V	V	
2.3	Casing & Impeller (machined surfaces)	Surface Defects	CR	DPT	100%	100%	ASTME:165	Appendix 8 of ASME Sec.VIII, Div.1	IR	√	P	V	V	On machined surface only
2.4	Impeller	Static & Dynamic residual unbalance	CR	Static, Dynamic balancing	100%	100%	ISO : 1940	ISO 1940 Gr. 6.3	IR	√	P	V	V	
2.5	Pump Motor Shaft	Internal Defects	CR	UT	100%	100%	ASTME:388	ASTME:388, Refer note 2	IR	√	P	V	V	On machined surface only
		Surface Defects	CR	DPT	100%	100%	ASTME:165	Appendix 8 of ASME Sec.VIII, Div.1	IR	√	P	V	V	On machined surface only
3.0 SUB-ASSEMBLY, ASSEMBLY CONTROL														
3.1	Pump, Motor, Rotor	Eccentricity	MA	Measurement	100%	100%	Manufacturers Drawing	Manufacturers Drawing	Log book / IR	√	P	V	V	
3.2	Pump and Motor assembly	Completeness, correctness	MA	Visual Examination	100%	100%	Manufacturers Drawing	Manufacturers Drawing	IR	√	P	V	V	
4.0 FINAL INSPECTION, PAINTING & PACKING														
4.1	Pump set (Pump+ Motor)	Q Vs Head, Q Vs Power, Q Vs Efficiency	CR	Performance test	100%	100%	Tech. Spec., Appd. Data Sheet, Appd. Curves, HIS, Test procedure	Tech. Spec., Appd. Data Sheet, Appd. Curves, HIS	Performance test record, Plotted Curves	√	P	W	V	
4.2	Routine Test on motor	HV, IR, Locked Rotor, No Load, Make type, Rating	CR	Electrical tests	100%	100%	IS 325	Approved Data Sheet	IR	√	P	V	V	Winding resistance Degree of protection shall be IP 68, HV at 2.5 KV AC for 1 Minute.
4.3	Strip down after Performance test	Undue wear, tear and breakages	CR	Visual examination of Casing & Impeller after stripping	100%	100%	Undue wer, tear and breakages	No undue wear, tear and breakages	IR	√	P	W	V	Witnessing one no. of each type
4.4	Complete Pump	Completeness, Correctness,	MA	Visual examination	100%	100%	Approved GA Drg	Approved GA Drg	IR	√	P	V	V	Compliance report for accessories will be submitted.

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	Girishchandra 4/9/2020	Girish Chandra	Checked by:	04.09.2020	Mohit Kumar		
Reviewed by:		Vishal Kumar Yadav	Reviewed by:		Ritesh Kumar Jaiswal		
	4/9/2020			04/9/2020			

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

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-TS-XXX-100-N002	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-100-N005, Rev-02	DATE: 6-May-2020
	PROJECT:		PO NO.:	DATE:
	ITEM: Sump Pump/Submersible Pump	SYSTEM: Plant Water/Common	SECTION: II	SHEET Page 3 of 3

S. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY **			REMARKS
1	2	3	4	5	6		7	8	9	D	M	C	N	
					M	C/ N								
		Workmanship and finish, overall dimensions												
4.5	Painting	Surface finish, DFT, Markings etc.	MA	Visual Exam. Measurement, Aesthetic	100%	100%	Approved Drg/Docs	Approved Drg/Docs	IR	√	P	V	V	Compliance report by Manufacturer
4.6	Packing, Marking	Soundness of packing	MI	Visual Aesthetic	100%	100%	Technical Specification / Approved procedure	Technical Specification / Approved procedure	IR	√	P	V	-	Photograph of packed material to be verified by BHEL before issuing MDCC.

NOTES:

1. For accessories and bought out items, Manufacturer will submit Compliance for review.
2. For UT test on shaft, defect echo < 20 % full screen height when back wall echo set @ 100 % screen height. Reduction in back wall echo to be <20%. Defect height > 20% of FSH is not acceptable, also loss in backwall echo>20 % not acceptable.
3. IP 68 protection certificate for test conducted on similar motor shall be submitted for review.
4. Compliance for provision of thermic switch for over heating protection of winding, reverse rotation protection device shall be submitted by Manufacurer.
5. For control panel separate QAP is applicable.
6. Before sending the documents for approval, supplier to ensure that "Reference documents" & "acceptance Norms" does contain data required for the Characteristic to be checked" as indicated in QP.
7. BHEL reserves the right for conducting repeat test, if required.
8. Photographs of packed material to be submitted to BHEL before issuing MDCC.
9. Project specific QP to be developed based on customer requirement.

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION, **D**: DOCUMENTATION
** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, **C**: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **N**: CUSTOMER,
P: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE
MA: MAJOR, **MI**: MINOR, **CR:** CRITICAL, MTC: MILL TEST CERTIFICATE. **IR**: INSPECTION REPORT **GA DRG**: GENERAL ARRANGMENT DRAWING

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	4/9/2020	Girish Chandra	Checked by:	04.09.2020	Mohit Kumar		
Reviewed by:	4/9/2020	Vishal Kumar Yadav	Reviewed by:	04/9/2020	Ritesh Kumar Jaiswal		

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

SUB-SECTION - IIB

STANDARD TECHNICAL SPECIFICATION (ELECTRICAL)

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-Q-006, REV-02	DATE: 17.04.2020
		PROJECT:		PO NO.:	DATE:
		ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 1 of 2

S. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/ N					M	C	N	
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	-	MFG. SPEC.	MFG. SPEC.	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	VISUAL	100%	-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	LOG BOOK		P	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	-	MFG.SPEC./	MFG.SPEC.	LOG BOOK		P	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	-	MFG. SPEC/ APPROVED DATASHEET	MFG. SPEC/ APPROVED DATASHEET	LOG BOOK	✓	P	V	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST	MA	VISUAL	100%	-	IS-325 / IS-12615/ APPROVED DATA SHEET	IS-325 / IS-12615/ APPROVED DATA SHEET	TEST/ INSPN. REPORT	✓	P	V *	-	* NOTE -1
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	-	APPROVED DRG/ DATA SHEET	APPROVED DRG/ DATA SHEET	TEST/ INSPN. REPORT	✓	P	V *	-	* NOTE -1 & NOTE-2

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KUSHWAHA	Checked by:	KUNAL GANDHI	KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-Q-006, REV-02	DATE: 17.04.2020
		PROJECT:		PO NO.:	DATE:
		ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 2 of 2

		3.NAMEPLATE DETAILS	MA	VISUAL	100%	-	IS-325 / IS-12615 / APPROVED DATA SHEET	SAME AS COL. 7	TEST/ INSPN. REPORT	✓	P	V	-	
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MFG. STANDARD / (#)	AS PER MFG. STANDARD / (#).	INSPC. REPORT	✓	P	W	-	(#) REFER NOTE-8

NOTES:
1. Routine tests on 100% motors shall be done by the vendor. However, BHEL/ Customer shall witness routine tests on random samples. The sampling plan shall be mutually agreed upon.
2. For exhaust/ventilation fan motors of rating up to 1.5 KW, only routine test certificates shall be furnished for scrutiny.
3. In case test certificates for these tests on similar type, size and design of motor from independent laboratory are available, the same is valid for 5 years.
4. BHEL reserves the right to perform repeat test, if required.
5. After packing and prior to issue MDCC, photographs of items to be despatched shall be sent to BHEL for review.
6. In case of any changes in QP commented by customer at contract stage, same shall be carried out by bidder without any implication to BHEL/ Customer.
7. Project specific QP to be developed based on customer requirement.
8. For export job, BHEL technical specification for seaworthy packing to be followed.
9. Packing shall be suitable for storage at site in tropical climate conditions.
10. Latest revision/ year of issue of all the standards (IS/ ASME/ IEC etc.) indicated in QP shall be referred.

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,
** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, B: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **C**: CUSTOMER,
P: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE
MA: MAJOR, **MI**: MINOR**, CR:** CRITICAL
D: DOCUMENTATION

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Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 1 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.0	RAW MATERIAL & BOUGHT OUT CONTROL													
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	LOG BOOK		P	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	SAMPLE	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	TEST REPORT		P/V	-		
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%	-		FREE FROM CRACKS, UN-EVENNESS ETC.	TEST REPORT		P	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	TC		P/V	-	-	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%	-	MANUFACTURER'S DRG./SPEC	FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK		P/V	-		
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	TC		P/V	-		HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG.	MANUFACTURER'S DRG.	LOG BOOK		P/V	-		
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	LOG BOOK		P/V	-		

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Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 2 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S DRG./ STD.	TC		P/V	-		
		3. DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S DRG.	LOG BOOK		P/V	-		
		4.INTERNAL FLAWS	CR	ULTRASONIC TEST	100%	-	ASTM-A388	MANUFACTURER'S STD.	INSPECTION REPORT	✔	P/W	V	-	FOR DIA OF 55 MM & ABOVE
1.6	SPACE HEATERS, CONNEC-TORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	100%	-	MANUFACTURER'S DRG./STD.	MANUFACTURER'S DRG./STD.	INSPECTION REPORT		P/V	-	-	
		2. PHYSICAL COND.	MA	VISUAL	100%	-	MANUFACTURER'S DRG./STD.	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	INSPECTION REPORT		P/V	-	-	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG./ STD	MANUFACTURER'S DRG. / STD.	INSPECTION REPORT		P/V	-	-	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-	MANUFACTURER'S DRG./ STD	MANUFACTURER'S DRG. / STD.	TEST REPORT		P/V	-	-	

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Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

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Sign & Date	
Seal	

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 3 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS	TEST REPORT		P/V	-	-	
		2.DIMENSION(BORE DIA, WALL THICKNESS, BDV AS RECEIVED, BDV AFTER FOLDING AT 180°	MA	TEST	SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK AND OR SUPPLIER'S TC		P/V	-	-	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK		P	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG. .	MANUFACTURER'S DRG.	LOG BOOK		P/V	-	-	
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	SAMPLE	-	MANUFACTURER'S DRG./ STD.	MANUFACTURER'S DRG./ STD.	TC		P/V	-	-	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		*P/V	-	-	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY
		2.ELECT. PROP, & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S / SPEC.	TC & VENDOR'S TEST REPORTS		P/V	-	-	

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Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

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	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 4 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLES	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S / SPEC.	LOG BOOK		P/V	-	-	
1.10	BEARINGS	1.MAKE & TYPE	MA	VISUAL	100%	-	MANUFACTURER'S DRG./ APPROVED DATASHEET	MANUFACTURER'S DRG./ APPROVED DATASHEET	LOG BOOK		P/V	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	APPROVED DATASHEET	APPROVED DATASHEET/ BEARING MANUF'S CATALOGUES	LOG BOOK		P/V	-	-	
		3.SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P/V	-	-	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	SAMPLE	-	MANUFACTURER'S STD./ APPROVED DATASHEET	MANUFACTURER'S STD./ APPROVED DATASHEET	LOG BOOK		P/V	-	-	
		4.HV/IR	MA	-DO-	100%	-	MANUFACTURER'S STD./ APPROVED DATASHEET	MANUFACTURER'S STD./ APPROVED DATASHEET	LOG BOOK		P/V	-	-	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	-	MANUFACTURER'S DRG/SPECS	MANUFACTURER'S DRG./ SPECS.	LOG BOOK		P	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	

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Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 5 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
2.0	IN PROCESS													
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-	MANUFACTURER'S DRG	GOOD FINISH	LOG BOOK		P/W	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-	-DO-	GOOD FINISH	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	100%	-	MANUFACTURER'S STD./ ASTM-E165	MANUFACTURER'S STD./ APPROVED DATASHEET.	LOG BOOK	✔	P	V	-	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		3.SHADE	MA	VISUAL	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	

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Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK		P	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK		P	-	-	
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		2.CLEANLINESS	CR	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		3.IR+HV-IR	CR	ELECT. TEST	100%	-	IS-325/IS-12615/IEC-60034 PART-1	IS-325//IS-12615/IEC-60034 PART-1	TEST/INSPC. REPORT	✔	P	V	-	
		4.RESISTANCE	CR	ELECT. TEST	100%	-	IS-325/IS-12615/IEC-60034 PART-1	IS-325//IS-12615/IEC-60034 PART-1	TEST/INSPC. REPORT	✔	P	V	-	
		5.INTERTURN INSULATION	CR	ELECT. TEST	100%	-	IS-325/IS-12615/IEC-60034 PART-1	IS-325//IS-12615/IEC-60034 PART-1	TEST/INSPC. REPORT		P	-	-	
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		3.NO. OF DIPS	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK	✔	P	V	-	THREE DIPS TO BE GIVEN

BHEL					
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Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

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	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 7 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		4.DURATION	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK	✔	P	V	-	
2.7	COMPLETE STATOR ASSEMBLY	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	VISUAL	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	TEST/INSPC. REPORT	✔	P	V	-	
		3.HV	MA	ELECT. TEST	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	TEST/INSPC. REPORT	✔	P	V	-	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	100%	-	MANUFACTURER'S SPEC./ ISO 1940	MANUFACTURER'S DWG.	LOG BOOK		P	-	-	
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	TEST/INSPC. REPORT	✔	P	V	-	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		2.WORKMANSHIP	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		3.AXIAL PLAY	MA	MEAS.	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK	✔	P	V	-	
		4.DIMENSIONS	MA	MEAS.	100%	-	MANUFACTURER'S DRG./ MANUFACTURER'S SPEC.	MANUFACTURER'S DRG./ MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK	✔	P	V	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 8 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS	MA	ELECT.TEST	1/TYPE/SIZE	1/TYPE/SIZE	IS-325/IS-12615/APPROVED DATASHEET	IS-325/IS-12615/APPROVED DATASHEET	TEST REPORT	✔	P	W*	-	* NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST	MA	ELECT.TEST	100%	-	IS-325/IS-12615/APPROVED DATASHEET	IS-325/IS-12615/APPROVED DATASHEET	TEST REPORT	✔	P	V$	-	$ NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	ELECT.TEST	100%	-	IS: 12075 / IEC 60034-14 & IS-12065	IS: 12075 / IEC 60034-14 & IS-12065	TEST REPORT	✔	P	V$	-	$ NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET &	TEST/INSPC. REPORT	✔	P	W	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	-	IEC 60034-5/IS-12615	APPROVED DATASHEET	TC	✔	P	V	-	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	ELECT. & MECH. TEST	100%	-	IS-325/IS-12615/IEC-60034 PART-1/IS: 12802	IS-325/IS-12615/IEC-60034 PART-1/IS: 12802	TC	✔	P	V$	-	$ NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	ELECT. & MECH. TEST	100%	-	IS-325/IS-12615/IEC-60034 PART-1	IS-325/IS-12615/IEC-60034 PART-1	TC	✔	P	V$	-	$ NOTE - 2
		8. NAME PLATE DETAILS	MA	VISUAL	100%	-	IS-325/IS-12615& DATA SHEET	IS-325//IS-12615 & DATA SHEET	TEST/INSPC. REPORT	✔	P	V$	-	$ NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	-	IS 2148 / IEC 60079-1	IS 2148 / IEC 60079-1	TC	✔	P	V	-	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	SAMPLE	APPROVED DATASHEET	APPROVED DATASHEET	TC	✔	P	W$	-	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY $ NOTE - 2

BHEL					
ENGINEERING			QUALITY		
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Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 9 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MANUFACT. STANDARD / (#)	AS PER MANUFACT. STANDARD / (#)	INSPC. REPORT	✔	P	W	-	(#): REFER NOTE-8

NOTES:

1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.

2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL/CUSTOMER SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON.

3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THE SAME IS VALID FOR 5 YEARS.

4 BHEL RESERVES THE RIGHT TO PERFORM REPEAT TEST, IF REQUIRED.

5 AFTER PACKING AND PRIOR TO ISSUE MDCC, PHOTOGRAPHS OF ITEMS TO BE DESPATCHED SHALL BE SENT TO BHEL PURCHASE GROUP FOR REVIEW.

6 IN CASE , ANY CHANGES IN QP COMMENTED BY CUSTOMER AT CONTRACT STAGE SHALL BE CARRIED OUT BY BIDDER WITHOUT ANY IMPLICATION TO BHEL/ CUSTOMER.

7 PROJECT SPECIFIC QP TO BE DEVELOPED BASED ON CUSTOMER REQUIREMENT.

8 FOR EXPORT JOB, BHEL TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING TO BE FOLLOWED.

9 PACKING SHALL BE SUITABLE FOR STORAGE AT SITE IN TROPICAL CLIMATE CONDITIONS.

10 LATEST REVISION/ YEAR OF ISSUE OF ALL THE STANDARDS (IS/ ASME/ IEC ETC.) INDICATED IN QP SHALL BE REFERRED.

LEGENDS:

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

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

P: PERFORM. **W**: WITNESS. **V**: VERIFICATION. AS APPROPRIATE

MA: MAJOR, **MI**: MINOR, **CR**: CRITICAL

D: DOCUMENT

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

SUB-SECTION - IIC

STANDARD TECHNICAL SPECIFICATION (C &I)

बी एच ई एल BHEL	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
		PROJECT:		PO NO.: --	DATE: --
		ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 1 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/N					M	C	N	
	RAW MATERIAL													
1.0	Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	Sample	IS:1079 IS:513	IS:1079 IS:513	Test Certificate	√	P/W	V		
		2. Bend Test	CR	Mech. test	Sample	Sample	IS:1079 IS:513	IS:1079 IS:513	Test Certificate	√	P/W	V		
		3. Surface finish	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	---		
		4. Waviness	MA	Visual	100%	10%	Manufacturing Standard	No Waviness	Inspection Report	√	P/W	---		
		5. Thickness	MA	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	V		
		6. Mill marking	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	Sample	IS:2062	IS:2062	Test Certificate	√	P/W	---		
		2. Surface Defects	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	---		
		3. Straightness	MA	Measurement	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	---		
		4. Mill marking	MA	Visual	100%	10%	IS:2062	IS:2062	Inspection Report	√	P/W	V		

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/02/2020	KUNDAN PRASAD		
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL		

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

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 2 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/N					M	C	N	
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	10%	IS:1554 or IS:694	IS:1554 or IS:694	Inspection Report	√	P/W			
		2. IR and HV	MA	Electrical	100%	10%	IS:1554 or IS:694	IS:1554 or IS:694	Inspection Report	√	P/W			
		3. Conductor a) Resistance b) Size c) Sheet colour	MA MA MA	Electrical Measurement Visual	100% 100% 100%	10% 10% 10%	IS:1554 or IS:694	IS:1554 or IS:694	Inspection Report	√	P/W			
		4. Type / Routine Test Certificates	MA	Verification	100%	10%	IS:1554 or IS:694	IS:1554 or IS:694	Inspection Report	√	P/W			
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays	1. Verification at make and Type	CR	Visual	Sample	Sample	Approved Drg/Datasheet	Approved Drg/Datasheet	Test Certificate	√	P/W			
		2. Verification of Test Certificates	CR	Scrutiny of Type / Routine T.Cs.	100%	10%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W			
		3. Operation / Functional check	CR	Electrical	Sample+ 100% @	Sample+ 10% @	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W			+ for relay & contactors only

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/02/2020	KUNDAN PRASAD		
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL		

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

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 3 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/N					M	C	N	
	Timers, Space Heaters, Thermostat, Indicating meters etc.	4. I.R.	MA	Electrical	100%	10%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W			@ for all components except relays & contactors.
		5. H.V.	MA	Electrical	100%	10%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W			
		6. Calibration	MA	Electrical	100%	10%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W	V		
		7. Pick up / Drop off Voltage	MA	Electrical	100%	10%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W			
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make	MA	Visual	Sample	Sample	Manufacturing Standard	Manufacturing Standard	Test Certificate	√	P/W			
		2. Surface defects	MA	Visual	Sample	Sample	Manufacturing Standard	Manufacturing Standard	Test Certificate	√	P/W			
		3. IR / HV on Terminal Blocks	MA	Electrical	Sample	Sample	Manufacturing Standard	Manufacturing Standard	Test Certificate	√	P/W			
	IN PROCESS INSPECTION													

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/02/2020	KUNDAN PRASAD		
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL		

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

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 4 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/N					M	C	N	
6.0	Blanking / Bending / Forming	1. Dimensions	MI	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		2. Surface defects after bending	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W			
7.0	Nibbling / Punching	1. Cutout Sizes	MI	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		2. Deburring	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
	ASSEMBLY													
8.0	Frame Assembly & Sheet fixing	1. Dimensions	MA	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		2. Alignment	MA	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		3. Welding Quality	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		4. Surface defects	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/02/2020	KUNDAN PRASAD
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 5 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Periodic	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		3. Dipping / Removal Time	MA	Measurement	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		4. Surface quality after every dip	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		5. Primer after phosphating	MA	Visual, Thickness	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		6. Putty Application & Rubbing after primer	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		7. Paint first coat	MA	Visual, Thickness	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	14/4/2020	CHETAN MALIK	Checked by:	14/04/2020	KUNDAN PRASAD		
Reviewed by:	14/4/2020	RK RAINA	Reviewed by:	14/4/2020	RK JAISWAL		

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Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 6 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9		**			
					M	C/N				D	M	C	N	
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
10.	Panel Wiring	1. Wiring Layout	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		2. Wiring Termination (Crimped Lugs)	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		3. Ferrule numbers	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		4. Colour of wiring	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	V		
		5. Size of Conductor	MA	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	V		
11.	Component Mounting	1. Correct components	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		2. Fixing	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/02/2020	KUNDAN PRASAD		
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL		

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 7 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/N					M	C	N	
	FINAL TESTING													
12.	Final Inspection	1. Workmanship	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	W		
		2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		At Random by BHEL, based on 100 % internal test reports by Mfr.
		3. Components identification Marking / Name plates	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		5. Dimensions	MA	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		6. Door functioning	MA	Functional	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		At Random by BHEL, based on 100 % internal test reports by Mfr.
		7. Paint Shade	CR	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	14/12/2020	CHETAN MALIK	Checked by:	14/12/2020	KUNDAN PRASAD
Reviewed by:	14/12/2020	RK RAINA	Reviewed by:	14/12/2020	RK JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 8 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/N					M	C	N	
		8. Paint Thickness	CR	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		9. Workmanship of Gaskets	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	W		
		10. Wiring Layout	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		11. Wire Termination	MA	Pulling manually	Sample	Sample	-----	Firm termination	Inspection Report	√	P/W	W		
		12. Continuity	MA	Electrical	100%	10%	-----	Continuity OK	Inspection Report	√	P/W	W		
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	Sample	Approved Drg/Datasheet Relevant IS-13947 Part-1, IS-2148.	Approved Drg/Datasheet Relevant IS-13947 Part-1, IS-2148.	Type Test Certificate	√	P/W	V		
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	10%	Approved Drg/Datasheet Relevant IS.	Approved Drg/Datasheet Relevant IS.	Inspection Report	√	P/W	W		

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/2/2020	KUNDAN PRASAD		
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL		

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

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 9 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
15	FUCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		2. Instrument Calibration	CR	Electrical	10%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		3. Temperature rise	CR	Electrical	100%	10%	Approved Drg/Datasheet Relevant IS.	Approved Drg/Datasheet Relevant IS.	Inspection Report	√	P/W	W		

NOTES:

1. Customer's specification for painting shall be included in the technical specification. In the absence of Customer's spec. for painting, vendor to obtain BHEL's approval on their painting specification / procedure.
2. Copies of all TC's (Test Certificates) for components shall be submitted to BHEL for verification and acceptance.
3. BHEL reserves the right to conduct repeat tests, if required.

LEGENDS:
*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION, **D**: DOCUMENTATION,
** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, **C**: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **N**: CUSTOMER,
P: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE
MA: MAJOR, **MI**: MINOR, **CR:** CRITICAL

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	14/12/2020	CHETAN MALIK	Checked by:	14/12/2020	KUNDAN PRASAD
Reviewed by:	14/12/2020	RK RAINA	Reviewed by:	14/12/2020	RK JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

STANDARD CHECK LIST FOR C&I INSTRUMENTS(for MSE& Max pckgs)
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 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 correlation is not available, MFR's compliance to be provided
5. Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same along with test certificates to be verified by BHEL.

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	31.08.20	VIPUL KUMAR VERMA	Checked by:	31/8/20	KUNAL GANDHI
Reviewed by:	31.08.2020	SURESH CHAND SHARMA	Reviewed by:	31/8/2020	RITESH KUMAR JAISWAL

SECTION III

DOCUMENTS TO BE SUBMITTED BY BIDDER

SECTION IIIA

COMPLIANCE CERTIFICATE

(TO BE SUBMITTED ALONG WITH BID)

	TITLE : TECHNICAL SPECIFICATION SUMP PUMPS 1X660 BHUSAWAL TPS UNIT-6	SPECIFICATION No. : PE-TS-415-100-N002, Rev-00
	COMPLIANCE CERTIFICATE	SECTION: IIIA
		Date: 02.06.2021
		Sheet 1 of 1

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/ deviations with regard to same.

b) QP/ test procedures shall be submitted in the event of order based on the guidelines given in the specification & QP enclosed therein.

c) QP will be subject to BHEL/Customer approval in the event of order & 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.

d) All drawings/data – sheets etc. to be submitted during contract shall be subject to BHEL/ Customer approval.

e) Bidder shall include the cost of Mandatory Spares, unless specified otherwise in Sec-IA of the specification or NIT.
Any mandatory spares stated as not applicable, shall have to be supplied without any cost implication to BHEL in the event they are found to be applicable during detail engineering stage.

f) There are no other deviation with respect to specification other than those furnished in the 'Schedule of Deviations'.

g) The offered materials should be either equivalent or superior to those specified. Also for components where material is not specified it shall be suitable for intended duty. All materials shall be subject to approval in the event of order.

h) Prices for recommended spares (if any) for 3 years operation shall be furnished separately & not included in the base price.

i) The commissioning spares (if any) are supplied on 'As Required Basis' & prices for same included in the base price (If bidders reply to this is "No commissioning spares are required" and if some spares are actually required during commissioning same shall be supplied by bidder without any cost to BHEL).

j) All sub vendors shall be as per BHEL/ Customer approved list.

k) Any special tools & tackles, if required, shall be in bidder's scope.

l) All models offered have been supplied by bidder in the past and are meeting the experience qualifying criteria of BHEL/ Customer (viz. The submersible pumps shall be of proven design. The pump manufacturer should have manufactured and supplied at least One (1) no. of submersible pump set for continuous duty for similar application, of type and capacity as offered or higher and which has been in successful operation for at least one (1) year prior to the date of Techno-Commercial bid opening. The pump set shall be suitable for pumping raw water with high turbidity and soft solids/fibrous solids which are generally observed in contaminated rivers / canal water. Components of Identical pumps shall be interchangeable. Any deviation to these criteria shall be suitably highlighted in deviation schedule).

m) All selected motor ratings have minimum margins as per Data sheet-A, section-1D of technical specification.

n) Power & Control circuits shall be with MCCB.

We the undersigned hereby undertake to meet the compliance requirements as listed above on the conditions as elsewhere specified.

PARTICULARS OF BIDDER/ AUTHORISED REPRESENTATIVE

NAME	DESIGNATION	SIGNATURE	DATE	

SECTION IIIB

GA DRAWING OF SUMP PUMPS

(TO BE SUBMITTED ALONG WITH BID--FOR REF. ONLY)

SECTION IIIC

DEVIATION SCHEDULE
(AS PER NIT FORMAT)

(TO BE SUBMITTED ALONG WITH BID)

SECTION IIID

ELECTRICAL LOAD DATA FORMAT

CABLE SCHEDULE

MOTOR DATA SHEET-C

AND BLALANCE DOCUMENT AS PER CL. 13.0 OF SECTION-IA

(TO BE SUBMITTED BY SUCCESSFUL BIDDER AFTER AWARD OF CONTRACT)

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.	415	ORIGINATING AGENCY		PEM (ELECTRICAL)
	PROJECT TITLE	1X660 MW BHUSAWAL TPS	NAME		DATA FILLED UP ON
	SYSTEM	SUMP PUMP	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

	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				REV.	
			SEAL		
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		

NAME OF VENDOR				
			REV.	
NAME	SIGNATURE	DATE	SEAL	