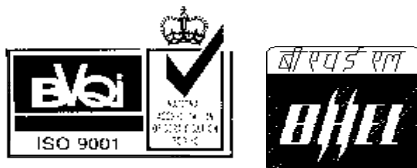


TANGEDCO

**2X660 MW ENNORE SEZ STPP
AT ASH DYKE OF NCTPS, CHENNAI**

**TECHNICAL SPECIFICATION
FOR
TRAVELLING BAND SCREENING SYSTEM**

Specification No. : PE-TS-412-172-N001 (REV. 00)



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



TITLE : TECHNICAL SPECIFICATION
FOR
TRAVELLING BAND SCREENING SYSTEM

SPEC. NO. PE-TS-412-172-N001

SECTION

REV. NO. 00

DATE : 20.01.2017

CONTENTS

This Technical Specification consists of three Sections:

SECTION TITLE

SECTION I SPECIFIC TECHNICAL REQUIREMENTS

- IA SPECIFIC TECHNICAL REQUIREMENT-MECHANICAL.
- IB SPECIFIC TECHNICAL REQUIREMENT-C&I.
- IC SPECIFIC TECHNICAL REQUIREMENT-ELECTRICAL.
- ID DATA SHEET – A.

SECTION II STANDARD TECHNICAL REQUIREMENTS

- IIA STANDARD TECHNICAL REQUIREMENT-MECHANICAL
- IIB STANDARD TECHNICAL REQUIREMENT-C&I
- IIC STANDARD TECHNICAL REQUIREMENT-ELECTRICAL.

SECTION III DOCUMENTS TO BE SUBMITTED BY BIDDER

- IIIA COMPLIANCE CERTIFICATE (TO BE SUBMITTED BY BIDDER DURING TENDER STAGE).
- IIIB ELECTRICAL LOAD (TO BE SUBMITTED BY BIDDER DURING CONTRACT STAGE).
- IIIC DATASHEET B & BALANCE DOCUMENTS AS PER CL. NO. 9.01.00 OF SECTION- IA (TO BE SUBMITTED BY SUCESSFUL BIDDER AFTER AWARD OF CONTRACT)



TITLE : TECHNICAL SPECIFICATION
FOR
TRAVELLING BAND SCREENING SYSTEM

SPEC. NO. PE-TS-412-172-N001

SECTION : I
SUB-SECTION : IA

REV. NO. 00 DATE : 20.01.2017

Sheet 1 of 11

**SECTION IA
SPECIFIC TECHNICAL REQUIREMENT
MECHANICAL SYSTEMS**



**TITLE : TECHNICAL SPECIFICATION
FOR
TRAVELLING BAND SCREENING SYSTEM**

SPEC. NO. PE-TS-412-172-N001

**SECTION : I
SUB-SECTION : IA**

REV. NO. 00 **DATE :** 20.01.2017

Sheet 2 of 11

1.00.0 GENERAL

The Travelling Band Screens complete with all accessories including special tools and tackles (if any) shall conform to the Data Sheet-A (Section ID) and other requirements of section II. In addition, the requirements of this Section I including Customer Specification attached at Appendix 1 (as applicable) shall also be complied with. In the event of Contradictions between Section IA /Customer Specification (Appendix 1)/ Datasheet A (Section IB), the same shall prevail in the order as:

Customer Specification (Appendix 1), Section IA, Datasheet-A (Section ID).

2.00.0 SCOPE OF SUPPLY AND SERVICES INCLUDED IN THE BIDDER'S SCOPE

A) The scope of supply under this specification shall be as follows:

- 2.1 Two (2) sets of Travelling Band Screens (TBS) viz. independent set of TBS for each inlet channel comprising of Electric drive with reduction gear box and fluid/hydraulic coupling, appropriate sealing arrangement to avoid escape of debris in clean side. All the Equipment supplied with this package should be suitable for Outdoor Location.
- 2.2 Spray wash/Flushing arrangement(if required) with necessary spray wash pumps, header isolation valves and spray wash nozzle headers with matching counter flanges complete with bolts, nuts and gaskets for all flanges at terminal points.
- 2.3 2x100% automatic self-cleaning strainers with debris discharge valves and other accessories as required.
- 2.4 Each travelling band screen stream shall be provided with required instrumentation as shown in Sketch-A and mentioned in Datasheet-A and Sub-Section IC of this Specification.
- 2.5 Starter Panel (cum Switch Gear Panel) shall be as follows:
 - (i) 2 Sets of TWS shall have one Common Starter Panel (cum Switch Gear Panel) for DCS based control system.
Switch Gear Panel should have suitable arrangement like Bus Coupler for providing redundancy to incoming supply feeder (1Working + 1 Standby feeder). For details of C&I scope please refer Section IC.
- 2.6 Supporting arrangement complete with foundation plates, anchor bolts, nuts, sleeves, embedment's, inserts etc. and installation materials like fixing bolts, clamps and other accessories etc for complete TBS as required to make TBS a complete package.
- 2.7 Two (2) nos. Debris segregation and collection baskets and other details as per Datasheet-A.
- 2.8 Complete Pipe work, including interconnection/distribution piping, valves, flanges/counter flanges (including Counter Flange at Terminal Point) for pipes/valves, bends, fittings, distributors, nozzles and support installation materials for equipments/piping/valves etc. shall be in Bidder's scope.
- 2.9 Any other items not listed above but required to make Travelling Band Screening system as complete package, shall be deemed to be included in bidder's scope of supply.

B) SCOPE OF SERVICES INCLUDED IN THE BIDDER'S SCOPE: The bidder's



**TITLE : TECHNICAL SPECIFICATION
FOR
TRAVELLING BAND SCREENING SYSTEM**

SPEC. NO. PE-TS-412-172-N001

**SECTION : I
SUB-SECTION : IA**

REV. NO. 00 **DATE :** 20.01.2017

Sheet 3 of 11

scope also includes following services at site, for scope under this specification viz. Travelling Band Screen and its accessories.

- a) Supervision during critical stages of Erection
- b) Final installation checks before commissioning
- c) Commissioning of Travelling Band Screen and its accessories
- d) Trial run and Site Testing

Bidder to include Five site visits for four days each for above activities in their offer price.

3.00.00 EXCLUSIONS :

The following are excluded from the bidder's scope:

1. Coarse Bar Screens
2. Stop log Gates at the inlet and outlet of each section
3. Gantry Crane
4. Civil works required for installation
5. Erection of Travelling Band Screen and its accessories

4.00.00 DESCRIPTION OF EQUIPMENTS:

Travelling Band Screening System

- 4.01.00 The Travelling Band Screening system shall be installed upstream of pumps installed in Sea Water Intake Pump House and are intended to remove floating matter coming from the source through the open sea water intake canal. The water analysis is enclosed with Data Sheet-A.

Coarse Bar screens (excluded from bidder's scope) shall be provided upstream of each Travelling Band Screen to collect the coarse floating/suspended matter up to the size as specified in Data Sheet-A.

The intake system comprises of 2 stream (1Working+ 1 Standby) as specified in Data Sheet-A.

Each stream shall be provided with an Independent Travelling Band Screen. However, common Spray wash/Flushing pumps (if required) and Self-cleaning Strainers shall be provided for both the Travelling Band Screens.

- 4.02.00 The travelling band screens shall be dual speed and central flow or dual flow designs. Each travelling band screen unit shall consist of a series of screening elements fastened to two parallel vertical strands of chains.

The screen basket shall carry debris and refuse above the operating floor where the screen shall be cleaned by a water jet spray. The wash water, debris and refuse shall be collected in a concrete trough provided on the deck level by the purchaser upto the discharge point.

- 4.03.00 Flushing water shall be taken by the Bidder from the discharge of Sea Water Intake Pumps at pressure specified in Data Sheet-A at Terminal point.

If required bidder may provide 2x100% Horizontal type booster pumps to raise the pressure of water so as to meet the requirements of the flushing operation. These



**TITLE : TECHNICAL SPECIFICATION
FOR
TRAVELLING BAND SCREENING SYSTEM**

SPEC. NO. PE-TS-412-172-N001

**SECTION : I
SUB-SECTION : IA**

REV. NO. 00 **DATE :** 20.01.2017

Sheet 4 of 11

pumps shall be provided with suitable control interlocks for satisfactory flushing/cleaning of screens.

Spray wash system for each Travelling Band screen shall be provided with a motorised inlet isolation valve, which shall be opened whenever a particular Travelling Band screen has to be spray washed/flushed.

Terminal point for Spray Wash/Flushing system shall be as per details shown in Sketch-A.

However the bidder shall hydraulically design the equipments for purchaser's pump shut off head specified in Data Sheet-A, and taking into consideration the shut off head of the bidder's spray wash/flushing pump(if provided).

- 4.04.00 The details of the Travelling Band Screens with the quantity, design parameters etc. to be supplied shall be as per Data Sheet-A in Sub-Section ID.

5.00.00 CONTROL PHILOSOPHY:

- 5.01.00 The operation philosophy as detailed below is suggestive only and successful Bidder shall furnish the complete control & interlock scheme for Travelling Band Screen and Auxiliaries after award of contract and it shall be subject to purchaser/End Customer approval.

- 5.02.00 Travelling Band Screens, Spray wash/flushing pumps, spray wash valves, automatic self-cleaning strainers and other auxiliaries shall be controlled and operated from standalone DDCMIS of Sea Water Intake pumps system located in Sea water intake pump house control room, supplied by the Purchaser.

- 5.03.00 The following shall be provided in DDCMIS.

- a) All interlocks and protections for Travelling Band Screens, spray wash pumps, automatic self cleaning strainers shall be realized in the DDCMIS.
- b) Auto/Manual Selector Switch for
 - ❖ Travelling Band Screens
 - ❖ Spray wash pumps(if applicable)
 - ❖ Self cleaning strainer.
- c) Indication(Running/ Stopped)/alarms/annunciations/ for
 - ❖ Travelling Band Screens
 - ❖ Spray wash pumps
 - ❖ Self cleaning strainer.
 - ❖ Spray wash valves
- d) Start/Stop facility for each TBS, spray wash pumps(if applicable), spray wash valves, Self cleaning strainers, etc.
- e) Key lockable type emergency stop push button shall be provided in the Local to TBS and spray wash pumps for Stopping in case of Emergency.



**TITLE : TECHNICAL SPECIFICATION
FOR
TRAVELLING BAND SCREENING SYSTEM**

SPEC. NO. PE-TS-412-172-N001

**SECTION : I
SUB-SECTION : IA**

REV. NO. 00 **DATE :** 20.01.2017

Sheet 5 of 11

- f) Differential Level indication for each Travelling Water Screens.
- g) Complete automatic shut-down of the system .
- h) Selection of various modes of operation as described in succeeding paras.

5.04.00 Differential Level Transmitter:

5.43.01 Two Nos. Differential Level Transmitter shall be provided across each Travelling Band Screen and following signals shall be derived:

- o Differential Level Display on DDCMIS
- o Differential Level High
 - ❖ Annunciation on DDCMIS
 - ❖ Starting of Spray Wash pump(if provided)
 - ❖ Starting of Travelling Band Screen on slow speed
- o Differential Level Very High
 - ❖ Annunciation on DDCMIS
 - ❖ Starting of Spray Wash pump(if provided)
 - ❖ Starting of Travelling Band Screen on high speed
- o Differential Level Normal
 - ❖ Stopping of Travelling Band Screen and Spray Wash pump

5.05.00 If Spray wash booster pumps are offered by bidder instrumentation as per Datasheet A shall be provided for spray wash pumps.

5.06.00 Travelling Band Screen Controls:

Each Travelling Band Screens (TBS) shall be provided with following modes of operation from DDCMIS.

- Manual Mode
- Timer Mode
- Auto Mode thru' differential level between upstream and downstream of TBS's.
- **Manual Mode**
When Manual mode is selected and start push button is pressed/selected, TWS will start on low or high speed as selected, irrespective of the differential levels and shall continue to run until operator switches it off.
- **Timer Mode**
The TWS will start on low/high speed (depending upon selection) thru' timer – at the selected time interval, irrespective of its differential level and shall stop after the preset run time.
Even though the run timer times out, but the differential level of the TWS has not fallen below “differential level normal” the TWS shall continue to rotate till the differential level falls below the preset limit.
- **Auto Mode**
On receipt of high differential level signal, the TWS selected in ‘Auto’ mode will start on low speed and rotate until differential level falls below the preset limit.
TWS Operation (Slow speed): TWS shall start on slow speed when it senses



**TITLE : TECHNICAL SPECIFICATION
FOR
TRAVELLING BAND SCREENING SYSTEM**

SPEC. NO. PE-TS-412-172-N001

**SECTION : I
SUB-SECTION : IA**

REV. NO. 00 **DATE :** 20.01.2017

Sheet 6 of 11

“TWS \$ Differential Level High” and shall continue to operate until “TWS \$ Differential Level Normal” is sensed.

TWS Operation (High Speed): TWS shall operate on high speed when “TWS \$ Differential Level Very High” is sensed through Level Transmitter or “TWS \$ Differential Level Very Very High” is sensed through Differential Level Switch.

5.07.00 In all modes of operation TBS once started shall complete minimum One (1) rotation before stopping.

5.08.00 TBS and its auxiliaries shall be designed for continuous operation.

5.09.00 Spray Wash Pumps Controls/ Instruments (if applicable):

5.09.01 Spray Wash Pump when selected in auto shall start with the starting of the Travelling Band Screen (in any mode of operation) and shall continue to run until all screens stop, in which case pump shall also stop.

5.09.02 The isolating valves at pump suction shall be provided with ‘Open’ limit switches and Motorized Valve at Pump Discharge for pump start permissive. On receipt of pump start command if any valve is closed/Not Open, it shall annunciate alarm in DDCMIS, trip the pump and start standby pumps.

5.09.03 Pump start permissive shall be provided as follows:

- i. Suction/ discharge Valves Open
- ii. “Suction Pressure Adequate”

5.10.00 Self-Cleaning Strainers Controls/ Instruments:

5.10.01 One number Differential pressure gage shall be provided across each SCS for local measurement of differential pressure across Self Cleaning Strainers.

5.10.02 Two (2) numbers Differential pressure transmitter shall be provided across each SCS and following signals shall be derived:

- “SCS Differential Pressure high” for starting of automatic back wash/self-cleaning/flushing
- “SCS Differential Pressure Normal” for stopping of automatic back wash/self-cleaning/flushing
- Remote differential pressure indication across Self-cleaning strainer to be displayed on DDCMIS

6.00.00 GENERAL REQUIREMENTS:

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

6.02.00 The typical flow diagram applicable, is enclosed herein in this Section (Sketch A) with scope demarcation for bidder's compliance.

6.03.00 General arrangement for Travelling Band Screens, Spray Wash piping, type of installations and location of the spray wash pump Skid etc shall be furnished along with the offer. Bidders to note that TBS with accessories shall be installed outdoors and therefore shall be suitable for outdoor duty.



**TITLE : TECHNICAL SPECIFICATION
FOR
TRAVELLING BAND SCREENING SYSTEM**

SPEC. NO. PE-TS-412-172-N001

**SECTION : I
SUB-SECTION : IA**

REV. NO. 00 **DATE :** 20.01.2017

Sheet 7 of 11

- 6.04.00 The materials of construction specified in Data Sheet-A are minimum requirements and materials of construction for other components not specified shall be similarly selected by the bidder for the intended duty which shall be subject to purchaser's approval during detailed engineering in the event of order.
- 6.05.00 TBS and its support structure shall be designed and manufactured as per the applicable codes and to take care of following conditions
- Design Differential level
 - During various mode of operations, at design flow and under all climatic conditions.
- 6.06.00 The TBS drive motor shall be sized to start the Travelling Band screen against differential head of 0.75 MWC and operate continuously thereafter.
- 6.07.00 Cathodic Protection for TWS and its accessories along with Sacrificial Anode shall be provided by the bidder in the equipment. Calculation for the same shall be provided during contract stage, subject to approval.
- 6.08.00 The TBS design shall be such as to ensure that Sea water at TBS outlet shall be free from any vortex and turbulence.
- 6.09.00 Each assembly and sub assembly shall be provided with suitable arrangement for lifting using gantry/crane/mono rail /chain pulley block. Lifting hooks shall be located so as to facilitate lifting in balanced position.
- 6.10.00 The make of various bought out items shall be subjected to purchaser's/owner's approval in the event of order.

7.00.00 QUALITY PLAN

Quality Plans for some items along with additional quality assurance & inspection requirement are enclosed in the Specification are for bidder's guidance only and are not exhaustive. The quality requirements/QP furnished in specification are not complete. The bidder shall comply with these minimum requirements and submit the QPs comprehensively including all components of complete Travelling Band Screens with accessories at raw material/ in process /final stages shall furnish the same as per format in the event of order based on the guidelines given as above, same shall be subject to BHEL/ Customer /Consultant's approval.

8.00.00 SITE DEMONSTRATION TESTING AND TRIAL RUN:

The Travelling Band Screens shall be guaranteed to meet the performance requirements specified in Data Sheet-A and also for trouble free operation after commissioning at site.

- 8.01.00 Site Demonstration Testing:
Following site demonstration tests shall be performed at site at Full load.
- i) Pressure drop (Differential Level) in clean condition viz. after Spray wash/ Flushing.
 - ii) Satisfactory cleaning operation of spray wash system.
 - iii) Smooth operation without any undue noise and vibration.
- 8.02.00 Above mentioned parameters shall be demonstrated by the supplier during



**TITLE : TECHNICAL SPECIFICATION
FOR
TRAVELLING BAND SCREENING SYSTEM**

SPEC. NO. PE-TS-412-172-N001

**SECTION : I
SUB-SECTION : IA**

REV. NO. 00 DATE : 20.01.2017

Sheet 8 of 11

demonstration testing. If the results of these tests show the non-performance of the TBS or its accessories, the supplier shall modify the TBS or accessories as required it to meet the test requirements.

8.03.00 If the vendor fails to demonstrate satisfactory operation as above after modification, the owner/purchaser may at his discretion reject the equipment.

9.00.00 DRAWINGS/ DOCUMENTS DISTRIBUTION SCHEDULE :

9.01.00 **Documents to be submitted after award of LOI:** Document submission schedule after the award of contract shall be as below:

BHEL DRG NO	DRG TITLE	Drg Sch for Vendors
PE-V9-412-172-N001	P&ID OF TWS SYSTEM	R-0 within 20 days from LOI/PO & subsequent revisions within 10 days of comments received from BHEL.
PE-V9-412-172-N002	GA OF TWS	
PE-V9-412-172-N003	CONTROL PHILOSOPHY & GA OF CONTROL PANEL- TWS	
PE-V9-412-172-N004	DETAILS OF DEBRIS SEGREGATION BASKET-TWS	
PE-V9-412-172-N007	DATASHEET FOR TWS	
PE-V9-412-172-N011	CIVIL DETAILS OF TWS	
PE-V9-412-172-N020	QP OF TWS	
PE-V9-412-172-N005	PIPING INSTALLATION DIAGRAM	R-0 within 20 days from Cat-I(or)II approval of 'PID, Datasheet & GA of TWS' and subsequent revisions within 10 days of comments received from BHEL.
PE-V9-412-172-N006	GA OF STRAINER	
PE-V9-412-172-N008	DATASHEET OF STRAINER	R-0 within 30 days from Cat-I(or)II approval of 'Datasheet of TWS' & subsequent revisions within 10 days of comments received from BHEL.
PE-V9-412-172-N009	DATASHEET OF VALVES	
PE-V9-412-172-N010	DATASHEET FOR PIPE, FITTING & FLANGES	
PE-V9-412-172-N019	DATASHEET FOR GEARED MOTOR OF TWS	
PE-V9-412-172-N012	DATASHEET FOR PRESSURE/DIFF. PRESSURE GAUGE	R-0 within 30 days from Cat-I(or)II approval of 'PID & Datasheet of TWS' and subsequent revisions within 10 days of comments received from BHEL.
PE-V9-412-172-N013	DATASHEET FOR DIFF. LEVEL TRANSMITTER	
PE-V9-412-172-N014	DATASHEET FOR ELECTRICAL ACTUATOR	
PE-V9-412-172-N015	DATASHEET OF DIFF. PRE. INDICATOR SWITCH	
PE-V9-412-172-N016	WIRING DIAGRAM	
PE-V9-412-172-N017	DATASHEET OF STARTER PANEL (CUM SWITCHGEAR	R-0 within 30 days from Cat-I(or)II approval of 'Control Philosophy' and



TITLE : TECHNICAL SPECIFICATION
FOR
TRAVELLING BAND SCREENING SYSTEM

SPEC. NO. PE-TS-412-172-N001

SECTION : I
SUB-SECTION : IA

REV. NO. 00 DATE : 20.01.2017

Sheet 9 of 11

	PANEL)	subsequent revisions within 10 days of comments received from BHEL.
PE-V9-412-172-N018	CABLE SCHEDULE	
PE-V9-412-172-N021	O&M MANUAL	Within 30 days from MDCC

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

- Compliance certificate duly signed and stamped.
- Deviation Schedule as per NIT.
- Electrical Load Data.
- GA Drawing for reference with following details clearly indicated/marked
 - a) All principal dimensions like dimensions of openings at Deck Level, etc.
 - b) Location and size of D wall, etc.
 - c) Recommended capacity and lift of the Gantry crane.



TITLE : TECHNICAL SPECIFICATION
FOR
TRAVELLING BAND SCREENING SYSTEM

SPEC. NO. PE-TS-412-172-N001

SECTION : I
SUB-SECTION : IA

REV. NO. 00 DATE : 20.01.2017

Sheet 10 of 11

ANNEXURE-1 PACKING PROCEDURE

1.0 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.

1.1 Preparation for Packing:

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

1.2 Protection of parts:

- The TWS main components (Sprockets, Screen baskets, Frame etc.) shall be packed in properly in high grad bubble plastic wrap for transportation, and long storage at site.
- Actuators shall be packed in separate wooden box of proper sizes.
- TWS miscellaneous 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 plate heat exchanger shall be closed properly by suitably covering to prevent foreign material entering in plate heat exchanger.
- All fabricated wooden cases & crates conform to the requirement as per



**TITLE : TECHNICAL SPECIFICATION
FOR
TRAVELLING BAND SCREENING SYSTEM**

SPEC. NO. PE-TS-412-172-N001

**SECTION : I
SUB-SECTION : IA**

REV. NO. 00 **DATE :** 20.01.2017

Sheet 11 of 11

table given below:

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

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

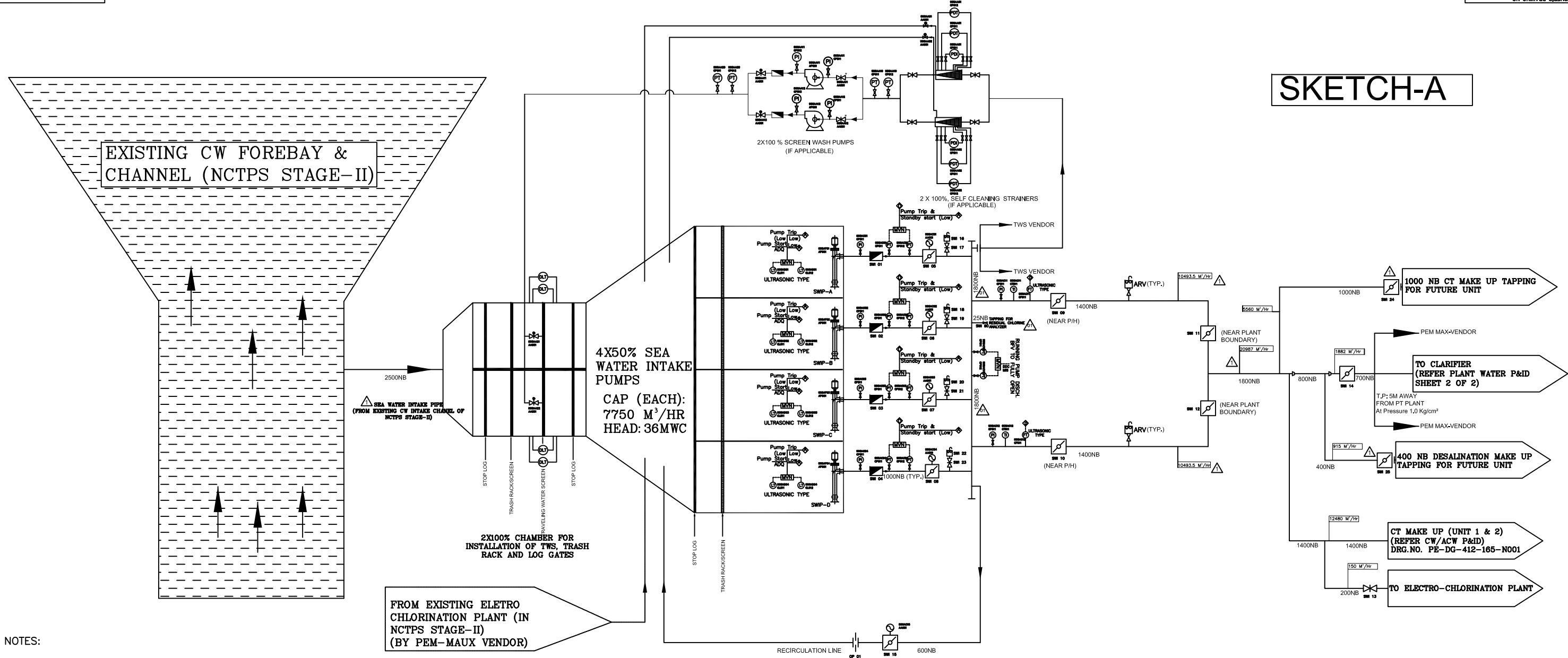
1.3 Preservation

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.

1.4 Photographs

Bidder to take photographs of all parts like Sprockets, Frame, Screen baskets, SCS, Spray wash pumps, piping, valves, instruments, actuators, panel (inside & outside) and sent to engineering deptt along with all inspection reports before final dispatch.

SKETCH-A



SEA WATER INTAKE PUMP HOUSE
(AT NCTPS STAGE-II, NEAR CW FOREBAY)

6. VMS & WINDING AND BEARING MEASUREMENT SHALL BE PROVIDED FOR ALL HT MOTORS & DRIVEN PUMPS.

NB	OD	THICK.
200	219.1	6.4
250	273.0	6.4
300	323.9	6.4
350	355.6	8.0
400	406.4	8.0
450	457.0	8.0
500	508.0	8.0
600	610.0	8.0
700	711.2	10.0
800	813.0	10.0
900	914.0	10.0
1000	1016	10.0
1400	1422	12.0
1800	1829	16.0

	SIGNAL TO DDCMS
	ALARM
	REDUCER/EXPANDER
	TEMPERATURE ELEMENT
	R.E. JOINT
	LEVEL TRANSMITTER (ULTRASONIC)
	VERTICAL PUMP
	AIR RELEASE VALVE

							DEPT.	SCALE	DRAWING NO.
							SIGN.		PE-DG-412-172-N001

13	
----	--

SIGN		PE-DG-412-172-N001		
DATE		SHEET	1 OF 2	REV 02



TITLE : TECHNICAL SPECIFICATION
FOR
TRAVELLING BAND SCREENING SYSTEM

SPEC. NO. PE-TS-412-172-N001

SECTION : I
SUB-SECTION : IB

REV. NO. 00 DATE : 20.01.2017

Sheet 1 of 1

**SECTION IB
SPECIFIC TECHNICAL REQUIREMENT
ELECTRICAL SYSTEMS**



TECHNICAL SPECIFICATION
FOR
TRAVELLING WATER SCREEN
ENNORE TPP (2x660 MW)

SPECIFICATION NO.
VOLUME II B
SECTION-C
REV 00
PAGE 1 OF 1
DATE 11.01.2017

SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER/ PURCHASER

- 1.1 Scope for supply, and erection & commissioning of various equipment forming part of electrical system for this package shall be as per Annexure-I to Section – C [Scope of Work (Electrical)].
- 1.2 Make of various equipment/ items in the scope of bidder shall be subject to approval of owner during detailed engineering stage without any commercial implications.
- 1.3 Bidder shall furnish all AC as well as DC loads required for the system at different voltage levels (eg. 415V AC, 240 V AC, 220 V DC etc.) of all types, such as motor feeders, supply feeders in PEM format along with the offer.
- 1.4 All electrical equipment shall be suitable for the power supplies, fault levels and climatic conditions indicated in project information enclosed with the specification.
- 1.5 All drawings, data sheets, Quality Plan, calculations, test reports, test certificates, etc. shall be submitted during detailed engineering stage as per formats enclosed. The same shall be subject to approval without any commercial implications.
- 1.6 Technical requirements shall be as per specifications listed in Clause 3.1, 3.2, 3.3, 3.4 & 3.5. In case of any discrepancy between Customer specification and BHEL standard specification, Customer specification shall prevail.

2.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

- 2.1 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 AC System' 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.
- 2.2 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

3.0 LIST OF ENCLOSURES

- 3.1 Electrical scope between BHEL & vendor (Annexure-I).
- 3.2 Technical specification – Customer specification - Motors
- 3.3 BHEL standard specification for LT motors : PE-SS-999-506-E101
- 3.4 Datasheets – A and C
- 3.5 Quality Plan for motors.
- 3.6 Load data format (Annexure-II).
- 3.7 Basic Technical Features for Motors (PE-DC-412-565-E003)

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE : TRAVELLING WATER SCREEN

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 2X660 MW ENNORE STPP

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C@	REMARKS
1	415V MCC Starter cum control panel (if applicable)	BHEL Vendor	BHEL BHEL	240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	BHEL Vendor BHEL	BHEL BHEL BHEL	1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Cabling/Termination by BHEL.
4	Junction box for control & instrumentation cable	Vendor	BHEL	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 mtrs) and trunk cable.
5	Any special type of cable like compensating, co-axial, prefab, MICC, optical fibre etc.	Vendor	BHEL	Refer C&I portion of specification for scope of fibre Optical cables if used between PLC/ microprocessor & DCS.
6	Cable trays, accessories & cable trays supporting system 100/ 50 mm FRP cable trays/ Conduits/ Galvanised steel cable troughs for local cabling	BHEL BHEL	BHEL BHEL	Local cabling from nearby main route cable tray (BHEL scope) to equipment terminal (vendor's scope) shall be through 100/ 50 mm. FRP cable trays/ conduits/ Galvanised steel cable troughs, as per approved layout drawing during contract stage.
7	Cable glands ,lugs and bimetallic strip for equipment supplied by Vendor	Vendor	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	Conduit and conduit accessories for cabling between equipment supplied by vendor	Vendor	BHEL	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537.
9	Lighting	BHEL	BHEL	
10	Equipment grounding (including electronic earthing) & lightning protection	BHEL	BHEL	Refer note no. 4 for electronic earthing

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE : TRAVELLING WATER SCREEN

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 2X660 MW ENNORE STPP

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

@ : Commissioning of all Equipment supplied by Vendor shall be in the scope of vendor.

NOTES:

1. Make of all electrical equipment/ items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
3. In case the requirement of Junction Box arises on account of Power Cable size mismatch due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.
4. Vendor shall indicate location of Electronic Earth pit in their Civil assignment drawing.

CHAPTER – 12

MOTORS

1.00.00 DESIGN CRITERIA

1.00.01 For the purpose of design of equipments /systems, an ambient temperature of 50 °C and relative humidity of 85% shall be considered. The equipment shall operate in a highly polluted environment.

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

1.00.03 Rating

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

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

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

1.00.04 Starting Voltage requirement for all motors (except mill motors):

1. 85 % of rated voltage for motors up to 1000 kW
2. 80 % of rated voltage for above 1000 kW and up to 4000 kW
3. 75 % of rated voltage for above 4000 kW

For Mill Motors:

1. 85 % of rated voltage for motors above 1000 kW
2. 90 % of rated voltage for motors up to 1000 kW

1.00.05 Canopy shall be provided for outdoor motors.

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



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

1.03.00 Voltage and frequency variations:

Frequency: (+) 3% and (-) 5%

Voltage :

i. AC

a. $\pm 6\%$ for 11 kV/3.3 kV

b. $\pm 10\%$ for 415 V

Combined 10 % (absolute sum)

ii. DC- +10% to -15% for 220 V DC

1.04.00 All LV motors above 10 kW with S1 duty shall be compulsorily of Energy efficient level IE 2 as per IS 12615: 2011.

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

1.06.00 Type

AC Motors:

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

(b.) Crane duty motors shall be slip ring type induction motor

DC Motors

(a.) Shunt wound.

1.07.00 Temperature Rise

Air cooled motors

70°C by resistance method

Water cooled

80° C over inlet cooling water temperature mentioned elsewhere, by resistance method.

1.08.00 Degree of Protection

Degree of protection for various enclosures shall be as follows :

i) Indoor motors — IP 54



- | | | | |
|------|--|---|-------|
| ii) | Outdoor motors | – | IP 55 |
| iii) | CW motors (in case of screen prot. Drip proof) | – | IP 23 |
| iv) | Cable box – indoor area | – | IP 54 |
| v) | Cable box – outdoor area | – | IP 55 |

2.00.00 CODES AND STANDARDS

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

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

- | | | | |
|-----|---|---|--|
| 1.) | Three phase induction motors | : | IS:325, IEC:60034 |
| 2.) | Single phase AC motors | : | IS:996, IEC:60034 |
| 3.) | Crane duty motors | : | IS:3177, IEC:60034 |
| 4.) | DC motors/generators | : | IS:4722 |
| 5.) | Degree of protection by enclosures for rotating electrical machines | : | IS: 4691
IS: 4728
IS: 6362
IS: 2253 |
| 6.) | Noise levels for rotating electrical machines | : | IS: 12065 |
| | Mechanical Vibrations for rotating electrical machines | : | IS: 12075 |

3.00.00 OPERATIONAL REQUIREMENTS

3.01.00 Starting Time

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



- 3.01.02 For motors with starting time more than 20 secs and up to 45 secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs more than starting time.
- 3.01.03 For motors with starting time more than 45 secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.
- 3.01.04 Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.
- 3.01.05 Motors shall be capable of restarting under full load after a momentary loss of voltage with the possibility of 150 % nominal voltage during fast bus transfer.
- 3.02.00 Torque Requirements
- 3.02.01 Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.
- 3.02.02 Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.

4.00.00 DESIGN AND CONSTRUCTIONAL FEATURES

- 4.00.01 Suitable single phase space heaters shall be provided on motors rated 30 kW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided.
- 4.00.02 All motors shall be suitable for direct on line starting through any type of breaker.
- L All motors shall be either totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. However, motors rated 3000KW or above can be Closed air circuit water cooled (CACW). CW motors can be screen protected drip proof (SPDP) type. Motors located in hazardous areas shall have flame proof enclosures conforming to IS: 2148 as detailed below

- (a) Fuel oil area : Group - IIB
- (b) Hydrogen generation plant Group - IIC
area :

4.00.03 Winding and Insulation

- (a) Type : Non-hygroscopic, oil resistant, flame resistant



- (b) Starting duty : Two hot starts in succession, with motor initially at normal running temperature
- (c) 11 kV / 3.3 kV AC motors : Class F: with winding temperature rise limited to class B. They shall withstand 1.2/50 micro sec switching surges of $4U+5$ KV (U=Line voltage in KV). The coil inter-turn insulation shall be suitable for 0.3/3 micro sec. surge of 32 KVp and 12 kVp for 11 kV and 3.3 kV system respectively followed by 1 min power frequency high voltage test of appropriate voltage on inter turn insulation.
- (d) 415V AC & 220V DC motors : Class 'F' with temperature rise limited to class 'B'
- 4.00.04 Motors rated above 1000 kW shall have insulated bearings to prevent flow of shaft currents.
- 4.00.05 Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature.
- 4.00.06 Noise level and vibration shall be limited within the limits prescribed in IS: 12065 & IS: 12075 respectively. Motors shall withstand vibrations produced by driven equipment.
- 4.00.07 In MV/HV motors, 12 nos. simplex or 6 nos. duplex RTDs (two per phase), each having D.C. resistance of 100 ohms at 0°C, embedded in the stator winding at locations where highest temperatures may be expected, shall be provided. The material of the ETD's shall be platinum. Each bearing shall be provided with dial type thermometer with adjustable alarm contact and resistance type temperature detector. All HV motors shall be provided with shaft grounding rings for bearing protection and earthing shaft current.
- 4.00.08 MV/HV motors shall also be capable of satisfactory operation at full load at a supply voltage of 80% of the rated voltage and shall be capable of either two starts in quick succession with third start after 5 minutes in cold condition or two starts at 15 minutes intervals in hot condition, both cases with voltage and frequency variation within specified limits.
- 4.00.09 Locked rotor current of the MV motors shall be limited to 600% (subject to IS tolerance) of the full load current of the motors and for HV motor shall be limited to 450% (inclusive of IS tolerance) of full load current of the motor.



Locked rotor current of the LV motor shall not exceed 600% of full load current inclusive of IS tolerance.

- 4.00.10 MV Motors shall be provided with differential protection. These motors shall be provided with star connected stator windings. The 3 nos. current transformers, one for each phase shall be mounted in a separate compartment in the neutral side terminal box. The three phases shall be connected to form the star point after they pass through the CTs. These differential protection CTs shall be supplied loose by 11/ 3.3 kV switchgear manufacturer.
- 4.00.11 Motor body shall be grounded at two earthing points on opposite sides with two separate and distinct grounding pads complete with tapped holes, GI bolts and washers.
- 4.00.12 HV motors can be offered with either elastimould termination or dust tight phase separated double walled (metallic as well as insulated barrier) cable boxes. In case elastimould terminations are offered, then protective cover and trifurcating sleeves shall also be provided. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided in case of cable boxes.
- 4.00.13 All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.
- 4.00.14 The motors shall be suitable for bus transfer schemes provided on the 11 kV, 3.3 kV/415V systems without any injurious effect on its life.
- 4.00.15 All motors below 15 kW shall be provided with sealed ZZ bearings.
- 4.00.16 For motors rated 1000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.
- 4.00.17 All motors shall be provided with an emergency stop push button near the motor as per the Indian Statutory regulations.
- 4.00.18 The motor terminal box shall be suitable for withstanding the maximum system fault current for a duration of at least 0.25 seconds.
- 4.00.19 Neutral in case of HV motors shall be kept accessible.



- 4.00.20 Motors shall be designed to easy access for drilling holes through motor feed of mounting flange for installation of dowel pins after assembly of the motor and driven equipment.
- 4.00.21 Well spacious working platforms shall be provided around the motor area for carrying out maintenance & testing works. Platform shall be minimum of 300 mm below the level of motor base plate.
- 4.00.22 Flow switches shall be provided for monitoring oil flow of forced lubrication bearings, if used. Alarm switch contact rating shall be minimum 0.5 A at 220 V DC and 10 A at 230 V AC.
- 4.00.23 For bearing temperature measurement, duplex RTDs shall be provided for each bearing and shall be wired up to the terminal box..
- 4.00.24 Lube oil pressure transmitters shall be provided to DCS for remote monitoring. Lube oil pressure very low trip to HV equipment shall be 2 out of 3 logic.
- 4.00.25 Capillary type temperature gauge cum switch shall be provided for DE / NDE of HV Motors
- 4.00.26 Motors with CACA/CACW heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate the following:
- Hot and cold air temperatures of the closed air circuit for CACA motors.
 - Hot and cold, air and water temperatures for CACW motors.
- The Alarm switch contact rating shall be minimum 0.5 A at 220 V DC and 10 A at 230 V AC.

4.00.27 Lifting Provisions

Motor weighing 25 kg or more shall be provided with eye bolt or other adequate provision for shifting. Electrical hoists shall be provided for motors above 1000 kgs for maintenance of the same.

4.00.28 DC MOTORS

DC motors shall be provided where specified/required. DC Motors shall be sized for operation with fixed resistance starting for reliability. DC motors shall be shunt wound type. Motors shall be capable of delivering the rated output at 220 V DC with (+) 10% and (-) 15% variations without exceeding its guaranteed temperature limits. 220 V DC



system shall be unearthed. Starting current of the DC motors shall be limited to 200% of the full load current of the motor, and is subject to IS tolerance. DC Motors shall be similar to AC Motors with respect to other features like enclosure type, cooling and class of insulation

4.00.30 Painting

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

4.00.31 Local Push Button Stations

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

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

5.00.00 LIST OF TESTS TO BE CONDUCTED FOR HV, MV and LV MOTORS

5.01.00 TYPE TESTS

- (a) No load saturation and loss curves up to approximately 115% of rated voltage
- (b) Momentary overload test
- (c) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp., core temp., coolant flow and its temperature shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose.
- (d) Surge withstand test on the sample coil after placing it in stator core at $(4U + 5 \text{ KV})$ and with at least five impulse of 1.2/50 micro sec. wave, for HV motors only, where U is the line to line voltage in kV.
- (e) Surge-withstand test with 0.3/3 micro sec. wave on each type of 3.3/11 kV motor coils with at least five such impulses, followed by one minute power frequency high voltage test on turn to turn insulation, after cutting the coil and bringing out



the turns suitably. The power frequency test voltage shall be decided during detailed engineering.

- f) Dimensions (for motors covered by IS 1231:1974 and IS 2223:1983 only)
- g) Measurement of resistance of windings of stator and wound rotor.
- h) Reduced voltage running up test at no load (for squirrel cage motors up to 37kw only)
- i) Full load test to determine efficiency, power factor and slip.
- j) Insulation resistance test
- k) Test for vibration severity of motor
- l) Test for noise levels of motor
- m) Test for degree of protection by enclosure
- n) Temperature rise test at limiting values of voltage and frequency variations
- o) Over speed test

5.02.00 ROUTINE TESTS

The following shall constitute the routine tests.

- a) Insulation resistance test
- b) Measurement of resistance of windings of stator and wound rotor.
- c) No load test
- d) Locked rotor readings of voltage, current and power input at a suitable reduced voltage
- e) Reduced voltage running up test (for squirrel cage motor)
- f) Open circuit voltage ratio of stator and rotor windings (for slip ring motors); rotor;
- g) High voltage test

6.00.00 INSPECTION AND TESTING AT SITE

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

- (a.) Blowing hot air in case of big motors.
- (b.) Putting the motor in electric oven in case of smaller motors.
- (c.) Placing heaters or lamps around and inside in case of small motors after making suitable guarding and covering arrangements so as to conserve the heat.



6.01.02 Site Test

- (a.) Measurement of vibration.
- (b.) Measurement of insulation resistance and polarization index.
- (c.) Measurement of full load current.
- (d.) Test running of the motors, checking the temperature rise and identifying the hot spot etc.

6.01.03 3.3 kV motors shall be tested for insulation by 500/1000V megger and its value should not be less than the safe minimum insulation of $\geq 20 \text{ M}\Omega$ resistance at 60 deg. C. In case the insulation is low, the following method of drying has to be adopted:

- a. By locking the motor so that it cannot rotate and then applying such a low voltage to the stator terminals that full load current flows in the stator, keeping the stator winding temperature below 90 deg. C. In this a close watch shall be kept for any possible overheating and I.R. Values vs. temperature shall be plotted and heating continued till I.R. Value becomes steady.
- b. By blasting hot air from external source, Maximum temperature of winding while drying should be 70 deg. C to 80 deg. C. (Thermometer) or 90 deg. C. to 95 deg. C. by resistance method. Heating should be done slowly till steady temperature of winding is reached after 4 to 5 hours and for large machines after 10 hours. A record has to be kept for drying process, with half an hour readings and, after steady temperature is reached, at an interval of 2 hours. In case it is essential, the drying process can be supplemented by blower.





2 x 660 MW ENNORE SEZ STPP

**BASIC TECHNICAL FEATURES
FOR HT / LT MOTORS
(FOR BHEL-PEM SCOPE PACKAGES)**

Doc. No.	PE-DC-412-565-E003
Rev. No.	01
Dated	13-03-2015
Page	2 of 7

1.0 This document covers the basic technical features of high tension (HT) and low tension (LT) squirrel cage induction AC motors employed for driving auxiliaries of BHEL-PEM scope packages in **2 x 660 MW ENNORE SEZ STPP**.

2.0 CODES AND STANDARDS

The motors shall generally conform to IS 325/IEC-60034. LT motors above 10 kW with continuous duty (S1) shall be energy efficient IE3 conforming to IS-12615: 2011.

3.0 DESIGN REQUIREMENTS

3.1 General Requirements

The design ambient temperature shall be 50 deg C.

3.2 Supply system and rated voltage of motors

KW rating	Supply system	Rated voltage of motor
Above 1500 kW	11 KV	11 KV
Above 160 kW up to & including 1500 kW	3.3 KV	3.3 KV
From 200W up to & including 160 kW	415 V	415 V
Below 200W	240V	240V

3.2.1 Supply voltage & variations shall be as follows:-

Voltage variation (AC Supply) (+/-) 10%
Frequency variation (+) 3% to (-) 5%
Combined V & F variation 10% (sum of absolute values)

3.2.2 Motors shall be capable of running continuously at rated output for each of the conditions specified.

3.3 Motor Rating

Motor ratings shall be adequate to meet the requirements of the drive equipment. Motors shall be continuously rated at the design ambient temperature of 50 degree C and relative humidity of 85%. Maximum continuous motor ratings shall have at least a 10% margin above the maximum load demand of the driven equipment under entire operating range including voltage & frequency variation.

3.4 Starting Requirements

3.4.1 Motor shall start smoothly and rapidly. 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% of the motor's full load torque.



2 x 660 MW ENNORE SEZ STPP
BASIC TECHNICAL FEATURES
FOR HT / LT MOTORS
(FOR BHEL-PEM SCOPE PACKAGES)

Doc. No.	PE-DC-412-565-E003
Rev. No.	01
Dated	13-03-2015
Page	3 of 7

- 3.4.2 Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.

Minimum Starting Voltage requirement for all motors (except mill motors):

1. 85 % of rated voltage for motors up to 1000 kW
2. 80 % of rated voltage for above 1000 kW and up to 4000 kW
3. 75 % of rated voltage for above 4000 kW

- 3.4.3 The locked rotor current of the HV (11 kV) motors (except MDBFP motors) shall not exceed 650% of full load current inclusive of tolerance as per IS: 325 and for MV (3.3 kV) motors locked rotor current shall not exceed 700% of full load current inclusive of tolerance as per IS: 325. For LT motors (except energy efficient motors) locked rotor current shall not exceed 700% of full load current inclusive of tolerance as per IS: 325. For LT energy efficient motors above 10kW with S1 duty, locked rotor current shall be as per IS: 12615-2011.

- 3.4.4 The following frequency of starts shall apply to HV (11 kV), MV (3.3 kV) & LT motors

- i) Two nos. consecutive cold starts in quick succession with third start after 5 minutes in cold condition.
- ii) Two nos. consecutive hot starts in the interval of 15 minutes in hot condition.

- 3.4.5 Locked motor withstand time of motors under hot condition at highest voltage limit shall be as follows:

- a) For motors with starting time up to 20 sec.
 - at least 2.5 sec. more than starting time.
- b) For motor with starting time above 20 secs but not exceeding 45 secs.
 - at least 5.0 sec. more than starting time.
- c) For motors with starting time above 45 secs.
 - at least 10% more than starting time.

The starting time of the motor referred above is at minimum permissible voltage. For motors and in cases where the above requirements are not complied with, speed switches of approved make & type shall be provided to bypass the locked rotor protection for a pre-selected time during starting of motors. The speed switches shall have one NO & one NC contacts having maximum interrupting capacity of 5 Amps at 240V AC and 0.25 amps at 220 V DC.

3.5 Running Requirements

- 3.5.1 Motors shall run satisfactorily at a supply voltage of 80% of rated voltage for 5 minutes with full load without injurious heating to the motor.
- 3.5.2 Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.

	2 x 660 MW ENnore SEZ STPP BASIC TECHNICAL FEATURES FOR HT / LT MOTORS (FOR BHEL-PEM SCOPE PACKAGES)	Doc. No.	PE-DC-412-565-E003
		Rev. No.	01
		Dated	13-03-2015
		Page	4 of 7

3.6 Stress during bus Transfer

3.6.1 Motors shall withstand the voltage 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.

3.6.2 Motor windings shall be adequately braced to satisfactorily withstand the mech. Stresses during above condition.

3.6.3 Motors shall be capable of withstanding heavy in-rush transient current caused by bus transfer without damage.

3.6.4 Motor and driven eqpt. Shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.7 Noise level

The maximum noise level for motors shall be in line with IS 12065.

3.8 Vibration

The maximum vibration for motors shall be in line with IS: 12075.

4.0 CONSTRUCTIONAL FEATURES

4.1 Degree of Protection

4.1.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. Canopy shall be provided for outdoor motors. CW motors (in case of screen prot. Drip proof) shall conform to degree of protection IP: 23 as per IS: 4691. The degree of protection for terminal boxes shall be IP 55 for outdoor area & IP 54 for indoor area as per IS 4691.

4.1.2 The stator laminations shall made from suitable silicon steel/magnetic steel sheet varnished on both sides and pressed to form a rigid core.

4.1.3 The rotor shall be of rigid cage construction with die cast aluminium / copper alloy / copper bars firmly wedged in bar slots and brazed to the end rings. The rotor cage shall be designed to operate satisfactorily under respective starting and load duty cycle.

4.2 Enclosure and Cooling

4.2.1 Motors shall generally have totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) enclosures or Closed Air circuit Air (CACA), the method of cooling conforming to IC-0141 or IC-0151 or IC-0161 of IS: 6362 up to 3000 kW motor. CW Motors may be screen protected drip proof (SPDP).

	2 x 660 MW ENNORE SEZ STPP BASIC TECHNICAL FEATURES FOR HT / LT MOTORS (FOR BHEL-PEM SCOPE PACKAGES)	Doc. No.	PE-DC-412-565-E003
		Rev. No.	01
		Dated	13-03-2015
		Page	5 of 7

4.2.2 Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.

4.2.3 Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.

4.3 Class of Insulation

HV/MV/LT motors shall have class F insulation. The temperature rise of all motors shall be limited to the limits applicable to Class 'B' insulation. In case of continuous operation at extreme voltage limits, 10deg C rise above the temperature limits specified in IS: 325 shall be permissible.

4.4 Bearings

4.4.1 Horizontally mounted motors shall have grease lubricated ball/roller or sleeve bearings. For HV/MV motors, the bearings shall be regreasable type and for LV motors, these bearings can be either sealed life lubricated type or regreasable type as per manufacturer's standard.

4.4.2 The vertical motors shall have a combined thrust and guide bearing on top and guide bearing at bottom. If the ball or roller bearings can take vertical thrust, thrust and guide bearing need not be provided.

4.4.3 After taking all motor driven equipment loads and thrust (if any) into account, the bearings shall be suitable for min. 20,000 working hours. Re-greasable bearings shall be provided with grease nipples and relief holes for on-line re-greasing and shall be suitable for 8000 working hours without changing of the grease.

4.4.4 The bearings of solidly coupled motors shall be of the same type as those of the driven equipment.

4.4.5 For motors below 15 kW shall be provided with sealed ZZ bearing.

4.4.6 Motors rated above 1000kW shall be provided with insulated end shield on non-driving end to prevent flow of shaft current.

4.5 Terminals and Terminal Boxes

4.5.1 Motors of rating 90 kW and up to 160kW will be controlled by air circuit breaker with numerical protection. For all motors of rating up to 90kW shall be provided with MCCBs. The terminal box of motors for HV (11 kV), MV (3.3 kV) & LT motors shall be designed for the maximum fault current for a duration of at least 0.25 secs.

4.5.2 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.

4.5.3 For HV/MV motors, the main terminal box shall be of phase-segregated type with clamping arrangement for the terminals.

4.5.4 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 V, W & U respectively.



2 x 660 MW ENNORE SEZ STPP
BASIC TECHNICAL FEATURES
FOR HT / LT MOTORS
(FOR BHEL-PEM SCOPE PACKAGES)

Doc. No.	PE-DC-412-565-E003
Rev. No.	01
Dated	13-03-2015
Page	6 of 7

4.5.5 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.

4.5.6 Motor terminals and terminal leads shall be fully insulated with no bar live parts.

4.5.7 Separate terminal boxes shall be provided for space heaters and temp. Indicators. If this is not possible in case of LT motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non-magnetic material for single core cables) with double compression tinned brass glands shall be provided in terminal boxes.

4.5.8 Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 180 and 90 degree for HT and LT motors respectively.

4.5.9 Cable glands and cable lugs as per selected cable sizes shall be provided in line with cable erection philosophy. For single core cable termination, gland plates shall be of non-magnetic material.

4.6 Grounding

Two separate earthing terminals suitable for connecting G.I. strip grounding conductor shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.

4.7 General

4.7.1 Motors provided for similar drives shall be interchangeable.

4.7.2 An arrow block shall be screwed on the body of the motors on the non-driving end to indicate the direction of rotation of the motors.

4.7.3 Motors for Fuel oil unloading and drain oil pumps located in hazardous areas shall be with flame-proof enclosures in accordance with IS 2148 / IEC 60079.

a) Fuel oil area: Group - IIB.

b) Hydrogen generation plant area: Group - IIC

5.0 ACCESSORIES

5.1 SPACE HEATERS

All motors rated 30KW and above shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.

The leads from space heaters of each motor shall be brought out to a separate terminal Box. Space heaters shall be mounted inside the motor in accessible places so that their removal and replacement is simple.

	2 x 660 MW ENnore SEZ STPP BASIC TECHNICAL FEATURES FOR HT / LT MOTORS (FOR BHEL-PEM SCOPE PACKAGES)	Doc. No.	PE-DC-412-565-E003
		Rev. No.	01
		Dated	13-03-2015
		Page	7 of 7

5.2 RESISTANCE TEMPERATURE DETECTORS (RTDs)

5.2.1 HV/MV motors stator windings shall be provided with 12 nos. Simplex 3 wire Platinum RTDs with 100 ohms resistance at 0 deg C for remote monitoring of winding temperature. The leads from RTDs of each motor shall be brought out to a separate terminal Box.

5.2.2 For HV/MV motors, each bearing shall be provided with 1 no. Duplex 3 wire Platinum RTDs with 100 ohms resistance at 0 deg C for remote monitoring of bearing temperature. The leads from these RTDs shall be brought out to a separate terminal Box or the terminal box same as for winding RTDs.

5.3 DIAL TYPE TEMP. INDICATORS

5.3.1 For HV/MV motors, each bearing shall be provided with dial type thermometer with adjustable alarm contact and resistance type temperature detector. The indicators shall have 2 nos. NO contacts rated for 5A, 240 V AC and 0.5 A, 220 V DC for alarm/trip purpose.

5.4 Vibration monitoring pads

5.4.1 Provision shall be made in all HV/MV motors for mounting vibration detectors.

6.0 NAME PLATE

Motors shall have stainless steel name plate with all particulars as per IS: 325. In addition bearing identification number and type of lubricant is to be indicated.

7.0 PAINTING

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

8.0 TESTING

8.1 Type Tests

For HT & LT Motors, type test reports for type tests as per IS: 325/ IS: 12615 conducted on equipment similar to those proposed to be supplied and carried out within last five years shall be submitted. However, if such reports are not available, one motor of each type shall be subjected to type tests for free of cost.

8.2 Routine Tests

All motors shall be subjected to routine tests as per IS: 325/ IS: 12615 in the presence of customer or customer representative.

SPECIFIC ELECTRICAL REQUIREMENT

SL.NO.	PARAMETERS	UNIT	ENNORE
	MOTOR		
1	DESIGN AMBIENT TEMP	DEG. C	50
2	VOLTAGE SUPPLY AND VARIATION	VOLT	415V, + 10%
3	FREQUENCY WITH VARIATION	Hz	50 (+) 3% to (-) 5%
4	COMBINED VOLTAGE & FREQUENCY VARIATION		10%
5	MAX ACCEPTABLE RATING OF MOTOR AT 415 V	KW	160 kW
6	SYSTEM FAULT LEVEL AND ITS DUARTION	KA	50 KA, 1 Sec
7	SUTABILITY OF TERMINAL BOX FOR FAULT LEVEL AND DURATION		50 KA, 0.25 sec
8	CLASS OF INSULATION & TEMP RISE LIMITED TO		Class-F and temp rise limited to Class-B
9	MIN. STARTING VOLTAGE		85%
10	MOTOR RATING FOR SINGLE PHASE SUPPLY		Upto 200W
11	MAXIMUM LOCKED ROTOR CURRENT	% OF FLC	For LT motors (except energy efficient motors) locked rotor current shall not exceed 700% of full load current inclusive of tolerance as per IS: 325. For LT energy efficient motors above 10kW with S1 duty, locked rotor current shall be as per IS: 12615-2011.
12	ACCEPTABLE NOISE LEVEL	DB	85dB at 1.0m in line with IS 12065
13	TYPE OF STARTER PROVIDED IN MCC		N.A.
14	DOP OF ENCLOSURE		Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. The degree of protection for terminal boxes shall be IP 55 for outdoor area & IP 54 for indoor area as per IS 4691.
15	SPACE HEATER REQUIREMENT		30KW & ABOVE
16	PAINT SHADE		Shall be confirmed during detailed engineering.
17	SPECIAL REQUIREMENT		For HT & LT Motors, type test reports for type tests as per IS: 325/ IS: 12615 conducted on equipment similar to those proposed to be supplied and carried out within last five years shall be submitted. However, if such reports are not available, one motor of each type shall be subjected to type tests for free of cost. All motors shall be subjected to routine tests as per IS: 325 / IS: 12615. The motors shall generally conform to IS: 325 / IEC-60034. All LV MOTORS ABOVE 10 KW WITH S1 DUTY SHALL BE COMPULSORILY OF ENERGY EFFICIENT LEVEL IE3 AS PER IS 12615:2011



TITLE : TECHNICAL SPECIFICATION
FOR
TRAVELLING BAND SCREENING SYSTEM

SPEC. NO. PE-TS-412-172-N001

SECTION : I
SUB-SECTION : IC

REV. NO. 00 DATE : 20.01.2017

Sheet 1 of 1

**SECTION IC
SPECIFIC TECHNICAL REQUIREMENT
CONTROL & INSTRUMENTATION SYSTEMS**

2x660 MW ENNORE STPP (JOB NO. 412)
TRAVELLING WATER SCREEN

1.00	SYSTEM	TRAVELLING WATER SCREEN
2.00	COMMON / PER UNIT	COMMON
3.00	CONTROL SYSTEM	Standalone DDCMIS (Sea water Intake Pumps)
3.10	PROCESSOR CONFIGURATION FOR PLC SYSTEM	NA
4.00	LOCATION OF CONTROL SYSTEM	Sea Water Intake Pump House Control Room
4.10	CONTROL SYSTEM SCOPE (BIDDER/ BHEL/ CUSTOMER)	BHEL
5.00	HARDWIRED INTERFACE WITH DCS (Y/N)	NA
5.10	PURPOSE OF HARDWIRED INTERFACE WITH DCS	
5.11	a) COMMAND FROM DCS (Y/N)	NA
5.12	b) STATUS FEEDBACK TO DCS (Y/N)	NA
5.13	c) GROUP FAULT ALARM TO DCS (Y/N)	NA
6.00	SOFTLINK TO DCS (Y/N)	NA
6.10	PURPOSE OF SOFTLINK TO DCS	
6.11	a) COMMAND INTERFACE WITH DCS (Y/N)	NA
6.12	b) STATUS MONITORING IN DCS (Y/N)	NA
7.00	PROTECTION CLASS FOR PLC / RIO PANEL	NA
8.00	CONTROL FROM PB's ON LCP/OWS ON LCP	CONTROL FROM PB's ON LCP
9.00	ANNUNCIATION ON LCP (Y/N) -- IF Y, MIN NO. OF HARDWIRED ALARMS / INDICATIONS	YES BIDDER TO PROPOSE MIN NO OF ALARMS/INDICATIONS
9.10	MIMIC ON LCP (Y/N)	Y
10.00	CONTROL FROM DCS IN CCR (Y/N)	Y
11.00	TYPE OF SOFTLINK (TP/OFC)	NA
11.10	COMMUNICATION CABLE SCOPE (BIDDER/ PEM/ EDN/ CUSTOMER)	NA
11.20	REDUNDANT CABLE (Y/N)	NA
11.30	PROTOCOL	NA
12.00	RIO / RPU (Y/N)	NA
13.00	## NO. OF OWS / LAPTOP	NA

**2x660 MW ENNORE STPP (JOB NO. 412)
TRAVELLING WATER SCREEN**

13.10	SIZE OF OWS/ CRT OR LCD	NA
14.00	NO. OF PRINTER	NA
14.10	PRINTER SIZE AND TYPE	NA
15.00	\$\$ POWER SUPPLY AVAILABLE FOR BALL MONITOR (24V DC / 110 V AC UPS / 230 V AC UPS)	NA
15.10	&& POWER SUPPLY AVAILABLE FOR PLC PANEL (3PHASE, 415 V AC/ 1PHASE, 110 V UPS/ 1PHASE, 230 V UPS)	415 V AC, 3 PHASE
15.20	REDUNDANT FEEDERS (R) / NON-REDUNDANT (NR) FEEDERS FOR POWER SUPPLY	R
15.30	UPS BATTERY CONFIGURATION (1X100% / 2X100%)	NA
15.40	BATTERY TYPE (LEAD ACID/ Ni-Cd)	NA
15.50	BATTERY BACK-UP TIME (in minutes)	NA
16.00	ACTUATOR WITH INTEGRAL STARTER (Y/N)	Y
17.00	PG/ DPG/ PS/ DPS/ PT/ DPT/LT for TWS	DPT=2 no. & DPG = 1 no(ACROSS EACH STRAINER) , ultrasonic LT (4 Nos.) for each screen and in addition other Instrument BOQ as finalised during detail engineering.
18.00	REMARKS	
19.00	PROJECT SPECIFIC INFO	

NOTES:

- 1.00 OPERATION THROUGH HARDWIRED PUSH BUTTON MOUNTED ON LOCAL CONTROL PANEL SHALL BE PROVIDED.
- 2.00 BIDDER TO TERMINATE ALL INSTRUMENTATION AND CONTROL ELEMENTS IN JUNCTION BOXES FOR FURTHER CABLING TO DCS BY BHEL/CUSTOMER. BIDDER TO PROVIDE INPUT/OUTPUT LIST, DRIVES LIST, JUNCTION BOX SCHEDULE AND TERMINATION DETAILS, RECOMMENDED CONTROL LOGICS / WRITE-UP ETC. DURING DETAILED ENGINEERING
- 3.00 ALL THE INSTRUMENTS ALONG WITH NECESSARY FITTINGS, ACCESSORIES AND VALVE MANIFOLD ETC., INSTRUMENT RACK & JUNCTION BOXES, ERECTION HARDWARE SHALL BE IN BIDDER SCOPE OF SUPPLY.
- 4.00 INSTRUMENT RACK AND JUNCTION BOXES SHALL BE IN BIDDER'S SCOPE OF SUPPLY.
- 5.00 BIDDER TO FURNISH ELECTRICAL LOAD DATA DURING DETAILED ENGINEERING.
- 6.00 ALARM FACIA SHALL BE UNDER BIDDER'S SCOPE. NO. OF FACIA SHALL BE DECIDED DURING DETAILED ENGINEERING.
- 7.00 THE SCOPE OF CABLE SHALL BE REFERRED IN ELECTRICAL SCOPE SPLIT SHEET IN ELECTRICAL PORTION OF THE SPECIFICATION.

CONTROL PHILOSOPHY for TWS

- 1 Travelling Band Screens, Spray wash/flushing pumps, spray wash valves, automatic self-cleaning strainers and other auxiliaries shall be controlled and operated from standalone DDCMIS of Sea Water Intake pumps system located in Sea water intake pump house control room, supplied by the Purchaser.
- 2 Ultrasonic LT shall be provided at the Inlet & Outlet of TBS for differential Level measurement
- 3 The following shall be provided in DDCMIS.
 - a) All interlocks and protections for Travelling Band Screens, spray wash pumps, automatic self cleaning strainers shall be realized in the DDCMIS.

SPECIFIC TECHNICAL REQUIREMENTS

	2X660 MW ENNORE STPP	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
Specific Technical Requirements (C&I): 1. All motorised valves of 200NB or more than 200NB size shall be provided with integral motorized bypass valves on all process lines. 2. Components of instruments, control devices, accessories, piping etc. which contact with steam, condensate or boiler feed water shall be manufactured from copper free materials which do not react with media at operating parameters. 3. Valve end position (Open & Close) shall be monitored for the manual critical valves, wherever provided. 4. All the instruments/drives shall be terminated on JB's/Panels in field. JB's/Panels shall be in Bidder's scope. 5. 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. 6. Bidder shall provide an unlimited warranty on all equipment and software for three years after the start of the warranty period, i.e. after satisfactory completion of initial operations. This warranty shall include repair, replacement or correction of identified software or hardware discrepancies at no cost to OWNER. 7. All local gauges, transmitters and switches shall be mounted on suitable enclosures, racks subject to owner's approval. All transmitters shall be HART compatible. 8. Bidder to delegate /depute their persons/experts as per owner/consultants' requirement. 9. Bidder must offer general tools and tackles and special calibration instruments required during start-up, trial run, operation and maintenance of the system. 10. The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to		

	2X660 MW ENNORE STPP	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
be supplied by bidder without any technical, commercial and delivery implication to BHEL. 11. All the instruments/equipment/electrical items shall be provided & designed with maximum star rating as available in line with energy conservation policies notified by BEE, GOI at the time of supply. 12. All approval/Inspection are to be carried out by Owner or owner appointed agency only. 13. 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. 14. Each of the Plant Auxiliaries & off site systems shall be provided with annunciation system. It shall be an integral part of the control system. All the fieldcontact for this purpose shall be acquired through control system. The annunciation sequence/logic shall conform to ISA sequence ISA-2A. The window lamps for the system shall be driven through output modules of the control system. 15. The instrumentation to be provided for each of the plant auxiliary & Off Site Plant systems shall be as per the technical specification document / drawings wherever provided for the respective systems as a minimum requirement for bidding purpose. However, for completeness of each of the plant auxiliay & Off Site system and its associated equipment, Bidder shall also provide all the necessary instruments to the process requirement even if it is not specifically indicated in the given technical Specification document /drawings 16. All cables terminated in the terminal block, power distribution scheme instruments shall be ferruled. Ferruling shall be double cross ferruling (i.e.) source and destination addresses shall be marked on both sides of the tube ferruling. 17. Bidder shall provide local panel for local start/ stop monitoring of auxiliaries and equipment as per requirement .The requirement shall be decided during detailed engineering. All local panel shall be NEMA 4X with canopy. 18. DP instruments with min. Capillary length of 15m to be supplied in case of installation in pit.		

	2X660 MW ENNORE STPP	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
19. It is mandatory to use sensors/signals/measurements with 2 out of 3 logic for critical control & protection (Analog & Binary) application/service and sensors with 1 out of 2 logic for all other control & interlock (Analog & Binary) application/service. 20. Instruments shall be suitable for sea or saline water application. MOC of impulse tubing & impulse pipe shall be CPVC (3/8") Sch 80 or better, Industrial grade up to manifold. MOC of impulse tubing, fittings (from manifold to instrument) and manifold shall be super duplex SS. 20. In the event of conflict between requirements of any two clauses or specification documents, the more stringent requirements shall apply. 21. Power Supply Requirement: 415V, 3 phase AC power supply (Redundant Feeders) shall be provided by Customer for the local control panel. Further any electrical distribution shall be in bidder's scope. Any other voltage requirement to be arranged/derived by bidder by providing suitable control transformer. 22. Number of pairs to be selected for Screen /Control cable (Size : 0.5 mm²): a) F-Type: 2P/4P/8P/12P/24P b) G-Type: 4P/8P/12P		



**SPECIFICATION FOR
CONTROL & INSTRUMENTATION FOR AUX
PACKAGES**

SPECIFICATION NO.:

VOLUME

SUB SECTION

REV. NO.

DATE :

SHEET

OF

- 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 of 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.

ACTUATOR DATA SHEET

	Data Sheet FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.: PE-ID-412-145-I902	
			VOLUME II B	
			SECTION D	
			REV. NO. 01	DATE: 04.07.15
			SHEET 1 OF 3	
Data Sheet A & B				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
GENERAL*	* PROJECT	2x 660 MW ENNORE STP		
	OFFER REFERENCE			
	* TAG NO. SERVICE			
	* DUTY	☐ ON / OFF ☐ INCHING		
	* LINE SIZE (inlet/outlet): MATERIAL			
	* VALVE TYPE	☐ GLOBE ☐ GATE ☐ REG. GLOBE ☐ BUTTERFLY		
	* OPENING / CLOSING TIME			
	* WORKING PRESSURE			
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%		
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY		
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY		
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY		
CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF, IP:68		
	MECHANICAL POSITION INDICATOR	TO BE PROVIDED FOR 0-100% TRAVEL		
	BEARINGS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.		
	GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION	METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.		
	SIZING	OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. FOR INCHING SERVICE - 150 STARTS/HR MINIMUM & FOR REGULATING SERVICE - 600 STARTS/HR MINIMUM.		
HANDWHEEL	* REQUIRED	☒ YES ☐ NO		
	* ORIENTATION	☐ TOP MOUNTED ☐ SIDE MOUNTED		
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.			
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY		
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY		
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT- INCLUSIVE OF I.S. TOLERANCE		
	ACTUATOR APPLICABLE WIRING DIAGRAM	☐ ENCLOSED (BIDDER TO CONFIRM) A: ☐ DRG. NO. 3-V-MISC-24227 R00 B: ☐ DRG. NO. 3-V-MISC-24550 R00 C: ☐ DRG. NO. 3-V-MISC-24283 R00 D: ☐ DRG. NO. 4-V-MISC-90271 R11 E: ☐ For Thyristor based Integral starter, Bidder/Vendor to furnish wiring diagram		
	COLOUR SHADE	☐ BLUE (RAL 5012) ☐ DURING DETAIL ENGG.		
	PAINT TYPE (## Refer Notes)	☐ ENAMEL ☒ EPOXY ☐		
	SHAFT RPM	BIDDER TO SPECIFY		
	OLR SET VALUE	BIDDER TO SPECIFY		
	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY		
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY		
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC		
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ☐ 230 V ☐ 110 V		

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.: PE-ID-412-145-I902		
			VOLUME II B		
			SECTION D		
			REV. NO.	01	DATE: 04.07.15
		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)	
	@ ENCLOSURE CLASS OF MOTOR	☐ IP 67 ☐ FLAME PROOF			
	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B			
	@ WINDING TEMP PROTECTION	☒ THERMOSTAT (3 Nos., 1 IN EACH PHASE) ☐ -----			
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED			
INTEGRAL STARTER	INTEGRAL STARTER	☒ REQUIRED ☐ NOT REQUIRED			
	TYPE OF SWITCHING DEVICE	☒ CONTACTORS ☐ THYRISTORS			
	TYPE	☒ CONVENTIONAL ☐ SMART (NON-INTRUSIVE)			
	STEP DOWN CONT. TRANSFORMER	☒ REQUIRED			
	OPEN / CLOSE PB	☒ REQUIRED ☐ NOT REQUIRED			
	STOP PB	☒ REQUIRED ☐ NOT REQUIRED			
	INDICATING LAMPS	☒ REQUIRED ☐ NOT REQUIRED			
	LOCAL REMOTE S/S	☒ REQUIRED ☐ NOT REQUIRED			
	STATUS CONTACTS FOR MONITORING	☒ REQUIRED ☐ NOT REQUIRED			
	INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (MOTOR THERMOSTAT TRIP, O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, PHASE LOSS, S/S IN LOCAL/OFF MODE, STOP PB OPTD, TORQUE OPEN/CLOSE CUTOFF)			
INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter)	TYPE OF ISOLATING DEVICE	☐ INTERPOSING RELAY ☐ OPTO COUPLER ☐ EITHER			
	QUANTITY	☒ 2 NOs. ☐ 3 NOs.			
	DRIVING VOLTAGE	☒ 20.5 – 24V DC ☐ _____ V DC			
	DRIVING CURRENT	☒ 125mA MAX ☐ _____ mA MAX			
	LOAD RESISTANCE	☒ > 192 ohms - <25 k ohms ☐ > _____ ohms - < _____ ohms			
TORQUE SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY			
	OPEN / CLOSE	☒ 1 No. ☐ 2Nos. / ☒ 1 No. ☐ 2Nos			
	CONTACT TYPE	2 NO + 2 NC			
	RATING	5A 240V AC AND 0.5A 220V DC			
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE			
	ACCURACY	+3% OF SET VALUE			
LIMIT SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY			
	OPEN : INT : CLOSE	☐ 1 No ☒ 2 Nos.	2 Nos. (ADJ.)	☐ 1 No. ☒ 2Nos.	
	CONTACT TYPE	2 NO + 2 NC			
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC			



Data Sheet FOR MOTORISED VALVE ACTUATOR

SPECIFICATION NO.: PE-ID-412-145-I902

VOLUME II B

SECTION D

REV. NO. 01

DATE: 04.07.15

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	$\pm 1\%$ FS	
SPACE HEATER	@SPACE HEATER	REQUIRED	
	@ POWER SUPPLY (NON INTEGRAL)	230V AC, 1 PH., 50 Hz	
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY	
	@ RATING		
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED	
	ENCL CLASS ACTUATOR/MOTOR T.B.	@ ☒ IP 68 @ ☐	
	@ EARTHING TERMINAL	REQUIRED	
	PLUG & SOCKET (9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT)	☐ REQUIRED ☒ NOT REQUIRED ☐ 2 NOS. ☐	
CABLE GLANDS	@ POWER CABLE GLAND	SIZE:-----	
	@ SPACE HEATER CABLE GLAND	SIZE:-----	
	OTHER CONTROL CABLE GLANDS	QUANTITY & SIZE :Cable gland 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 INTERNATIONAL STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH:
IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722
3. ACTUATOR SHALL HAVE HARDWIRED CONTACTS FOR FOLLOWING SIGNALS (a) ACTUATOR IN LOCAL MODE (b) ACTUATOR IN REMOTE MODE.
4. BIDDER TO ENSURE AVAILABILITY OF SPARE 1NO + 1NC LIMIT SWITCH & TORQUE SWITCH. 1
5. SS TAG NAME PLATE SHALL BE PROVIDED.
6. TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
7. CABLE GLANDS OF DOUBLE COMPRESSION TYPE, NI PLATED BRASS MATERIAL SHALL BE PROVIDED.
8. 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.
9. THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%.
10. THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.

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

EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.

NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @ = TO BE FILLED BY ES

LIST OF DOCUMENTS/DELIVERABLES

C&I DELIVERABLES LIST FOR TWS			
SI.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY
INSTRUMENTATION			
1	PE-V9-412-165-I901D	INSTRUMENT DATA SHEETS	A
2	PE-V9-412-165-I902D	BOQ	I
3	PE-V9-412-165-I903D	INSTRUMENT QP / CHECK LIST	A

STARTER PANEL/ LOCAL CONTROL PANEL			
1	PE-V9-412-165-I950D	LOCAL CONTROL PANEL DATA SHEET	A
2	PE-V9-412-165-I951D	WIRING DIAGRAM	A
3	PE-V9-412-165-I952D	PANEL EXTERNAL GA DRAWING (INCLUDING FOUNDATION DETAILS & FLOOR CUT-OUT)	A
4	PE-V9-412-165-I953D	PANEL INTERNAL GA DRAWING	A
5	PE-V9-412-165-I954D	PANEL FRONT VIEW DRAWING	A
6	PE-V9-412-165-I955D	LIST OF HARDWIRED SIGNAL EXCHANGE WITH DDCMIS	A
7	PE-V9-412-165-I956D	BILL OF MATERIAL	I
8	PE-V9-412-165-I957D	LOCAL CONTROL PANEL QUALITY PLAN	A
9	PE-V9-412-165-I958D	PANEL O & M MANUAL	I

SPECIFICATION OF FIELD INSTRUMENTS

CHAPTER-3**FIELD AND MEASURING INSTRUMENTS****3.00.00 FIELD & MEASURING INSTRUMENTS (PRIMARY & SECONDARY INSTRUMENTS)****3.01.00 GENERAL REQUIREMENTS**

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

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

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

3.01.04 For plug in type instruments, The plug & sockets shall be polarized to prevent wrong connections and have facility for secure coupling in plug-in position to prevent loose connections.
Signal/Electrical connection shall be screwed connection with double compression type Nickel-plated brass cable glands for Explosion proof area, Flame proof area and high vibration prone area.

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

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

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

- i. Level switches / pressure switches / flow switches/any other process switches etc. for OLCS / Alarms / Interlocks / Protection. Pressure switches at inlet, outlet



- of individual pumps and discharge header of pumps for protection and auto start / stop & alarms.
- ii. Level switches for sump/tank level high/normal/ low/very low interlocks.
 - iii. Level Transmitters (Type as per Owner approval) for open sump/tank/bunker/vessel/heaters.
 - iv. Stand pipes on both side of tank for all level instruments (LT, LS & LG).
 - v. Flow elements with flow transmitter & Flow meter for flow measurement of process medium like Steam, Water, Air, Flue Gas, Fuel oil, open channel liquid, solid fuel, ash flow, DM water, Raw water, Instrument and Service air etc. as decided by owner.
 - vi. Pressure gauges and temp. Gauges at inlet and outlet of each heat exchanger and cooler.
 - vii. DPG, DPT & DPS across the filters/strainers.
 - viii. Tapping points/test points shall be provided.
 - ix. All primary Instruments, hardwares & JB's etc used for measurement for HFO, LDO & Turbine Lube Oil system shall be flame proof (IEC-79.1, Part I). All primary Instruments, hardwares & JB's etc used for measurement for Hydrogen shall be intrinsically safe and explosion proof as per NEC article 500, class 1, Division 1 area I.
 - x. All Thermocouples & RTDs shall be Duplex.
 - xi. All Field Instruments used in acid or alkaline atmosphere shall be with standard Anti corrosion coating i.e. the combination of Polyurethane and epoxy resin baked coating (ANSI/ISA-71.04).
 - xii. All primary instruments installed at "Minus level or Floor" shall be with protection class of IP 68.
 - xiii. Transmitters (all type) for monitoring & controls purpose.
 - xiv. Pull cord, belt sway, zero speed switches, emergency stop PB for conveyers, other limit switches, cable gland etc. of CHP which produce spark shall be provided with dust and flame proof enclosure conforming to IS-2148.
 - xv. Lockable Deinterlock switches shall be provided for CHP as per requirement.
 - xvi. Bidder shall provide electronics weighing in motion system as per IS-11547, hermitically sealed load cell of precision strain gauge type, 100% over load protection of cell and 250% overload protection for the construction; one calibrator attachment with two weighers.



- xvii All field mounted push button, selector switch etc. shall be as per IEC or NEMA 4X protection.
- xviii All limit switch shall be conform to IEC-60947-5-1.
- xix At APH, **temperature measuring device of different lengths forming grid** shall be provided to have average temperature for variable flow of flue gas, secondary air and primary air. These temperatures may be connected to nearest remote I/O panel.
- xx. On both left and right sides of furnace, separate lines shall be laid and provided with **furnace pressure transmitters having wide range** than the furnace pressure transmitter.
- xxi. Temp. Transmitters are envisaged with RTD & Thermocouples for monitoring services/application only. However any RTD & Thermocouples are used for control, interlock & protection application, same shall be directly wired to DDCMIS/DCS/PLC using instrumentation & Extension cables respectively.
- xxii. As for the water flow/ steam flow measurements, **necessary flow elements/transmitters are chosen in the process line and supplied such that their algebraic summation shall be mass balanced for calculating the system efficiency.**
- xxiii. Contacts less, electronic 2-wire position transmitters shall be provided for all inching type motorised valve and dampers.
- xxiv. For CW sump level, Raw water reservoir level, Turbine oil tank, coal bunkers, Ash Silo, LDO/HFO tank, DM water tanks, CS tank, Acid and alkali applications, only non contact type level transmitters like Acoustic, Ultrasonic, Radar based shall be provided by bidders as specified in NIT and as approved by owner.
- xxv. Considering the type of application, wireless technology to bring signals to DDCMIS may be adopted by interfacing with OPC gateway to avoid cabling for smart level transmitters specified above at sr. no. xxiv. However Wireless technology as adopted by Bidder shall be reliable and field proven in power plants and same shall be approved by Owner.
- xxvi. For Turbine oil, HFO/LDO applications & H2 Gas application, zener protection on power supplies shall be included.
- xxvii. Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application. For HFO, LFO Applications, SS capillary with thin wafer element with ANSI RF flanged ends are to be provided. For hazardous area, explosions proof enclosure as described in NEC article 500 shall be provided.

FIELD INSTRUMENTS SHALL BE SUPPLIED & OFFERED AS PER DATA SHEETS SPECIFIED BELOW:



2 x 660 MW ENNORE SEZ Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/P&E/EE/E/OT.No.03/2013-14



3.03.00 TRANSMITTERS, SWITCHES, GAUGES AND PANEL MOUNTED INSTRUMENTS**3.03.01 Pressure, Differential Pressure, DP type Level and Flow Transmitters (PT, DPT, LT & FT)**

Smart Transmitters of the electronic type shall be furnished.

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

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

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

Type/Construction	:	Sealed capacitance/ Inductance/ Silicon resonance type
Material		
- Body	:	Die cast Aluminum with epoxy coating for air & flue gas SS316 for other services
- Diaphragm	:	316 SS
- Measurement element	:	Teflon seal
- Valves	:	Carbon steel for non-corrosive Applications SS316 for corrosive applications.
Output signal	:	4 to 20 mA Amp. DC (Two wires) HART Compatible
Local Indicator	:	LCD indicator (5 digit) with scale of Engg. unit
Overall Accuracy	:	$\pm 0.04\%$ or better of Span for BTG package $\pm 0.065\%$ or better of Span for BO P packages $\pm 0.2\%$ or better of span for remote seal type transmitter.
Turn down ratio	:	100:1 in general
Stability	:	$\pm 0.15\%$ of URL for 5 years.
Response time	:	150 msec.
Power supply	:	24V DC nominal
Drive capability	:	600 Ohms nominal
Enclosure Class	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
Span and Zero	:	Locally adjustable, non-interacting



Zero suppression / elevation : At least 100% of Span

Connection

- Process : 1. Half (1/2) inch NPT (F)
Quarter (1/4) inch NPT
with/without oval flanges

- Electrical : Suitable for Plug in type connection (Both side of transmitter), unused entry with blind plug.

Accessories

- For Absolute Pressure Transmitters: Two (2) valve SS316 manifold

- For Gauge & Vacuum pressure transmitter : Three (3) valve SS316 manifold

- For DP, level & flow transmitter : Five (5) valve SS316 manifold

- For oil and corrosive liquids : Separator diaphragm seals

- For all transmitters : Mounting bracket

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

3.03.01.01 Transmitters & other HART based instruments shall be supplied along with 3 Nos. of universal type hand held/portable pressure calibrators. Temperature transmitters shall be supplied along with 3 Nos. of hand held/portable mV source generators.

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

Applicable Standards : IS3624 - 1966/ISA-RP-8.1 except as modified in spec.

Type/Construction : Bourdon/Sealed Diaphragm Piston
Actuated preferable. Indicators with contacts are not acceptable.

Materials

- Bellows : 316 SS

- Bourdon tube : 316 SS

- Movement : 316 SS

- Enclosure : Die-cast aluminum with stoved enamel black finish. Epoxy coating shall be provided for corrosive atmosphere.

- Protective Diaphragm : Teflon



Accuracy	:	$\pm$ One (1) percent or better
Repeatability	:	$\pm$ 0.5(half) percent or better
Setting & Differential	:	Adjustable
Contact		
- Number	:	DPDT /2 SPDT
- Type	:	Auto reset with internal Adjustable snap action micro switch
- Rating	:	5 Amp, 240V AC / 0.2 Amp, 220V DC
Connection - instrument	:	Half (1/2) inch NPT Male Process
Electrical	:	Suitable for Plug in type connection. All the switches are internally connected and brought to the surface with Amphenol male/female connection. Cabling need not be terminated inside the switch. Cable ends are to be soldered in connector and to be inserted for easy maintenance.
- Over range protection	:	One Fifty (150) percent of full scale
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)
Accessories		
- 3 / 5 valve manifold	:	As applicable for all switches
- Self cleaning type pulsation dampners/Snubber (Material SS316)	:	Pump and compressor discharge lines
- Syphon	:	For all steam lines
- Protective separating diaphragm	:	For fuel oil & corrosive liquid lines.
Mounting	:	Local (in LIE/LIR for BTG package).

3.03.03 PRESSURE & DIFFERENTIAL PRESSURE GAUGES (PG & DPG)

Applicable standard	:	IS:3602-1966, IS/3624, ASME B 40.1
Type/Construction	:	
-760 mm to 1.0Kg/cm ²	:	Bellows/Diaphragm
-Above1.0Kg/cm ²	:	Bourdon Tube
- Suction side of pumps	:	Compound gauge
Materials		
- Bourdon tube	:	316 SS
- Bellows	:	316 SS
- Movement	:	316 SS
- Case	:	SS 316/ Die-cast aluminum with stoved enamel black finish. Epoxy coating



		shall be provided for corrosive atmosphere.
- Protective Diaphragm	:	Teflon
Dial size	:	150mm with shatter proof glass
Scale Details	:	Graduations in black lines on white dial, on white dial, 270 Deg. pointer deflection scale provided with glass cover. Smallest scale division shall be one (1) percent of full scale value or smaller. Pointer stop for all gauges.
Accuracy	:	$\pm$ One (1) percent or better
Connection - Instrument Process	:	1/2 inch NPT Male Bottom
Mounting	:	Local
	:	1/2 inch NPT Male (Back entry) mounted on local gauge board.
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)

Accessories

- 3 way needle valve/manifolds	:	For all gauges
- Self cleaning type	:	Pump and compressor discharge lines
Pulsation dampener/snubber (S316)	:	
- Syphon	:	For all steam lines
- Protective separating	:	For fuel oil and corrosive liquid lines

Other particulars

- External Zero adjustment	:	For all gauges
- Safety device	:	
Ranges 5 to 20 Kg/cm ²	:	Rubber blow out disc with open front construction.
Ranges above 20 Kg/cm ²	:	Neoprene safety diaphragm at the back with solid front construction.
- Over range protection	:	One Fifty (150) percent of full scale

Other Requirments

	:	Movement mechanism shall be glycerin filled for oil services & vibration prone area.
	:	For Fuel oil & corrosive liquid lines diaphragm type sensors required. Armored capillary of 10 M for Fuel oil & Corrosive liquid service.



- : Contact type pressure gauges are not acceptable for interlock & protection.
- : For condensate storage tank the pressure gauge in terms of 0-10000 mm wc or suitable range having **dial size of 300mm or bigger size** shall be provided.



Temp., Fuel oil temp. measurement
as per IBR rules and regulations

3.03.10 TEST THERMOWELLS (TW)

Applicable Standard	:	ASME PTC 19.3 TW - 2010
Type/Construction	:	Machined from Bar Stock
Material	:	316 SS/F11/F22/F91
Connection	:	
- Pipe	:	M33 x 2
- Test Instrument	:	To suit test instruments
Accessories	:	Plug with chain
IBR Certification	:	For high pressure service, Steam Temp., Fuel oil temp. measurement as per IBR rules and regulations Bidder shall provide calculation for thermowell as per ASME – PTC- 19.3 TW - 2010.

Test wells shall be provided on main steam, reheat steam, extraction steam, feed water, condensate, spray water lines and other piping as required to meet ASME test requirements.

3.03.11 DIRECT MOUNTED LEVEL TRANSMITTERS (LT)

Displacer type level transmitter shall not be used in the process anywhere in the plant.

3.03.12 Ultrasonic Level Transmitter (for Water sump/Tank level, Raw water reservoir level, Cooling water fore bay level measurements)

Principle of Operation	:	Detection of reflected ultrasonic pulse
Measuring Ranges	:	Up to 30 meters (typical)
Signal Processing	:	Microprocessor Controlled Signal Processing
Operating Freq.	:	10 KHz to 50 KHz (typical)
Display	:	Head mounted alpha-numeric back lit LCD/LED
Calibration & Configuration	:	Accessible from front of panel & HART calibrator.
Diagnosis	:	On-line
Status	:	For power, Hi / Lo / V. Hi / V. Lo- level indication, fault etc.
Construction	:	Plug-on board
Power supply	:	240 V AC 50 Hz / 24V DC
Signal Output	:	4-20 mA DC with HART (isolated) - 600 Ohm load.
Hysteresis	:	Fully adjustable preferred
Output contacts	:	2SPDT Potential free changeover contacts @ 8A 230V AC.
Accuracy & Repeatability	:	$\pm 0.25\%$ of span or better
Resolution	:	$\pm 0.1\%$ of span
Temperature Compensation:	:	To be provided with Transducer.



Operating temp.	:	Transmitter-50 deg C and Sensor – 80 deg C
MOC Sensor	:	Body- PVDF and Face – Polyurethane
Humidity	:	1% to 95% non condensing.
Enclosure	:	IP-67 Epoxy painted die cast Aluminum or SS316L housing.
Cable Connection	:	3/4" ET
Mounting	:	2" – 4" NPT or flanged
Accessories	:	Cable gland, prefab cable, mounting accessories like EPDM seal, SS316 flanged etc.
		Additional separate local display unit with large Alphanumeric back light LCD/LED & to be provided for the applications which will be decided during detailed engineering.

3.03.13 CAPACITANCE TYPE LEVEL TRANSMITTER

The total system shall consist of capacitance probe, pre-amplifier and transmitter

Type	:	Capacitance type
Probe	:	a) Rod or suspended electrode. b) Rope type probes may be used only where required probe length is greater than 3 meters
Probe Mounting	:	Stainless steel 1-1/2 ANSI RF Flange / 3/4" NPT (M)
Material of construction	:	316 SS
Insulation	:	PTFE Part/Full as per service.
Transmitter	:	The transmitter shall receive output of the preamplifier and convert it into 4-20 mA DC output signal.
Accuracy	:	± 1% of Full scale
Repeatability	:	± 0.5 % of Full scale
Load	:	Min 600 Ohms
Enclosure	:	Powder/Epoxy coated Die cast aluminum. with neoprene gasket conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
Ambient temperature	:	0-60 °C.
Mounting	:	Wall / Surface
Supply voltage	:	240V AC, 50Hz / 24V DC
Response time	:	100 m sec or better
Cable connection	:	3/4" ET
Accessories	:	Counter flange, Cable gland, prefab cable if any
Preferable features	:	Alarm output contacts with adjustable set point facility

3.03.14 GUIDED WAVE RADAR/RADAR LEVEL TRANSMITTER

Type	:	Guided wave Radar (Contact type)/Radar (Non contact type) as finalized by owner.
Application	:	For Turbine Lube oil tank, HFO & LDO tank level,



- Failure Diagnostics
- Long Term Stability
- Fast Response
- IP 66 / NEMA4X Protection
- Supplied with Calibration Certificate Traceable to National & International Humidity Standards
- Sensor protection with sintered filter
- Local LCD Display for Dew Point

3.03.42

Junction Boxes

v.	Type	:	Flame proof/weather proof
vi.	Enclosure	:	IP-65/Explosion/Flame Proof as per area classification.
vii.	Material	:	FRP with protective Coating
viii.	Cable entry	:	Bottom or Side
ix.	Cable glands	:	Double compression type – Nickel plated brass with PVC hoods.
x.	Mounting	:	Indoor/Outdoor
xi.	No. of terminals	:	As required with standardization with 20% spare of each size & type.
xii.	Terminals	:	Phoenix/Wago (screw less cage clamp type spring loaded)
xiii.	Grounding	:	Two terminals for body and shield ground
xiv.	Door	:	Hinged, lockable type.
xi.	Suitable mounting clamps and other accessories shall be in scope of bidder.		
xii	The brackets, bolts, nuts, screws, glands, lugs required for erection shall be of brass, included in bidder scope of supply. High voltage & insulation resistance test shall also be conducted.		
Xiii	M6 Ni plated Brass earthing stud shall be provided (external 2 nos. internal 1 no.)		
xiv	Gasket (Normal)- Neoprene thickness 6.0 mm		

3.03.43

Interposing Relays (IPR)

Electromagnetic type IPRs with modular design, plug-in type connections, suitable for channel/DIN rail mounting in cabinets; coil rating 24V D.C; 2 set of silver plated change over contacts rated for 0.5A 220 V DC/8 A 240 V AC. Free wheeling diode across relay copper coil and self reset type status LED indicator flag (electronic) shall be provided. Manual forcing/override facility is required. The test voltage for relay shall not be less than 4 KV with operating temperature from –20 deg. C to 60 deg. C. The relay shall have the necessary approvals like V0 inflammability class in accordance with UL94", IEC60664/IEC60664A/DIN VDE 0110. Facility to stimulate IPR manually shall be provided. The VA burden of relays shall be suitable to match the capacity of output modules. Interposing relay & sockets for mounting the interposing relay shall be of same make only.

3.03.44

RECORDERS (CHARTLESS)

Type	:	Micro-processor based, Digital TFT display type
- No. of Channels	:	Forty Eight (48) point).



**SPECIFICATION
FOR
CONTROL PANELS**

CHAPTER-6**SUPERVISORY CONTROL PANELS, SUPERVISORY CONTROL DESKS,
EQUIPMENT PANELS****6.00.00 PANEL AND DESKS****6.01.00 GENERAL REQUIREMENTS**

All DDCMIS/PLC/any other control system's electronic modules, power supply components, other control devices (except field mounted sensors/transmitters) and required for completeness of the system shall be housed in cabinets furnished by the Bidder. All equipment and dedicated cabinets required for termination, marshalling and proper interface within Bidder's system and also with other systems shall also be provided by the Bidder.

The cabinet mounted equipments shall be fully assembled, installed in mounting racks, wired and fully tested as per specification requirements and Owner approved drawings in the manufacturing works of a qualified manufacturer prior to shipment to the project site. The Bidder shall ensure that the cabinets are complete and ready for installation before dispatch from manufacturing works. The installation work at project site for these cabinets should only involve connections through multi pair cables from marshalling cabinets (wherever provided) to system cabinets and inter-cabinet/cabinet to UCD/UCP/BUP.

The Control cabinets shall house all types of modules / hardware to achieve all functions of Control System including signal conditioning modules, controller modules, I/O modules, communication controller modules, and all other requisite hardware for a complete system.

6.02.00 SUPERVISORY CONTROL PANELS AND DESKS**6.02.01 Control Desks & Other Furnitures**

Supervisory control desks for DDCMIS and other systems shall be supplied for mounting the required operating station as specified elsewhere in the specification. Also control desk will be provided for balance work stations – located in computer room, supervisor room etc. All furniture including chairs and tables for printers etc. shall also be provided by the bidder.

Also control desk & complete furniture will be provided for work stations & printers – located in respective control room for BOP packages.

Industry standard Cushioned revolving, wheel, independently, adjustable seat and back chairs with provision for adjustment of height shall be provided for the operator & unit in charge & other personnel in central control room area & BOP's control rooms, simulator rooms, Conference room, meeting room, documentation room, staff room, CAAQMS shelters, CAAQMS room etc. These shall be designed for sitting for long duration such that these are comfortable for the back. The exact details shall be finalised & approved by Owner during detailed engg.

The actual nos., placement and profile of the main plant control room desk shall be decided during the detailed Engineering.



The tentative layout of central control desk, LVS & consoles are shown in the Drg. No. 114-05-0108, 0105 & 0111.

Control Desk for programmer's, Maintenance Engineer's, EWS, Serves, P C & diagnostic OWSs: -

Required numbers of control desks for accommodating programmer's/main-tenance engineer's/diagnostic etc shall be supplied. These shall preferably have the same dimension as that of supervisory control desks. Also required nos. of control desk will be provided for work stations & printers – located in respective control room for BOP packages.

Desks for accommodating printer:

Adequate number of table/desks/stands for accommodating printers in bidder's scope shall be supplied. Each printer shall be on a separate table / stand.

Care shall be taken to ensure ergonomically aspects so as to create ergonomically ideal work place considering physical aspects such as an average Indian person's size and reach, physiological aspects such as line of sight and field of vision and cognitive factors such as concentration and perceptivity. Extreme care shall be taken to design the desks with correct angles and dimensions.

Glass top teak wood office table with lockable drawers shall be provided for Chief Engineer room and all other executive rooms.

6.02.02

Supervisory Panel Unit Control Panel

In addition to the LVS and OWS, a limited operation from backup unit control panel is envisaged for emergency operation and to provide safe shut down of plant. The Unit control panel shall housed Conventional Push-button (ILPB) stations, Console inserts (for SG, TG & Generator like FSSS, HPBP, SADC, APRDS, ATRS, ATT, DEHC, LPBP etc), Trip Push Buttons, EWLI, Ammeters, chartless recorders, & min. 15 nos. programmable digital display units for Boiler, Turbine & Generator's parameters. The mosaic grid shall be heat resistant, flame retardant, self extinguishing, and shrinkage free, non reflecting type. Finish of mosaic grid shall be mat type with out flaring. Hard wired emergency trip pushbuttons shall be arranged on operator station desk & in parallel on UCP.

Unit control Panel (UCP), shall be located suitably in the CCR.

In addition to above, 21 nos. Programmable digital display units common for both units showing total MW shall be provided by bidder at different locations of plant. The data to this DDU will be fed from DDCMIS through MOD BUS/PROFI BUS /RS 485 protocol and not hard wired. The **digit size** of the display unit will be **300 mm for 6 Nos.** and **200 mm for 15 Nos.** The placements/locations shall be decided during detailed Engineering.

Control panel cum desk with HW annunciation windows, ILPBs, Ammeters, Annunciation & desk PBs, mimic, lamps, Indicators, recorders, etc. shall be provided as per Annexure A – Control System Philosophy for BOP packages.



(Exact service & quantities will be worked out & approved during detailed engineering by owner).

6.02.03 Two (2) nos. vertical Steel Almirahs shall be provided for keeping documents in each BOP package's control room. Glass doors for each rack shall be provided such that the documents are visible from outside. Size of the rack shall be sufficient to easily fit technical manuals. The exact details shall be approved by Owner during detailed engg.

Suitable lockers (min. 24 nos. per unit) shall be provided in the room adjacent to the each central unit control room for storing of personal articles of control room personnel. Similarly suitable lockers (min. 8 nos. in each control room) shall be provided in BOP package control rooms for storing of personal articles of control room personnel. Also, vertical steel almirahs (min. 4 nos. per unit) shall be provided in Documentation Room for storing of documents.

Vertical Steel Almirahs shall also be provided for the following rooms, wherein final quantity may be decided by owner during detailed engineering

- a. Maintenance room – 6 nos. min. (per Unit)
- b. ERP room – 2 nos. min (Common for both unit).
- c. PADO Room – One (1) no. min.(per unit)
- d. Station In charge room – One (1) no. min (common for both unit).
- e. Simulator room – 4 nos. min. (per Unit)

Thickness of steel almirah sheet shall be 18 gauges.

In addition to above, All industry grade furniture including chairs, control tables, tables for printers etc. & Almirahs for storage of consumables/catalogues/manuals shall also be provided by the bidder as on required basis and finalized by owner anywhere in power plant. Details shall be finalised and approved by Owner during detailed engineering.

6.02.04 Control panels for service system like C.W. Pumps etc. will be located in the respective control room. In addition, some local panels will be provided near respective system/equipment such as Boiler Feed Pump, Hydrogen seal oil system, Electrostatic precipitator etc.

6.03.00 TERMINATION/Marshalling CABINETS & Interposing Relay Panel

Marshalling/Termination cabinets for the control system shall be supplied for terminating all cables originating from the field, MCC/SWGR or any other source of signal and for distributing the signals to different functional panels, MCC/SWGR and control cubicles.

Incoming cables from the field, MCC/SWGR or any other source of signal shall be terminated in suitable terminal blocks in logical sequence.

Prefabricated cables with plug in connectors at both ends shall be used for extending the signals to the functional panels. Matching plug sockets shall be provided in the termination cabinets for terminating the plugs.



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

Interposing relay shall be mounted in respective SWGR/MCC/integral starter required for commands signals of HT/LT unidirectional drives and bidirectional drives, breakers, isolators & bus couplers etc from DDCMIS/DCS/PLC or any control system.

Terminal blocks shall be located inside the cabinets on support wings fabricated of metal plates.

The plug socket shall be mounted on hinged plates to provide an access to the rear pins of the plugs.

General features of termination cabinets and accessories shall conform to the general design and construction specification of panels. Terminal blocks shall be Rail mounted Terminal blocks (Screw less cage clamp type) with markers.

6.04.00 CONSTRUCTIONAL FEATURES OF PANELS, CONSOLES, CONTROL DESK, CUBICLES & ENCLOSURES

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

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

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

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



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

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

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

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

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

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

Doors shall be provided with neoprene/polyurethane gasket only.

All the cable entries shall be at the bottom of electronic cubicles/control panels.

Protection class of panels shall be as specified at Vol. V, chapter 2.

6.04.01 Operator Control Desk

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

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

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

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

- i. Operator Control desk shall be free standing table top type with doors at the back and shall be constructed of 3 mm thick CRCA steel plates. It shall have concealed cable & wire way management system. The top surface of control



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

- ii. To achieve durable & water resistant finish, a sheet of "plastic PVC membrane" on the surface of control desks shall be provided. Final paint finish with proper smoothening is to be ensured. Final finish of CD should be in line with relevant International standards. For more durability, the membrane sheet of the Control desk should extend 200 mm more into the underside of the desk. The cabling / wiring between OWS & CPU's, power supply cables etc. shall be aesthetically routed and concealed from view.
- iii. All the control desk shall be equipped with Anti vibration pad of min. 15 mm size. Cable gland plate thickness shall be 3 mm.
- iv. Doors shall be provided with neoprene/polyurethane gasket only.

6.05.00 SURFACE PREPARATION AND PAINTING

All panel exterior steel surfaces shall be ground smooth, and painted as specified below:

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

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

- a) Exterior - RAL 7032/RAL 7035.
- b) Interior - Glossy white two coats/RAL 7035 with fire resistant paint

One uniform colour shade as finalized shall be applicable for complete plant.

Paint films, which show sags, checks, blisters teardrops, fat edges or other painting imperfections, shall not be acceptable and if any such defects appear, they shall be repaired by and at the expenses of the Bidder.

6.06.00 PANEL WIRING

Interconnecting wiring shall be provided between all electrical devices mounted in the panels, and between the devices and terminal blocks if the devices are to be connected



to equipment outside the panels by cabling and through pre-fabricated plug in cables. All alarm contacts located within a panel shall be wired to terminal blocks. Thermocouple and other special circuits shall be field wires direct to instrument terminal blocks without the use of panel wiring.

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

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

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

Panel wiring shall have a flame resistant insulation with adequately sized 650/1100 V grade tinned copper stranded conductor based on current carrying capacities as etc forth by the National Electric Code.

Wire sizes shall be as specified herein and suitable for intended applications.

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

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

Panel wires shall be identified with wire number and each termination by means of Action craft products split sleeve or Borden Chemical Co. indelible tubing markers or owner approved equal. Corrections and modifications of all panel wiring shall be Bidder's sole responsibility. Any corrections/modifications required at site for successful commissioning shall be done by the Bidder without any additional costs. Terminal lugs furnished must be of the compression, insulated sleeve, half ring tongue type. Open-ended terminal lugs will not be accepted. Wires shall not be looped around the terminal screws or studs.

Wires shall not be tapped or spliced between terminal points.

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



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

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

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

Conductor Clamping shall also confirm to Standard IEC – 60947-1 & IEC-60947-7-1.

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

6.06.01

Following Wire size shall be utilized for internal wiring:

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

6.07.00

INSTRUMENTS MOUNTING



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

6.08.00 PANEL ILLUMINATION

Panels shall be provided with LED based illuminating lamps with door switch and six (6) point 6/ 16A, 240V A C uni versal t ype po wer so ckets with sw itch f or m aintenance purposes. These switches shall be with quick make and break mechanism. 100 % spare LED l amps shall be p rovided with each panel , t hese a re i n a dditional t o mandatory spares.

6.09.00 FUSE BLOCKS

Where fuse blocks rated 30 amp. 250 Volts are required by the specifications or the manufacturer's design, t hey sh all be m odular t ype w ith bakelite frame and r einforced retaining clips. B locks shall be cl ass H.2 pole, screw terminal fuse blocks. B locks for other current and voltage ratings shall be similar in construction.

6.10.00 FUSES & MCB

All fuses shall be fast acting semiconductor types for AC supply and compatible to the UPS f uses. For al l D C P owered dev ices, si milarly t he f uses shall be f ast ac ting compatible to DCDB fuse provisions. All the AC power supplies shall be provided with the protection of Fast acting semi conductor fuses & 2 P thermomagnetic type MCB. Make of Fuses shall be GE or Siemens. For all the DC power supply circuits, electronic type DC MCB shall be use d only. Make of DC MCB shall be S iemens, Phoenix contacts, Murr, Weidmuller, or Lutze.

50 % spare fuses shall be provided with each panel, these are in additional to mandatory spares.

6.11.00 MOULDED CASE CIRCUIT BREAKERS

Moulded ca se ci rcuit br eakers used i n e quipment co vered under t hese sp ecifications shall have not less than 5000 amp. Interrupting capacity at 220 Volts DC 10,000 Amp. Symmetrical interrupting capacity at 240 Volts AC. MCCB shall be provided at each main feeder line like ACDB & DCDB main feeders, PLC main feeder, control panels, UPS circuits etc.

6.12.00 GROUNDING

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

Each circuit requiring grounding shall be i ndividually and di rectly connected to the panel ground bus by ring tongue type co mpression lugs. For electronic system cabinets the system ground bus shall be insulated from the cabinet enclosure and shall be separately



connected to the system ground. All system cabinets shall be brought to a common system ground by the bidder.

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

6.13.00 TERMINAL BLOCKS

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

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

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

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

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

6.14.00 NAME PLATES AND LABELS

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

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

Markings/Labels

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



- iv. ~~Back up panel system~~ shall be designed for handling ~~the situation in clause 2.12.00 for failure of HMI.~~
- v. ~~For electrical layout, complete backup panel with mosaic~~ shall have to be provided for complete on/off operations with necessary meters, DDU's, synchroscope etc. as specified elsewhere in specification.
- iv. Control panel cum desk with HW annunciation windows, ILPBs, Ammeters, PBs, voltmeters, indicators, mimic, recorders etc. shall be provided as per Annexure A – Control System Philosophy for BOP packages. Profile/Overall GA of backup control panel cum desk for BOP packages shall be same as indicated in drawing no. 114-05-0105 attached with NIT.

2.06.00**PROTECTION, CLASS OF CABINETS / PANELS, ENCLOSURES ETC.**

- a) All panels, desks cabinets, consoles & enclosures furnished at least comply with the requirements of protection classes as indicated below.
 - 1. In-door Air-conditioned (A.C.) areas - IP32/42 (min.)
 - 2. In-door Non A.C. areas:
 - (a) Ventilated enclosures - IP42
 - (b) Non Ventilated. IP 54
 - 3. Out-door IP55 / IP65
(As per the requirement)
- b) Distribution boxes, junction boxes, cold junction compensation boxes, terminal boxes and all other field mounted equipment to be furnished as per this specification shall have weather protection conforming to IP 65.
- c) The design of panels, cabinets, enclosures and packaging density of components mounted therein shall be such that the temperature rise does not exceed 10 deg. C above the ambient under the worst conditions.
- d) The panels housing electronic hardware shall be provided with flame and smoke detectors by bidder.
- e) Enclosures for peripheral equipments like printers, etc. shall take care of noise and shall ensure minimum possible noise disturb to the working personnel.

2.06.01

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

2.07.00**System Documentation**

**APPLICABLE
CODES
&
STANDARDS**

1.08.00 CODES AND STANDARDS

1.08.01 All equipments, system and service covered under this specification shall comply with the requirements of the latest statutes regulations and safety codes as applicable in the locality where the equipments/systems will be installed. The Bidder shall fully acquaint himself with these requirements and shall ensure compliance with them.

The equipments, systems and services furnished as per this specification shall conform to the codes and standards mentioned in Cl. no. 1.08.02 of this Section. However in the event of any conflict between the requirements of two standards or between the requirements of any standard and this specification, the more stringent requirements shall apply unless confirmed otherwise by the Owner in writing. The decision of the Owner shall be final and binding in all such cases.

The Bidder's scope of supply shall include some items such as thermowells, and other in-line devices for main steam, hot reheat, cold reheat, feed water system falling under the purview of Indian Boiler Regulation (IBR) Act. It shall be the responsibility of the Bidder to obtain the necessary approval of the concerned Inspecting Authority/Chief Inspector of Boilers for the design and design calculations and manufacturing and erection procedures as called for under the IBR act for all items requiring such certifications.

The requirements of statutory authorities (e.g. MOEF, Inspectors of factories, IBR, TAC, BEE, CPCB/TNPCB etc) with regards to various plants areas like Main plant, Fuel oil plant/system, Chlorination Plant, Fire Fighting system, Emission Measurement, Ambient Air Monitoring system etc. shall be complied, even if not actually spelt out.

1.08.02 Reference Codes and Standards

The design, manufacture, inspection, testing, site calibration and installation of all equipment and systems covered under this specification shall conform to the latest editions of codes and standards mentioned below and all other applicable ANSI,



ASME, IEEE, NEC, NEMA, ISA, DIN, VDE, NFPA, IEC, EIA, TIA and Indian Standards and their equivalents. Bidder to note that in no case, OEM/manufacturers own standards shall be accepted.

1.08.02.01 Temperature Measurement

1. Performance Test Code for temperature measurement ASME PTC 19.3 (1974 – R 1998)
2. Temperature measurement - Thermocouples ANSI-MC 96.1 – 1982, IEC 584
3. Temperature measurement by electrical resistance thermometers - IS-2806.
4. Thermometer-element-platinum resistance-IS-2848, IEC 751/DIN 43760
5. RTD Design Code – DIN EN 60751:1996, BS EN 60751 : 2008
6. Thermowell Design Code – ASME PTC 19.3 TW – 2010

1.08.02.02 Pressure Measurement

1. Performance Test Code for pressure measurement - ASME PTC 19.2 (2010)
2. Bourdon tube pressure and vacuum gauges - IS 3624, IS 3602, ASME B 40.1

1.08.02.03 Electronic measuring Instruments & Control hardware

1. Automatic null balancing electrical measuring instruments - ANSI C 39.4 (Rev. 1973), IS 9319
2. Safety requirements for electrical and electronic measuring and controlling instrumentation - ANSI C 39.5 - 1974.
3. Compatibility of analog signals for electronic industrial process instruments - ISA-S 50.1:ANSI MC 12.1 - 1975.
4. Dynamic response testing of process control instrumentation - ANSI MC 4.1 (1975): ISA-S26 (1968).
5. Surge withstand capability (SWC) tests - ANSI C 37.90A (1974) IEEE Std. 472 (1974). IEC – 255.4.
6. Printed circuit boards - IPC TM-650, IEC 326 C
7. General requirements and tests for printed wiring boards - IS 7405 (Part-I) - 1973
8. Edge socket connectors - IEC 130-11.
9. Requirements and methods of testing of wire wrap terminations DIN 41611 Part-2.
10. Dimensions of attachment plugs & receptacles ANSI C73-1973.
11. Direct acting Electrical Indicating Instruments: IS-1248-1968.

1.08.02.04 Instrument Switches and Contacts

1. Contact rating - AC services NEMA ICS Part-2 125, A600
2. Contact rating - DC services NEMA ICS Part-2-125, N600.

1.08.02.05 DDCMIS & other Control System

1. Application of Safety Instrumented System – ANSI/ISA 84.01 1996
2. Functional Safety - Safety Instrumented System for Process Sector – IEC – 61151



3. IEEE Application Guide for Distributed Digital Control Monitoring for Power Plant – IEEE 1046
4. Fossil Fuel Power Plant Steam Turbine Bypass System – ANSI/ISA – 77.13.01
5. Human System Interface Design Review Guide lines – NUREG – 700
6. Annunciation Sequence and Specification – ANSI/ISA 18.1
7. “IEEE 1050, IEEE guide for Instrumentation & control system grounding in generating station”,
8. ANSI/ISA-77.44.01-2007 - Fossil Fuel Power Plant - Steam Temperature Controls
9. ANSI/ISA-RP77.60.05-2001 (R2007) - Fossil Fuel Power Plant Human-Machine Interface: Task Analysis
10. ANSI/ISA-77.42.01-1999 (R2006) - Fossil Fuel Power Plant Feedwater Control System – Drum-Type
11. ANSI/ISA-77.20-1993 (R2005) - Fossil Fuel Power Plant Simulators - Functional Requirements
12. ANSI/ISA-77.41.01-2005 - Fossil Fuel Power Plant Boiler Combustion Controls
13. ANSI/ISA-RP77.60.02-2000 (R2005) - Fossil Fuel Power Plant Human-Machine Interface: Alarms
14. ANSI/ISA-77.70-1994 (R2005) - Fossil Fuel Power Plant Instrument Piping Installation
15. ANSI/ISA-TR77.60.04-1996 (R2004) - Fossil Fuel Power Plant Human-Machine Interface-Electronic Screen Displays
16. ANSI/ISA-77.43.01-1994 (R2002) - Fossil Fuel Power Plant Unit/Plant Demand Development-Drum Type
17. ANSI/ISA-77.13.01-1999 - Fossil Fuel Power Plant Steam Turbine Bypass System

1.08.02.06 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 Emission | : | VDE 0871, Class B |

1.08.02.07 UPS System/DC control power supply system:

1. Practices and requirements for semiconductor power rectifiers - ANSI C34.2-1973.



2. Relays and relay systems associated with electrical power apparatus - IEEE Std. 3.13, ANSI C 3790-1983.
3. Surge withstand capability tests - ANSI C37.90a-1974. IEEE Std. 472 - 1974
4. Recommended practice for sizing large lead storage batteries for generating stations & substations - IEEE-485.
5. Performance testing of UPS - IEC 146.
6. IEC 62040 – General & Safety requirement of UPS.
7. IEC 62040-2 - UPS – EMC Requirement.
8. IEC 62040-3 - UPS – Method of specifying the performance and test requirement.
9. IEC 60269-2 – Main Supply Fuse.
10. IEC 60947 – MCCB.
11. IEC/EN 60623– BATTERIES.
IEEE485/IEEE1115
IS : 10918, IS : 1069
12. IEC 60146 - For DC system.

1.08.02.08 Control Valves

1. Control Valve sizing - Incompressible fluids - ISA S39.2 - 1972.
2. Control valve sizing - Compressible fluids - ISA S39.3 - 1973, ISA S39.4 - 1974.
3. Face to face dimensions of control valves - ANSI B16.10
- 1) ISA Hand book of control valves - ISBN B1047-087664-234-2.
- 2) Valves - flanged, threaded and welding end : ANSI B 16.34(2009)
- 3) Casting : ASTM A 216 / A 351 (2008)
- 4) Welded end connection : As per ASME boiler and pressure vessel code / ANSI.B 16.34(2009), B 16.25 (2009), B 16.11(2009).
- 5) Defect removal: ANSI B 16.34 2009.
- 6) Cleaning : ASTM A 380 2006.
- 7) CV test : As per ISA procedure S 75.02 (2008).
- 8) Control Valve seat leakage : ANSI/FCI 70.2

1.08.02.09 Enclosures

1. Types of enclosures - NEMA Std. ICS-6-110.15 through 110.22 (Type 4 to 13).
2. Racks, panels, and associated equipment - EIA: RS-310-B (ANSI C83.9 - 1972)
3. Protection Class for Enclosure, Cabinets, Control Panels and Desks - IS-13947-1962.

1.08.02.10 Apparatus, enclosures and installation practices in hazardous areas

1. Classification of hazardous area - NFPA Art. 500, Vol.70-1984.
2. Electrical Instruments in hazardous dust locations - ISA-RP 12.11
3. Intrinsically safe apparatus - NFPA Art.493 Vol.4.1978
4. Purged and pressurized enclosure for electrical equipment in hazardous location - NFPA Art. 496 1982.

1.08.02.11 Sampling System



1. Stainless steel material of tubing and valves for sampling system - ASTM A269-82 Gr TP316.
2. Submerged helical coil heat exchangers for sample coolers ASTM D 11-98.
3. Water and Steam in power cycle - ASME PTC 19.11(2008).
4. Standard methods of sampling system - ASTM D 1066-69.

1.08.02.12 Annunciators

1. Specifications and guides for the use of general purpose annunciators - ISA RP 18.1-1979.
2. Surge withstand capability tests - ANSI C.37.90a - 1974 and IEEE std. 472-1974

1.08.02.13 Interlocks, Protections

1. Relays and relay system associated with electric power apparatus - IEEE std.3.13.
2. Surge withstand capability tests - ANSI C.37.90a - 1974 and IEEE Std. 472 - 1974.
3. General requirements & tests for switching devices for control and auxiliary circuits including contactor relays - IS-6875 (Part-I) 1973.
4. Turbine water damage prevention - ASME - TDP-1980.
5. Boiler safety interlocks - NFPA Section 85B, 85D, 85E, 85F, 85G.

1.08.02.14 Process Connection and Piping:

1. Codes for pressure piping power piping ANSI B31.1
2. Seamless carbon steel pipe ASTM A-106.
3. Forged and Rolled Alloy steel pipe flanges, forged fittings, valves and parts - ASTM A-182.
4. Material for socket welded fittings - ASTM A-105.
5. Seamless ferrite alloy steel pipe - ASTM A-335.
6. Pipe fittings of wrought carbon steel and alloy steel - ASTM A-234.
7. Composition bronze or metal castings - ASTM B-62.
8. Seamless copper tube, bright annealed ASTM B-168.
9. Seamless copper tube - ASTM B-75.
10. Dimensions of fittings - ANSI B-16.11
11. Valves flanged and butt welding ends - ANSI B16.34.
12. Nomenclature for Instrument tube fittings ISA-RP-42.1 - 1982.

1.08.02.15 Instrument Tubing

1. Seamless carbon steel pipe - ASTM - A106.
2. Material for socket weld fittings - ASTM - A105.
3. Dimensions of fittings - ANSI B16.11
4. Code for pressure piping, welding, hydrostatic testing - ANSI B31.1.

1.08.02.16 Cables

1. Thermocouple extension wires/cables - ANSI C 96.1 - 1982.
2. Colour coding of single or multi-pair cables – VDE 0815



3. Guide for design and installation of cable systems in power generating stations (insulation, jacket materials) - IEEE Std. 422 - 1977.
4. Requirements of vertical tray flame test - IEEE 383 - 1974.
5. Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B-33 - 81.
6. Oxygen index and temperature index test - ASTM D-2863.
7. Smoke generation test - ASTM D-2843 and ASTM E-662.
8. Acid gas generation test - IEC-754-1.
9. Swedish chimney test - SEN - 4241475 (F3)
10. Instrumentation cables and internal wiring I S-1554 (Part-I, 1976) and I S-5831(1984).
11. Standard for Control, Thermocouple Extension and Instrumentation cable - NEMA W C57-2004 IEC 60331-2, Rev. 2, 2004)
12. PVC insulated (heavy duty) Electric cables for working voltages upto and including 1100V - IS:1554 (Part-I)
13. Conductors for insulated electric cables and flexible cords. - IS:8130
14. PVC insulation and sheath of electric cables - IS:5831
15. Mild steel wires, strips and tapes top armoring cables - IS:3975
16. Water Immersion Test - VDE 0815
17. Drums for electric cables - IS : 1048

1.08.02.17 Cable Trays, Conduits

1. Guide for the design and installation of cable systems in power generating station (cable trays, support systems, conduits) - IEEE Std. 422, NEMA VE-1, NFPA-70-1984.
2. Guide for the design and installation of cable systems in power generating station (Cable trays, support systems, conduits) Test Standards, NEMA VE-1 - 1979.
3. Galvanising of Carbon steel cable trays - ASTM A-386-78.

1.08.02.18 Flow measurement

1. ASME Performance Test Code PTC-19.5 (2004), ISA RP3.2
2. BS 1042
3. ISO 5167

1.08.02.19 Surge Protection System

1. Surge withstand capability tests - ANSI C37.90a-1974. IEEE Std. 472 – 1974
2. IEC 61643-1:1998-02 and E DIN VDE 0675 part 6:1996-03/A2: 1996-10
3. IEC 61643-21:2000-09 and E VDE 0845 part 3-1:1999-07

1.08.02.20 Digital Video Recording & Management System (DVRMS)

1. ISO 9001 (2000)
2. ISO/IEC15504 Level3 or higher (SPICE 2.0 Software Process Improvement and Capability Determination)



3. ~~SEICMM Level 3 or higher (American Software Engineering Institute - Capability Maturity Model)~~

Where:

- i) IEEE - Institute of Electrical and Electronics Engineers.
- ii) ISA - Instrument, Systems and Automation Society
- iii) NEMA - National Electrical Manufacturers Association
- iv) ANSI - American National Standards Institute
- v) NFPA - National Fire Protection Association
- vi) ASME - American Society of Mechanical Engineers
- vii) IS - Indian Standards
- viii) IEC - International Electro-technical Commission
- ix) ASTM - American Society for Testing Materials
- x) EIA - Electronic Industries Association
- xi) DIN - Deutsche Institute Normale
- xii) TIA – Telecommunication Industries Association



CHAPTER-14**QUALITY ASSURANCE AND TESTING AND GUARANTEES****14.01.00 GENERAL REQUIREMENT**

- 14.01.01** All equipment furnished under this specification shall be subject to test by authorized quality assurance personnel of the Bidder, representatives of the Owner during manufacture, erection and on completion. Bidder's quality assurance personnel for these shop and site tests shall be identified in advance and shall be acceptable to the Owner. The approval of the Owner or passing of such inspection of tests will not, however, prejudice the right of the owner to reject the equipment if it does not comply with the specifications when erected or fails to give complete satisfaction in service.
- 14.01.02** The Bidder shall furnish details of shop and site tests proposed to be conducted by him at various stages to meet the specification requirements for each type of instrument/system along with his proposal. Bidder shall also furnish details of his proposed shop and site quality assurance organization for this contract
- 14.01.03** Bidder shall prepare a detailed shop and site 'Quality Assurance Programme' to meet the requirements of these specifications for Owner's approval. This document shall also contain the formats for reports and maintenance of test records specification of test equipment to be used for site tests.
- 14.01.04** All equipment and systems furnished under this specification shall be subjected to shop & site tests in accordance with the Quality Assurance Program approved by the Owner and shall be adequate to ensure full compliance with these specification, all applicable codes & standards and detailed engineering drawings and documents approved by the Owner.
- 14.01.05** The Bidder shall provide all required test equipment and simulation devices for performing all shop and site tests. All tests equipment shall be of reputed make, required accuracy class and shall be recently calibrated. The record of calibration of test equipment shall be made available to the Owner on demand.
- 14.01.06** The cost of all tests as per the requirements of this specification and approved quality assurance programme shall be included in Bidder's lump sum price for this package and no extra price shall be payable by the Owner for conducting any test as per the intent and requirements of this specification.
- 14.01.07** All approval/Inspection are to be carried out by the Owner only.

14.02.00 SHOP TESTS**14.02.01 General Requirement**

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



14.02.01.01 Individual components, instruments and devices furnished in accordance with specification sheets, and I&C device list enclosed with these specifications shall be shop tested by manufacturer prior to shipment. The manufacturer shall conduct these tests for certifying compliance with published specifications for the equipment and provide test results to the Owner in writing. These tests and test certificates shall be in accordance with the agreed 'QA' programme for major systems/equipments. However, manufacturer's standard methods shall be followed if details of tests for any equipment are not covered under this agreed 'QA Programme'.

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

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

14.02.02 Material Tests

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

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

14.02.03 Test at Manufacturer's Works

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

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

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

14.02.04 Factory Tests



14.02.04.01 Automatic Control and Monitoring system (DDCMIS, PLC & any other microprocessor based control system) including alarm annunciation system furnished as per this specification shall be subject to shop and site tests as per the requirements of this specification, applicable codes and Owner approved Quantity Assurance Program so as to demonstrate to the Owner that the equipment furnished by the Bidder meets the intent and requirement of this specification. These tests shall include but shall not be limited to the tests indicated in the subsequent clauses.

14.02.04.02 **Surge Protection Test for Solid State Equipment**

All solid state equipment shall be able to withstand the noise and surge inherent in a Power House, and shall strictly comply with SWC tests ANSI C 37.90A, 1974 for IEEE-472 (1974). Complete details of the features incorporated in electronic system to meet this requirement, the relevant test carried out, and the test certificates shall be submitted along with the proposal.

14.02.04.03 **Burn-in and Elevated Temperature Test**

All solid state electronic equipment shall be tested as a complete system/equipment with all devices connected for a minimum of 168 hours continuously under energized conditions prior to shipment from manufacturer's works, as per the following cycle :-

During the first 48 hours of testing the ambient temperature shall be maintained at 50 deg.C and relative humidity at 95%. The equipment shall be interconnected with all devices, which will cause it to repeatedly perform all operations; it is supposed to perform in actual service, with load on various components being equal to those, which will be experienced in actual service.

The 48 hours tests period shall be continuous but shall be divided into four 12 hours segments. The input voltage during each 12-hour segment shall be nominal voltage for 11 hours, followed by 110% of nominal voltage for 30 minutes followed by 90 percent of nominal voltage for 30 minutes.

The 48 hours elevated temp test shall be followed by 120 hours of burn in test as specified in the above paragraphs except that the temperature is reduced to ambient temperature prevalent at that time. Alternatively copy of type test certificate for burn-in test shall be submitted.

14.02.04.04 The Bidder shall furnish full details regarding shop tests and site tests, as per good engineering practices. The Owner shall approve all such tests and the supplier shall conduct all such tests without calling for additional price.

The tests shall cover factory tests, burn-in and elevated temperature tests, simulation and functional tests, insulation tests as applicable, the rating of the contact devices and components, surge withstand capability test, conformity of interconnection cables, testing and checking of other conditions deemed to be necessary with the system/equipment items.

14.02.04.05 All instruments and control equipment supplied against this contract shall be factory calibrated at least at five (5) points throughout the range and checked for their



- functional/performance requirements. The instruments shall also be calibrated at site prior to commissioning.
- 14.02.04.06 All panels, instruments enclosures, junction boxes, etc. shall be type tested for degree of protection and applicable in accordance with IS: 2147. 8.02.04
- 14.02.04.07 Type, routine and acceptance testing of all equipments, supplied under this contract, shall be in accordance with relevant N EEA/IS/IEC/ANSI/BS/ISA standards, in addition to the requirements of Owner approved Quality Plans. Six (6) copies of test reports shall be submitted to the Owner for approval prior to dispatch of respective equipment
- 14.02.04.08 The representative of Owner shall be given opportunity to witness the factory tests which shall be mutually finalized during the progress of the contract.
- 14.02.04.09 All control systems to be furnished for this project, shall be factory tested for circuit continuity and direction of response. The Components to be tested shall include all controllers, HAND/AUTO station, other system modules, alarm contactors and multi-conductor interconnecting cables. The tests shall be performed with all of the system components supplied by the Bidder connected to form a complete system with the sole exception of transmitters. The tests shall include a means of confirming the mathematical design response of the control system by simulating changes in system input. The tests shall be a qualitative functional test of each component of control system, which simulates dynamic inputs and monitors system outputs.
- 14.02.04.10 Certain control loops shall be factory tested using closed loop mathematical simulation techniques. Control loops to be tested by closed loop methods are broadly as under. However, owner has discretion to test and all control loops during simulation testing.
- ii) Firing rate control (fuel and air flow control)
 - iii) Furnace draft control
 - iv) Boiler separator level control
 - (d) **Response time for Turbine Control System.**
- The input simulation equipment shall be designed to produce effects from control system outputs based on mathematical model of the predicted performance and process dynamics of the main unit equipment. The control constants of various control loop components shall be adjusted to produce a stable and optimum control adjusted to produce a stable and optimum control when connected to the simulation equipment.
- 14.02.04.11 Simulation data including factory adjustment of control system constants, and simulation equations shall be tabulated and shall be made available by the Bidder for owner's use during field check out and the start up of the control system.
- 14.02.04.12 Availability of a simulated type test for automatic control loops specified with a detailed description of testing methods utilized, shall be indicated.



- 14.02.04.13 The availability of facilities for carrying out the model test for the control systems shall be indicated by the bidder. Also details of test procedures and copies of test results conducted for a similar fossil fuel fired unit shall be furnished. The data required from Boiler and Turbo generator supplies shall also be furnished by the Bidder.
- 14.02.04.14 Brief description of all tests proposed to be conducted on each control system components during various stages of manufacture, installation and commissioning shall be furnished. Copies of test data accumulated during the tests shall be submitted to the mutually agreed formats.
- 14.02.04.15 The owner shall witness the factory tests which shall be performed at a time mutually agreeable to the Bidder and the owner.



14.02.04.16 Factory Acceptance Tests for DDCMIS, DCS, Simulator & PLC

GENERAL	1	FACTORY ACCEPTANCE TEST (FAT): REF NOTE-1	✓
	2	FACTORY ACCEPTANCE TEST (FAT) PROCEDURE: REF.NOTE -2	✓
	3		
	4		
	5		
TEST REQUIREMENTS	6	TEST SHALL BE PERFORMED WITH THE COMPLETELY ASSEMBLED SYSTEM AND ALSO WITH COMPLETE	✓
	7	I&C SOFTWARE AND PERFORMING ALL FUNCTIONS EXPECTED OUT WHILE IN ACTUAL SERVICE AND	
	8	WITH SYSTEM CONFIGURATION AS FINALISED.	
	9	PROCESS INPUT/OUTPUT CONDITIONS AND OTHER LOAD ON THE SYSTEM TO BE STIMULATED	✓
	10	EITHER BY HARDWARE/SOFTWARE.	
	11	ALL SYSTEM SOFTWARE and APPLICATION SOFTWARE TO BE LOADED AND OPERATIONAL ON THE	✓
	12	SYSTEM PRIOR TO FAT	
	13	FAT TO BE CONDUCTED AT ELEVATED TEMP. OF 45 DEG C FOR MINIMUM 48 HOURS	✓
	14	FAT UNDER FOUR CYCLES OF VOLTAGE FLUCTUATIONS VIZ NOMINAL AT 110 % OF RATED VOLTAGE	✓
	15	PERFORMANCE TEST:	✓
TEST DOCUMENTS DRAWINGS	16	-	
	17	-	
	18	TOTAL SYSTEM CONFIGURATION DRAWINGS	
	19	FAT PROCEDURE CONSISTING OF:	
	20	(i) TEST EQUIPMENT	
	21	(ii) TEST ENVIRONMENT	
	22	(iii) TEST CONFIGURATION	✓
	23	(iv) TEST PROCEDURE	
	24	(v) TEST SCHEDULE	
	25	(vi) TEST VENUE	
PR ELIMINARY CHECKS	26	(vii) TEST REPORTS- SPECIMEN COPIES	
	27	FUNCTION DESIGN SPECIFICATION FOR EACH EQUIPMENT / SYSTEM	
	28	-	
	29	-	
	30	GENERAL APPEARANCE CHECK and BILL OF MATERIALS CHECK	✓
	31	CONSTRUCTION CHECK AS PER OVER ALL GENERAL ARRANGEMENT DRAWINGS	✓
TE M	32	DIMENSIONAL CHECK	✓
	33	LABELLING, TERMINAL ARRANGEMENT AND EQUIPMENT IDENTIFICATION CHECK	✓
	34	POWER SUPPLY VOLTAGE LEVEL CHECK and POWER 'LEDs' -ON CHECK	✓
	35	COOLING FAN OPERATION CHECK	✓
	36	GROUNDING NETWORK CHECK	✓
	1	POWER SUPPLY UNDER VOLTAGE AND OVER VOLTAGE CHECK ($\pm 10\%$)	✓
	2	PROCESSOR and MAIN DATA BUS NETWORK REDUNDANCY CHECK, IF APPLICABLE	✓
	3	COMMUNICATION COUPLER IF APPLICABLE REDUNDANCY CHECK	✓
CONTROL ENGINEERING	4	COMMUNICATION MODULE OF THE CONTROLLER TO NETWORK REDUNDANCY CHECK, IF APPLICABLE	✓
	5	POWER SUPPLY REDUNDANCY CHECK	✓
	6	HARDWARE ON-LINE MAINTAINABILITY CHECK,	✓
	7	-	
	8	-	
	9	CLOSED LOOP CONTROL SIMULATION CHECK	✓
	10	OPEN LOOP CONTROL SIMULATION CHECK	✓
	11	CONTROL LOOP RESPONSE CHECK	✓
	12	BUMPLESS AUTO MANUAL TRANSFER CHECK	✓
	13	OPERATING STATION – GRAPHIC OVERVIEW CHECK	✓
	14	OPERATING STATION- TREND CHECK	✓
	15	OPERATING STATION- REAL TIME TREND CHECK	✓
	16	OPERATING STATION- MIMICS CHECK	✓
	17	OPERATING STATION- CHECK FOR OPERATING CONTROL DIRECTLY FROM MIMICS	✓
	18	OPERATING STATION- FUNCTION KEYS CHECK	✓
	19	OPERATING STATION- TOUCH SCREEN FUNCTION CHECK	✓
	20	OPERATING STATION- ANALOG CONTROL DISPLAY CHECK	✓
	21	OPERATING STATION- SEQUENCE CONTROL DISPLAY CHECK	✓
	22	OPERATING STATION- OPERATOR GUIDANCE MESSAGE CHECK	✓
	23	OPERATING STATION- ALARM MANAGEMENT FUNCTION CHECK	✓



	24	OPERATING STATION LOGGING FUNCTION CHECK	✓
	25	OPERATING STATION / RESPONSE / UPDATING CHECK	✓
	26	KEYBOARD LOCK FUNCTION CHECK	✓
	27	OPERATING STATION INTERCHANGEABILITY and ASSIGNABILITY CHECK	✓
	28	PRINTER ASSIGNABILITY and BACK-UP FUNCTION CHECK	✓
	29	FLOPPY DISK / STD / OPTICAL DISK UNIT STORAGE and RETRIEVAL CHECK	✓
	30	OPERATING STATION ASSIGNABILITY CHECK FOR HARD COPIER FUNCTION	✓
	31	PLANT PERFORMANCE CALCULATION CHECK	✓
	32	COMMUNICATION INTERFACE TO OTHER'S SYSTEM SIMULATION CHECK	✓
	33	-	
	34	DATA BUS DISTANCE BUILDING CHECK (REFER NOTE- 3)	✓
	35	GRAPHIC DISPLAY BUILDING FUNCTION CHECK	✓
M A I N T E N A N C E	36	CLOSED LOOP CONTROL SYSTEM MODIFICATION CHECK	✓
	37	OPEN LOOP CONTROL SYSTEM MODIFICATION CHECK	✓
	38	ALARM DISPLAY PRIORITISATION CHECK	✓
	39	SYSTEM SECURITY CHECK	✓
	40	SYSTEM ALARM CHECK	✓
	41	SYSTEM DIAGNOSTIC FUNCTION CHECK	✓
	42	POINT DETAIL CONFIGURATION CHECK	✓
	43	CONTROL LOOP TUNING CHECK	✓
	44	SYSTEM SELF DOCUMENTATION CHECK	✓
N O T E S	1.	THE INTENT OF THE FAT IS TO DEMONSTRATE AND ENSURE THAT THE I&C SYSTEM MEETS ALL THE FUNCTIONAL REQUIREMENTS AS INTENDED IN THE SPECIFICATION / CONTRACT. A COMPLETED INTEGRATED TEST OF THE SYSTEM SHALL BE CARRIED OUT AT VENDOR'S WORKS IN THE PRESENCE OF OWNER, ON COMPLETION OF INTEGRATION/MANUFACTURING OF THE SYSTEM. THE SHIPMENT OF I&C EQUIPMENT TO SITE WILL BE EFFECTED ONLY AFTER THE FAT HAS BEEN ACCEPTED BY THE OWNER.	
	2.	FAT PROCEDURE SHALL BE PREPARED BY VENDOR AND TO BE SUBMITTED FOR OWNER'S/ APPROVAL WELL IN ADVANCE PRIOR TO THE COMMENCEMENT OF FAT	
	3.	FAT SHALL BE CONDUCTED WITH THE DISTANCE BETWEEN THE PROCESSOR AND OTHER SUPPORTING PERIPHERALS AS PER THE FINAL LAYOUT IN THE CONTROL ROOM.	
	4.	ALL THE RELEVANT APPROVED DOCUMENTS REQUIRED FOR FAT SHALL BE SUBMITTED BY THE BIDDER IN ADVANCE PRIOR TO COMMENCEMENT OF FAT.	

14.02.04.17 Tests to be performed during FAT of PLC system

Following minimum tests shall be performed during FAT at manufacturer's place of PLC system:

- 1) Hardware Inspection of PLC Sub System
 - i) Heat run test
 - ii) Hardware check / physical software package check
 - iii) I/O loading specification
 - iv) PLC start-up and power fail restart
 - v) PLC processor back-up function
 - vi) Communication redundancy
- 2) Application Inspection for Logic Functions
 - i) Ladder logic functional check and graphic screen check
- 3) Application Inspection for PLC Panels
 - i) General arrangement
 - ii) Appearance and construction
 - iii) Panel wiring
 - iv) Panel functional check
 - v) Power supply redundancy check



- 4) PLC System Checks
 - i) PLC Scan time functional test
 - ii) PLC/IO panel/Engineering station functions
 - iii) Diagnostic and process alarm test
 - iv) Controller redundancy test
 - v. I/O cards redundancy test.
 - vi) Controller loading test

In addition to above test, Bidder shall also perform other tests as per approved QAP & FAT procedure. Also bidder shall submit "Type Test" report as per IEC – 61131.2 along with FAT report for PLC.

14.02.04.19 FACTORY ACCEPTANCE TEST FOR SIMULATOR

Factory Acceptance Test (FAT) shall include all required tests to fully demonstrate to Owner's satisfaction that each equipment/sub-system/system software modules etc. furnished as per this specification, as well as Simulator as a whole, fully meets the functional, parametric and other requirements of this specification and Owner's approved drawings/documents under all operating regimes.

Bidder to note that FAT procedure given below in subsequent clauses are only indicative in order to help the Bidder in understanding the requirements and help him in submitting a detailed procedure based on these guidelines meeting all the specification requirements.

The Bidder shall also carry out the tests included in subsequent clause as pre FAT and submit its results before inviting Owner for FAT.

The Factory Acceptance Test (FAT) shall include all reasonable exercises, which the combination of equipment and software can be expected to perform. These tests shall be divided into, as a minimum, but not limited to the following categories:

- i. Pre power on checks
- ii. Power on check
- iii. Hardware tests
- iv. Functional tests
- v. Parametric tests
- vi. Specific tests on Electronic hardware

14.02.04.19.1 The major Functional Tests shall include but not limited to the following:

- a) Verification of individual modules in line with approved documents.
- b) Verification of adherence to parameters for various plant configurations at different initial conditions.
- c) **Functional test for C&I Model**



Verification of proper realization of Control and Logic functions as per input documents and approved functional design specification (FDS).

d) **Functional tests for HMIPIS**

- i. Verification of all types of displays, logs including their formats, bar graphs, X-Y plots etc. Verification of all function keys on keyboards and availability of all operator functions.
- ii. Verification of event generation and handling capabilities of HMIPIS processors by simulating various types of events / data and observing associated event sequence display and alarm signaling boxes.
- iii. Calculations:

All calculations shall be tested to demonstrate that these are in accordance with the specification and I/O schedule. The Bidder shall prepare all tests cases for calculations (3 for each calculation at low, mid and upper ranges of inputs) and submit them for the owner's approval. Test cases shall include performance calculations, flow and level calculations, pressure and temperature compensations, etc.
- iv. Checking historical storage and retrieval functions including long-term storage.
- v. Checking healthiness of processor, main memory. Testing of initialization and loading of configuration data, etc.
- vi. Verification of all programmers' stations functions for HMIPIS and Control System, as well as for documentation facility as specified.
- vii. Various display response time / System accuracy etc.
- viii. Display update time on OWS

e) **Functional test for networking & communication devices**

- i. Verification of various features as per approved documents.
- ii. Verification of throughput after creating high communication traffic.

f) **Instructor's workstation Functions**

Verification of all features of instructor functions like malfunction, initial conditions, snapshots, trainee exercises etc. in line with specification & approved documentation.

g) **Programming and Documentation functions**



- i. Verification of all programming function like, modification of application software, database, administrator's function etc. in line with specification and approved documents.
- ii. Verification of all documentation functions in line with specification and approved documents.

14.02.04.19.2 FAT Procedure

The Bidder shall submit a detailed FAT procedure for owner's approval during detailed engineering stage based on the above guidelines. The FAT procedure to be submitted by the Bidder shall be detailed and exhaustive enough such that owner is satisfied that all the Simulator System specification requirements and features are being tested and the system meets these requirements.

14.02.04.20 Tests to be performed during FAT of Peripherals & other control system

1. Colour Graphic Video Display Unit (OWS)
 - i. Functional tests (As per FAT procedure. Note-1)
 - ii. Test for capabilities of OWS including error detection for the complete system (Both hardware & software) simulating worst conditions
 - iii. Noise test
 - iv. Surge withstanding capacity as per IEEE or equivalent
 - v. Quality assurance as governed by BS 5750 or equivalent
 - vi. Design, construction, components, finishes and testing of electronic equipment as per EES-1980 (General specification of electronic equipment) or equivalent

Note-1: Test to be witnessed by Owner.
2. Keyboard
 - i. Test for satisfactory operation of keyboard controls, push buttons and all associated functions (As per FAT procedure. Note-1)
 - ii. Quality assurance as governed by BS 5750 or equivalent for functional test for the complete system simulating worst conditions
 - iii. Design, construction, components, finishes and testing of electronic equipment as per EES-1980 (General specification of electronic equipment) or equivalent

Note-1: Test to be witnessed by Owner.
3. Printers
 - i. Noise level test for the printer
 - ii. Test of interlock performance and error detection feature.
 - iii. Quality assurance as governed by BS 5750 or equivalent
 - iv. Design, construction, components, finishes and testing of electronic equipment as per EES-1980 (General specification of electronic equipment) or equivalent



4. Floppy / Tape Drive Unit / Bulk Memory Unit / DVD, CD drive Unit / DAT Drive
 - i. Noise test
 - ii. Surge withstanding capacity as per IEEE or equivalent
 - iii. Quality assurance as governed by BS 5750 or equivalent
 - iv. Design, construction, components, finishes and testing of electronic equipment as per EES-1980 (General specification of electronic equipment) or equivalent
 - v. Test of Control unit and drive for all features, date checking features.
5. Vibration Monitoring & Analysis System
 - i. Simulated functional test (Note-1)
 - ii. Tests for server, LED monitor, Printer, Keyboard

Note-1: Test to be witnessed by Owner.
6. PADO (Performance & Optimization System)
 - i. Simulated functional test (Note-1)
 - ii. Tests for server, LED monitor, Printer, Keyboard

Note-1: Test to be witnessed by Owner.
7. ERP System
 - i. Simulated functional test (Note-1)
 - ii. Tests for server, LED monitor, Printer, Keyboard

Note-1: Test to be witnessed by Owner.
8. MIS System
 - i. Simulated functional test (Note-1)
 - ii. Tests for server, LED monitor, Printer, Keyboard

Note-1: Test to be witnessed by Owner.
9. HMS System
 - i. Simulated functional test (Note-1)
 - ii. Tests for server, LED monitor, Printer, Keyboard

Note-1: Test to be witnessed by Owner.

NOTES:

1. The intent of the FAT is to demonstrate and ensure that the I & C system meets all the functional requirements as intended in the specification / contract. A completed integrated test of the system shall be carried out at vendor's works in the presence of Owner or Owner's representative, on



completion of integration / manufacturing of the system. The shipment of I&C equipment to site will be effected only after the FAT has been accepted by Owner.

2. FAT procedure shall be prepared by vendor and to be submitted for Owners approval well in advance prior to the commencement of FAT.

14.02.04.21 Calibration of Instruments

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

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

i TESTS TO BE PERFORMED FOR FIELD INSTRUMENTS

1.	Pressure Gauges
	Calibration Hydro test (1.5 times max. pr.)
2.	Pressure switches
	Calibration test / Hydro test / Contact rating test / Accuracy test / Repeatability
3.	Differential Pressure Gauges
	Calibration test / Hydro test / Leak test / Over range test / Accuracy test / Repeatability test.
4.	Differential Pressure Switches
	Calibration test / Hydro test / Contact rating test / Leak test / Accuracy test / Repeatability test.
5.	Thermometers
	Calibration / Material test / Accuracy test / Bore concentricity : $\pm 5\%$ of wall thickness / Hydrostatic test for TW (1.5 times max. pr.)
6.	Temperature switch
	Calibration / Material test / Accuracy test / Bore concentricity : 1.5% of wall thickness / Hydrostatic test for TW (1.5 times max. pr.) / Contact rating test.
7.	Resistance temperature detector assembly.
	Calibration / Material test / Bore concentricity test / Insulation test ($\leq 500 \text{ M}\Omega$ at 500V DC) as per ISA, Hydro test for TW. Bore concentricity: $\pm 5\%$ of wall thickness, Accuracy test.
8.	Thermocouple assembly
	Calibration / Material test, Insulation test ($\geq 500 \Omega$ at 500 V, DC) as per ISA, Hydro static test (1.5 times max. pr.), Bore concentricity : $\pm 5\%$ of wall thickness.
9.	Thermowells
	Material test / Bore concentricity : $\pm 5\%$ of wall thickness / Hydrostatic test for TW (1.5 times max. pr.)



10.	Level Guages
	Hydrostatic test / Material test / Seat leakage test / Ball check test.
11.	Level switches (Magnetic)
	Material test / Contact rating test / Hydro test / Calibration test.
12.	Flow Switch
	Material test / Hydro static test (1.5 times max. pr.) / function test.
13.	Flow glasses
	Material test / Hydrostatic test (1.5 times max. pr.) / function test.
14.	Variable area flow meters
	Calibration test / Material test / Hydrostatic test (1.5 times max. pr.)
15.	Flow element
	100% Radiography test / Hydro test / Calibration test, IBR Certificate.
	Calibration test for flow element shall be witnessed by Owner.
16.	Control valves/Pneumatic block valve/Pressure regulating valve – Refer chapter 11.
17.	Position transmitters
	Calibration / hysteresis and Accuracy test
18.	Electro Pneumatic Convertors
	Calibration test / Accuracy test
19.	Solenoid valves
	Hydrotest / Seat leakage test / CV test / Coil insulation test
20.	Air filter regulators
	Calibration test / Accuracy test
21.	Junction Boxes
	Test for degree of protection / Material test
22.	Tests for terminal blocks
	Test for moulding for flame resistant, Non-hygroscopic and Decarbonised / Insulation test between terminals / Insulation between terminal block and frame.
23.	Thermocouple extension cable
	Thermo-emf characteristic / Continuity test / Measurement on capacitance, inductance and loop resistance / Insulation resistance / High voltage test as per latest IS / Tensile and elongation test / Oxygen index test / Any other test applicable.
24.	Mass flow meter
	Performance test / Calibration test / Hydrostatic test.
25.	Boiler Level Gauge
	Hydrostatic test / Material test / Seat leakage test / IBR Certificate
26.	pH/Conductivity measurement / Silica / Dissolved oxygen analysers:
	Calibration test, Accuracy test
27.	Sample cooler :



	Hydro test, IBR Certificate
28.	Sampling racks :
	Hydro test, IBR Certificate for tubes and fittings.
29.	S02 / Nox analyser / SPM analyser:
	Calibration test, accuracy test
30.	Interposing relay
	Functional test, temperature rise test, H.V test, Insulation test
31.	Transmitter Racks :
	Hydro test, air leak test for piping / tubing and fittings. IBR certification as required for tubing / piping and fittings.
32.	Pressure Transmitter
	Calibration test / Hydro test / Leak test / Over range test / Accuracy test / Repeatability test.
33.	Differential pressure transmitter
	Calibration test / Hydro test / Leak test / Over range test / Accuracy test / Repeatability test.
34.	Temperature Transmitter
	Calibration test / Accuracy test / Ambient temperature error test
35	Pneumatic Block Valves
	a) IBR certificate form III C b) Hydrostatic test : ANSI B 16.34 c) Seat leakage test : As per ANSI B 16-104 d) CV test: As per ISA procedure e) Magnetic particle test ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 DegC) f) Liquid penetration test: ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 DegC) g) Radiography test: ANSI B 16.34 special class h) Calibration and Hysteresis test i) Actuator leakage test
36.	Pressure Regulating Valve



	a) IBR certificate form III C b) Hydrostatic test : ANSI B 16.34 c) Seat leakage test : As per ANSI B 16-104 d) CV test: As per ISA procedure e) Magnetic particle test ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 DegC) f) Liquid penetration test: ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 DegC) g) Radiography test: ANSI B 16.34 special class h) Calibration and Hysteresis test i) Actuator leakage test
37.	Local Panels : Visual inspection, wiring & continuity check, H.V. and I.R. tests on panels, checking of bill of materials, functional tests.
38	Wiring Termination & Accessories
	Routine test: Conductor resistance test/High voltage test/Impulse dielectric test/insulation test/Humidity test/Temperature rise test on power circuits/short time current test on power circuits.
	Type test:Annealing test/Test for insulation and sheath/ Flame retardance test - a) Oxygen index, b) Flammability / Test for acid gas generation/test for water absorption/wet dielectric test
39	Marshalling/System cabinets
	Verification of degree of protection/Electrical tests as detailed under wiring Termination& accessories/Type test and routine test as per relevant Indian standards.
	Notes:
	1. Test Certificates in addition to inspection at manufacturers works shall be furnished for all the instruments for Owner's review.
	2. Above Test to be witnessed shall be finalized by Owner.
	3. In addition to above test, test as per approved QAP shall also be witnessed by owner.

17.02.05 TYPE TESTING

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

A. Out of these test listed , the bidder /subvendor/manufacture is required



to conduct certain type test specifically for this contract (and witnessed by employer or his authorized representative). Even if the same have been conducted earlier as clearly indicated subsequently such tests.

- B. For the rest, submission of type test, results, and certificates shall be acceptable provided following points
- i. The same have been carried out by the bidder/ subvendor on exactly the same model/rating of equipment. (For control valves this shall be same size, type & design).
 - ii. There has been no change in the components from the offered equipments and tested equipments.
 - iii. The test has been carried out as per the latest standards along with amendments as on the date of bid opening.
- C. In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the bidder/sub-vendor within the quoted price and no extra cost will be payable by the owner on this account.

17.02.05.1 As mentioned against certain items, the test certificates for some of the items shall be reviewed and approved by the main bidder or his authorized representative and balanced have to be approved by the employer.

The schedule of conduction of type test/submission of reports shall be submitted and finalized during pre award discussion.

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

17.02.05.3 SPECIAL REQUIREMENTS FOR SOLID STATE EQUIPEMNTS /SYSTEMS

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

- i. Surge Withstand Capability (SWC) for solid state equipments/equipments

All solid state systems/equipments shall be able to withstand the electrical noise and the surges as encountered in actual service conditions and inherent in the power plant. All the solid states systems /equipments shall be provided with all required protection that needs the surge withstand capability as defined in ANSI 37.90.1/IEEE 472. Hence, all front end cards which receive external signals like analog input and output modules, Binary input and output modules etc including power supply, data highway, data links shall be provided with protection that meets the surge withstand capability as



defined in ANSI 37.90.1/IEEE 472. Complete details of the features incorporated in the electronic system to meet this requirement the relevant test carried out, the test certificates, etc shall be submitted along with the proposal. As an alternative to the above, suitable class of EN 61000-4-12 which is equivalent to ANSI 37.90.1/IEEE 472 may also be adapted for SWC test.

- ii. The dry heat test as per IEC-68-2-2 or equivalent
- iii. Damp heat test as per IEC 68-2-3 or equivalent
- iv. Vibration test as per IEC 68-2-6 or equivalent
- v. Electrostatic Discharge test as per EN 61000-4-2 or equivalent
- vi. Radio frequency immunity test as per EN 61000-4-6 or equivalent
- vii. Electromagnetic Field Immunity test as per EN 61000-4-3 or equivalent

Test listed at Item no v, vi, vii above are applicable for electronic cards only as defined under item no. (i) above

17.02.05.4 TYPE TEST REQUIREMENTS FOR C&I SYSTEMS

S.No.	Item	Test requirement	Standard	Test to be specifically conducted	Owner's Approval required on Test Certificate
1	Electrical metering instruments	As per standards	IS 1248	No	Yes
2	Thermocouple	Degree of Protection Test	IS - 13947	No	No.
3	Junction Box	Degree of Protection Test	IS - 13947	Yes	Yes
4	RTD	As per standards	IEC-60751	No	No
5	Electronic Transmitter	As per standards	BS 6447/ IEC 60770	No	Yes
6	E/P convertor	As per standards	Manufacturing standard	No	Yes
7	Instrumentation cable (Twisted and shielded) (Refer Vol. V, Chapter 9)				
8	Battery	As per standard	IS 10918	Yes	YES
9.	Voltage stabiliser	Over load test	Approved procedure	No	YES
		Temp. rise test without redundant fans	Approved procedure	No	YES
		Input voltage variation test	Approved procedure	No	YES
10	DDCMIS				
	CLCS	Model Test	Approved	No	No



	system		procedure		
	BMS & MFT	Safety requirement	VDE 0116, SEC 8.7	No	YES
11	Conductivity type level switch	Degree of protection test	IS 13947	No	No
12	Local gauges	Degree of protection test	IS 13947	No	No
13	Process actuated switches	Degree of protection test	IS 13947	No	No
14	Control valves	CV test	ISA 75.02	No	YES
15	PLCs	As per Standard	IEC 1131	No	YES
16	LIE/LIR	Degree of protection test	IS 13947	YES	YES
17	Flue gas O ₂ analyser, other Flue gas Analysers	Degree of protection test	IS 13947	No	YES
18	Flow nozzles & Orifice plates	calibration	ASME PT C BS 1042	YES	YES

Note:

Type test are to be conducted only for the items, which are being supplied as part of this package.

- A. For batteries with electric power supply system of main plant C&I, the bidder shall submit for owner's approval the reports of all the type tests as per IS-10918 carried out within last 5 years from the date of bid opening and the test should have been either conducted at an independent laboratory or should have been witnessed by a owner/client. The complete type test report shall be for any rating of battery in a particular group, based on plate dimensions being manufactured by supplier.

For batteries with electric power system of auxiliary plants, type test reports for batteries shall be as per standard –practice of manufacturer.

14.02.06 Testing at Site [Prior to commercial operation]

- a. All equipment shall be checked thoroughly in respect of the following:
 - i. Visual and mechanical testing
 - ii. Complete system configuration loading functions; system diagnostics; system proper operation specified power supply specifications.



ERECTION HARDWARE

CHAPTER-9**ERECTION HARDWARE****9.00.00 PROCESS CONNECTION AND PIPING****9.00.01 General Requirements**

This section covers the material requirement for instrument connection to process, instrument process, piping, tubing, supports, Instrumentation cables, control cables and power cables for connecting UPS, 24/48 V DC, unregulated power supply for cubicle illumination, compensating cables/Extension cables, transmitter racks and main accessories to be furnished under this specification and the requirements of installation and routing. Impulse lines, fittings and other accessories required for the erection of complete Instrumentation and Control System supplied under various packages of this specification shall be supplied on "as required" basis. Bidder shall offer all necessary items for this section based on his experience on similar plants, plant layout diagrams, installation drawings and other applicable sections of this specification. Based on the good engineering practices Bidder shall furnish installation drawings during the engineering of the system for Owner's review and approval. The installation of the drawings shall be suitable for his installation of his range of instrumentation.

The Bidder shall furnish and test all required erection hardware, which is necessary for proper installation and interconnection of the equipment/systems furnished by the Bidder and their integration with main equipment/systems as per the enclosed installation drawings and other applicable clause. The Bidder shall furnish all hardware and accessories to ensure that the equipment/systems furnished form a complete and operational system meeting the intent and requirement of this specification.

All materials, furnished shall conform to the latest editions of America National Standard Code for Pressure piping, Power piping, ANSI B311.1, ANSI B16.11, ASME Boiler and Pressure Vessel Codes, IBR and other applicable ASME, ANSI and Indian Standards. Schedule numbers, sizes and dimensions of all carbon steel, stainless steel and alloy seamless steel pipe shall confirm to ANSI B.36.10 and of stainless steel pipe shall confirm to ANSI B 36.19 unless otherwise specified.

All materials supplied under this section shall be suitable for intended service; process operating conditions and type of instruments used and shall fully conform to the requirements of this specification.

The Bidder is responsible for the performance of the equipment furnished on system basis any shortfall in erection material observed during erection stage shall be compensated by the Bidder at no extra cost. (Installation drawings # 114-04-0000, 0100 to 0113 shall also be referred by bidder).

9.01.00 GUIDLINE FOR INSTALLATION AND ROUTING OF INSTRUMENT PIPING**9.01.01 General Requirements**

The following general erection guidelines have been enumerated here to enable the Bidder to estimate the requirement of instrument piping in plant:-



- i) All instrument piping shall be in accordance with good engineering practice. It shall be finalized during engineering stage. Instrument piping shall be complete with fittings, valves and other required accessories.
- ii) Instrument piping shall not be routed:-
 - a) Across equipment removal areas
 - b) Below mono-rails and cranes
 - c) Above or below removable gratings
 - d) Above or below cable trays.
- iii) Primary Impulse Piping System:
 - a) The primary impulse piping system shall include the instrument piping and all required accessories from process tap off point (root valves onwards) up to the respective instruments. From the same source, Tee off for instruments are not allowed. Separate tapping shall be provided for each instrument. The Bidder shall provide the necessary fittings and accessories along with impulse pipes for completeness and arrangements as per the finalized Instrument Installation Diagrams. Special accessories such as reservoirs and other devices shall be installed as required for flow primary element connection as required by the design of instruments, in accordance with the instructions of the instrument manufacturer.
 - b) The Bidder shall prepare impulse pipe routing drawings.
 - c) Impulse piping shall include a blow-down line and shut-off valve adequate for the duty requirements and for withstanding continuous design pressure and temperature of process medium. For process pressure above 40 Kg/Cm²g, double valves shall be used before connecting to the blow-down header (This arrangement shall be provided for installation for the new transmitter if the existing transmitter has the same arrangement.)
 - d) To assure a constant static head the connections from low pressure steam and low pressure liquid filled lines should preferably slope downward continuously towards the instrument as the instrument is mounted below the source point. If downward slope is not feasible or the instrument is mounted above the source point, the line should slope upward continuously and a "pigtail" installed at the instrument to assure a water seal for temperature protection. Upward sloping liquid lines should be used only if the process pressure is sufficient to assure a head of liquid at the instrument. Horizontal runs should have a slope of not less than 40 mm per meter and must be adequately supported to maintain a constant slope. Vacuum connections to the condenser should always slope upward to the instrument.
 - e) Primary process piping for steam flow, liquid flow and manometric level measurement systems should preferably slope downward from the primary element connections to the instrument. Primary piping for flue gas and air flow measurement systems should preferably slope upward from



the primary element connections to the instrument. If these requirements cannot be met, special venting or drain provisions will be required. Horizontal runs must have a slope of not less than 40 millimeters per meter and must be adequately supported to maintain a constant slope.

- f) Primary process piping from the field which enters the instrument enclosure from the bottom shall extend into the enclosure approximately 150 millimeters and be equipped with a socket weld to flare less tubing coupling of stainless steel. This coupling shall be used to connect the field primary process line to the enclosure process line. The field primary process line shall be anchored to the enclosure angle with U-bolts. Holes for supporting U-bolts shall be field or drilled.
- g) All impulse piping shall be supported rigidly at an interval not exceeding 1.5 meters so as to prevent excessive sag in piping. Process piping shall not be used for supporting impulse piping.
- h) Impulse lines subject to severe sonic pulsations such as boiler feed pump discharge, shall be of sufficient length and of suitable configuration to scatter harmful sonic wave energy before it reaches the instrument.
- i) Impulse piping shall be installed to permit thermal expansion without placing excessive stress on the piping and without affecting the gradient of slope. Long continuous straight runs of piping shall always be avoided. If required, expansion loops shall be provided at least every 2.5 meters to break the continuity.
- j) All welded and screwed fittings shall conform to ANSI B16.11. Threads of piping components shall be taper pipe thread in accordance with ANSI B2.1. All threads shall be clean machine cut with all burrs and chips removed. Lubricants shall be of dry film type. Any one of the following compounds may be used as a pipe thread sealer. Bidder shall supply adequate amount of his preferred sealer for erection purpose.
 - a) Permatex
 - b) Molycote
 - c) Neolube
 (Teflon tape shall not be used as a pipe thread sealer).

9.01.02 Impulse Piping System

Impulse piping system consists of primary impulse pipes/tubes, valves, fittings, valve manifolds and other accessories between the source connection point (source shut-off valve on wards) and all instruments/devices. Impulse pipe span for supporting clamp shall be 1.5 mtr. This will also include all piping and valves etc. required for instrument drain and vent connections. The Bidder shall furnish and test all items required for completeness of this specification.

9.01.03 AIR SUPPLY PIPING



The piping for air supply shall be as specified below (However the Bidder shall supply the materials as required basis to complete the system in all respect)

i) Individual Supply Lines and Control Signal Lines:-

Air lines shall be ¼ inch size, connected by brass/SS316 flare less tubing fittings. Copper/SS316 tubing shall be light drawn tempered tubing conforming to ASTM B75 except copper tubing in tubing cables shall be annealed soft temper tubing conforming to ASTM B68 or B75. Fittings on the branch line to facilitate connections to the individual supply line shall be cast brass screwed type.

ii) Flexible Hoses:-

Flexible hoses shall be ¼ inch SS flexible hose pipe and with Buna-N liner steel wire braid reinforcement complete with ¼ inch brass/SS316 fittings and shall have swivel male pipe threads. Each hose shall be done meter in length.

iii) Pipe Material Specification:-

The piping material shall be carbon steel hot-dipped galvanized inside and outside as per IS-1239 or the equivalent of these standard heavy quality with screwed ends. The piping threads shall be as per ASA B.2.1.

iv) Isolating Valves:-

Gate valves as per ASTM B62 inside screw rising stem screwed female ends as per ASA B.2.1 valve bonnet shall be union type and trim shall be stainless steel body rating 150 pounds ASA. Valves sizes shall be ½ inch to 2 inch.

v) Fittings:-

Forged cast steel A234 Gr. WPM galvanized inside and outside; screwed as per ASA B2.1 dimensions as per ASA B16.11, rating 2000 pounds, elbows and soft seats. The size of the fittings shall be ½ inch through 2 inch.

vi) Air Filter Regulator Set:-

An instrument Air Filter Regulator Set with mounting assemblies shall be provided for each pneumatic device requiring air supply.

vii) Instrument Air Piping System:-

a) Instrument Air shall be made available by the bidder at 3.5 to 7.0 Kg/cm² pressure. The instrument air may be arranged as under:-

11. For the control valves and power cylinders in owner's scope but controlled by bidder's control system, the instrument air requirement for E/P converter shall be tapped from the nearest instrument air header laid by bidder / already laid existing piping with accessories available near the control valves or damper.



Complete hardware required for interfacing with Owner system shall be in bidder scope.

- b) Air supply piping shall be installed at site always with a slope of over 1/100 to prevent accumulation of condensed water within the pipe.
 - c) All joints in the instrument air sub-header shall be of screwed type.
 - d) Instrument air line shall be separate for each individual instrument, equipment & drive with own isolation valve and other required hardware. Tee off of instrument line for two or more same/similar services instrument, equipment & drive are not acceptable.
 - e) Instrument air flushing/purging lines shall be provided for Bowl Mill DP, secondary air flow measurement instrument and other all flue gas services instruments etc.
- viii) Signal / Control Air Tubing System:-

Necessary tubes with fittings and accessories for output signal from pneumatic instruments mounted in the field and control signals to final control elements shall be covered under this tubing system.

9.02.00 **SPECIFICATION FOR ERECTION HARDWARE**

The erection hardware shall meet the following specifications:-

	<u>Item</u>	<u>Specification</u>
9.02.01	Impulse Piping	
i)	High pressure and high temperature services (Medium: Steam & Water and furnace region)	Seamless Alloy Steel piping to ASTM A335 GR.P91/22 (schedule XXS/160 for high pressure & high temperature)
ii)	Low pressure and low temperature services (Medium: Steam & Water)	Seamless carbon steel piping to STM A106, Gr.C
iii)	Low pressure and low temperature services (Air, Flue gas)	ERW carbon steel piping to IS 1239:1973 Heavy class System)
iv)	Steam and water analysis system	Seamless stainless steel piping to ASTM A312 GR. TP-321
v)	Seamless copper tubing	ASTM B-75



9.02.02 Fittings Double compression type

- | | | |
|------|--|---|
| i) | Material for socket weld fittings | ASTM A105
ASTM A182,
Gr. F22
6000/3000 lbs |
| ii) | Dimensions of fittings | ANSI B16.11 |
| iii) | Fittings for steam and water analysis. | Gr. F-321 |

9.02.03 Valves

- | | | |
|------|----------------------------|---|
| i) | 3 – way valves | SS body/forged CS
body stellited internals and SW ends
as per requirement for 2500 lb/800 lb
ASA ratings. |
| ii) | 5- valve manifolds | FAS body/FCS body
316SS stellited internals with NPT(F)
SCRD ends for 3000/ 2500 lb/1500
lb/800 lb ASA ratings. Construction –
Single block (Bar stock) |
| iii) | 3-valve manifolds | FAS body/FCS body
316SS stellited internals with NPT(F)
SCRD ends for 3000/ 2500 lb/1500
lb/800 lb ASA ratings. Construction –
Single block (Bar stock) |
| iv) | 2-valve manifolds | FCS body, 316SS
stellited in ternals, NP T(F) S CRD
ends. C onstruction – Single bl ock
(Bar stock) |
| v) | Isolation and drain valves | Globe valves with
FAS body/FCS body, 316SS stellited
internals SW ends for 3000/2500
lb/1500 lb/800 ASA ratings. |

9.02.04	Condensation vessels	FAS/FCS body with NPT (F) SCRD connection and vent plugs for 3000/2500/1500/800 lb ASA ratings.
----------------	----------------------	---

9.02.05	Racks and Associated Equipment	ANSI C83.9-1972
----------------	--------------------------------	-----------------

9.02.06	Code for pressure piping, welding and Hydrostatic testing	ANSI B-31.1
----------------	---	-------------



- 9.02.07** Flexible conduits with fittings Lead coated, paper insulated, heat resistant flexible metallic conduits with necessary fittings.
- 9.02.08 3 Valve manifold shall be used, wherever Diff Pressure transmitter/switch have been used for pressure measurement.
- 9.02.09 5 Valve manifold shall be used for Diff. Pressure & Flow measurement Transmitters/Switches.
- 9.02.10 In addition to above, table # 9.1 shall also be followed for selection of specific erection hardware as per process requirements.

9.03.00 TRANSMITTER & SWITCHES ENCLOSURES

In general, BTG process transmitters & switches installed at outdoor location and in areas where they are subjected to splashing oil, water, steam etc., shall be mounted in closed type transmitter rack. For other areas (indoor), open type racks may be used for installation of transmitters and process switches. However the actual requirement shall be finalized during detailed Engineering considering following:-

- i) Transmitter/Switches enclosures shall be free standing, enclosed type of ferrous protection against dust, moisture and vermin. Enclosures shall be suitable for outdoor installations, in thermal power plants.
- ii) The enclosures shall comprise of Galvanized Sheet mounting plate internally. Also external-mounting brackets in Polyamide or Stainless Steel shall be available. Alternatively transmitter enclosures can be glass Fiber Reinforced Polyester (GRP) compression moulded and shall be weather proof.
- iii) Instrument piping inside the enclosure shall conform to the specification and in line with typical installation drawings enclosed with the specification.
- iv) Blow down header shall be provided inside the enclosure as called for.
- v) Bulk head connection shall be provided to receive and terminate the impulse pipes from root valves.
- vi) Instrument tubing, fittings and isolation, drain valves shall be to ANSI code for pressure piping. Piping/tubing shall be subject to hydrostatic tests at 1.5 times maximum system pressure.
- vii) Support angles shall be provided for valve manifolds, wiring trays etc. Enclosures shall be complete with necessary bulk head fittings, junction boxes, drain header and other accessories as needed on the basis of approved hook up drawings.
- viii) Sufficient spacing among adjacent transmitters shall be maintained to offer easy accessibility and operational convenience. The enclosure shall be designed with sizes to suit the grouping and to completely include all the hardware for hooking up



the transmitters to the process on the basis of approved installation diagrams. A maximum of five (5) transmitters are envisaged to be grouped in one enclosure.

- x) A minimum of twenty (20) percent spare terminals shall be provided. Only one wire per terminal shall be used on the outgoing side of these blocks (for cable panel). Any common connections required shall be provided on the panel side of the block. All incoming power terminals are to be clearly identified in a manner distinctly different from all other terminals and grouped in a logical pattern.
- xi) Chapter no. 6 of this volume shall also be referred for designing of Transmitter/Switches enclosures.

9.04.00

LOCAL INSTRUMENTS, LOCAL BOARDS AND TAPPING POINTS

- i) All local gauges as well as sensors, Transmitters and switches any other instruments for parameters like pressure, temperature, level, flow etc for safe and efficient operation of equipment under the scope of specification, shall be provided by bidder as approved by Owner. Such equipment shall be listed by the Bidder detailing the items with their respective functions in service. All field mounted instruments shall be mounted in such a way as not to be affected by vibration & environmental conditions. Racks to mount these instruments shall be furnished by bidder complete with requisite erection hardware, tubings and junction boxes with all terminals of the instruments duly wired complete with cable glands. Groupings of instruments, actual number of racks for instruments and its construction shall be to Owners approval.
- ii) Transmitters & Switches provided shall be mounted in transmitter/Switches enclosures to owner's approval. The junction box for electrical connections shall be outside the transmitter enclosures.
- iii) All erection hardware required for complete installation/ implementation of entire instrumentation specified is included in bidders scope. Any change in size, type, rating or in quantity deemed necessary during engineering shall be supplied within package price with no additional financial implication to owner.
- iv) Bidders scope includes providing counter flanges on pipe lines/ vessels to suit owner arranged flanged devices. Counter flanges shall be complete with gaskets, nuts, bolts and other requisite accessories for proper installation.
- v) Separate and independent tapping on equipment/associated piping shall be provided to suit the philosophy of redundant primary sensors. Separate sensors for control and monitoring etc are as decided by Owner. This shall include application such as first stage pressure. Wherever the process value being measured needs to be compensated for temp, pressure variations, the tapping points for such compensating elements shall be provided in requisite number along with the tapping for the process value.
- vi) Wherever transmitters & switches are provided, in addition Local gauges shall also be provided by bidder for local field monitoring.



- vii) Local instruments and remote sensors & transmitters to be furnished with the equipment shall generally be as indicated herein and as per redundancy criteria indicated elsewhere but not be limited to the following: -

1. Pressure Measurement

i. **Pressure Gauge for:**

- a) Shell pressures of all Deaerator, HP and LP heaters and other vessels.
- b) Mercury manometers shall be provided during air outlet flows measurement.
- c) Bleed steam pressure at extraction point for all turbine extractions and for pressure on drain lines.
- d) Pressure gauges at inlets and outlets of condensate extraction pumps, main oil pump, each auxiliary oil pump, ACS standby oil pump, DC Emergency oil pump, jacking oil pumps, DM makeup pumps, DMCW pumps, BFP, or any other pumps etc.
Pressure Gauge at outlet of each type of Fan.
- e) Lube oil pressure before and after oil coolers, HPT & IPT front seal chamber leak off pressure.
- f) MS pressure downstream of ESV, after HPT control valves and after HPT first stage, HRH steam pressure after IV, Gland steam header pressure, HPT exhaust etc.
- g) Condensate pressure in condensate pump discharge header, and feed water pressure at inlet and outlet of each LP & HP heaters.
- h) LP turbine exhaust pressure and condenser pressure
- i) Relay/Lube/Control oil pressure, Drain oil lines pressure.
- j) Pressure gauges for vacuum pumps and each pump discharge.
- k) Pressure gauge at Instrument and service air header in compressor room and in the field at the main location of instrument/service air header, the pressure gauges shall be provided.
- l) Pressure gauges at inlet and outlet of each heat exchanger and cooler.
- m) Frame mounted Pressure Gauges (FMG) shall be provided for Main steam Pressure, Feed water pressure to economizer, CRH Steam Pressure, HRH Steam Pressure etc.
- n) For condensate storage tank the pressure gauge in terms of 0-10000 mm wc or suitable range having **dial size of 300 mm or bigger size** shall be provided.
- o) **U-tube manometer with Hg filled for direct measurement of condenser vacuum** shall be provided in the fixed with isolation valve for local indications.
- p) Above are the minimum requirements, actual quantities shall be as decided during detailed engineering by owner.
- q) Pressure gauge for all IBOP packages as decided during detailed engineering by owner.

ii. **Pressure Switches**

- a) Pressure switches at condensate Extraction Pump Discharge header, Boiler feed pump, seal water line or any other pumps for alarm (high & low) and interlock purpose.



- b) Pressure switches for steam supply to LP/HP heaters.
- c) Pressure switches for initiation of turning gear.
- d) Pressure switches for control oil, jacking oil and lube oil pressure for all required alarms and interlocks.
- e) Steam pressure downstream of ESV, steam pressure after first stage of HPT, gland steam header pressure and suction line from turbine glands to Gland cooler.
- f) Pressure switches for condenser vacuum low, very low alarms & interlocks.
- g) Condenser water box pressure for alarm interlocks.
- h) Pressure switches (low & high) for individual pumps/blowers suction/discharge and discharge header – alarms, interlocks and protection
- i) At the main location of instrument air header the pressure low switches shall be provided for alarms in DDCMIS
- j) Pressure switches/any other process switch etc. for OLCS / Alarms / Interlocks / Protection. Pressure switches at inlet, outlet of individual pumps and discharge header of pumps for protection and auto start / stop & alarms.
- k) Above are the minimum requirements, actual quantities shall be as decided during detailed engineering as per redundancy criteria by owner.
- l) Pressure switches for all BoP packages as decided during detailed engineering by owner.

iii. **Differential Pressure Transmitters, Diff Pressure Switches & Diff. Pressure Gauges**

- a) Pressure across strainers and filters.
- b) Diff. Pressure Transmitters/switches/Gauges for all BoP packages as decided during detailed engineering by owner.
- c) Diff. Pressure Transmitter across condenser on CW lines, Air pre heaters on air & flue gas lines, on PA lines, CEP suction strainers, Feed control station etc.
- d) Above are the minimum requirements, actual quantities shall be as decided during detailed engineering as per redundancy criteria by owner.

iv. **Pressure Transmitters**

- a) For all services as mentioned for Pressure gauges & Pressure Switches.
- b) Pressure Transmitters at condensate Extraction Pump individual Discharge and discharge header, Boiler feed pump individual Discharge and discharge header, seal water line or any other pumps/fans/HT/LT unidirectional drive for alarm (high & low) and interlock purpose.
- c) Pressure transmitter for wind box (Left/Right) & pulverizer seal air fans discharge pressure.
- d) Pressure Transmitters as on required basis for monitoring, interlocks & controls as per redundancy criteria and approved by owner.
- e) Above are the minimum requirements, actual quantities shall be as decided during detailed engineering as per redundancy criteria and approved by owner.
- f) Pressure Transmitters for all BoP packages as decided during detailed engineering by owner.



2. Temperature Measurements:-

The Bidder shall furnish all temperature sensing elements to be installed in their piping. The scope of supply shall include, but not limited to the following: -

- i) Duplex RTDs for all bearing, drain oil from bearings, LPT exhaust steam, 3 no's of duplex RTDs each on left and right CW outlet of condenser etc.
- ii) 6 no. duplex or 12 no. simplex Embedded temperature detectors for various motor stator windings and duplex RTDs for Motor/Pump bearing temp.
- iii) Chromel-alumel surface/other thermocouples for turbine casings, ESV, IV bodies, superheated steam, hot reheat steam piping, steam of first stage HPT, inlet bowl of IPT, steam exhaust of HPT, down stream of ESV and IV, steam in ESVs and IVs, steam admission pipes metal temperatures, HPC, IPC flange metal temperature etc.
- iv) For all HP heaters remote monitoring with redundant independent sensors of inlet/outlet temperatures of feed water and extraction steam shall be provided in addition to local gauges.
- v) For all LP heaters remote monitoring with redundant independent sensors of inlet/outlet temperatures of feed water and extraction steam shall be provided in addition to local gauges.
- iv) Temperature sensors for HP-LP bypass system for measurement as well as for control.
- v) Adequate number of temperature Elements shall be furnished to provide initiating contacts for temperature interlocking and trip circuits. The temperature elements shall be provided, but not limited to the following: -

Steam temperature of HPT exhaust, steam temperature after ESV (L&R), IV (L&R), LPT exhaust hood steam, drain oil temperature of all journal bearings and thrust bearing & lube oil heater temperatures, thrust bearing of each condensate extraction pump and vacuum pump protection, interlocks.

- vi) Metal Temp measurement and steam temp measurement at each super heater & Reheater location.
- vii) Temp. Element & Temp gauges at Feed water line to economizer inlet, economizer to steam separator, spray water lines to desuperheaters, Soot blower steam, Soot blower steam drain lines, steam drain lines, Flue gas & air lines etc
- viii) Temp. Measurements (Local & remote) for all BOP packages as decided during detailed engineering.
- ix) Thermocouples for Temp. above 200 deg C shall be provided by bidder.
- x) For plate heat exchangers, spare thermowell provision shall be made at inlet & outlet of ACW & DMCW lines in addition to local & remote temperature monitoring points.
- xi) Each ESP Hopper shall be provided with RTDs to control the temperature of ash through Hopper heater.

xii) Temperature gauges.

- a) For bearing temperatures AC and DC lube oil pumps, LPT exhaust hood etc.
- b) For condensate and feed water at inlet and outlet of HP heaters, Vacuum pumps, LP heaters etc.



- c) Steam & water inlet/outlet of LP and HP heaters, steam and air mixture inlet to vacuum pumps, and drain lines etc.
 - d) Journal/thrust bearing drain oil, lube oil at inlet/outlet of oil coolers, cooling water at inlet and outlet of oil coolers etc.
 - e) Thrust bearing of each condensate extraction pump.
 - f) Temp. Gauges at inlet and outlet of each heat exchanger and cooler.
 - g) Frame mounted Temperature Gauges (FMG) shall be provided for Main steam Temperature, Feed water Temperature to economizer, CRH Steam Temperature, HRH Steam Temperature etc
- xiii) Above are the minimum requirements, actual quantities shall be as decided during detailed engineering by owner.

3. Level Measurement

- i) Level gauges - level gauges for boiler separator, HP heaters, LP heaters, deaerator, drain cooler, gland steam cooler, vacuum tanks, condenser hot well CBD tank, sator water tank, Sator water expansion tank and other pressure vessels, main oil tank and all oil tanks in BTG & BOP package. The level gauges shall be mica shielded steel armoured transparent glass type. Level gauges for condenser hot well shall be provided on both sides.
- ii) Level switches for HP/LP heaters, drain cooler, gland steam cooler, condenser hot well, deaerator, main oil tank and other pressure vessels, tanks, sumps etc. The separate switches for high, very high and low levels shall be provided as per interlocks and protection requirements.

External cage mounted magnetic level switches/ displacer type shall be employed for low pressure & low temp. services.

However conductivity type level switches shall be provided for high pressure & high temp services like HP heaters, CRH/HRH drain Pot, Turbine Drains etc.

- iii) Level Transmitters (Type as per Owner approval) for open sump/tank/bunker/vessel/heaters.
- iv) Level measurement for all BoP packages as decided during detailed engineering.
- v) Level switches for OLCS / Alarms / Interlocks / Protection. Level switches for sump/tank level high/normal/ low/very low interlocks.
- vi) Each ESP hopper must be provided with 3 nos. level switch (switches 2 nos. for high level and One no. for low level.)
- vii) Above are the minimum requirements, actual quantities shall be as decided during detailed engineering by owner.

4. Flow Measurements:-

- a) Primary Elements: Flow nozzles shall be used for feed water flow and other critical measurements where weld-in construction is required. Flow nozzles shall be made of stainless steel, with three sets of pressure taps installed in the pipe wall where required. One no. spare set of pressure tap shall also be provided on flow nozzle,



wherever required. Installation of flow nozzles and pressure taps shall be made in the pipe fabricator's shop and shall be witnessed by a representative from the flow nozzle manufacturer.

- b) Paddle type orifice plates shall be used for other flow measurements where flanged construction and higher pressure loss are acceptable. Orifice plates shall be made of stainless steel. Orifice flanges shall be of the raised face weld neck type with dual sets of taps.
- c) Construction and installation of flow nozzles and orifices shall conform to the requirements of ASME Performance Test Code PTC-19.5, and discharge coefficients shall be predicted in accordance with data published in ASME Research Report on Fluid Meters.
- d) Airfoil or venturi flow sections, shall be used for measuring boiler combustion airflow.
- e) A special high accuracy flow nozzle pipe shall be provided to determine feed water flow to the economizer. This nozzle shall be hydraulically calibrated and utilized for feed water flow control and for turbine testing as described in ASME PTC 6 (latest revision).
- f) Orifice plates shall be supplied with carrier rings as per process requirement.
- g) Doppler effect type flow meters shall be used for sludge applications.
- h) For Raw water, water treatment plant and effluent treatment plant, ultrasonic type flow meters to be used.
- i) Secondary Elements: Secondary elements for differential type flow sensors shall be strain gauge or capacitance type differential pressure transmitters. Square root extraction required for the DP transmitters shall be performed electronically in the transmitter itself.
- j) HFO/LDO flow meters shall be based on coriolis mass flow technology. Fuel Oil meters shall be provided for fuel oil unloading system and near boiler after day oil tank (at main supply & return line).
- k) Flow nozzles shall be provided for following services in main plant:-
 - i) Steam flow measurement for BFP Turbines.
 - ii) Feed water flow measurement
 - iii) Auxiliary steam flow measurements
 - iv) HP bypass flow measurements
 - v) BFP suction flow.
 - vi) Deaerator water flow measurement
 - vii) HP heaters drain Flow measurements.

Orifices shall be provided for following services:-

- i) Spray water flow measurement



- ii) Condensate flow measurements
 - iii) DM/hotwell makeup to condenser.
 - iv.) Condensate dump flow to CST
 - v) Gland Steam Condensate flow measurements
- l) For DM water flow & Ash Slurry flows measurements online electromagnetic flow meter shall be used.
- m) At CW & ACW pump discharge headers flow transmitters shall be provided (Non Contact ultrasonic Type are preferable). In addition flow measurement shall also be provided for CW water used any where except condenser service.
- n) Instrument and Service Air - Vortex/Swirl type Flow meter
- o) Flow transmitters for general applications shall be of the differential pressure type
- p) Flow switches for OLCS / Alarms / Interlocks / Protection.
- q) Lubricating oil Flow transmitter/meter with switch shall be provided for Bearing systems of APH, FD, PA, etc.,
- r) Sight glasses flapper indication type shall be provided on lube oil cooling water piping as required to ensure indication of fluid flow.
- s) On line Fuel flow & velocity measurement facility in each Pulverized Fuel (PF) pipe for each coal pulveriser shall be provided by bidder for accurate, absolute and simultaneous measurement of coal velocity, coal density, coal mass flow rate and air-to-fuel ratio. The equipments shall comprise of sensors working on micro wave technology.
- t) In addition to the **conventional triple DP measurement techniques** involving venturi/Airfoil or secondary air flow measurement, One number **Flow measurement** system each on Left side and Right side shall be provided as **redundant/checking measurement for secondary air flow** which could be used in the optimization package.
- On line secondary air flow & velocity measurement facility in each on Left side & right side shall be provided by bidder for accurate, absolute and simultaneous measurement of air velocity & flow rate. The equipments shall comprise of sensors working on tribo-electric (Correlation technique) technology.
- u) Any other flow element/meter required for system shall be finalised as per system requirement and as per approved drawings/documents by owner.

9.05.00

Process Connections

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



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

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



Technical Specifications for C&I Systems-Table-No. 9.1

S.No.	System/Line Description	Piping Class	Impulse Pipe material	Schedule (Size)	Materials for fitting/ valve body	Valve steam material	Rating of Piping Fitting	Pressure Class of valve
1	Main steam, Up steam & down stream of HP bypass and up stream of auxiliary steam pressure reducing valve.	A	ASTM-A335 Gr.P-91/22 (Note-2)	XXS (½ Inch)	Note-3	Note-3	9000lb	3000 SPL
2	BFP discharge/ superheater attemperator/spray to PRDS	B	ASTM-A106 Gr. C	160 (½ Inch)	Note-3	ASTM-A-182 Gr.F6a	6000lb	2500 SPL
3	Reheater attemperator	C	ASTM-A106 Gr. C	160 (½ Inch)	ASTM-A-105	ASTM-A-182 Gr.F6a	6000lb	1500 SPL
4	Hot. Reheat/Down stream of Aux.Steam pressure reducing valve upto desuperheater/flash tank drain manifold, HRH upstream & down stream of LP Bypass valve.	D	ASTM-A335 Gr.P-91/22 (Note-2)	160 (½ Inch)	ASTM-A182 Gr.F-22	Note-3	3000lb	2500 SPL
5	Cold reheat upto Tee-off for HP bypass.	E	ASTM-A335 Gr.P-22	80 (½ Inch)	ASTM-A182 Gr.F-22	ASTM-A-182 Gr.F6a	3000lb	800
6	Cold reheat down steam of Tee-off (HP Bypass)	F	ASTM-A106 Gr. C	80 (½ Inch)	ASTM-A105	ASTM-A-182 Gr.F6a	3000lb	800



2 x 660 MW ENnore SEZ Supercritical Thermal Power
 Project at Ash Dyke of NCTPS
 Spec. No. CE/C/P&E/EE/E/OT.No.03/2013-14
 Vol. V :328



7	BFP suction/condensate system/Extraction to LPH/HPH and Extractions to BFPT, Desecrator, auxiliary steam.	G	ASTM-A106 Gr. C, ASTM-A335 Gr.P-11/22	80 (½ Inch)	ASTM-A105	ASTM-A-182 Gr.F6a	3000lb	800
8	Air/Flue gas outside furnace.	M	ASTM-A106 Gr.B/C	80 (¾ Inch)	ASTM-A105	ASTM-A-182 Gr.F6a	3000lb	800
9	Air flue gas inside furnace	N	ASTM-A335 Gr.P-22	80 (¾ Inch)	ASTM-A182 Gr.F-22	ASTM-A-182 Gr.F6a	3000lb	800
10.	Purge Air	O	ASTM-A106 Gr.C	80 (¾ Inch)	ASTM-A105	SS316	3000lb	800
11.	DM Cooling water	P	ASTM-A312 TP 316	80/40 (1/2 Inch)	ASTM – A 182 F 316	SS316	3000lb	800
12.	CW & ACW	Q	ASTM-A106 Gr.C	80 (1/2 Inch)	ASTM-A105	SS316	3000lb	800

Note:-

- 1). Above requirements are minimum to be complied by bidder. Rating of piping / fittings / valves etc. is subjected to be approved by owner as per the final design pressure & temperature finalized during the detailed engineering, as per ANSI B 31.1.
- 2). In case temperature is more than 540 deg C, the material shall be P-91 only.
- 3). Material shall be compatible with that of the impulse pipe material and design parameter.
- 4). For DM Plant or DM water services, complete erection Hardware material shall be SS316 only.



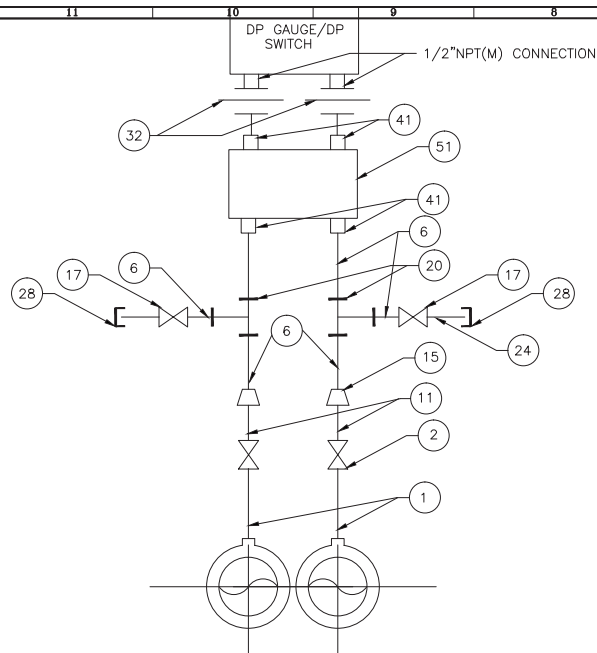


FIG-A

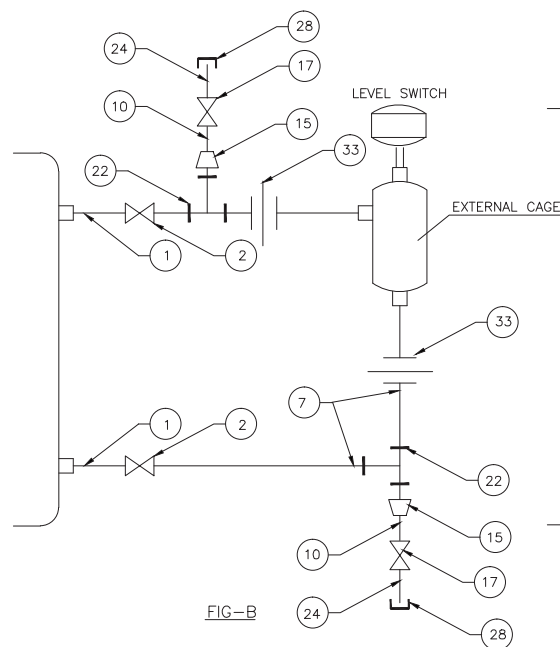


FIG-B

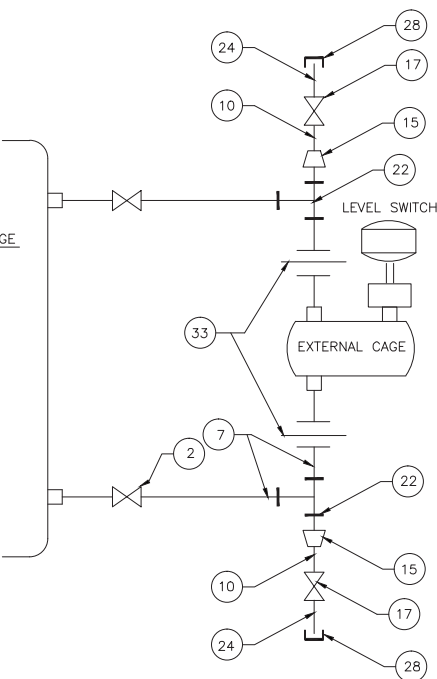


FIG-C

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

78	1/2" NPT(F) X 1/2" NPT(M) SNUBBER/PULSATION DAMPNER	1	—	—
51	5 VALVE MANIFOLDS, SS-316	—	—	—
41	1/2" NPT(M) X 1/2" OD TUBE COMPRESSION FITTING,SS-316	—	—	—
38	3 WAY GAUGE VALVE 1/2"NB SW	1	—	—
33	1" SW EQUAL PIPE UNION	—	2	2
32	1/2" NPS,3 PIECE PIPE UNION 1/2" NPT(F) SCREWED AND 1/2" SW CONNECTION	1	—	—
28	1/2" NPT(F) CS. CAP	1	2	2
24	1/2" NPS,SCH 80/160 X 1/2" NPT(M) CS/AS NIPPLE	1	2	2
22	1" SW EQUAL TEE CS/AS	—	1	2
20	1/2"SW EQUAL TEE CS/AS	1	—	—
17	1/2" SW,CS/AS, GLOBE VALVE	1	2	2
15	1" TO 1/2" SOCKET WELD REDUCER	1	2	2
11	1"NPS SCH 80/160 CS/AS NIPPLE	1	—	—
10	1/2"NPS,SCH 80/160 CA/AS NIPPLE	—	2	2
6	1/2"NPS,SCH 80/160 CARBON/ALLOY STEEL PIPE	AS REQD.		
7	1" NPS,SCH 80/160 CS/AS STEEL PIPE	AS REQD.		
2	1/2"3/4"/1" ROOT VALVE — SW GLOBE VALVE	2	2	2
1	1/2"/3/4"/1" CARBON/ALLOY STEEL NIPPLE OF MTL SAME AS THAT OF MAIN PIPE (AS PER PROCESS REQD.)	AS REQD.		
TAG NO.	DESCRIPTION	A	B	C
		QTY.		

11	
10	
9	
8	
7	
6	
5	
4	
3	
2	
1	
SR. No.	PARTY

11		
10		
9		
8		
7		
6		
5		
4		
3		
2		
1		
PRINT DISTRIBUTION		

11		
10		
9		
8		
7		
6		
5		
4		
3		
2		
1		
NOTES		

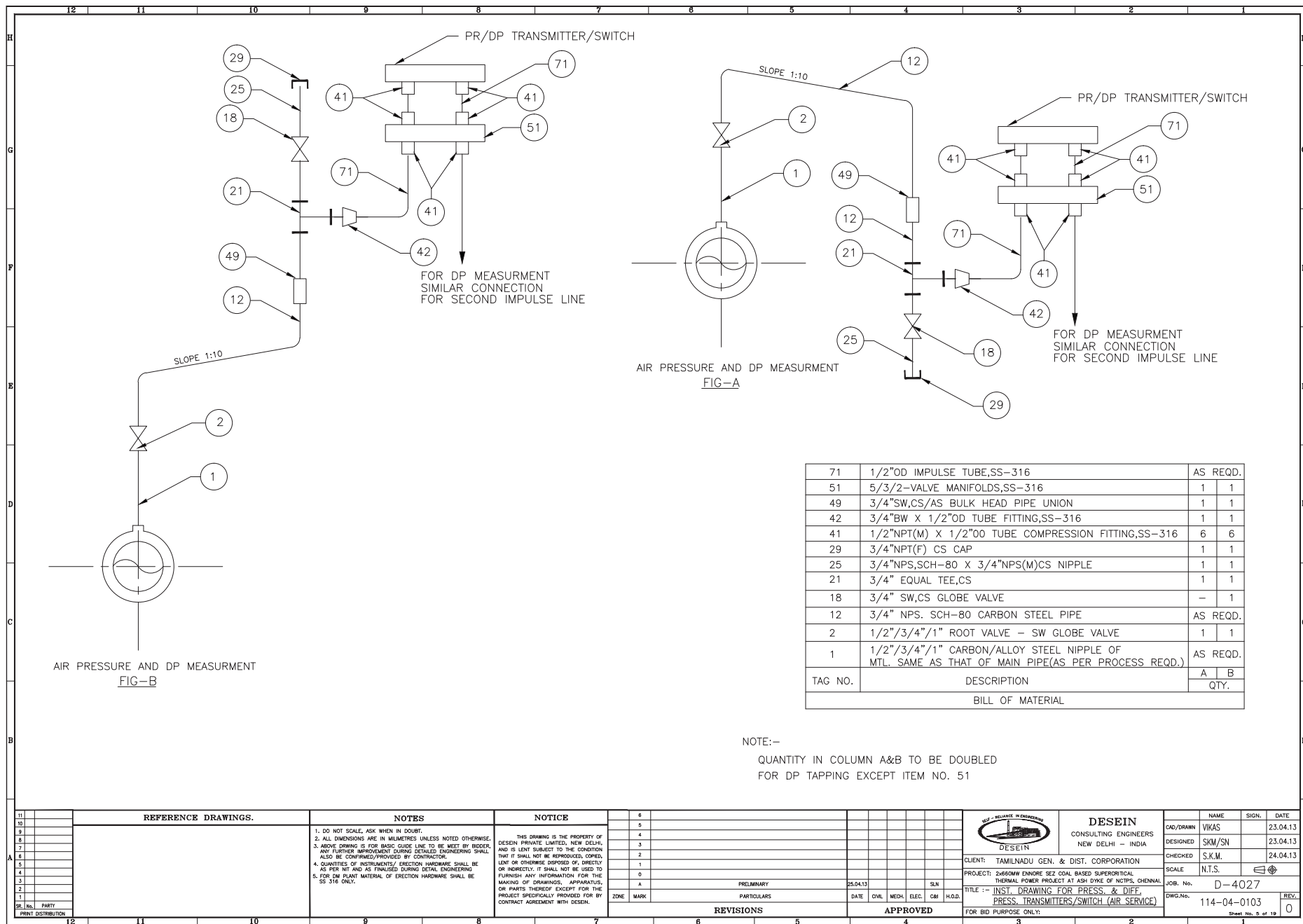
11		
10		
9		
8		
7		
6		
5		
4		
3		
2		
1		
NOTICE		

11		
10		
9		
8		
7		
6		
5		
4		
3		
2		
1		
REVISIONS		

11		
10		
9		
8		
7		
6		
5		
4		
3		
2		
1		
APPROVED		

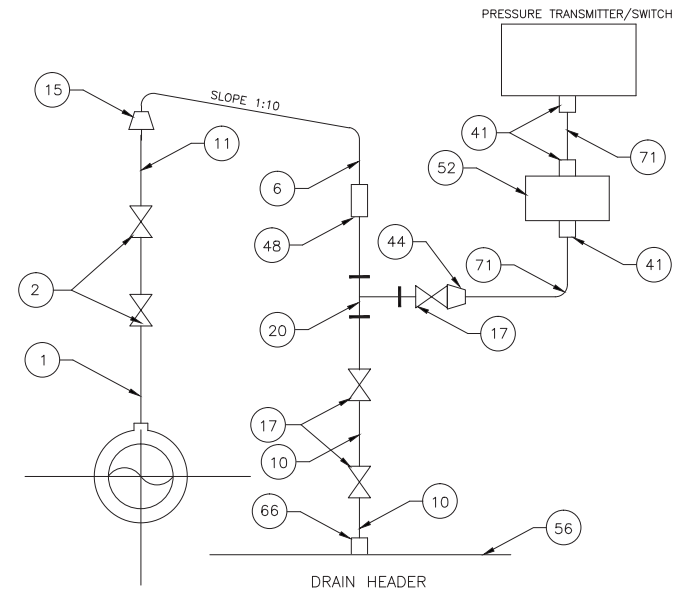
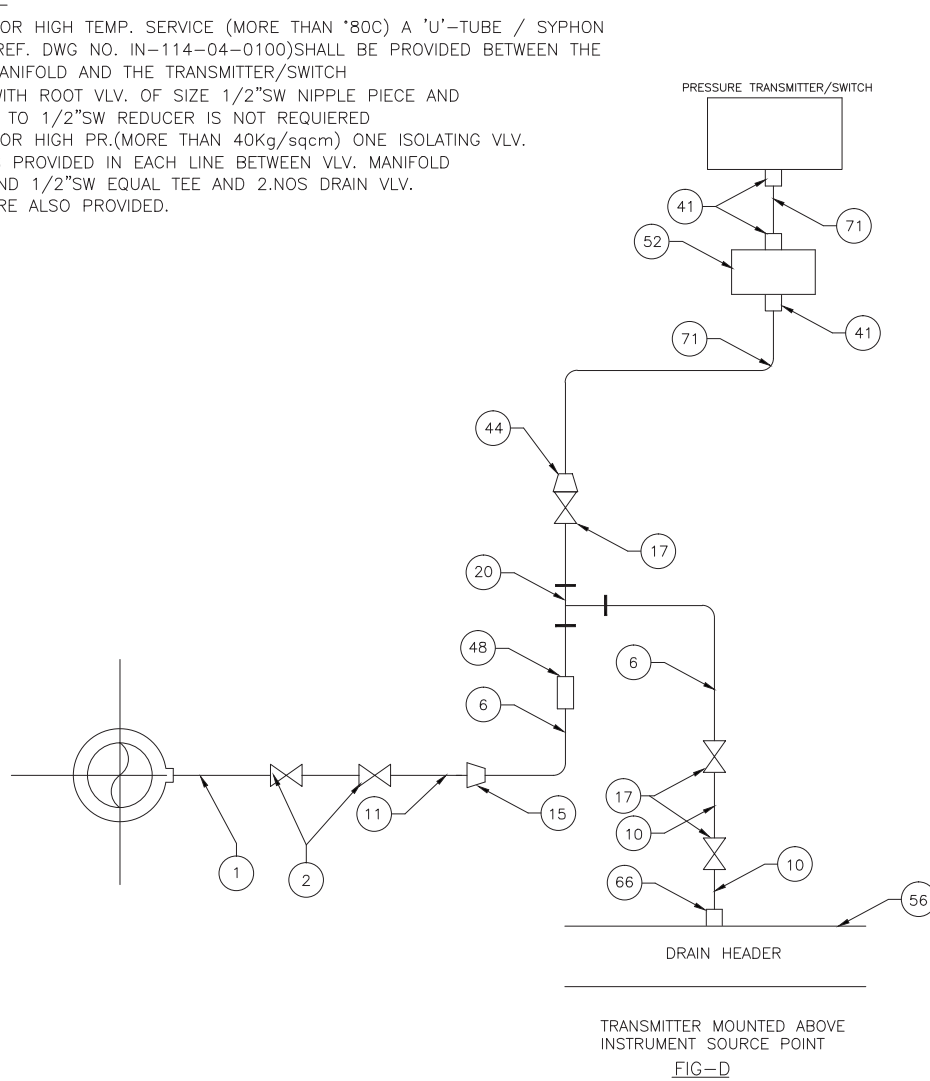
11		
10		
9		
8		
7		
6		
5		
4		
3		
2		
1		
DESEIN		

11		
10		
9		
8		
7		
6		
5		
4		
3		
2		
1		
NAME		



NOTE:-

1. FOR HIGH TEMP. SERVICE (MORE THAN 80°C) A 'U'-TUBE / SYPHON (REF. DWG NO. IN-114-04-0100) SHALL BE PROVIDED BETWEEN THE MANIFOLD AND THE TRANSMITTER/SWITCH
2. WITH ROOT VLV. OF SIZE 1/2"SW NIPPLE PIECE AND 1 TO 1/2"SW REDUCER IS NOT REQUIRED
3. FOR HIGH PR.(MORE THAN 40Kg/sqcm) ONE ISOLATING VLV. IS PROVIDED IN EACH LINE BETWEEN VLV. MANIFOLD AND 1/2"SW EQUAL TEE AND 2.NOS DRAIN VLV. ARE ALSO PROVIDED.



TAG NO.	DESCRIPTION	C	D	QTY.
71	1/2"OD IMPULSE TUBE,SS-316	AS REQD.		
66	1/2" GI SOCKET	1	1	
56	2"NB GI DRAIN HEADER			
52	5/3/2-VALVE MANIFOLDS,SS-316	1	1	
48	1/2"SW,CS/AS BULK HEAD PIPE UNION	1	1	
44	1/2"BW X 1/2"OD COMPRESSION TUBE FITTING,SS-316	1	1	
41	1/2"NPT(M) X 1/2"OD TUBE COMPRESSION FITTING,SS-316	3	3	
20	1/2"SW EQUAL TEE,CS	1	1	
17	1/2" SW,CS GLOBE VALVE / NEEDLE VALVE	3	3	
15	1" TO 1/2" SW REDUCER	1	1	
11	1" NPS SCH-80 CS/AS NIPPLE	1	1	
10	1/2" NPS,SCH 80/160, CS/AS NIPPLE	2	2	
6	1/2" NPS. SCH-80/160 CS/ AS PIPE	AS REQD.		
2	1/2"/3/4"/1" ROOT VALVE	2	2	
1	1/2"/3/4"/1" CARBON/ALLOY STEEL NIPPLE OF MTL. SAME AS THAT OF MAIN PIPE(AS PER PROCESS REQD.)	AS REQD.		

BILL OF MATERIAL			
NAME	SIGN.	DATE	
CAD/DRAWN	VIKAS	23.04.13	
DESIGNED	SKM/SN	23.04.13	
CHECKED	S.K.M.	24.04.13	
SCALE	N.T.S.		
JOB. No.	D-4027		
DWG.No.	114-04-0104		
REV.	0		

CLIENT: TAMILNADU GEN. & DIST. CORPORATION
 PROJECT: 2x600MW ENCORE SET COAL BASED SUPERCRITICAL THERMAL POWER PROJECT AT ASH DIKE OF NCTPS, CHENNAI
 TITLE :- INST. DRAWING FOR PRESS. & DIFF.PRESS. TRANSMITTERS/SWITCH (STEAM & LIQUID SERVICE)
 FOR BID PURPOSE ONLY:



PRELIMINARY 25.04.13
 DATE CIVIL MECH. ELEC. CM H.O.D.

APPROVED

REVISIONS

ZONE MARK

NOTICE

NOTES

REFERENCE DRAWINGS.

PRINT DISTRIBUTION

SR. No. PARTY

11 10 9 8 7 6 5 4 3 2 1

VENDOR LIST

PEM REGISTERED VENDOR

Package Code	Package Name	Vendor Name	Vendor Address
145-45000-A	INSTRUMENT FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA-UTTAR PRADESH-INDIA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
145-45000-A	INSTRUMENT FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI-MAHARASHTRA-INDIA Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
145-45000-A	INSTRUMENT FITTINGS	HP VALVES & FITTINGS INDIA PVT. LTD.	S. Harichandran/P.S. Pandi B-11, Mugappair Industrial Estate, CHENNAI-Tamilnadu-INDIA Phone- 044 26252537 Pincode : 600037 Email : sales@hpvalvesindia.com
145-45000-A	INSTRUMENT FITTINGS	Perfect Instrumentation Control (India) Pvt. Ltd.	MD Hussain Shaikh/Shahanawaz Khan Gala No. 168, Loheki Chwal,216/ 218, Maulana Azad Rd. Nagpada Junction Mumbai-Maharashtra-INDIA Phone- 91-9324383121 Pincode : 400008 Email : shahanawaz.khan@perfectinstrumentation.com
145-45000-A	INSTRUMENT FITTINGS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai,-Maharashtra,-India, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,
145-45000-A	INSTRUMENT FITTINGS	Comfit & Valve Pvt. Ltd.	Mr. Jeetu Jain/Mr. Vinay Sosa Survey No. 23/1, Part 2, Ahmedabad-Mehsana Highway Laxmipura, Nandasan-Gujarat-INDIA Phone- 02764-267036/37 Pincode : 382705 Email : marketing@com-fit.com
145-45000-A	INSTRUMENT FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI-DELHI-INDIA Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
145-45000-A	INSTRUMENT FITTINGS	Arya Crafts & Engineering Pvt. Ltd.	Mr.Sanjay Brahman/Mr.Shyam Vazirani 102, Vora Industrial Estate No.4 Navghar, Vasai Road (E) Dist.Thane, Mumbai-Maharashtra-INDIA Phone- +91-250-2392246 Pincode : 401210 Email : arya@aryaengg.com
145-45000-A	INSTRUMENT FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI-MAHARASHTRA-INDIA Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
145-45000-A	INSTRUMENT FITTINGS	FLUIDFIT ENGINEERS PVT. LTD.	Mr. Abbas Bhola Potia Building No. 2, Office No. 3,292, Bellasis Road,Mumbai Central (East) Mumbai-Maharashtra-India Phone- 9920044113 Pincode : 400008 Email : ab@fluidfitengg.com
145-38000-A	INSTRUMENTS PIPE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI-MAHARASHTRA-INDIA Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
145-38000-A	INSTRUMENTS PIPE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI-DELHI-INDIA Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
145-38000-A	INSTRUMENTS PIPE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI-MAHARASHTRA-INDIA Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
145-38000-A	INSTRUMENTS PIPE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA-UTTAR PRADESH-INDIA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
145-32000-A	INSTRUMENTS TUBE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA-UTTAR PRADESH-INDIA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com

145-32000-A	INSTRUMENTS TUBE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI-MAHARASHTRA-INDIA Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
145-32000-A	INSTRUMENTS TUBE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI-DELHI-INDIA Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
145-32000-A	INSTRUMENTS TUBE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moomhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI-MAHARASHTRA-INDIA Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
145-25000-A	JUNCTION BOX	FLEXPRO ELECTRICALS PVT. LTD.	Mr. Dineshbhai Zaveri C-1/ 27&37, GIDC, Kabilpore, Navsari-Gujarat-India Phone- 02637-265140,265003 Pincode : 396424 Email : flexpro@flexproltd.com
145-25000-A	JUNCTION BOX	AJMERA INDUSTRIAL & ENGINEERING WORKS	JIGNESH MAHENDRA AJMERA DENA BANK BLDG.,SHREE NAGESH INDL. ESTATE,STATION ROAD, MUMBAI-MAHARASHTRA-INDIA Phone- 022 67973578 Pincode : 400 088 Email : ajmera@ajmera.net, jmajmera@yahoo.com
145-25000-A	JUNCTION BOX	K.S.INSTRUMENTS PVT.LTD.	S Raghavan No. 72, 3rd Main, 1st Stage Industrial Suburb, Yeshwanthpur Bangalore-Karnataka-India Phone- 9880385770 Pincode : 560022 Email : sales1@ksinstruments.net
145-25000-A	JUNCTION BOX	SUCHITRA INDUSTRIES	NO-2,OPP-27 AECS LAYOUT 2ND STG REJAMAHALVILAS EXTN 2ND STG BANGALORE -- Phone- Pincode : Email : suchitra.industriesblr@gmail.com
145-25000-A	JUNCTION BOX	Shrenik & Company,	Mr. Mitesh Shah/Mr. Pulin Shah 39 A/3 ,Panchratna Industrial Estate, Sarkhej-Bavla Road Ahmedabad-Gujarat-India Phone- 9825024921 Pincode : 382213 Email : sales@pustron.com, pulin@sumip.com
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI-Maharashtra-INDIA Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai,-Maharashtra,-India, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA-WEST BENGAL-INDIA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE-KARNATAKA-www.hgurusouth.com Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	FORBES MARSHALL (HYD) LTD.	MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD-TELANGANA-INDIA Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	BOSE PANDA INSTRUMENTS PVT.LTD.	Mr. Partha Bose 44, Saheed Hemanta Kumar Bose, Sarani, Kolkata-West Bengal-India Phone- +91 33 2548 7220 Pincode : 700074 Email : parthabosebpi@gmail.com; bosepanda@vsnl.net
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol-Gujarat,-INDIA Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA-WEST BENGAL-INDIA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol-Gujarat,-INDIA Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com

145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Barksdale GmbH, Germany	Michael Weileder Dorn Assenheimer, Strasse 27 Reichelsheim--Germany Phone- +91-9999107840 Pincode : D-61203 Email : msingh@barksdale.de
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	DRESSER INDUSTRIES INC.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol- Gujarat-India Phone- 02764-233682 Pincode : 382729 Email : Nishit.patel@ashcroftindia.com
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INFOS (INDIA) LIMITED	MR.L.C.VENKATRANGAN/MR.B.KANNAN New No.17, II Floor, Adwave Towers, Dr.Sevalia Shivaji Salai, T.Nagar Chennai-TamilNadu-INDIA Phone- +91 44 24353407 Pincode : 600017 Email : delhi@infos.com
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	GENERAL INSTRUMENTS CONSORTIUM	Mr. Amarendra Kulkarni 194/195, Gopi Tank Road, Off. Pandurang Naik Marg, Mahim Mumbai-Maharashtra-India Phone- 9323195251 Pincode : 400016 Email : amarendra@general-gauges.com
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Kaustubha Udyog,	S.No. 36/1/1, Sinhgad Road, Vadgaon Khurd, Near Lokmat Press, Pune,- Maharashtra,-India, Phone- 020-24393577, Pincode : Email : pressure@vsnl.com,
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INFOS INDUSTRIES LIMITED	B-20-21, INDUSTRIAL AREA, MEERUT ROAD, GHAZIABAD-UP-INDIA Phone- 0120-2712016 Pincode : Email : mktg@infos.com
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SWITZER PROCESS INSTRUMENTS PVT. LTD.	B Kannan/V S Jayaprakash 9, SOUTH BOAG ROAD, II FLOOR, PB NO-1423, T.NAGAR, CHENNAI-TAMIL NADU-INDIA Phone- 044-24340999 / 24344 Pincode : 600017 Email : marketing@switzerinstrument.com
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA- KANSAS-USA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,
145-13000-A	TEMP. ELEMENT	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	D2/5, Mapusa Industrial Estate, Mapusa, Goa,-MAHARASHTRA-INDIA Phone- 09326054551, Pincode : 403507, Email : sumukh@goainstruments.com,
145-13000-A	TEMP. ELEMENT	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai,- Maharashtra,-India, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,
145-13000-A	TEMP. ELEMENT	DETRIVE INSTRUMENTATION & ELECTRONICS LTD.	320, TV INDUSTRIAL ESTATE, OFF.DR.A.BESANT ROAD, BEHIND GLAXO, WORLI, MUMBAI-MAHARASHTRA-INDIA Phone- 24934125,24938403 Pincode : 400025 Email : trivtech@vsnl.com
145-13000-A	TEMP. ELEMENT	PYRO ELECTRIC INSTRUMENTS GOA PVT.LTD.	M. D. BICHU/R. M. BICHU G.B, HILL CROWN APARTMENTS, COLLEGE ROAD, MAPUSA-GOA-INDIA Phone- 9326114601 Pincode : 403507 Email : priyanka.marketing@pyro-electric.in
145-13000-A	TEMP. ELEMENT	TM TECNOMATIC SPA	MR. ANTONIO NOVIELLO/Mrs. Enrica Bazzocc VIA DELLE INDUSTRIE, 36 CREMONA--ITALY Phone- 39037221574 Pincode : 26100 Email : info@tmtecnomatic.com
145-13000-A	TEMP. ELEMENT	TECHNO INSTRUMENTS	Abhijit Gohel/Mr. Amit Pandya Plot No. 1145/1, Uma Convector Lane, Santej,Ta. Kalol, Gandhinagar-Gujarat-India Phone- 9909925223 Pincode : 382721 Email : amit@techno-instruments.com
145-13000-A	TEMP. ELEMENT	Tempsens Instrument (I) Pvt Ltd	MR. V.P.RATHI/MR. HEMANT RATHI B-188A ROAD NO.5 , M.I.A UDAIPUR- RAJASTHAN-INDIA Phone- 09352420069 Pincode : 313003 Email : info@tempsens.com
145-13000-A	TEMP. ELEMENT	Thermal Instrument India Pvt. Ltd.	Mr. Raghavendra M. Kulkarni 194/195, Gopi Tank Road Behind Citylight Cinema,Mahim Mumbai-Maharashtra-India Phone- 09322664709 Pincode : 400016 Email : ramk@giconindia.com
145-13000-A	TEMP. ELEMENT	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhupura, Ajmer,-Rajasthan,-India, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,

145-13000-A	TEMP. ELEMENT	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI-Maharashtra-INDIA Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
145-10000-A	TEMPERATURE GAUGE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI-Maharashtra-INDIA Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
145-10000-A	TEMPERATURE GAUGE	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA-WEST BENGAL-INDIA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net
145-10000-A	TEMPERATURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai,-Maharashtra,-India, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,
145-10000-A	TEMPERATURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE-KARNATAKA-www.hgurusouth.com Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com
145-10000-A	TEMPERATURE GAUGE	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	D2/5, Mapusa Industrial Estate, Mapusa, Goa,-MAHARASHTRA-INDIA Phone- 09326054551, Pincode : 403507, Email : sumukh@goainstruments.com,
145-10000-A	TEMPERATURE GAUGE	GOA THERMOSTATIC INSTRUMENTS PVT.LTD.	FLAT -B , GF, HILL CROWN APTS., COLLEGE ROAD, MAPUSA-GOA-INDIA Phone- Pincode : 403525 Email : gtilworks@pyro-electric.in
145-10000-A	TEMPERATURE GAUGE	FORBES MARSHALL (HYD) LTD.	MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD-TELANGANA-INDIA Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com
145-10000-A	TEMPERATURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol-Gujarat,-INDIA Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com
145-10000-A	TEMPERATURE GAUGE	BUDENBERG GUAGE CO.LTD.	PO BOX-5, ALTRINCHAM CHESHIRE-UK-UK Phone- 0161-9285441 Pincode : WA14 4ER Email : dhbdelhi@vsnl.net
145-10000-A	TEMPERATURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA-WEST BENGAL-INDIA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in
145-15000-A	TEMPERATURE SWITCH	DRESSER INDUSTRIES INC.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol-Gujarat-India Phone- 02764-233682 Pincode : 382729 Email : Nishit.patel@ashcroftindia.com
145-15000-A	TEMPERATURE SWITCH	INDFOS (INDIA) LIMITED	MR.L.C.VENKATRANGAN/MR.B.KANNAN New No.17, II Floor, Adwave Towers, Dr.Sevalia Shivaji Salai, T.Nagar Chennai-TamilNadu-INDIA Phone- +91 44 24353407 Pincode : 600017 Email : delhi@indfos.com
145-15000-A	TEMPERATURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA-KANSAS-USA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,
145-15000-A	TEMPERATURE SWITCH	SWITZER PROCESS INSTRUMENTS PVT. LTD.	B Kannan/V S Jayaprakash 9, SOUTH BOAG ROAD, II FLOOR, PB NO-1423, T.NAGAR, CHENNAI-TAMIL NADU-INDIA Phone- 044-24340999 / 24344 Pincode : 600017 Email : marketing@switzerinstrument.com
145-15000-A	TEMPERATURE SWITCH	TOSHNIWAL BROTHERS PVT.LTD.	WORKS:TOSHNIWAL IND.PVT.LTD, INDUSTRIAL ESTATE MAKHUPURA, AJMER-RAJASTHAN-INDIA Phone- 441171 Pincode : 305002 Email : toshniwalprocess@gmail.com
145-14000-A	TRANSMITTERS	Honeywell Automation India Limited	Mr. Ritwij Kulkarni 917, INTERNATIONAL TRADE TOWER, NEHRU PLACE, NEW DELHI-DELHI-INDIA Phone- 9890200584 Pincode : 110019 Email : rajesh.chaudhary@honeywell.com

145-14000-A	TRANSMITTERS	V. AUTOMAT & INSTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI-DELHI-INDIA Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com
145-14000-A	TRANSMITTERS	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhupura, Ajmer,-Rajasthan,-India, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,
145-14000-A	TRANSMITTERS	YOKOGAWA INDIA LIMITED,	PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, BANGALORE,-KARNATAKA,-INDIA, Phone- 080-41586000, Pincode : Email : uday.shankar@in.yokogawa.com,
145-14000-A	TRANSMITTERS	SIEMENS LIMITED	Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai-Maharashtra-INDIA Phone- 0124 383 7377 Pincode : 400018 Email : ankit.varshney@siemens.com
145-14000-A	TRANSMITTERS	EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	Mr. Amit Paithankar/Vikram Raj Singh 206-210,BALARAMA BUILDING 2ND FLR. BANDRA EAST MUMBAI-MAHARASHTRA-INDIA Phone- 9619121500 Pincode : 400051 Email : vikramraj.singh@emerson.com
145-14000-A	TRANSMITTERS	SMART INSTRUMENTS LTD, BRAZIL	Agents: Digital Electronic Ltd. 74/11 'C' Cross Road MIDC Andheri (East) MUMBAI-MAHARASHTRA-INDIA Phone- 28208477 Pincode : 400093 Email : corp@delbby.rpgms.ems.vsnl.net.in
145-14000-A	TRANSMITTERS	SBEM PVT. LTD.	MR.N.K. BEDARKAR/MR. VISHWANATH KARANDIK 39, ELECTRONIC CO.OP. ESTATE, PUNE SATARA ROAD PUNE,-MAHARASHTRA-INDIA Phone- 912041030100 Pincode : 411009 Email : newdelhi@sbem.co.in
145-14000-A	TRANSMITTERS	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune-Maharashtra-INDIA Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com
145-14000-A	TRANSMITTERS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai,-Maharashtra,-India, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,
145-14000-A	TRANSMITTERS	NIVO CONTROLS PVT. LTD.	Mr. Praveen Toshniwal 104-115, Electronic Complex, Indore-M.P.-India Phone- 0731-4081305 Pincode : 452010 Email : sales@nivocontrols.com
145-14000-A	TRANSMITTERS	Moore Industries International Inc.	Leonard.W. Moore/ Matt Moren 16650 Schoenborn St. North Hills-CALIFORNIA-USA Phone- +1 818 830 5548 Pincode : 91343 Email : mmoren@miinet.com
145-14000-A	TRANSMITTERS	ABB LIMITED	MR. RAJIV GOVIL 14, MATHURA ROAD, FARIDABAD-HARYANA-INDIA Phone- 09971085678 Pincode : 121003 Email : vipin.swami@in.abb.com
145-14000-A	TRANSMITTERS	Endress + Hauser (India) Pvt. Ltd.,	Mr. Prakash Vaghela 215-216, DLF Tower 'A', Jasola District Centre, New Delhi,-New Delhi,-India, Phone- 9717593001, Pincode : 110025, Email : prakash.vaghela@in.endress.com,

PEM REGISTERED VENDOR

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

Notes:-

- 1) The above sub-vendor list is tentative & reference only. However sub-vendor list is subject to BHEL/end user approval without any commercial/delivery implication.
- 2) New subvendor if proposed by vendor during contract stage shall be subject to BHEL/end user approval without any commercial implication.

SI No.	Package Name	Vendor Name	LOCATION
1	LOCAL CONTROL PANELS	C and S ELECTRIC LTD.	New Delhi
		PYROTECH ELECTRONICS PVT. LTD.	Udaipur
		PROCON INSTRUMENTATION PVT. LTD.	Chennai
		INDUSTRIAL CONTROLS & APPLIANCES PVT LTD	Mumbai
2	ANALYSERS (ALL TYPES)	ABB INDUSTRIES AG	SWITZERLAND.
		ROSEMOUNT ANALYTICAL INC	IRVINE
		ENDRESS + HAUSER INDIA PVT. LTD.	MUMBAI
		HACH LANGE S.A.R.L CH-1222,	VESENAZ
		SWAN Analytische Instrumente AG, CH-8340	Hinwii
		METTLER-TOLEDO INDIA PVT. LTD.,	MUMBAI
		THERMO ORION INC	BEVERLY
3	UPS	EMERSON NETWORK POWER,	AMBERNATH
		EMERSON NETWORK POWER	PUNE
		HITACHI-HIREL,	GANDHINAGAR
		KELTRON,	TRIVANDRUM
		CONSUL NEOWATT POWER SOLUTIONS,	PUNE
5	MOTORISED ACTUATOR	ROTARK	UK
		AUMA	Bengaluru
		WEIR BDK VALVES	Hubli
		LIMITORQUE	Faridabad
6	AIR FILTER REGULATOR	PLACKA	Chennai
		SHAVO-NORGREN	Mumbai
		SCHRADER SCHORILL DUNCAN LTD.	Mumbai
		FAIRCHILD	USA
		SMC PNEUMATICS	Noida
7	SOLENOID VALVE	ASCO	USA
		ROTEX	Vadodra
		SCHRADER	Pune
		AVCON	Mumbai
		HERION-NORGREN	Germany
		IMI-NORGREN	Germany
		JAFFERSON	Argentina

Notes :-

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

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



TITLE : TECHNICAL SPECIFICATION
FOR
TRAVELLING BAND SCREENING SYSTEM

SPEC. NO. PE-TS-412-172-N001

SECTION : I
SUB-SECTION : ID

REV. NO. 00 DATE : 20.01.2017

Sheet 1 of 1

SECTION ID
DATA SHEET – A

	TITLE: TECHNICAL SPECIFICATION FOR TRAVELLING BAND SCREEN SYSTEM		SPEC NO: PE-TS-412-172-N001
	TECHNICAL DATA SHEET- A		SECTION : ID
			REV.NO: 00
S.no.	Description	Units	Data/Parameters
1	General		
1.1	Nos. of Traveling Band screening systems sets required	Nos.	2 Nos. for station
1.2	Nos. of Spray wash pumps common for all TBS	Nos.	2 Nos. (1 Working + 1 Standby)
1.3	Liquid handled		Sea Water (Analysis attached)
1.4	Type of Travelling Band Screen		Central Flow / Dual Flow
1.5	No. of speed levels for the TBS		Dual Speed
1.6	Hydraulic /Fluid coupling		Required
1.7	Manufacturer		By Bidder
1.8	Country of Origin		By Bidder
1.9	Drive Mechanism Safety Devices		By Bidder
2	Site Data		
2.1	FGL of the Site	m	RL 9.5 M
2.2	Elevation of the TBS Operating Floor	m	RL 10.0 M
2.3	Invert level of the Intake canal at TBS Inlet	m	RL 2.65 M
2.4	Min. W.L. at upstream of TBS	m	RL 5.35 M
2.5	Max. W.L. at upstream of TBS	m	RL 7.34 M
2.6	Clearance between bars of coarse bar screens at upstream of TBS(Not in Bidder scope)	mm	50
2.7	Maximum Chamber length & width for the TBS		4000 mm X 4000 mm
2.8	Design Mechanical temperature	Deg. Cel.	60
2.9	Spray wash/Flushing water source		Sea Water Intake Pump Discharge at Downstream of TBS
2.10	Pressure available at Tap off from discharge of purchaser's pump	mwc	30 MWC (g)
2.11	Max. Limit on shut off head of purchasers pump"	mwc	75 MWC (g)
3	Design Data		
3.1	Flow rate per stream		
-	Design/Normal	cum/hr	21000
-	Maximum	cum/hr	30225
3.2	No. of Speed levels of TBS		By Bidder (Minimum 2)
3.3	Protection Mechanism for Differential level $\geq$ Design Differential		Required (Type Details: By Bidder)
3.4	Travelling Band Screen clear opening	mm ²	5 mm X 5 mm
3.5	Screen wire mesh size (Diameter)	mm	2 (Minimum)

	TITLE: TECHNICAL SPECIFICATION FOR TRAVELLING BAND SCREEN SYSTEM		SPEC NO: PE-TS-412-172-N001
	TECHNICAL DATA SHEET- A		SECTION : ID
			REV.NO: 00
S.no.	Description	Units	Data/Parameters
3.6	Maximum water velocity through screen at min. WL	m/sec	0.6
3.7	Design differential head for Travelling Band screens	MWC	1.5
3.8	Maximum head loss permitted across TBS (i.e. between inlet and outlet) in clean condition at Min WL	MWC	0.1
3.9	Screen backwashing/flushing start "ON" Slow speed head loss across TBS	MWC	0.2
3.10	Screen backwashing/flushing start at fast speed	MWC	0.35
3.11	Corrosion Protection system		YES, with Sacrificial anode type Cathodic protection by Bidder. (Calculation for same to be furnished during contract stage for approval)
3.12	Service Factor for Gear Box		2 (minimum)
3.13	The velocities for Calculating the inside diameters shall be limited to		At Pump Suction: 1.8 m/sec At Pump Discharge and Headers: 2.4 m/sec
4	Spray Wash/Flushing system		
4.1	Spray wash/flushing water Piping		
	a) Material		• Pipe upto 150 NB: DUPLEX SS (AS PER SCH 40S FOR PIPE UPTO 50 NB & SCH 10S FOR PIPE SIZE ABOVE 50 NB) • Pipe 200 NB and Above: PIPING 200 NB AND ABOVE SHALL BE CARBON STEEL AS PER IS 3589 FABRICATED FROM IS 2062 PLATES INTERNALLY LINED WITH CORROCOAT OR POLYUREA COATING INSIDE OF 1500 MICRONS DFT.
	b) O.D.Xthickness of Stub at Terminal Point	mmXmm	219.1 X 6.4
4.2	Motor Rating of Spray Wash pump		Drive Motor shall be rated, at an ambient temp. of 50 Deg C, with a margin of at least 15 % over the shaft requirement at the duty condition or 10 % above the maximum load demand in the operating range whichever is higher including voltage and frequency variation.
5	Self Cleaning Strainer		
5.1	Screen perforation size	mm	1.1 mm (Max.) & less than spray Nozzle hole
5.2	Free flow area in the Screen basket		Minimum 110 % of Pipe Inlet Area
6	Debris Segregation and collection baskets		
6.1	Quantity	Nos.	2 (1 No. for each TBS)
6.2	Size(Preferable) - L x B x H	MxMxM	1 X 1 X 0.75
6.3	Discharge mechanism for emptying the basket		Lever operated bottom mechanism

	TITLE: TECHNICAL SPECIFICATION FOR TRAVELLING BAND SCREEN SYSTEM		SPEC NO: PE-TS-412-172-N001
	TECHNICAL DATA SHEET- A		SECTION : ID
			REV.NO: 00
S.no.	Description	Units	Data/Parameters
6.4	Type of arrangement for handling by Gantry crane provided		YES, By Purchaser
6.5	Basket frame plate thickness	mm	Min. 6
6.6	Wire Mesh size dia	mm	Min. 5
6.7	Guide Ways		
6.7.1	Number	Nos.	4
6.7.2	Type		Embedded in wall
7	Guide ways section		
7.1	Cathodic Protection to be provided against corrosion		YES, with Sacrificial anode type Cathodic protection by Bidder. (Calculation for same to be furnished during contract stage for approval)
7.2	Fixing method of guide ways to be supplied by Bidder		YES
8	Control and Instrumentation		
8.1	Control Panel		N.A (DDCMIS control). Only Starter cum Switchgear Panel to be provided by Bidder as per Section IC
8.2	Differential Level Switch		NA
8.3	Differential Level Transmitters		2 nos. per stream
8.4	Pressure Transmitters		
8.4.1	Spray wash Suction Header		2 nos . Common for all the pumps
8.4.2	Spray wash Discharge Header		2 nos . Common for all the pumps
8.5	Pressure Gauges		
8.5.1	Spray wash individual suction line		1 no for each pump
8.5.2	Spray wash individual discharge line		1 no for each pump
8.6	Differential Pressure Very High Switch		NA
8.7	Differential Pressure Transmitters		2 no . Per SCS
8.8	Differential Pressure Gauge		1 no . Per SCS
8.9	Limit Switches		1 No . Per suction valve (OPEN) of TBS Spray wash pumps
9	Operation		
9.1	Travelling Band Screening sysetm shall be designed for the following operation modes:		
9.1.1	Automatic start up initiated by High differential level		YES
9.1.2	Automatic start-up intiated by timer.		YES

	TITLE: TECHNICAL SPECIFICATION FOR TRAVELLING BAND SCREEN SYSTEM		SPEC NO: PE-TS-412-172-N001
	TECHNICAL DATA SHEET- A		SECTION : ID
			REV.NO: 00
S.no.	Description	Units	Data/Parameters
9.1.3	Manual mode of operation		YES
9.1.4	Provision for manual operation of the Travelling band shall be made in case of control system failure.		YES
10	Spray wash/Flushing system/Self Cleaning Strainer		
10.1	Spray wash pumps		Applicability By Bidder based upon calculations
10.2	No. of Spray wash pumps	Nos.	2 Nos. (1 W + 1 S)
10.4	No. of Self Cleaning Strainer	Nos.	2 Nos. (1 W + 1 S)
10.4	Whether Inserts/embedments/packers for Spray wash pumps/distributors and nozzles being supplied.		YES, By Bidder
10.5	Hydrostatic Test		
10.5.1	Hydrostatic test pressure for Spray wash/ flushing system/Self Cleaning Strainer	Bar (g)	Refer Section IIA
10.5.2	Test duration	Min	Refer Section IIA
11.0	Painting		
11.1	Surface preparation		Refer Section IIA
11.2	Primer coating thickness		Refer Section IIA
11.3	Finish coating thickness		Refer Section IIA
12.0	Materials of Construction		
12.1	Screen Wire mesh		SS 316L
12.2	Clamping Plates/Clamps		SS 316L
12.3	Basket frame and wire damping bars		SS 316L
12.4	Fasteners		SS 316L
12.5	Head Shaft		SS 316L
12.6	Foot Shaft (if applicable)		SS 316L
12.7	Head/Foot Sprockets		SS 316L
12.8	Carrying chain		SS 316L
12.9	Rubber Seals		As per Appendix-B of IS: 4622
12.10	Carrying chain & rollers		
12.10.1	Carrying Chain pins,&Bushing		Duplex SS for Pin SS 420 Hardened to at least 450 BHN for Bush or vice versa
12.10.2	Drive Chain type		Duplex Type of Approved Make
12.10.3	Drive chain pin/Bushing		Duplex SS for Pin SS 420 Hardened to at least 450 BHN for Bush or vice versa

	TITLE: TECHNICAL SPECIFICATION FOR TRAVELLING BAND SCREEN SYSTEM		SPEC NO: PE-TS-412-172-N001
	TECHNICAL DATA SHEET- A		SECTION : ID
			REV.NO: 00
S.no.	Description	Units	Data/Parameters
12.10.4	Shaft bearing Bushing spherical roller		SS 316L
12.10.5	Sprocket		SS 316L
12.10.6	Torque tube		SS 316L
12.10.7	Main supporting frame		SS 316L
12.10.8	Screen chain side bars		SS 316L
12.10.9	Drive Chain guard		SS 316L
12.10.10	Baffle plate in boot section		SS 316L
12.10.11	Guide ways / Anchor		SS 316L
12.10.12	Splash housing and refuse chute		SS 316L
12.10.13	Basket frame		SS 316L
12.11	Pipe & Nozzles		
12.11.1	Spray nozzle		SS 316L
12.11.2	Pipe work		
12.11.2.1	Upto 150 NB		Duplex SS
12.11.2.2	200 NB and above		Carbon Steel (Internally Coated with PolyUrea/CorroCoat)
12.12	Valves		
12.12.1	Valve 250 NB and above (Butterfly Valves only)		
12.12.1.1	Body & Disc		Duplex SS
12.12.1.2	Shaft		Duplex SS
12.12.1.3	Seal		Nitrile Rubber
12.12.1.4	Sealing ,retaining segment& internals		Duplex SS
12.12.2	Valve 200 NB and Below (Gate/Globe Valves only)		
12.12.2.1	Body, Bonnet & Trim		Duplex SS
12.12.3	Check Valves		
12.12.3.1	Body & Bonnet		Duplex SS
12.12.3.2	Seating surface &stem		Duplex SS
12.12.3.3	Disc		Duplex SS
12.12.3.4	Hinge Pin		Duplex SS
12.13	Spray Wash pump		
12.13.1	Spray Wash pump Casing		Duplex SS

	TITLE: TECHNICAL SPECIFICATION FOR TRAVELLING BAND SCREEN SYSTEM		SPEC NO: PE-TS-412-172-N001
	TECHNICAL DATA SHEET- A		SECTION : ID
			REV.NO: 00
S.no.	Description	Units	Data/Parameters
12.13.2	Spray Wash pump impeller		Duplex SS
12.13.3	Spray Wash pump Shaft		Duplex SS
12.13.4	Material of Gland Packing /Mechanical Seal (If applicable)		Braided Impregnated Teflon (Asbestos Free)
12.14	Debris Segregation and collection baskets		
12.14.1	Frame		SS 316L
12.14.2	Wire Mesh		SS 316L
12.14.3	Flanges		SS 316L
12.15	Self Cleaning Strainer		
12.13.1	Body		Carbon Steel (Internally Rubber Lined)
12.13.2	Screen / Wetted Fasteners		Duplex SS
12.16	All Non-Wetted Fastners		SS 316L
13.0	MANDATORY SPARES		AS PER ANNEXURE-A OF THIS DATASHEET
	NOTE: The material of construction of each component of the Travelling Band Screen shall be such as to resist erosion and give a long and satisfactory life for plant. MOC indicated above is minimum requirement and Bidder to provide suitable MOC for various components for the attached water analysis. For components not mentioned above, suitable compatible MOC shall be provided for the attached water analysis.		

ANNEXURE-A
2X660 MW ENNORE SEZ STPP
Mandatory Spares List for TBS Package

	<u>Spare Description</u>	<u>Unit</u>	<u>Quantity</u>
1	415 V Motor		
1.1	Terminal plates	Nos.	10 Nos. each for small motors upto 30 kW & 4 Nos. each for more than 30 kW
1.2	Heaters	Set	2 Sets
1.3	Greasing arrangements	Set	4 sets each type of motor
1.4	Motor of each type and rating	Nos.	1 No.
1.5	Bearings (DE and NDE) for each type and rating of motor	Set	4 Sets
2	C&I Spares		
2.1	Each type of lamps, PBs, ILPBs, fuse, MCB, MCCB used in the equipment/system.	Nos.	20% of installed of each type
2.2	Indicators, recorders and meters offered from each model for the project. These instruments shall be supplied with three sets of blank scales.	Nos.	10 % of Installed of each type/Model or a minimum of one number for each model and type, whichever is more
2.3	For skid mounted instruments	Nos.	10 % of total no. of instruments for each type and Model or a minimum of one number for each model and type, whichever is more
2.4	Temperature, Transmitters and Electronic Transmitters (For Pressure, DP, Temp, Flow, Level), Temperature, Pressure, Flow & Level Switch, safety switches, Gauges, meters, Transducer or any other instrument etc.	Nos.	10% of total number of Instruments/transducers offered for each model and type for the project or a minimum of one number, whichever is more.
2.5	Hooters, Buzzers, Cooling fans of each type.	Nos.	Ten (10) percent or 2 no. (Whichever is more)
2.6	Interface cables	Set	2 sets of each type/model
2.7	Power supply modules (AC to DC Convertors)	Nos.	10% or Five no. (Whichever is more) of each type/model

ANNEXURE-A
2X660 MW ENNORE SEZ STPP
Mandatory Spares List for TBS Package

2.8	Relay based Control Panels		
2.8.1	LEDs for indicating lights	Nos.	10% of qty installed.
2.8.2	Control circuit fuses/MCB/MCCB/Semiconductor Fuses	Nos.	300% of installed of each type, current rating.
2.8.3	Relays modules & contactors.	Nos.	20% spare of qty Installed of each type & rating.
2.9	Alarm Annunciation System		
2.9.1	logic modules, group card modules, power supply modules, Hooters and any other electronic module.	Nos.	20% spares of each type installed
2.9.2	un-engraved window boxes complete with LED etc.	Nos.	5% spares of each type installed
2.9.3	LEDs for annunciation facia windows and LEDs box assemblies offered for the project	Nos.	20% of qty installed
2.9.4	Annunciator hooter	Nos.	One (1) No. of each type
2.10	Erection Hardware		
2.10.1	Instrument valves	Nos.	Ten (10) percent of each type & Size installed
2.10.2	Condensate pots of each type & Size installed	Nos.	Ten (10) percent of total number of Installed or four numbers whichever is higher .
2.10.3	Manifold	Nos.	Ten (10) percent of each type & Size installed
2.10.4	Fittings	Nos.	Ten (10) percent of each type & Size installed

Notes for Mandatory Spares:

1. For C&I Mandatory Spare not covered above: Bidder to supply 10% or 1 no. (whichever is more) of each type of sensor/instrument, instrumentation/mechanical fittings etc for any other electronic system, feeder control cabinets, hydrastep (EWLI), Vibration Monitoring System, CCTV, C&I Lab Instruments, On line Carbon in Ash analyser system, On line Coal mass flow/speed measurement system, On line secondary air flow measurement system Mass Flow meter, Solid flow meter, 3 D Acoustic type level transmitters, Nucleonic & non nucleonic density transmitter etc.
2. All Spares mentioned at S.No. 1 are for 2x660 MW units (i.e for complete station).
3. All Spares mentioned at S.No. 2 are for each 660 MW unit (i.e per Unit).
4. Spares not applicable for the Package to be specifically quoted as "NOT APPLICABLE".
5. In case if such items of spares indicated as "not applicable" by bidder in its offer, are

ANNEXURE-A
2X660 MW ENNORE SEZ STPP
Mandatory Spares List for TBS Package

found applicable at a later date during execution of the project, such items of spares are to be supplied within the ordered cost of the mandatory spares.

6. Wherever % is indicated for the mandatory spares, the quantity shall be calculated for % of supply for total quantity for station, unless otherwise specified. The quantity to be reckoned for % indicated shall be rounded off to the next higher whole number. For example if the % arrived is 0.2 the quantity to be supplied shall be 1 and if the % arrived is 5.1 the quantity to be supplied shall be 6.
7. In respect of quantity mentioned as 'Set' means the total quantity of all the components/items used in particular equipment unless otherwise specified.

SEA WATER ANALYSIS

S.No.	Parameter	Unit	Value (Range)
1	General		
a	pH		7.94-8
b	Conductivity	millisiemens/cm	43.8-44.1
c	Temperature	Deg C	25-32
d	Turbidity	NTU	20-40
e	Total Organic carbon (total/ dissolved)	PPM of C	2.4-2.84
f	CO ₂	Mg/l	<2
g	TDS	Mg/l	39600-39740
h	BOD	Mg/l	10-12
i	COD	Mg/l	88-96
j	Oil & Grease	Mg/l	<10
k	Phenols	Mg/l	0.08-0.09
l	Free Residual Chlorine	Mg/l	<0.2
2	Cations		
a	Calcium	Mg/l	459-478
b	Magnesium	Mg/l	1510-1516
c	Sodium	Mg/l	10100-12000
d	Potassium	Mg/l	358-450
e	Ammonia	Mg/l	4.43-5.42
f	Strontium	Mg/l	12.9-12.4
g	Barium	Mg/l	1.55-1.58
h	Aluminum Total	Mg/l	1-1.8
i	Aluminum Dissolved	Mg/l	0.8-1.0
j	Manganese Total	Micro g/l	0.2-0.6
k	Manganese Dissolved	Micro g/l	0.1-0.2
l	Iron total	Micro g/l	220-260
m	Iron Dissolved	Micro g/l	Below detectable limit (detectable Limit : 10)
3	Anions		
a	Chloride	Mg/l	18994-19194
b	Sulphate	Mg/l	3710-3949
c	Nitrate	Mg/l	136-152
d	Nitrite	Mg/l	0.46-0.62
e	Bicarbonate	Mg/l	144-148
f	Carbonate	Mg/l	Nil
g	Fluoride	Mg/l	2.64-2.8
h	Boron	Mg/l	0.14-0.17
i	Phosphate	Micro g/l	240-380
j	Sulphide	Micro g/l	Below detectable limit (detectable Limit : 100)
k	Silica Dissolved	Micro g/l as SiO ₂	200-250
4	Heavy Metals		
A	Arsenic	Micro g/l	Below detectable limit (detectable Limit : 2)
B	Mercury	Micro g/l	Below detectable limit (detectable Limit : 1)
C	Cadmium	Micro g/l	120-130
D	Copper	Micro g/l	200-220
E	Nickel	Micro g/l	470-490
F	Molybdenum	Micro g/l	Below detectable limit (detectable Limit : 100)



5	Suspended Particle Size Range		
A	10 micron & above	Mg/l	Below detectable limit (detectable Limit : 10)
B	5 micron to 10 micron	Mg/l	Below detectable limit (detectable Limit : 10)
C	1 micron to 5 micron	Mg/l	Below detectable limit (detectable Limit : 10)
D	0.1 micron to 1 micron	Mg/l	20-26
6	Colloidal Particle Size Range		
A	SDI (10 Minutes)	-	10-20
B	SDI (5 Minutes)	-	20-40
7	Density of sea water	Kg/ cum	1030

Note : Unless otherwise indicated all elements shall be expressed in respective ionic form only.





TITLE : TECHNICAL SPECIFICATION
FOR
TRAVELLING BAND SCREENING SYSTEM

SPEC. NO. PE-TS-412-172-N001

SECTION : II
SUB-SECTION : IIA

REV. NO. 00 DATE : 20.01.2017

Sheet 1 of 1

**SECTION IIA
STANDARD TECHNICAL REQUIREMENT
FOR
MECHANICAL SYSTEMS**

	TITLE : STANDARD TECHNICAL SPECIFICATION TRAVELLING BAND SCREENING SYSTEM	SPECIFICATION NO. PE-TS-999-165-N004	
		SECTION : II A	
		REV. NO. 01	DATE : 14.06.16
		SHEET 1 OF 12	

1. **GENERAL**

This specification covers the design, performance and operational requirements, configuration and constructional features, manufacture, assembly, inspection and testing at the manufacturer's and/or his sub-contractor's works and painting for delivery of Travelling Band Screening System complete with all accessories as specified hereinafter.

2. **CODES AND STANDARD**

2.1. The design, manufacture and performance of travelling water screens and accessories shall comply with all currently applicable statutes, regulation and safety codes in the locality where the system will be installed. The equipment shall also conform to the latest applicable codes / standards. Nothing in this specification shall be construed to relieve the vender of this responsibility.

2.2. The design, materials, manufacture, inspection and testing of the travelling band screening system complete with all accessories, shall comply with the requirements of the latest versions of the following appropriate codes and standards.

2.2.1. IS/BS/DIN/US Standards regarding pumps, piping, flanges and others as necessary.

2.2.2. IS/BS/DIN/ASTM Standards for materials specification and testing procedures.

2.2.3. IS/BS/DIN/AWWA Standards for valves and the testing.

2.2.4. In case of any conflict between the above codes/standards and this specification, the later shall prevail and in case of any further conflict in the matter, the interpretation of the specification by the Engineer shall be final and binding.

3. **DESIGN**

Unless otherwise necessary, manufacturer's standard and proven models of the Travelling Band Screening System shall be supplied. The Travelling Band Screening System shall be capable of safe, continuous and trouble-free operation under all prevailing climatic and load conditions, for removal of floating and suspended matter coming along with the Raw Water intake coming from the Raw water source, before the Pumps. Vibration, noise, mechanical stresses shall be kept within allowable limits specified by relevant codes/standards. In design, due attention shall be given to ease of maintenance, repair and cleaning. Suitable corrosion allowance shall be provided whenever necessary. The Travelling Band Screening System shall consist of Travelling Band Screens, Spray wash/flushing pumps, differential level measuring system, instrumentations, control panel, interconnecting cables and others as necessary. The configuration of the Travelling Band Screening System shall be as specified in Data Sheet-A. Each travelling screen unit shall consist of appropriate quantity of screening elements arranged in a series to form an endless arrangement and fastened to two parallel vertical strands of chains. Material of construction shall be suitably selected to prevent Galvanic corrosion between various components.

3.1. The provision for sacrificial anode for corrosion protection shall be made for future use as specified in the Data sheet-A.

4. **CONSTRUCTION FEATURES**

4.1. **Main Frame**

4.1.1. The main frame of the screens shall be of rugged construction from structural material as mentioned in Data Sheet-A, not less than 10 mm thick.

4.1.2. All the members of the main frame shall be able to withstand the full hydraulic thrust on the upstream side when the screen becomes choked.

	TITLE : STANDARD TECHNICAL SPECIFICATION TRAVELLING BAND SCREENING SYSTEM	SPECIFICATION NO. PE-TS-999-165-N004	
		SECTION : II A	
		REV. NO. 01	DATE : 14.06.16
		SHEET 2 OF 12	

4.1.3. The main frames, sprocket shaft assemblies, bearings and all components of the drive system (except the shear pin. If provided) shall be designed to resist all forces without damage resulting from the full breakdown torque of the motor while the screen is jammed at any point in its travel.

4.1.4. Suitable guides shall be furnished for both sides of the screen frames so as to set in guideways on the sump pit walls.

4.1.5. Guide shall be continuous so that no open space exists for entrance of refuse between the screen frame and pit walls.

4.1.6. The guides shall prevent the front or ascending side of the chain from weaving.

4.1.7. The construction shall be such that no open space is left between the traveling screening media and the screen frame except the minimum running clearance required for satisfactory operation.

4.1.8. The main frame shall have a suitable provision for lifting the screen from the deck by means of an monorail hoist for erection and maintenance. Tension on the carrier chains shall be adjustable from accessible location near the head shaft by means of take-up screws made of stainless steel.

4.2. Screening Elements

4.2.1. The screening elements shall be constructed to offer minimum practical obstruction to free passage of water within the width of screen.

4.2.2. The screening elements shall have frames of welded steel construction provided with curved end plates/shrouds or any other suitable mechanism to provide sealing between adjacent screening elements and screening elements & the travelling band screen boots and frames, so as to stop the ingress of floating/suspended matter above guaranteed particle size as mentioned in the Data Sheet-A.

4.2.3. The screening materials shall be attached to the screen basket frames in a manner which provides easy replacement of screens without projecting bolting of clamping bars on the inlet side of the screen unit.

4.2.4. The min. size of the screening element wire and its material of construction mesh shall be as per Data Sheet-A.

4.3. Carrying Roller Chains

4.3.1. The screen chains to which the screening elements shall be fastened shall be made with side bars pins, bushings and rollers, with materials as per Data Sheet-A. The chain pitch shall be equal to the screening element's spacing.

4.3.2. The rollers shall be of high quality rust resistant material.

4.3.3. The pins, bushing and their respective side pars shall present a water tight, corrosion resistant assembly.

4.3.4. The chain side bar material shall be as per Data Sheet-A not less than 10 mm thick.
The chains shall be especially designed for travelling water screen service and shall operate

	TITLE : STANDARD TECHNICAL SPECIFICATION TRAVELLING BAND SCREENING SYSTEM	SPECIFICATION NO. PE-TS-999-165-N004 SECTION : II A REV. NO. 01 DATE : 14.06.16 SHEET 2 OF 12
4.1.3. The main frames, sprocket shaft assemblies, bearings and all components of the drive system (except the shear pin. If provided) shall be designed to resist all forces without damage resulting from the full breakdown torque of the motor while the screen is jammed at any point in its travel. 4.1.4. Suitable guides shall be furnished for both sides of the screen frames so as to set in guideways on the sump pit walls. 4.1.5. Guide shall be continuous so that no open space exists for entrance of refuse between the screen frame and pit walls. 4.1.6. The guides shall prevent the front or ascending side of the chain from weaving. 4.1.7. The construction shall be such that no open space is left between the traveling screening media and the screen frame except the minimum running clearance required for satisfactory operation. 4.1.8. The main frame shall have a suitable provision for lifting the screen from the deck by means of an monorail hoist for erection and maintenance. Tension on the carrier chains shall be adjustable from accessible location near the head shaft by means of take-up screws made of stainless steel. 4.2. Screening Elements 4.2.1. The screening elements shall be constructed to offer minimum practical obstruction to free passage of water within the width of screen. 4.2.2. The screening elements shall have frames of welded steel construction provided with curved end plates/shrouds or any other suitable mechanism to provide sealing between adjacent screening elements and screening elements & the travelling band screen boots and frames, so as to stop the ingress of floating/suspended matter above guaranteed particle size as mentioned in the Data Sheet-A. 4.2.3. The screening materials shall be attached to the screen basket frames in a manner which provides easy replacement of screens without projecting bolting of clamping bars on the inlet side of the screen unit. 4.2.4. The min. size of the screening element wire and its material of construction mesh shall be as per Data Sheet-A. 4.3. Carrying Roller Chains 4.3.1. The screen chains to which the screening elements shall be fastened shall be made with side bars pins, bushings and rollers, with materials as per Data Sheet-A. The chain pitch shall be equal to the screening element's spacing. 4.3.2. The rollers shall be of high quality rust resistant material. 4.3.3. The pins, bushing and their respective side pars shall present a water tight, corrosion resistant assembly. 4.3.4. The chain side bar material shall be as per Data Sheet-A not less than 10 mm thick. The chains shall be especially designed for travelling water screen service and shall operate		



TITLE :
STANDARD TECHNICAL SPECIFICATION
TRAVELLING BAND SCREENING
SYSTEM

SPECIFICATION NO. PE-TS-999-165-N004

SECTION : II A

REV. NO. 01

DATE 14.06.16

SHEET 3 OF 12

satisfactorily for the type water as specified in Data Sheet-A. Each pin shall be drilled for pressurized grease lubrication.

4.4. Shafts and Sprockets

4.4.1. Head Shaft

The head shaft shall be made of material as specified in Data Sheet-A and will have suitable bearings, provided with pressurized grease lubrication. The head shaft bearing shall be readily accessible and provided with an arrangement for maintaining adequate tension in the screen assembly and to compensate for any slackness during operation.

4.4.2. Sprocket Assemblies

Head sprocket wheel shall be constructed of material as specified in Data Sheet-A. Head wheels shall have replaceable tooth inserts of material as specified in Data Sheet-A and shall be interconnected using a torque tube or an extra large diameter solid shaft.

The tooth shall be adequately sized to withstand impact loading and starting torque of driving motor due to jamming. Bolts and nuts for attachment of the tooth to sprocket wheel shall be constructed of stainless steel.

4.4.3. Screen Drive Units

Each screen unit shall be provided with a drive unit assembly mounted on a welded steel based plate on top of the screen frame splash housing. The drive unit shall have an electric motor directly connected through an all metal flexible coupling to a reduction gear unit.

There shall be arrangement for jogging control of the screen drive motor in case of emergency.

The reduction gear unit shall be of the helical or herring bone gear type operation in an oil bath and completely enclosed in a waterproof, oil-tight housing.

The reduction gear unit shall drive the head sprockets through a hardened steel roller chain or it may be coupled as per manufacturer standard.

The drive sprocket (if supplied) on the output shaft of the reduction gear unit shall incorporate shear-pin safety device to provide protection against overload.

Alternatively suitable fluid coupling may also be incorporated in the screen drive system.

4.4.4. Guards

All couplings/ chain drives and exposed shafts shall be provided with suitable guards for protection of personnel.

4.4.5. Splash Housing

Each screen shall be provided with splash housing which will enclose the screens, spray system and chain drives above the deck level.

The housings including access doors shall be constructed of 5mm (minimum) nominal thickness moulded fibre glass reinforced with stainless steel.

Reinforcing shall be located on the inside of housing wherever possible. Enclosures for external drive chains and sprockets may be either integral with the main housing



TITLE :
STANDARD TECHNICAL SPECIFICATION
TRAVELLING BAND SCREENING
SYSTEM

SPECIFICATION NO. PE-TS-999-165-N004

SECTION : II A

REV. NO. 01

DATE : 14.06.16

SHEET 4 **OF** 12

enclosures or there may be separate stainless steel enclosures attached to the main housing.

Enclosures for external drive mechanism shall be of watertight designs and shall be furnished complete with shaft seals.

Inspection and access door hinges, latches and dogs shall be constructed of Carbon Steel and shall be designed to minimize the projection of these devices beyond the exterior surface of the main housing a system of Carbon steel or fibre glass deflector plates and seals shall be provided as necessary to direct the refuse into the refuse through and to prevent refuse from being deposited on the screen deck.

The refuse trough shall be provided common to all travelling water screens. Refuse removal shall be done by pressurized water or by other approved means.

4.4.6. Spray Cleaning/Back Wash System

A complete spray cleaning system with minimum two sets of spray system at different elevations shall be provided with each screen unit. The system shall be located near the top of the unit. The spray cleaning shall take place in the ascending run of the basket. The refuse chute shall be arranged accordingly.

The spray nozzles shall be removable and of non dogging type constructed from stainless steel. The nozzles shall be designed to pass any object passed by the travelling screen.

The spray nozzles headers and all feed piping between the spray nozzle header and the spray water valves shall be constructed of material as specified in Data Sheet-A. Flanged joints (125 lbs) shall be provided in the piping for easy removal of the spray nozzle headers. All counter flanges, gaskets, nuts, bolting etc. for terminal connections shall be furnished by the bidder.

4.5. Spray wash/Flushing Pumps and Accessories

4.5.1. Horizontal centrifugal type booster pumps (2x100% Capacity) shall be employed for screen washing, the pump shall be furnished complete with drive motors, base plates and other accessories along with suction and discharge pipe work. The total head developed by the pump shall meet the requirement of pressure at spray nozzle inlet including losses in the pipeline and fittings. Capacity of the pumps shall be so selected that it shall be possible to meet the spray water requirement of each screen with all rows of spray.

4.5.2. The design, and material features of construction of pumps shall be as per specification titled "Horizontal Centrifugal Pumps" annexed therewith. All the pumps shall be connected to one common discharge header through individual check valves and isolating valves. All the pumps shall be provided with pressure gauges on its discharge and suction lines and required instruments as per Control Philosophy described elsewhere.

4.5.3. The casing shall be designed to withstand 1.5 times the shut-off pressure or twice the operating pressure, whichever is higher.

	TITLE : STANDARD TECHNICAL SPECIFICATION TRAVELLING BAND SCREENING SYSTEM	SPECIFICATION NO. PE-TS-999-165-N004	
		SECTION : II A	
		REV. NO. 01	DATE : 14.06.16
		SHEET 5 OF 12	

4.5.4. The impeller shall be non-clog type. The impeller shall be secured suitably to the shaft and shall be retained against circumferential movement by keys, pins or lock rings. Loctite compound shall be applied after tightening of locknuts to prevent dislocation of impeller.

4.5.5. Replaceable type wearing ring shall be provided to prevent damage to the casing and impeller. Pumps shall be provided with mechanical seals to the extent feasible. If Gland packing is provided it should be of good quality to be provided to prevent leakage of water from pump glands. Shaft size selected shall take into consideration the critical speed which shall be away from the operating speed as recommended in applicable codes / standards. Renewable type fine finished shaft sleeves shall be integral with water thrower plates at the end and the length must extend beyond the outer faces of gland packing so as to distinguish between the leakage between shaft and the shaft sleeve and that past the seals / glands.

4.5.6. Bearings of adequate design shall be provided for taking the entire pump load arising from all probable conditions of continuous operation through its range of operation. The bearings shall be designed on the basis of 20,000 working hours minimum for the load corresponding to the duty point. Proper lubricating element does not contaminate the liquid being pumped. Bearings shall be easily accessible without disturbing the pump assembly.

4.5.7. Stuffing box of suitable design to permit replacement of packing without removing any part other than the gland shall be provided. The stuffing boxes shall be sealed / cooled by the fluid being pumped.

4.5.8. Pumps shall be of self-lubricated, self - sealed and self-cooled type. All pipework, fitters etc., for sealing, cooling and lubricating purpose shall be supplied and no external cooling/lubricating/sealing water will be supplied. Pump capacity shall take into account the cooling/lubricating/sealing water requirement.

4.5.9. All rotating components shall be statically and dynamically balanced.

4.5.10. The pump shall be designed such that pump impellers and other accessories of the pump, are not damaged due to flow reversal.

4.5.11. The pump shall be capable of developing the required total head at rated capacity for continuous operation. Also the pumps shall be capable of being operated to give satisfactory performance at any point on the head Vs. flow characteristic curve over a range or 40% of rated flow to 120 -130 % of rated flow.

4.5.12. The pump shall preferably be non-overloading type. The total head Vs. capacity curve shall be continuously rising from the maximum flow point towards shut-off without any zone of instability.

4.5.13. The pump shall run smoothly without undue noise and vibration. Peak to peak vibration limits and noise level shall be within the acceptable values of applicable codes/standards.

4.5.14. The pump and motor shafts shall be connected through a pin and rubber bush flexible type of couplings. Suitable coupling guards shall be provided for the couplings.

	TITLE : STANDARD TECHNICAL SPECIFICATION TRAVELLING BAND SCREENING SYSTEM	SPECIFICATION NO. PE-TS-999-165-N004	
		SECTION : II A	
		REV. NO. 01	DATE : 14.06.16
		SHEET 6 OF 12	

4.5.15. The pump shall be capable of being started with discharge valve fully opened. Motor rating shall be adequate for this condition.

4.5.16. Pump shall be Dynamically balanced to grade 6.3 or better as per ISO 1940 of assembled rotors.

4.5.17. Following shall be applicable for spray wash pumps

- Pumps with 1500rpm shall be preferred
- No negative tolerance shall be permitted in rated capacity & TDH.
- No negative tolerance shall be permitted in efficiency at rated capacity.
- The shut off head of pumps shall be at least 115% of pump rated TDH.

4.6. **Strainers on Spray wash System**

4.6.1. 2X100% strainers shall be provided on the common discharge header of the spray wash/back wash pumps, to prevent choking of the spray nozzles.

4.6.2. The Screen perforation size of Self Cleaning Strainer shall be lesser than spray nozzle opening but not to exceed 2 mm.

4.6.3. The free flow area in the Screen basket shall be at least 150% of inlet pipe.

5. **Differential Level Measuring System.**

Each travelling band screen shall be provided with a differential level measuring system for differential level across the Travelling Band screen, to check debris accumulation and to initiate the spray wash/flushing operation. This shall consist of a differential level switch/transmitter for automatic spray wash/flushing operation, a differential level indicator/display for manual observation.

The contacts for differential level switch/transmitter and for differential level gauge shall be independent so that in the event of failure of one, the other is available.

6. **Piping, Fittings, Valves, Distributors and Spray Nozzles.**

6.1. The Bidder shall supply all the piping, valves, fittings, pipe supports, flanges gaskets etc.

6.2. All piping shall be of ERW steel pipe as per IS-3589 (Pipes > 150 Nb) /IS – 1239 (Heavy Grade) Pipes ≤ 150 Nb).

6.3. The valve shall have cast body as specified in Data Sheet-A Counter flanges, gaskets, bolt, nuts, etc. shall be furnished by the bidder.

6.4. Interconnecting piping, valves, spray nozzles and other fittings shall be designed to withstand 2.0 times the operating pressure or 1.5 times the pump shut-off pressure whichever is higher.

6.5. Interconnecting piping shall be sized and routed optimally.

6.6. Necessary isolation valves, vent and drain valves for various equipments shall be provided. Valves shall conform to appropriate standards. Gland packing of all valve shall be of superior quality to avoid leakage.

6.7. Adequate number of spray nozzles be provided for proper distribution of spray along the width of the Travelling Band Screen. All joints in the spray wash system shall be flanged type for ease of removal during repairs or checking.

6.8. Bidder shall provide proper arrangement for draining and venting of the system.

6.9. **Debris Segregation Basket**

6.9.1. Debris Segregation Basket shall be kept at the end of the refuse trough to remove and



TITLE :
STANDARD TECHNICAL SPECIFICATION
TRAVELLING BAND SCREENING
SYSTEM

SPECIFICATION NO. PE-TS-999-165-N004

SECTION : II A

REV. NO. 01

DATE : 14.06.16

SHEET 7 **OF** 12

collect debris and shall have suitable arrangement of drainage of spray wash/flushing water.

6.9.2. Debris Segregation Basket shall have provision for handling using gantry crane/monorail etc. as specified in the Data Sheet-A.

6.9.3. Suitable emptying mechanism shall be made for emptying the Debris Segregation Basket by lifting it using the material Handling equipment as mentioned above and emptying the debris in a cart/truck etc. Bottom discharge baskets with a lever assisted discharge and a locking mechanism are preferable.

7. Actuators

Travelling Band Screening System shall be provided with actuators wherever necessary for various automatic operations. The actuators shall be electric motor operated and shall meet the requirements of the enclosed specification.

The actuator shall be provided with auxiliary hand wheel for manual operation in the event of control system failure.

8. Electric Motors

The drive motors for recirculation pump and other pumps if any shall conform to the requirements of the enclosed specification.

9. Instrumentation and Control System.

9.1. Complete instrumentation and control system for automatic operation of Travelling Band Screen, protection, interlocking, indication / annunciation of differential pressure and other malfunctions etc., shall be provided. This shall consist of adequate operational hardware, local control panel and interconnecting control and power cabling between the control panel and various equipments in the Travelling Band Screen.

9.2. The control panel shall house all necessary instruments, indicating / annunciation lamps, alarms, differential level indicator, timer, function selection switches, relays, protection and interlocking systems, start / stop push button etc., and shall be complete with internal wiring. The control panel shall meet the requirements of the enclosed specification.

9.3. Pressure gauges shall be provided at spray wash/flushing pump suction and discharge. All instrumentation shall be of reputed make and shall meet the requirements of the enclosed specifications.

10. Other Accessories

10.1. Counter flanges, flat faced slip on type, complete with gaskets, bolts and nuts etc., shall be supplied for inlet, outlet connections and all other terminal points. Fabrication, dimensions and drilling of the flanges shall conform to the codes/standards specified in Data Sheet-A

10.2. Spray wash/flushing pump with interconnecting piping and valves, shall be mounted on a frame/skid. For fixing the frame/skid, necessary foundation plates, bolts, nuts etc. shall be provided.

10.3. Suitable lifting arrangements shall be provided for various equipments of the travelling band system, for handling during erection and maintenance.

11. Materials of Construction

Materials of various equipments in the travelling band screening system shall be



TITLE :
STANDARD TECHNICAL SPECIFICATION
TRAVELLING BAND SCREENING
SYSTEM

SPECIFICATION NO. PE-TS-999-165-N004

SECTION : II A

REV. NO. 01

DATE : 14.06.16

SHEET 8 **OF** 12

corrosion resistant and consistent with the fluid handled. However, material specification for various components shall be equal to or superior to those specified in Data Sheet-A. Bidder to ensure that no galvanic corrosion takes place in any component, for the quality of water handled. Details of water analysis are as per Data Sheet-A.

12. Performance Requirements.

- 12.1. The Travelling Band Screening System shall perform satisfactorily under the flow and pressure drop/ differential level conditions specified in Data Sheet - A and shall be capable of removing the various forms of floating and suspended matter from raw water intake. The pressure drop/differential level maximum particle ingress shall be guaranteed that it will be permanently maintained as long as the system is in operation.
- 12.2. The travelling band screen, shall be designed such that the pressure drop/differential level across the system under clean conditions shall not be more than that specified in Data Sheet - A. The performance of the system shall be continuous with minimum number of flushing/spray wash operations.
- 12.3. The power consumption by Travelling Band screen actuators and spray wash/flushing pumps during various operations shall be minimum possible.

13. Operational Requirements.

- 13.1. The travelling band screens shall be designed with completely automatic system for continuous unattended operation.
- 13.2. The Travelling Water Screens shall be controlled through a Local Control Panel and shall be common for all Travelling Band Screens.
- 13.3. The drive motor shall have ample power to start the screen against design differential head as mentioned in the Data Sheet-A and operate continuously there after.
- 13.4. Level switches, alarms and annunciations shall be provided for each stream in Local Control Panel.
- 13.5. The start/stop facility, operation mode selection annunciation etc. for Travelling Band Screens shall be provided in LCP.
- 13.6. System interface of the Local control panel with the DDCMIS and other plant control panel as specified in the Data Sheet-A

14. Safety Features and Mechanism

- 14.1. Sufficient no. of safety mechanism of proven design shall be installed in the Travelling Band screening system to avoid failure in part or total of the system, if differential Level during choked condition exceeds the design differential Level.
- 14.2. Suitable (foolproof) isolation mechanism for drive isolation of TBS in case of overload, other than the motor overload shall also be provided.

15. PAINTING

- 15.1. The surface of SS, Gun metal, brass, bronze and non metallic component shall not be applied with any painting.
- 15.2. For all the steel surfaces, after surface preparation, shall be a coated with zinc chromite primer of min. thickness of 50 microns followed up with under coat of epoxy paint of min. thickness of 50 microns shall be applied. the top coat shall consist of two coats each of min. thickness of 50 microns of Epoxy paint and thus total thickness shall be min. 200

	TITLE : STANDARD TECHNICAL SPECIFICATION TRAVELLING BAND SCREENING SYSTEM	SPECIFICATION NO. PE-TS-999-165-N004	
		SECTION : II A	
		REV. NO. 01	DATE : 14.06.16
		SHEET 9	OF 12

microns. Epoxy paint shall be of approved make and quality.

- 15.3. The surface preparation of the various equipments / components of the travelling band Screens shall be done as per the agreed procedure and shall include the following :
- Removal of oil, grease, dirt and swarf etc.
 - Removal of rust and scale etc.
 - Sand blasting / shot blasting.

16. **SHOP INSPECTION AND TESTS**

16.1. **General**

- 16.1.1. Manufacturer shall conduct all tests and stage inspections as per the approved quality plan to ensure that the various equipments and other accessories of the travelling band screening system shall conform to the requirements of this specification and of the applicable codes / standards.
- 16.1.2. All materials used for manufacture / fabrication of the various equipments of the travelling band screening system shall be of tested quality. Relevant test certificates for chemical analysis, mechanical tests and heat treatment shall be made available before the final shop inspection. In case the relevant test certificates are not available, the manufacturer shall arrange to carry out the necessary tests as per the approved quality plan and applicable codes at his cost for which samples shall be identified by BHEL's representative.
- 16.1.3. All shop tests shall be conducted and test certificates / reports for the same shall be furnished to BHEL for approval.
- 16.1.4. Qualification of welding procedures and welders shall be as per applicable codes.

16.2. **Travelling Band Screen**

- 16.2.1. Chemical analysis, mechanical tests shall be carried out on materials used for body, Travelling Band Screen frame, Basket frame, screen and drive shaft and other appurtenances as per the applicable material specification standards.
- 16.2.2. All butt welded joints shall be subjected to radiographic/ ultrasonic testing as per applicable codes. However, all welded joints shall be subjected to 100% magnetic particle / penetrant testing to ensure freedom from defects.
- 16.2.3. Travelling Band Screen drive shafts shall be subjected to ultrasonic test as per ASTM-A388 for subsurface defects with acceptance norms as per applicable codes.

16.3. **Spray Wash/ Flushing Pump**

- 16.3.1. Chemical analysis, mechanical tests shall be carried out on materials used for casing, impeller, shaft, sleeves, wear rings etc., as per the applicable material specification standards.
- 16.3.2. The casting used for pump casing and impeller shall be sound, clean and free from porosity, blow holes, hard spots, cold shuts, distortion and other harmful defects. All accessible surfaces of the impeller shall be subjected to penetrant test as per ASTM-E165 for surface defects with acceptance norms as per ASME B&PV code, Section VIII, Division 1. No welding or repairs shall be carried out without prior permission of BHEL.
- 16.3.3. Pump shaft and sleeves shall be subjected to ultrasonic test as per ASTM - A388 for



TITLE :
STANDARD TECHNICAL SPECIFICATION
TRAVELLING BAND SCREENING
SYSTEM

SPECIFICATION NO. PE-TS-999-165-N004

SECTION : II A

REV. NO. 01

DATE : 14.06.16

SHEET 10 **OF** 12

sub-surface defects and penetrant test after finish machining as per ASTM-E165 for surface defects.

16.3.4. Wear rings shall be subjected to penetrant test as per ASTM-E165.

16.3.5. Pump impellers and rotor assembly shall be statically and dynamically balanced as per ISO-1940.

16.4. **Piping, Valves, Distributors, and Spray Nozzles.**

16.4.1. Chemical analysis, mechanical tests shall be carried out for materials used for piping, fittings, valves, distributors and injection nozzles.

16.4.2. All welded joints of distributors & injection nozzles shall be subjected to penetrant test as per ASTM-E165 for surface defects with acceptance norms as per ASME B&PV code, Section VIII, Division 1.

16.4.3. Inspection and testing of valves including leakage test shall be carried out as per the requirements of the applicable standards. Valve stem and ball shall be subjected to penetrant test as per ASTM-E165.

16.4.4. All materials for various nozzles, stubs, gaskets, nuts, bolts etc. shall be of tested quality and correlating test certificates for chemical and mechanical properties shall be furnished.

16.5. **Flanges**

16.5.1. Chemical and mechanical test certificates shall be furnished for flange materials.

16.5.2. In case of fabricated flanges, all the welds shall be subjected to 100% radiography.

16.5.3. In case of forged flanges, ultrasonic testing shall be carried out as per ASTM-A 388.

16.5.4. If the thickness of the plate used for flanges is 40mm or more, the same shall be checked ultrasonically as per ASTM-A435 to demonstrate the absence of lamination and lack of fusion etc.

16.5.5. Flanges shall be checked for edge preparation, fit up and satisfactory working with matching parts.

16.6. **Dimensional Checks.**

Dimensional checks for various equipments/components of the travelling band screening system shall be carried out as per assembly drawing approved by BHEL. Alignment and fit up of movable parts shall be checked.

16.7. **Hydrostatic Test**

Hydrostatic test shall be conducted on various assemblies / equipments / components (wherever applicable) of the Travelling Band Screening System at a pressure of 1.5 times and design pressure. The duration of the test shall be minimum 30 minutes.

16.8. **Functional Tests**

16.8.1. Various assemblies / equipments / components of the travelling band screening system shall be subjected to functional tests and the following shall be checked.

	TITLE : STANDARD TECHNICAL SPECIFICATION TRAVELLING BAND SCREENING SYSTEM	SPECIFICATION NO. PE-TS-999-165-N004	
		SECTION : II A	
		REV. NO. 01	DATE : 14.06.16
		SHEET 11	OF 12

16.8.2. Smooth and free operation of all movable parts.

16.8.3. Interlock and sequential operation.

16.8.4. Satisfactory operations of actuators torque switches, limit switches etc.

16.9. TESTING AT SITE

After completion of installation at site, the travelling band screening system will be tested to check that the travelling band screening system performance meets the requirements of this specification. Rectification of all defects shall have to be done by the supplier at no extra cost to the owner / purchaser. However, the owner / purchaser reserves the right to reject the equipments / parts not meeting the requirement if the deficiency still persists.

17. PERFORMANCE GUARANTEE

17.1. The travelling band screening system complete with all accessories shall be guaranteed to meet the performance requirements as given in Data Sheet-A / Section-C and also for trouble-free operation after commissioning.

17.2. If the guarantees specified are not achieved by the supplier, the owner / purchaser, at his discretion, reject or accept the travelling band screening system after assessing the liquidated damages listed in Section-C / Data Sheet-A against the supplier and such amounts shall be deducted from the contract price.

17.3. Performance of the control scheme as specified.

17.4. Performance of the travelling water screen shall be free from vibration.

18. QUALITY ASSURANCE & QUALITY PLAN

18.1. The travelling band screening and other accessories to be supplied, shall have assured quality and workmanship.

18.2. Typical quality plans are enclosed herewith this specification for bidder's guidance. The bidder shall furnish his own quality plan based on materials, equipments and components of the Travelling Band Screening System being offered

19. NAME PLATE AND TAG NUMBERS

19.1. Various equipments and sub assembly of travelling band screening system shall be provided with a permanently attached brass or stainless steel plate indicating the following details :-

- Design and maximum flow rates.
- Design and test pressures (wherever applicable)
- Design temperature.
- Empty and operating weights.

19.2. Each valve in the travelling band screening system shall be provided with a name plate indicating the following :-

- Service.
- Design and test pressures.
- Maximum flow and flow direction.
- Size.
- Engineer's Tag Number.

Tag Numbers will be indicated on the drawings submitted for approval during contract stage.



TITLE :
STANDARD TECHNICAL SPECIFICATION
TRAVELLING BAND SCREENING
SYSTEM

SPECIFICATION NO. PE-TS-999-165-N004

SECTION : II A

REV. NO. 01

DATE 14.06.16

SHEET 12 **OF** 12

19.3. Each motor shall be provided with a name plate indicating the following details

- a) Supply conditions.
- b) KW Rating.
- c) Make.

BHARAT HEAVY ELECTRICALS LIMITED												
PROJECT			PROJECT ENGINEERING MANAGEMENT									
VENDOR			STANDARD QUALITY PLAN						SECTION : II A			
									ITEM : TRAVELLING BAND SCREEN			
SL. NO.	COMPONENT & OPERATION	CHARACTERISTICS	CATEGORY	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.0	Raw Material											
1.1	Head shaft, foot shaft Sprocket tooth insert, etc.	a) Verification of Mill TC for mech. / chem. Props., dimensional check. b) Ultrasonic test c) DPT on machined surface	MA MA MA	Visual, Measurement Chemical analysis, Mech. Test NDT NDT	100% 100% 100%	Appvd. Data Sheet Drugs. ASTM A 388 ASME Sect V / ASTM E 165	Appvd. Data Sheet Drugs. ASTM A 388 ASME Sect VIII & No surface defect	Mtrl. Test cert./ Lab. Report Inspection report Inspection report	3 3 3	3 3 3	2 2 2	For bar < 50 mm dia shall be MPI tested instead of UT Test certificates shall be submitted Test certificates shall be submitted Test certificates shall be submitted
1.2	Carrying chain side bars	a) Verification of Mill TC for mech. / chem. Props., dimensional check. b) DPT on machined surface	MA MA	Visual, Measurement Chemical analysis NDT	100% 10%	Appvd. Data Sheet /Drugs. ASTM E 165	Appvd. Data Sheet /Drugs. No Surface Defects 100%	Mtrl. Test cert./ Lab. Report Inspection Report	3 3	3 3	2 2	Test certificates shall be submitted Test certificates shall be submitted
1.3	Guides, embedments	Verification of Mill TC for mech /chem. props., dimnl.		Visual, Measurement	100%	ASTM E 165	No Surface Defects	Inspection Report	3	3	2	Test certificates shall be submitted
1.4	Fasteners	a.)Surface finish b.)Chemical properties c.)Physical properties	MA MA MA	Visual Verification of MTC Verification of MTC	100% 1 per heat 1 per heat	SS : SA193 CS: IS 1364/ IS 1367 SS : SA193 CS: IS 1364/S 1367 SS : SA193 CS: IS 1364/S 1367	SS :SA193 Gr B8M CS: IS 1364/S 1367 SS :SA193 Gr B8M CS: IS 1364/S 1367 SS :SA193 Gr B8M CS: IS 1364/S 1367	Insp. Report Material Test Certificate Material Test Certificate	3 3 3	3 3 3	2 2 2	Test certificates shall be submitted Test certificates shall be submitted Test certificates shall be submitted
1.5	Rubber Seals	a.)Surface defects b.)Resistance to scratch	MA CR	Visual Hardness	100% 10% of the Lot	No surface defect As per approved Drawing/Data Sheet	No surface defect As per approved	Insp. Report Insp. Report	3 3	3 3	2 2	Test certificates shall be submitted
1.6	Screen wire mesh	a.) Visual, Dimension & b.) Chemical composition	MA MA	Visual, Dimension and verification of MTC	100% / 1 / Lot	As per approved Drawing/Data Sheet As per approved Drawing/Data Sheet	As per approved Drawing/Data Sheet As per approved Drawing/Data Sheet	Insp. Report / Material Test Certificate	3 3	3 3	2 2	Test certificates shall be submitted
1.7	Splash housing,	a.) Surface defects,	MA	Visual	100%	As per approved Drawing/Data Sheet	As per approved Drawing/Data Sheet	Insp. Report	3	3	2	
MANUFACTURER				LEGENDS								
SIGNATURE:				P - Perform W - Witness V - Verification 1 - BHEL 2 - Vendor 3 - Vendor's Sub Vendor MA - Major CR - Critical MTC - Material test certificate				REVIEWED BY				

BHARAT HEAVY ELECTRICALS LIMITED															
PROJECT		PROJECT ENGINEERING MANAGEMENT													
VENDOR		STANDARD QUALITY PLAN						SECTION II A ITEM : TRAVELLING BAND SCREEN							
SL. NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS			
									P	W	V				
1	2	3	4	5	6	7	8	9	10			11			
1.8	Head Sprocket	b.) Dimension	MA	Measurement	100%	As per approved Drawing/Data Sheet	As per approved Drawing/Data Sheet	Insp. Report	3	3	2	Test certificates shall be submitted			
		a.) Surface defects,	MA	Visual	100%	As per approved Drawing/Data Sheet	As per spec./		3	3	2				
		b.) Dimension c.) NDT	MA CR	Measurement Ultrasonic testing	100% 100%	Drawing As per approved procedure	Drawing As per approved procedure		3 3	3 3	2 2		Test certificates shall be submitted		
1.9	Reduction gearbox	a.)Routine test	CR	Functional test	100%	Appvd. Drgs./ Data Sheet	Appvd. Drgs./ Data Sheet	Supplier's test certificates	3	3	2	Test certificates shall be submitted			
		b.)Surface finish	MA	visual	100%	Appvd. Drgs./ Data Sheet	Appvd. Drgs./ Data Sheet		3	3	2				
1.10	Fluid coupling	a.)Routine test	CR	Functional test	100%	Appvd. Drgs./ Data Sheet	Appvd. Drgs./ Data Sheet	Supplier's test certificates	3	3	2	Test certificates shall be submitted			
		a.)Surface finish	MA	visual	100%	Appvd. Drgs./ Data Sheet	Appvd. Drgs./ Data Sheet		3	3	2				
1.11	Valves	Hydraulic Test of Body & Bonnet, Air Test, Phy./Chem. properties-TC reviews,	Major	Visual, Measurement Chemical analysis	100%	Appvd. Drgs./ Data Sheet	Appvd. Drgs./ Data Sheet	Supplier's test certificates/Test Report	3	3	2	Test certificates shall be submitted			
1.12	Spray wash Pump	a.) Run Test	CR	Performance Test	100%	Appvd. Drgs./ Data Sheet	Appvd. Drgs./ Data Sheet	Supplier's test certificates Test report	3	3	2	Test certificates shall be submitted			
		b.) Surface finish	MA	Visual	100%	Appvd. Drgs./ Data Sheet	Appvd. Drgs./ Data Sheet		3	3	2				
1.13	Self cleaning Strainer	a.)Run Test	CR	Performance Test	100%	Appvd. Drgs./ Data Sheet	Appvd. Drgs./ Data Sheet	Supplier's test certificates Test report	3	3	2	Test certificates shall be submitted			
		b.) Surface finish	MA	Visual	100%	Appvd. Drgs./ Data Sheet	Appvd. Drgs./ Data Sheet		3	3	2				
1.14	Control Instruments: a) Pressure gauge, b) Pressure switch, c) Diff. Pr. Gauge, d) Diff. Pr. Switch e) Diff. Pr. Transmitter, f) Diff. Level transmitter & g) diff. Level switch	a.) Accuracy Class b.) Calibration	MA	AS per approved make			Supplier's test certificates	3	3	2	Test certificates shall be submitted				
2.0	Inprocess Inspection		MA												
2.1	All machined items	Visual Dimension	MA	Visual Measurement	100%	As per appvd dwg.	As per appvd dwg.	Insp. Report	2	2	1				
MANUFACTURER				LEGENDS											
SIGNATURE:				P - Perform 1 - BHEL MA - Major				W - Witness 2 - Vendor CR - Critical				V - Verification 3 - Vendor's Sub Vendor MTC - Material test certificate			
				REVIEWED BY											

BHARAT HEAVY ELECTRICALS LIMITED												
PROJECT		PROJECT ENGINEERING MANAGEMENT						SECTION II A				
VENDOR		STANDARD QUALITY PLAN						ITEM : TRAVELLING BAND SCREEN				
SL. NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.2	Welding procedure qualification	Correctness of welding	CR	Scrutiny	100%	ASME sec IX	ASME sec.IX	QW-482 of ASME sec.IX	2	2	1	All TBS will be offered for functional test
2.3	Welder Performance Qualification	Ability of welder	MA	Welder qualification	100%	ASME sec IX	ASME sec IX	PQR / WPQ	2	2	1	
2.4	Root run	Surface defects	MA	LPE	100%	As per appvdprocedure	As per appvdprocedure	Insp. Report	2	2	1	
2.5	LPE on butt joints	NDE	MA	LPE	100%	As per appvdprocedure	As per appvdprocedure	Insp. Report	2	2	1	
3.0	Final inspection											
3.1	Part assembly and shop testing (Head shaft assy. with drive unit & few baskets)	No load dry run test	CR	Functional test	100%	As per appvd procedure	As per appvd procedure	Test Report	2	2,1	1	
3.2	a.)Sub-assembly (basket assly, link chain assly)	Dimension	MA	Measurement	100%	As per dwg	As per dwg	Insp. Report	2	2,1	1	
	b.) Sub-assembly (basket assly, link chain assly)	Surface defect	MA	Visual	100%	/Spec.	/Spec.	Insp. Report	2	2,1	1	
	c.) spray header assly & piping layout assly)	Leak test	CR	Hydro test	100%	As per appvd procedure	As per appvd procedure	Insp. Report	2	2,1	1	
3.3	Surface Preparation	Surface finish	MA	Visual	100%	As per appvd procedure	As per appvd procedure	Insp. Report	2	2,1	1	
	and Painting	Coating thickness	MA	DFT	At random	As per appvd procedure	As per appvd procedure		2	2,1	1	Report to be provided
3.4	Packing	Soundness & asthetics		Visual	100%	As per Manufacturer's practice	As per Manufacturer's practice		2	2	2	Packing as per attached Annexure-1.

MANUFACTURER				LEGENDS							
SIGNATURE:				P - Perform 1 - BHEL MA - Major				W - Witness 2 - Vendor CR - Critical			
				V - Verification 3 - Vendor's Sub Vendor MTC - Material test certificate				REVIEWED BY			



TITLE : TECHNICAL SPECIFICATION
FOR
TRAVELLING BAND SCREENING SYSTEM

SPEC. NO. PE-TS-412-172-N001

SECTION : II
SUB-SECTION : IIB

REV. NO. 00 DATE : 20.01.2017

Sheet 1 of 1

**SECTION IIB
STANDARD TECHNICAL REQUIREMENT
FOR
ELECTRICAL SYSTEMS**



TITLE :
GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO. PE-SS-999-506-E101
VOLUME NO. : II-B
SECTION : D
REV NO. : 00 DATE : 29/08/2005
SHEET : 1 OF 1

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.: PE-SS-999-506-E101 Rev 00

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 1 OF 4

1.0

INTENT OF SPECIFIATION

The specification covers the design, materials, constructional features, manufacture, inspection and testing at manufacturer’s work, and packing of Low voltage (LV) squirrel cage induction motors along with all accessories for driving auxiliaries in thermal power station.

Motors having a voltage rating of below 1000V are referred to as low voltage (LV) motors.

2.0

CODES AND STANDARDS

Motors shall fully comply with latest edition, including all amendments and revision, of following codes and standards:

IS:325	Three phase Induction motors
IS : 900	Code of practice for installation and maintenance of induction motors
IS: 996	Single phase small AC and universal motors
IS: 4722	Rotating Electrical machines
IS: 4691	Degree of Protection provided by enclosures for rotating electrical machines
IS: 4728	Terminal marking and direction of rotation rotating electrical machines
IS: 1231	Dimensions of three phase foot mounted induction motors
IS: 8789	Values of performance characteristics for three phase induction motors
IS: 13555	Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment
IS: 2148	Flame proof enclosures for electrical appliance
IS: 5571	Guide for selection of electrical equipment for hazardous areas
IS: 12824	Type of duty and classes of rating assigned
IS: 12802	Temperature rise measurement for rotating electrical machnines
IS: 12065	Permissible limits of noise level for rotating electrical machines
IS: 12075	Mechanical vibration of rotating electrical machines

In case of imported motors, motors as per IEC-34 shall also be acceptable.

3.0

DESIGN REQUIREMENTS

3.1

Motors and accessories shall be designed to operate satisfactorily under conditions specified in data sheet-A and Project Information, including voltage & frequency variation of supply system as defined in Data sheet-A

3.2

Motors shall be continuously rated at the design ambient temperature specified in Data Sheet-A and other site conditions specified under Project Information
Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment, under entire operating range including voltage & frequency variation specified above.

3.3

Starting Requirements

3.3.1

Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.

3.3.2

Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 2 OF 4
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 minimum 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: 4691 and 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.		

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 3 OF 4
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	

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 4 OF 4
4.9.1 Motors provided for similar drives shall be interchangeable. 4.9.2 Suitable foundation bolts are to be supplied alongwith the motors. 4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above. 4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956. 4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz. 4.9.6 Name plate with all particulars as per IS: 325 shall be provided 4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions. 5.0 INSPECTION AND TESTING 5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied. 5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser. 5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan. 5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A. 6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT a) OGA drawing showing the position of terminal boxes, earthing connections etc. b) Arrangement drawing of terminal boxes. c) Characteristic curves: (To be given for motor above 55 kW unless otherwise specified in Data Sheet). i) Current vs. time at rated voltage and minimum starting voltage. ii) Speed vs. time at rated voltage and minimum starting voltage. iii) Torque vs. speed at rated voltage and minimum voltage. For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling. iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.		

		QUALITY PLAN		CUSTOMER :		PROJECT			SPECIFICATION :			
				BIDDER/ :		TITLE			NUMBER :			
				VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION TITLE			
SHEET 1 OF 2		SYSTEM		ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION			VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	13
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	2	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1		
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	NOTE -1 & NOTE-3
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE			SPECIFICATION : NUMBER :			
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION : TITLE :			
		SHEET 2 OF 2		SYSTEM		ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION		VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	
NOTES: 1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON 2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. 3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY												
BHEL			PARTICULARS		BIDDER/VENDOR					BIDDER'S/VENDORS COMPANY SEAL		
			NAME									
			SIGNATURE									
			DATE									



TITLE : TECHNICAL SPECIFICATION
FOR
TRAVELLING BAND SCREENING SYSTEM

SPEC. NO. PE-TS-412-172-N001

SECTION : II
SUB-SECTION : IIC

REV. NO. 00 DATE : 20.01.2017

Sheet 1 of 1

**SECTION II C
STANDARD TECHNICAL SPECIFICATION
FOR
CONTROL & INSTRUMENTATION SYSTEMS**



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-1248:2 003 : Direct Acting Indicating Analog Elec Measuring Instruments.
- d) IS/IEC 60947:Part 1:2004 : Low Voltage switchgear & control gear: Part-I (General Rules)
- e) IS-8828:1996 : Circuit breaker for household and similar installations.
- f) IS-13947 (Part-I):1993 : Low Voltage switchgear & control gear : Part-I (General Rules)
- g) ISA-18.1:1979 : Annunciator Sequences and Specification
- h) NFPA-496:2003 : Purged & Pressurised Enclosure for Electrical Equipment in Hazardous Locations.

3.0 TECHNICAL REQUIREMENTS

3.1 Panel Construction

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

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

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

3.1.4 The salient features of construction shall be:

Sheet material: Cold rolled sheet steel

Frame thickness: Not less than 3.0mm

Enclosure thickness: Not less than 2.5 mm for load bearing sections (Mounted with instruments)
1.6 mm for doors and Not less than 2.0 mm for others

Panel Height: As Required

Gland plate thickness: 3.0mm

Base channel: ISMC 100 with anti-vibration mounting & foundation bolts.

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

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



SPECIFICATION FOR LOCAL PANELS

SPECIFICATION NO.: PE-SS -999- 145 -054A

VOLUME II B

SECTION D

REV. NO. 03

DATE : 16-09-2013

SHEET 2 OF 6

- 3.1.7 The class of protection shall be in accordance with IP-42 unless otherwise specified in the data sheet – A (No. PES-145-54A-DS1-0).
- 3.1.8 All steel surfaces shall be cleaned by sand / pellet blasting, treated for pickling, degreasing and phosphating etc. by seven tank method. The panel shall have a high quality finish and appearance. The panel shall be painted with two coats of primer followed by two coats of epoxy / synthetic enamel based final paint of color shade and finish as given in data sheet-A (No. PES-145A-DS1-0). Minimum thickness of the paint shall be 85 microns for external paint and 70 microns for internal paint.
- 3.1.9 The cable glands of the required size and type as given in data sheet-A (No. PES-145A-DS1-0) shall be supplied alongwith the Panel.
- 3.1.10 All operable and indicating devices shall be mounted on the front of the panel while aux. Relays / timers MCBs etc. required for realization of control logics shall be mounted on a mounting plate inside the panel. Auxiliary relays and timers etc. shall be grouped according to the control function. No operable or indicating devices shall be mounted below 750 mm and above 1800 mm (w.r.t. finished ground level). The devices shall be located in such a way so as to ensure easy access for operation / maintenance.
- 3.1.11 Single / dual control power supply feeders of voltage class as specified in data sheet-A (No. PES-145A-DS1-0) shall be provided by the purchaser. In case redundant power supply feeders are provided then auto changeover unit shall be mounted on the panel are in the panel supplier's scope. Where DC control power supply is specified an additional 240V, 50 Hz AC supply feeder for powering of space heater and lighting shall be provided by the purchaser. Suitable arrangement shall be provided inside the panel to receive and terminate the power supply feeder(s). For this purpose MCBs of suitable current rating shall be provided by the vendor. A supervisory relay along with a pilot lamp to indicate control supply 'ON' shall be provided on the panel. Any other power supply required for the operation of the devices mounted in the panel shall be arranged by the vendor.
- 3.1.12 The internal wiring shall be carried out with 1100 volt grade PVC insulated copper multi strand wire / flexible of 1.5mm² size. AC & DC wires shall be kept separate from each other. Separate coloured wires to be used for AC and DC circuits. All wires shall be properly numbered and identified with ferrules as per the Control scheme / wiring diagram. Wires shall be routed and run through PVC troughs.
- 3.1.13 Terminal blocks shall be clip on type, 1100 volts grade. Separate terminal blocks shall be used for AC & DC circuits. The terminals shall be suitable for terminating 0.5 mm² to 2.5mm² external cables. The TB points in terminal block shall be cage clamp type / screw type. The terminal for ammeters shall be provided with removable links for shorting CTs. Each terminal strip shall be provided with identification strip. The terminal shall not be mounted below 250 mm height from finished floor. The panel shall have ten (20) percent spare terminal.
- 3.1.14 The interior of each panel shall be suitably illuminated through fluorescent lamps / tube lights with shrouded cover of minimum 15W operable on 240V 50 Hz AC power supply through panel door switch. A 15 Amp. 3-pin Power receptacle shall be provided.
- 3.1.15 Suitable space heaters operable on 240 Volts 50 Hz AC power system shall be provided at the panel bottom. These shall be designed to maintain the panel temperature five (5) deg. C above the ambient temperature during maintenance shutdown. Suitable isolating and control devices comprising of MCB, thermostat etc. shall be provided for the space heater.
- 3.1.16 The panel shall be provided with a copper earth bus of 25 x 6 mm size running throughout the width of the panel. It shall be terminated internally with 10 mm bolts at extreme ends for connection to; main station earth. The panel mounted equipments / devices shall be connected to earth bus through green coloured PVC insulated stranded copper conductor of 2.5 mm² size.
- 3.1.17 Local Panel shall be provided with main name plate of 150 mm x 40 mm size having inscription of 20 mm height. The individual devices on the panels shall be as provided with separate name plate with inscription of 3 mm height. The instrument / devices shall be provided with stick on label plates inside the panel. The material of the main and individual labels shall be three (3) ply 3 mm thick Traffolyte



SPECIFICATION FOR LOCAL PANELS

SPECIFICATION NO.: PE-SS -999- 145 -054A

VOLUME II B

SECTION D

REV. NO. 03

DATE : 16-09-2013

SHEET 3 OF 6

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 repeating 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.



SPECIFICATION FOR LOCAL PANELS

SPECIFICATION NO.: PE-SS -999- 145 -054A

VOLUME II B

SECTION D

REV. NO. 03

DATE : 16-09-2013

SHEET 4 OF 6

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.



SPECIFICATION FOR LOCAL PANELS

SPECIFICATION NO.: PE-SS -999- 145 -054A

VOLUME II B

SECTION D

REV. NO. 03

DATE : 16-09-2013

SHEET 5 OF 6

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



SPECIFICATION FOR LOCAL PANELS

SPECIFICATION NO.: PE-SS -999- 145 -054A

VOLUME II B

SECTION D

REV. NO. 03

DATE : 16-09-2013

SHEET 6 OF 6

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 along with 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 along with 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 Sheet No. PES-145A-DS2-0
2. GA Drawing indicating layout of instruments, construction details, foundation details, cable gland plate along with 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, corrosion, 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 |



DATA SHEET FOR LOCAL PANELS

SPECIFICATION NO.: PE-SS-999-145-054A

VOLUME

SECTION

REV. NO.

02

DATE: 16.09.2013

SHEET

1 OF

3

TAG No. Qty.....

Data Sheet No.: PES-145A-DS1-0

Data Sheet A & B

DATA SHEET-A FOR LOCAL PANEL
(TO BE FILLED BY PURCHASER)

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

GENERAL

MANUFACTURER

CONSTRUCTION

☐ FOLDED ☐ WELDED
(As per requirement EDN)

ENCLOSURE SHEET THICKNESS

FRONT

☐ 2.0 mm

OTHER

☐ 2.0 mm

DOOR

☐ 1.6 mm

HEIGHT

☐ 2365 mm for stand alone panels. ☐ Other

OTHER

☐ Load bearing sheet front shall have 3mm thickness

TECHNICAL

INPUT POWER SUPPLY *

(ANY OTHER POWER REQUIREMENT
TO BE DERIVED FROM THIS SUPPLY ONLY)

☐ 240V 50 Hz AC ☐ 220V DC
☐ 415V 3 PHASE 3W ☐ 415V 3 PHASE 4W

NO. OF FEEDERS

☐ ONE ☐ TWO

STARTER WITH MCC

(CHECK WITH MAUX/ELEC)

☐ REQUIRED ☐ NOT REQUIRED

IPR POSITION

☐ MCC ☐ RELAY PANEL

CONTACT RATING OF RELAY

☐ 5 Amp, 230 V AC ☐ 0.25 Amp, 220V DC

CONTROL SUPPLY

☐ 110V AC ☐ 220V AC
☐ 220V DC ☐ Other.
(As per requirement)

ALARM ANNUNCIATOR WINDOW

(EXCLUDING SPARES)

____ NOS. (AS REQUIRED)

TEMP SCANNER

(IF REQUIRED –NO. OF CHANNELS TO BE
SPECIFIED UNDER SEC-C)

☐ REQUIRED ☐ NOT REQUIRED

PAINT TYPE

☐ EPOXY ENAMEL
☐ EPOXY POWDER COATED

MIMIC (TYPE OF MIMIC- MATERAIL, THICKNESS
TO BE SPECIFIED DURING DETAILED ENGG.)

☐ REQUIRED ☐ NOT REQUIRED

PANEL COLOUR (EXTERNAL)

☐ LIGHT GREY (Shade 631 IS-5)
☐ OPALINE GREEN (Shade 275) .

FINISH (EXTERNAL)

☐ MATT
☐ GLOSSY ☐ SEMI GLOSSY

PANEL COLOUR (INTERNAL)

☐ WHITE ☐ CREAM
☐ OFF WHITE

FINISH (INTERNAL)

☐ MATT
☐ GLOSSY ☐ SEMI GLOSSY

CLASS OF PROTECTION

☐ IP-42 (FOR INDOOR SERVICE)
☐ IP-55 (FOR OUTDOOR SERVICE) ☐ ANY
OTHER

CONTROL HARDWARE

☐ RELAY BASED



DATA SHEET FOR LOCAL PANELS

SPECIFICATION NO.: PE-SS-999-145-054A

VOLUME

SECTION

REV. NO.

02

DATE: 16.09.2013

SHEET

2 OF

3

TAG No. Qty.....

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

Data Sheet A & B

DATA SHEET-A FOR LOCAL PANEL
(TO BE FILLED BY PURCHASER)

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

FOUNDATION ARRANGEMENT

☐ FOUNDATION BOLTS ☐ ANCHOR
FASTENERS

WEIGHT OF PANEL (Kg.)

.....(Vendor to specify)

PANEL TYPE

☐ PRESSURISED ☐ UNPRESSURISED
As per Requirement

CABLE GLAND

☐ DOUBLE COMPRESSION

AMMETER (TYPE OF INPUT) *

☐ 1 Amp CT ☐ 4-20 mA
SCOPE OF SUPERVISION FOR
ERECTION & COMMISSIONING
☐ APPLICABLE ☐ NA

* TO BE CO-ORDINATED WITH PEM ELECTRICAL

PREPARED BY

CHECKED BY

APPROVED BY

NAME

AANCHAL CHOUDHARY

SACHIN SRIVASTAVA

MA MANSOORI

COMPANY SEAL

NAME:

DESIGNATION

SR.ENGR

DY.MNGR

D. GM

SIGNATURE

SIGNATURE:

DATE

16.09.2013

16.09.2013

16.09.2013

DATE:



DATA SHEET FOR LOCAL PANELS

SPECIFICATION NO.: PE-SS-999-145-054A

VOLUME

SECTION

REV. NO.

02

DATE: 16.09.2013

SHEET

3

OF

3

TAG No. Qty.....

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

Data Sheet C

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

GENERAL	MANUFACTURER				
	CONSTRUCTION		☐ FOLDED ☐ WELDED (As per requirement EDN)		
	ENCLOSURE SHEET THICKNESS	FRONT			
		OTHER			
		DOOR			
		HEIGHT			
	OTHER				
TECHNICAL	INPUT POWER SUPPLY				
	NO. OF FEEDERS				
	CONTACT RATING OF RELAY				
	TEMP SCANNER				
	CONTROL SUPPLY				
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)				
	PAINT TYPE				
	PANEL COLOUR (EXTERNAL)				
	FINISH (EXTERNAL)				
	TYPE OF MIMIC				
	MATERIAL OF MIMC				
	THICKNESS OF MIMIC				
	PANEL COLOUR (INTERNAL)				
	FINISH (INTERNAL)				
	CLASS OF PROTECTION				
	CONTROL HARDWARE				
	FOUNDATION ARRANGEMENT				
	WEIGHT OF PANEL (Kg.)				
	PANEL TYPE				
	CABLE GLAND				
	AMMETER (TYPE OF INPUT)				
SCOPE OF SUPERVISION					
NAME SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL NAME: SIGNATURE: DATE:	
	AANCHAL CHOUDHARY	SACHIN SRIVASTYAVA	MA MANSOORI		
	16.09.2013	16.09.2013	16.09.2013		

**SPECIFICATION
FOR
QUALITY ASSURANCE
&
TESTING**



STANDARD CHECK LIST FOR C&I INSTRUMENTS

CHECK LIST FOR TRANSMITTER

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECKS FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	VISUAL.						
	MODEL/TAG No						
2	PROCESS CONNECTION			P	W	V	
3	ACCURACY			P	W	V	
4	REPEATABILITY			P	W	V	
5	HYSTERESIS			P	W	V	
6	EFFECT OF TEMP VARIATION ON ACCURACY			P	W	V	
7	SPAN / ZERO ADJUSTMENT	ONE / TYPE		P	W	V	
8	EFFECT OF SUPPLY VOLTAGE VARIATION			P	W	V	
9	EFFECT OF LOADING (500 OHM METERS)			P	W	V	
10	HIGH PRESSURE TEST	SEE NOTE-1 BELOW		P	W	V	
11	BURN-IN TEST	ONE / TYPE		P	W	V	
12	DEGREE OF PROTECTION			P	W	V	
13	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- When material corelation are not available manufacturer's compliance to be provided.
- Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.



STANDARD CHECK LIST FOR C&I INSTRUMENTS

CHECK LIST FOR PRESSURE & DP GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	SENSOR TYPE						
	DIAL SIZE						
	MODEL NO/TAG NO						
	RANGE/SCALE						
	SWITCH CONTACT RATING & NOS.						
	END CONNECTION						
2	CALIBRATION			P	W	V	
	ACCURACY						
	REPEATABILITY						
	SET POINT ADJUSTMENT						
3	OVER PRESSURE & LEAK TEST	P	W	V			
4	OPERATION OF PRESSURE. RELIEF DEVICE	ONE	P	W	V		
5	REVIEW OF TC FOR	FOR LOT	V	V	V		
	MATERIALS OF SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST	V	V	V		
7	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW	V	V	V		

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out ROUTINE TEST on 100 %.
- When material correlation is not available, MFR's compliance to be provided
- Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.



STANDARD CHECK LIST FOR C&I INSTRUMENTS

CHECK LIST FOR PRESSURE SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	V	V	
	1.1 MODEL NO/TAG NO						
	1.2 RANGE						
	1.3 END CONN						
	1.4 NO. OF CONTACT						
2	CALIBRATION			P	V	V	
	2.1 REPEATABILITY						
	2.2 SET POINT ADJUSTMENT						
	2.3 DIFFERENTIAL						
3	OVER PR & LEAK TEST				P	V	V
4	ELECT. INSULATION/HV TEST	ONE		P	V	V	
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT		V	V	V	
	5.1 SENSOR						
	5.2 MOVEMENT						
	5.3 PROCESS CONNECTION						
	5.4 HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	REVIEW OF TC OF MICROSWITCH	FOR LOT		V	V	V	

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified by contractor and the same alongwith test certificates to be verified by BHEL



STANDARD QUALITY PLAN FOR LOCAL PANEL

STD QUALITY PLAN NO.: **PE-QP-999-145-I056**

VOLUME IIB

SECTION D

REV. NO. **01** DATE: **22-02-2008**

SHEET 1 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	
1.0	INCOMING Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	IS:1079 IS:513	IS:1079 IS:513	Test Certificate	3	---	2	
		2. Bend Test	CR	Mech. test	Sample	IS:1079 IS:513	IS:1079 IS:513	Log Book	2	---	---	
		3. Surface finish	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---	
		4. Waviness	MA	Visual	100%	Factory Standard	No Waviness	Log Book	2	---	---	
		5. Thickness	MA	Measurement	100%	BHEL Spec.	BHEL Spec.	Log Book	2	---	---	
		6. Mill marking	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	1	
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	IS:2062	IS:2062	Log Book	2	---	---	
		2. Surface Defects	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---	
		3. Straightness	MA	Measurement	100%	Factory Std.	Factory Std.	Log Book	2	---	---	
		4. Mill marking	MA	Visual	100%	IS:2062	IS:2062	Log Book	2	---	1	
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		2. IR and HV	MA	Electrical	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics

\$ P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor



PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL PANEL

STD QUALITY PLAN NO.: **PE-QP-999-145-I056**

VOLUME IIB

SECTION D

REV. NO. **01** DATE: **22-02-2008**

SHEET 2 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	
		3. Conductor a) Resistance b) Size c) Sheet colour	MA MA MA	Electrical Measurement Visual	100% 100% 100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	3	---	2	
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type 2. Verification of Test Certificates 3. Operation / Functional check 4. I.R. 5. H.V. 6. Calibration 7. Pick up / Drop off Voltage	CR CR CR MA MA MA MA	Visual Scrutiny of Type / Routine T.Cs. Electrical Electrical Electrical Electrical	Sample 100% Sample+ 100% 100% 100% 100% 100%	BHEL Spec. and BOM Relevant IS Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue	BHEL Spec. and BOM Relevant IS Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue	Log Book Log Book Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2 2 2	--- --- --- --- --- --- ---	--- --- --- --- --- 1 ---	+ for relay & contactors only @ for all components except relays & contactors.

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics

\$ P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor



PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL PANEL

STD QUALITY PLAN NO.: **PE-QP-999-145-I056**

VOLUME IIB

SECTION D

REV. NO. **01** DATE: **22-02-2008**

SHEET 3 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		2. Surface defects	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		3. IR / HV on Terminal Blocks	MA	Electrical	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
6.0	IN PROCESS Blanking / Bending / Forming	1. Dimensions	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Surface defects after bending	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	---	
7.0	Nibbling / Punching	1. Cutout Sizes	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Deburring	MA	Visual	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
8.0	ASSEMBLY Frame Assembly & Sheet fixing	1. Dimensions	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		2. Alignment	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		3. Welding Quality	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		4. Surface defects	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics

\$ P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor



PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL PANEL

STD QUALITY PLAN NO.: **PE-QP-999-145-I056**

VOLUME IIB

SECTION D

REV. NO. **01** DATE: **22-02-2008**

SHEET 4 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		3. Dipping / Removal Time	MA	Measurement	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		4. Surface quality after every dip	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		5. Primer after phosphating	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		6. Putty Application & Rubbing after primer	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		7. Paint first coat	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics

\$ P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor

 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL PANEL							STD QUALITY PLAN NO.: PE-QP-999-145-I056			
									VOLUME IIB			
									SECTION D			
									REV. NO. 01		DATE: 22-02-2008	
									SHEET 5		OF 7	
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	
10.	Panel Wiring	1. Wiring Layout	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		2. Wiring Termination (Crimped Lugs)	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		3. Ferrule numbers	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		4. Colour of wiring	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
		5. Size of Conductor	MA	Measurement	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
11.	Component Mounting	1. Correct components	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
		2. Fixing	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
12.	FINAL Final Inspection	1. Workmanship	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.
		2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		3. Components identification Marking / Name plates	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics

\$ P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor

बी एच ई एल BHEL PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL PANEL						STD QUALITY PLAN NO.: PE-QP-999-145-I056					
								VOLUME		IIB			
								SECTION		D			
								REV. NO.		01		DATE: 22-02-2008	
								SHEET		6		OF 7	
Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks	
									P	W	V		
		5. Dimensions	MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.	
		6. Door functioning	MA	Functional	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
		7. Paint Shade	CR	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
		8. Paint Thickness	CR	Measurement	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
		9. Workmanship of Gaskets	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1		
		10. Wiring Layout	MA	Visual	100%	BHEL approved drg.	BHEL approved drg.	Inspection Report	2	1	1		
		11. Wire Termination	MA	Pulling manually	Sample	-----	Firm termination	Inspection Report	2	1	1		
		12. Continuity	MA	Electrical	100%	-----	Continuity OK	Inspection Report	2	1	1		

LEGEND: * CR - Critical characteristics			\$ P - Agency Performing the Test.			1 - BHEL		
MA - Major characteristics			W - Agency Witnessing the Test.			2 - Vendor		
MI - Minor characteristics			V - Agency Verifying the Test.			3 - Sub-vendor		



STANDARD QUALITY PLAN FOR LOCAL PANEL

STD QUALITY PLAN NO.: PE-QP-999-145-I056	
VOLUME	IIB
SECTION	D
REV. NO.	01
DATE:	22-02-2008
SHEET	7 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	Type Test Certificate	3	---	1	
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant IS.	BHEL approved spec., drg., BOM & relevant IS.	Test Report	2	1	1	
15	FUNCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		2. Instrument Calibratio	CR	Electrical	10%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		3. Temperature rise	CR	Electrical	100%	BHEL approved spec/drg. & relevant IS.	BHEL approved spec/drg & relevant IS.	Inspection Report	2	1	1	

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics

\$ P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor



TITLE : TECHNICAL SPECIFICATION
FOR
TRAVELLING BAND SCREENING SYSTEM

SPEC. NO. PE-TS-412-172-N001

SECTION : III

REV. NO. 00

DATE : 20.01.2017

Sheet 1 of 1

SECTION III

(DOCUMENTS TO BE SUBMITTED BY BIDDER)

	TITLE : COMPLIANCE CERTIFICATE FOR TRAVELLING BAND SCREEN	SPEC. NO.	PE-TS- 412-172-N001
	PROJECTS: 2X660 MW ENNORE SEZ STPP	DATE:	20.01.2017
		SHEET	1 OF 2

COMPLIANCE CERTIFICATE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate and furnish same with the offer

- a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification and there are no exclusions with regard to same.
- b) There are no other deviations w.r.t. specification other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'.
- c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL/ Customer/Customer's Consultant approval and customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. Charges for 3rd party inspection (TUV/ equivalent) for imported components wherever required shall be included by bidder in the base price itself.
- d) Any drawing/ document/ data-sheet/ calculation/ Quality plan/ Instrumentation etc. if submitted along with the offer shall be considered for reference only, same shall be subject to BHEL / Customer/ Customer's Consultant approval in the event of order.
- e) The offered materials shall be either equivalent or superior to those specified in the specification.
For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.
- f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.
Prices for special tools & tackles, if any, shall also be included in the base price.
Recommended spares shall be quoted separately with price indicated separately.
- g) Charges for supervision during critical stages of erection, final installation checks before commissioning, commissioning of Travelling Band Screen and its accessories, Trial run and Site Testing shall be included by bidder in the base price itself.
- h) All sub - vendors shall be subject to BHEL/ Customer/Customer's Consultant approval in the event of order.
The guarantees of Equipments shall stand valid till the satisfactory completion of site demonstration testing & trial run its acceptance by BHEL/ Customer/Customer's Consultant.
- i) The offered Travelling Band Screens have been supplied by bidder in the past and are in operation at two sites for minimum period of two years as per pre-qualification requirement indicated in NIT. Any deviation to this criteria shall be suitably highlighted in the deviation schedule.
- j) The orientation of piping shall be finalised during detailed Engg.

	TITLE : COMPLIANCE CERTIFICATE FOR TRAVELLING BAND SCREEN	SPEC. NO.	PE-TS- 412-172-N001
	PROJECTS: 2X660 MW ENNORE SEZ STPP	DATE:	20.01.2017
		SHEET	2 OF 2

k) Electrical/ C&I :

- All motor ratings have been considered in line with Section -I.
- Supply of electrical viz. LT power cables, instrumentation and control cables, cable glands, lugs, cable trays etc. shall be as per specification. Their erection shall be done by BHEL.
- The junction boxes for termination of field instruments are included in bidder's scope. The instrumentation cable and cabling from instruments/ actuators to junction boxes is also included in bidder's scope.
- Valve actuators and controls shall be provided as specified in Data Sheet-A and Project specific requirements as specified in Sub-Section IB & Section IC.
- Alarms/ annunciations/ instruments shall be finalised during detailed engineering in the event of order which shall be subject to BHEL/ Customer/Customer's Consultant approval and shall be without any commercial implications to BHEL.

[illegible]

	TITLE: TECHNICAL SPECIFICATION FOR TRAVELLING BAND SCREEN SYSTEM		SPEC NO: PE-TS-412-172-N001
	TECHNICAL DATA SHEET- B		SECTION : III
			REV.NO: 00
S.no.	Description	Units	Data/Parameters
1	General		
1.1	Nos. of Traveling Band screening systems sets required	Nos.	
1.2	Nos. of Spray wash pumps common for all TBS	Nos.	
1.3	Liquid handled		
1.4	Type of Travelling Band Screen		
1.5	No. of speed levels for the TBS		
1.6	Hydraulic /Fluid coupling		
1.7	Manufacturer		
1.8	Country of Origin		
1.9	Drive Mechanism Safety Devices		
2	Site Data		
2.1	FGL of the Site	m	
2.2	Elevation of the TBS Operating Floor	m	
2.3	Invert level of the Intake canal at TBS Inlet	m	
2.4	Min. W.L. at upstream of TBS	m	
2.5	Max. W.L. at upstream of TBS	m	
2.6	Clearance between bars of coarse bar screens at upstream of TBS(Not in Bidder scope)	mm	
2.7	Maximum Chamber length & width for the TBS		
2.8	Design Mechanical temperature	Deg. Cel.	
2.9	Spray wash/Flushing water source		
2.10	Pressure available at Tap off from discharge of purchaser's pump	mwc	
2.11	Max. Limit on shut off head of purchasers pump"	mwc	
3	Design Data		
3.1	Flow rate per stream		
-	Design/Normal	cum/hr	
-	Maximum	cum/hr	
3.2	Total Effective area at Min. water level	m ²	
3.3	Total Effective area at Max. water level	m ²	
3.4	No. of Speed levels of TBS		

	TITLE: TECHNICAL SPECIFICATION FOR TRAVELLING BAND SCREEN SYSTEM		SPEC NO: PE-TS-412-172-N001
	TECHNICAL DATA SHEET- B		SECTION : III
			REV.NO: 00
S.no.	Description	Units	Data/Parameters
3.5	Screen Wire Mesh Size (Diameter)	mm	
3.6	Slow Rotating speed	rpm	
3.7	Fast rotating speed	rpm	
3.8	TBS Length	m	
3.9	TBS Width	m	
3.10	TBS Depth	m	
3.11	Protection Mechanism for Differential level $\geq$ Design Differential		
3.12	Type of protection mechanism		
3.13	Differential Head across TBS at Min. W.L		
	At Design flow		
	At Max Flow		
3.14	Differential Head in Clean Condition	MWC	
3.15	Differential Head in Choked Condition(Start of slow speed backwash/flushing)	MWC	
3.16	Differential Head in Choked Condition(Start of fast speed backwash/flushing)	MWC	
3.17	Water velocity through TBS at Mn. W.L at design flow and clean condition	m/sec	
3.18	Design pressure of Spray Wash system		
3.19	Travelling Band Screen clear opening	mm ²	
3.2	Maximum water velocity through screen at min. WL	m/sec	
3.21	Design differential head for Travelling Band screens	MWC	
3.22	Maximum head loss permitted across TBS (i.e. between inlet and outlet) in clean condition at Min WL	MWC	
3.23	Screen backwashing/flushing start "ON" Slow speed head loss across TBS	MWC	
3.24	Screen backwashing/flushing start at fast speed	MWC	
3.25	Corrosion Protection system		
3.26	Service Factor for Gear Box		
3.27	The velocities for Calculating the inside diameters shall be limited to		
4	Spray Wash/Flushing system		
4.1	Spray wash/flushing water terminal point pipe		
	a) Material		

	TITLE: TECHNICAL SPECIFICATION FOR TRAVELLING BAND SCREEN SYSTEM		SPEC NO: PE-TS-412-172-N001
	TECHNICAL DATA SHEET- B		SECTION : III
			REV.NO: 00
S.no.	Description	Units	Data/Parameters
	b) O.D.Xthickness	mmXmm	
4.2	Motor Rating of Spray Wash pump		
5	Self Cleaning Strainer		
5.1	Quantity		
5.2	Screen perforation size	mm	
5.3	Free flow area in the Screen basket		
6	Submersible sump pump		
6.1	Capacity	cum/hr	
6.2	Head	MWC	
7	Debris Segregation and collection baskets		
7.1	Quantity	Nos.	
7.2	Size(Preferable) - L x B x H	MxMxM	
7.3	Discharge mechanism for emptying the basket		
7.4	Type of arrangement for handling by Gantry crane provided		
7.5	Basket frame plate thickness	mm	
7.6	Wire Mesh size dia	mm	
7.7	Guide Ways		
7.7.1	Number	Nos.	
7.7.2	Type		
8	Guide ways section		
8.1	Frame work section size		
8.2	Whether provision for sacrificial anode provided for future		
8.3	Thickness of frame plates	mm	
8.4	Section for chain guide ways		
8.5	Plate thickness for chain guide ways	mm	
8.6	Fixing method of guide ways to be supplied		
9	Splash Housing & refuse trough		
9.1	Required Section of refuse trough (pl. provide dimensional sketch) along with required gradient		
10	Head Shaft & Sprocket		

	TITLE: TECHNICAL SPECIFICATION FOR TRAVELLING BAND SCREEN SYSTEM		SPEC NO: PE-TS-412-172-N001
	TECHNICAL DATA SHEET- B		SECTION : III
			REV.NO: 00
S.no.	Description	Units	Data/Parameters
10.1	Head shaft diameter	mm	
10.2	Foot shaft diameter	mm	
10.3	Connection details of Head sprocket with Head shaft (Keyed/Shrink fit/ others pl. specify)		
10.4	Connection details of Foot sprocket with FOOT shaft (Keyed/Shrink fit/ others pl. specify)		
10.5	Nos. of teeth on Head sprocket	Nos.	
10.6	Nos. of teeth on Foot Sprocket	Nos.	
10.7	Type of Sprocket teeth, whether insert are being used or not , or two teeth construction		
10.8	Centre distance between head shaft & foot shaft	mm	
10.9	Type of suport &Bearing for the Head shaft		
10.10	Type of support &Bearing for the foot shaft		
10.11	Max. power demand at Head shaft at Design differential head		
11	Control and Instrumentation		
11.1	Control Panel		
11.2	Differential Level Switch		
11.3	Differential Level Transmitters		
11.4	Pressure Transmitters		
11.4.1	Spray wash individual suction line		
11.4.2	Spray wash Suction Header		
11.4.3	Spray wash Discharge Header		
11.4.4	Spray wash individual discharge line		
11.5	Pressure Gauges		
11.5.1	Spray wash individual suction line		
11.5.2	Spray wash pump suction header		
11.5.3	Spray wash pump discharge header		
11.5.4	Spray wash individual discharge line		
11.6	Differential Pressure Very High Switch		
11.7	Differential Pressure Transmitters		

	TITLE: TECHNICAL SPECIFICATION FOR TRAVELLING BAND SCREEN SYSTEM		SPEC NO: PE-TS-412-172-N001
	TECHNICAL DATA SHEET- B		SECTION : III
			REV.NO: 00
S.no.	Description	Units	Data/Parameters
11.8	Differential Pressure Gauge		
11.9	Limit Switches		
12	Operation		
12.1	Travelling Band Screening sysetm is designed for the following operation modes:		
12.1.1	Automatic start up initiated by High differential level		
12.1.2	Automatic start-up intiated by timer.		
12.1.3	Manual mode of operation		
12.1.4	Provision for manual operation of the Travelling band is made in case of control system failure.		
13	TBS Drive motor		
13.1	Make &Rating		
13.2	Max. Power output of motor	KW	
13.3	Speed	rpm	
13.4	Coupling Type		
14	Reduction Gear Box		
14.1	Make		
14.2	Gear ratio/Speed ratio		
14.3	Type		
14.4	Duty Factor		
14.5	Drive mechanism		
14.5	Type fo drive mecahnism to transmit power from Gear Box to Head Shaft		
15	Carrying Roller Chain Mechanism		
15.1	Type of chain		
15.2	No. of chains per TBS	Nos.	
15.3	Type		
15.4	Chain pitch	mm	
15.5	Chain side bar size	mm	
15.6	Chain roller diameter	mm	
15.7	Chain Pin diameter	mm	
15.11	Chain Bushing diameter	mm	

	TITLE: TECHNICAL SPECIFICATION FOR TRAVELLING BAND SCREEN SYSTEM		SPEC NO: PE-TS-412-172-N001
	TECHNICAL DATA SHEET- B		SECTION : III
			REV.NO: 00
S.no.	Description	Units	Data/Parameters
15.12	Method of chain pin lubrication		
15.13	How weaving action of chain is prevented?		
15.14	Type&nos. of arrangement for adjusting chain tension per TBS		
16	Screening Elements		
16.1	Type of screening elements		
16.2	No. of screening Element rows per TBS	Nos.	
16.3	No. of Screening Element per row	Nos.	
16.4	Total no. of screening elements per TBS	Nos.	
16.5	Dimensions of Screening elements (LXB)	mmXmm	
16.6	Clearance between successive baskets	mm	
16.7	Wire mesh size Dia	mm	
16.8	Clearance between rotating screening elements and static components	mm	
16.9	Type of sealing and its material		
16.10	How trash bypassing is avoided?(give sketch w.r.t to basket sketch)		
17	Spray wash/Flushing system		
17.1	Spray wash pumps		
17.2	No. of Spray wash pumps	Nos.	
17.3	Type & make of pump		
17.4	Design flow	cum/hr	
17.5	Design TDH of pump	MWC	
17.6	Design pump speed	rpm	
17.7	Design pump efficiency	%	
17.8	Type of impeller		
17.9	Whether Inserts/embedments/packers for Spray wash pumps/distributors and nozzles being supplied.		
18.0	Spray Nozzles		
18.1	Nos. provided per TBS	Nos.	
18.2	Pitching of nozzles	Min	
18.3	Size of the nozzle	mm	
18.4	Spray Nozzle Effective envelope	m2	
18.5	Max. Flow rate for each nozzle	cum/hr	

	TITLE: TECHNICAL SPECIFICATION FOR TRAVELLING BAND SCREEN SYSTEM		SPEC NO: PE-TS-412-172-N001
	TECHNICAL DATA SHEET- B		SECTION : III
			REV.NO: 00
S.no.	Description	Units	Data/Parameters
18.6	Spray Nozzle Effective envelope		
19.0	Drive motor for Spray wash/Flushing pump		
19.1	Type and make of motor		
19.2	Rating	KW	
19.3	Speed	rpm	
20.0	Motorised valves- Spray Wash header		
20.1	Nos. provided per TBS	Nos.	
20.2	Type & make of motor		
20.3	Motor rating	KW	
20.4	Whether supports (whenever necessary) complete with foundation plates, bolts,nuts,inserts etc. are included in the offer.		
21.0	Counter flanges:		
21.1	Counter flanges complete with gaskets, bolts and nuts etc. for all terminal points		
22.0	Tests		
22.1	Whether all the tests and inspections to be carried out at the shop are mentioned in the Quality plan submitted by bidder?		
23.0	Hydrostatic Test		
23.1	Hydrostatic test pressure for Spray wash/ flushing system/Self Cleaning Strainer	Bar (g)	
23.2	Test duration	Min	
24.0	Painting		
24.1	Surface preparation		
24.2	Primer coating thickness		
24.3	Finish coating thickness		
25.0	Weights:		
25.1	Weight of the heaviest equipment/assembly to be handled including filled up debris segregation basket	Kgs	
25.2	Recommended Gantry crane capacity	Kgs	
26.0	Civil loading Data		
26.1	Travelling Band Screen(per screen)		
26.2	Static load		
26.3	Dynamic load		

	TITLE: TECHNICAL SPECIFICATION FOR TRAVELLING BAND SCREEN SYSTEM		SPEC NO: PE-TS-412-172-N001
	TECHNICAL DATA SHEET- B		SECTION : III
			REV.NO: 00
S.no.	Description	Units	Data/Parameters
26.4	Spray wash/Back flushing pump (per pump)		
26.5	Static load		
26.6	Dyanamic load		
27.0	Materials of Construction		
27.1	Screen Wire mesh		
27.2	Clamping Plates/Clamps		
27.3	Basket frame and wire damping bars		
27.4	Fasteners		
27.5	Head Shaft		
27.6	Foot Shaft (if applicable)		
27.7	Head/Foot Sprockets		
27.8	Carrying chain		
27.9	Rubber Seals		
27.10	Carrying chain & rollers		
27.10.1	Carrying Chain pins,&Bushing		
27.10.2	Drive Chain type		
27.10.3	Drive chain pin/Bushing		
27.10.4	Shaft bearing Bushing spherical roller		
27.10.5	Sprocket		
27.10.6	Torque tube		
27.10.7	Main supporting frame		
27.10.8	Screen chain side bars		
27.10.9	Drive Chain guard		
27.10.10	Baffle plate in boot section		
27.10.11	Guide ways / Anchor		
27.10.12	Splash housing and refuse chute		
27.10.13	Basket frame		
27.11	Pipe & Nozzles		
27.11.1	Spray nozzle		
27.11.2	Pipe work		

	TITLE: TECHNICAL SPECIFICATION FOR TRAVELLING BAND SCREEN SYSTEM		SPEC NO: PE-TS-412-172-N001
	TECHNICAL DATA SHEET- B		SECTION : III
			REV.NO: 00
S.no.	Description	Units	Data/Parameters
27.11.2.1	Upto 150 NB		
27.11.2.2	200 NB nd above		
27.12	Valves		
27.12.1	Valve 250 NB and above (Butterfly Valves only)		
27.12.1.1	Body & Disc		
27.12.1.2	Shaft		
27.12.1.3	Seal		
27.12.1.4	Sealing ,retatining segment& internals		
27.12.2	Valve 200 NB and Below (Gate/Globe Valves only)		
27.12.2.1	Body, Bonnet & Trim		
27.12.3	Check Valves		
27.12.3.1	Body & Bonnet		
27.12.3.2	Seating surface &stem		
27.12.3.3	Disc		
27.12.3.4	Hinge Pin		
27.13	Spray Wash pump		
27.13.1	Spray Wash pump Casing		
27.13.2	Spray Wash pump impeller		
27.13.3	Spray Wash pump Shaft		
27.13.4	Material of Gland Packing /Mechanical Seal (If applicable)		
27.14	Debris Segregation and collection baskets		
27.14.1	Frame		
27.14.2	Wire Mesh		
27.14.3	Flanges		
27.15	Self Cleaning Strainer		
27.15.1	Body		
27.15.2	Internals / Wetted Fastners		
27.16	All Non-Wetted Fastners		

	TITLE MOTOR DATA SHEET - C	SPECIFICATION NO.
		VOLUME II B
		SECTION D
		REV NO. 00 DATE 29/08/2005
		SHEET 1 OF 2

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

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

	TITLE MOTOR DATA SHEET - C	SPECIFICATION NO.
		VOLUME II B
		SECTION D
		REV NO. 00 DATE 29/08/2005
		SHEET 2 OF 2

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

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			