SEPC 1X525 MW TUTICORIN TPS STAGE-IV
TANGEDCO 1X800 MW NORTH CHENNAI TPP STG-III
TANGEDCO 2X800 MW UPPUR STPP UNIT#1&2

TECHNICAL SPECIFICATION

FOR CONDENSER ON LOAD TUBE CLEANING SYSTEMS (COLTCS)

Specification No. : PE-TS- 422/423/425-165-N002 (REV. 00)

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

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THIS TECHNICAL SPECIFICATION CONSISTS OF FOLLOWING SECTIONS:

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SPECIFIC TECHNICAL REQUIREMENTS

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1.0 GENERAL

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

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

2.0 DESCRIPTION OF EQUIPMENTS :

2.1 **Condenser on load tube cleaning systems (COLTCS) :**

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

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

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

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

3.2.1 Each set of COLTCS shall comprise following :

a) One No. Ball Separator at Condenser CW outlet pipe.
b) One No. Ball recirculation pump with drive motor.
c) One No. Ball collector.

d) One No. Manual ball sorter (Bucket type sorter with sieves to manually sort out the undersized balls by shaking the sieved bucket manually) for each set of COLTCS.

e) Differential pressure measuring system for ball separator. DP measuring system shall comprise of 2 nos. DPT +1 no. DPG for each COLTCS. Instrument shall be with *Remote seal* arrangement. Stubs for DPT and DPG shall be independent.

f) Ball monitoring system comprising an independent balls recirculation monitor and an independent balls oversize monitor. If bidder is not manufacturing Ball over size monitor then they can offer other alternatives like automatic ball sorter etc.

g) Length of Ball separator, Scope of Counter Flange, Nuts, bolts and gaskets shall be as per Datasheet-A.
Thickness of body flange and counter flange shall be as per Drg no PE-DG-999-141-M017 enclosed at enclosures at Annexure-II of Datasheet-A.

h) Complete Pipe work, including interconnection piping, flanges/counter flanges for pipes, bends, fittings, distributors, nozzles and support installation materials shall be in Purchaser's scope. **However, valves along with its Flanges/Counter Flanges/Gaskets/Nuts & Bolts shall be in Bidder's Scope**. Isometric Drawing along with BOM for interconnection piping, flanges/counter flanges for pipes, bends, fittings, distributors, nozzles and support installation materials inline with approved Installation Drawing to be submitted by the Bidder within 4 weeks after approval of the Installation Plan.

i) The Electrical and C&I item / accessory as specified in succeeding clause/ respective sections herein.

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

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

2 Sets of COLTCS shall have one Common Switch Gear Panel for DCS based control system. However, separate Local Control Panel (Starter Panel) shall be provided near to each COLTCS for its operation.

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

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

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

n) Commissioning balls and other commissioning spares on "As required basis" and to be supplied at the time of commissioning of COTCS system.

o) Set of mandatory spares as indicated in Data Sheet A. Spare balls (if applicable) to be supplied at the time of commissioning of COLTCS system.

p) Supporting arrangement complete with saddle support, foundation plates, anchor bolts, nuts, sleeves, inserts, all installation materials, fixing bolts, clamps and other accessories etc. for complete equipment supplied under this package.

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

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

s) Various drawings, data test reports/ certificates instruction manuals for erection operation and maintenance etc. as specified in Data Sheet-C. and cables schedule indicating BOQ for power & control cables.

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

u) Cathodic Protection of COLTCS along with Sacrificial Anode.

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

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

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

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

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

- **For drawings/documents approval**
  In the event of order all drawings / documents in soft as well as hard copy shall be submitted as per cl. 10.0 (b) below.

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

- **Site Visits for Installation Check, Commissioning, Trial Run & PG Testing:**

  Bidder to consider cost of two site visits for three days each for installation check / commissioning of COLTCS for each unit i.e for 2 nos of COLTCS system.

  Bidder to consider cost of two site visits for twenty days each for trial run and PG Testing of COLTCS for each unit i.e for 2 nos of COLTCS system.

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

5.0 EXCLUSIONS :

The following are excluded from the bidder's scope.

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

6.0 DESIGN CONSTRUCTION :

In addition to the requirements of Section-D the following shall also be complied.

6.1 Layout Piping Arrangement Drg. is enclosed in the specifications at Annexure-III of Datasheet-A.

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

6.3 The materials of construction specified in Data Sheet-A are minimum requirements and materials of construction for other components not specified shall be similarly selected by the bidder for the intended duty which shall be subject to purchaser's approval during detailed engineering in the event of order.

6.4 Housing/ body of COLTCS shall be designed and manufactured as per the applicable codes for pressure vessels and to take care of force and moments as enclosed in the specification. However in no case thickness of housing/ body shall be less than connecting pipe thickness as specified in Data Sheet-A of COLTCS.

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

6.6 Any flow straightner for streamlining the CW flow in balls collecting strainer if required shall be supplied by the bidder along with mounting arrangement and the fixing details. Suitable Coating for protection against Sea Water and Touch-up Paint in sealed Container after welding in Condenser Outlet Pipe at Site to be provided by the Bidder.

6.7 Velocity in the pipe work shall be less than 1.5 m/ sec for pump suction and less than 2.0 m/ sec. in other pipe work. All valves upto 150 NB shall be ball valves. For higher sizes, gate/ globe/ B.F. valves shall be provided. All instrument valves shall be needle valves.

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

Performance Parameters to be guaranteed by bidders under demonstration category under compulsory corrections shall be as under:

i) Percentage recovery of balls (min. 90% recovery for 1000 hrs of normal plant operation with 8 hrs Operation of COLTCS per day)

ii) Life of Sponge Rubber Ball (Min. 3 weeks with 8 hrs operation of COLTCS per day**).**

iii) Max. Pressure drop in ball separator in clean condition (Test to be conducted along with commissioning) – not exceeding 0.2 MWC. The Bids shall be technically rejected for pressure drop quoted higher than 0.2 MWC.

For demonstrating the parameters at sl no. (i) & (ii) above, the COLTCS system shall be operated 24 hours per day for two weeks.

Any deviation to above balls life, percentage recovery and pressure drop will not be accepted.
In case the successful bidder fails to demonstrate any of these parameters he shall carry out modifications at his own cost, to purchaser's approval.
In case bidder fails to demonstrate above parameters to purchaser's satisfaction even after modification carried by him at site, the purchaser has the right to reject the equipment out rightly.

8.0 SPARES :

8.1 **Mandatory Spares**

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

9.0 Quality Plan

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

10.0 DELIVERY & DRAWINGS/ DOCUMENTS DISTRIBUTION SCHEDULE :

a. Delivery of Equipment shall be as per NIT.

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

BHEL DRG NO	DRG TITLE	Drg Schedule for vendors
Primary Documents		
PE-V2-XXX-165-N001	P&ID OF COLTCS SYSTEM	R-0 within 20 days (for all except Installation plan, for Installation Plan 30 Days) from LOI/PO & subsequent revisions within 10 days of comments received from BHEL.
PE-V2- XXX -165-N002	TECHNICAL DATA SHEET-COLTCS	
PE-V2- XXX -165-N003	INSTALLATION PLAN- COLTCS	
PE-V2- XXX -165-N004	GENERAL ARRANGEMENT OF BALL SEPERATOR	
PE-V2- XXX -165-N005	DETAILS OF BR SKID,BALL INJECTION PIPE & FIXING DETAILS	
PE-V2- XXX -165-N006	C&I Part-I,PANEL-TDS, I/O LIST, CABLE SCH AND CONTROL PHILOSPHY FOR COLTCS	
PE-V2- XXX -165-N008	QP-COLTCS	
PE-V2- XXX -165-N007	C&I Part-II, GA & WIRING DIAGRAM OF PANEL- COLTCS	R-0 within 30 days from Cat-I(or)II approval of C&I Part-I document & subsequent revisions within 10 days of comments received from BHEL.
Secondary Documents		
PE-V2- XXX -165-N009	O& M MANUAL -COLTCS	Within 30 days from MDCC
PE-V2- XXX -165-N010	PG TEST PROCEDURE -COLTCS (If Applicable)	R-0 within 20 days of Cat-I(or)II approval on COLTCS document.

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

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

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

- Compliance certificate duly signed and stamped (Enclosed at section-III).
- Guarantee schedule duly signed and stamped (Enclosed at section-III).

- GA drawings of following with empty/ filled-ups.
  - Balls Collecting Strainers (as applicable).
  - Balls recirculating Skids.
  - Other equipments considered necessary for Layout/ Civil.

- Electrical Load Data (Enclosed at section-1B of Specification)
- Schedule of Deviation (As per NIT format)

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

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

14.0 COLTCS packing procedure before dispatch

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

14.1 **Preparation for Packing:**

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

14.2 **Protection of parts:**

- BALL SEPARATOR) 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.

- COLTCS items (EXCEPT BALL SEPARATOR) 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 table given below:

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

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

14.3 **Preservation**

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

14.4 **Photographs**

Bidder to take photographs of all parts like Ball separators, screen, pumps, piping, valves, instruments, actuators, panel (inside & outside) and sent to engineering deptt along with all inspection reports before final dispatch.

SUB-SECTION – IA

SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)

SUB-SECTION – IB

SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)

TECHNICAL SPECIFICATION FOR

COLTCS

(ELECTRICAL PORTION)

1.0 **EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:**

a) Services and equipment as per "Electrical Scope between BHEL and Vendor".

b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.

c) Supply of mandatory spares as specified in the specifications of mechanical equipments.

d) Electrical load requirement for COLTCS.

e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.

f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer/BHEL approval without any commercial and delivery implications to BHEL

g) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.

h) Motor shall meet the general technical requirements for motor.

i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.

j) Cable BOQ worked out based on routing of cable listing provided by the vendor for " both end equipment in vendor's scope"shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

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

Refer "Electrical Scope between BHEL and Vendor".

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of compliance certificate/No deviation certificate.

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

4.0 List of enclosures :

a) Electrical scope between BHEL & vendor (Annexure –I)
b) General technical requirements for LV motors.
c) Datasheet A & C.
d) Quality plan for motors.
e) Electrical Load data format (Annexure –II)
f) BHEL cable listing format (Annexure –III)

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

PACKAGES: COLTCS
SCOPE OF VENDOR: SUPPLY

PROJECT:

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

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

PACKAGES: COLTCS
SCOPE OF VENDOR: SUPPLY

PROJECT:

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

NOTES:

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

SL.NO.	PARAMETERS	SPECFIIC TECHNICAL REQUIREMENTS OF ELECTRICAL MOTOR (SPEC NO- PE-TS- 422/423/425-165-N002)	
		1X525 TUTICORIN TPS STAGE-IV	1X800 MW NORTH CHENNAI TPP STG-III & 2X800 MW UPPUR STPP UNIT#1&2
1	CODE ANS STANDARDS	IS-325, IS-12615, IEC-60034, IS-4691, IS-4728	IS : 325, IS : 900, IS : 996, IS : 1231, IS : 1271, IS : 2223, IS : 2254, IS : 3043, IS : 3177, IS : 4029, IS : 4691, IS : 4722, IS : 4728, IS : 4889, IS : 5571, IS : 6362, IS : 8223, IS : 8789, IS : 12065, IS : 12075, IS : 12615, IS : 12802, IS : 12824, IS : 12824, IS : 14222, IEC: 60034-1, ISO : 1940-1, NEMA, MG-1, DIN/IEC/IS, BS 5308 part II
2	SERVICE CONDITIONS	Hot, Humid and Tropical Atmosphere highly polluted.	Hot, Humid and Tropical Atmosphere highly polluted.
3	TYPE AND RATING	General purpose, Constant speed, Squirrel cage, Three/Single phase, Induction type, Continuous duty, motor name plate rating at 50°C shall have more than 10% margin over the input power requirement of the HT driven equipment and 15% for LT driven equipments at rated duty point.	General purpose, Constant speed, Squirrel cage, Three/Single phase, Induction type, Continuous duty, motor name-plate rating at 50°C, relative humidity of 95% (at 50°C) and shall have at least 15% margin. All LV motors above 10 kW with S1 duty.
4	EFFICIENCY CLASS	IE3	IE3
5	RUNNING REQUIREMENT	(a) The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals. (b) Motor shall not stall if the supply voltage drops to 70% of the rated voltage two (2) second duration. (c) The motor shall be designed to withstand momentary overload of 60% of full load torque for 15 second without any damage.	(a) 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. (b) 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. (c) All motors shall be designed to withstand hundred twenty (120) percent of rated speed without any mechanical damage for two (2) minutes.
6	STARTING CURRENT	(a) Starting current shall not exceed 6 times full load current for all auxiliaries. No further tolerances are applicable on starting current specified above for HT motors. (b) For LT motors, the applicable starting current shall be limited to 7.2 times of full load current including all tolerance. (b) The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage. (c) Motor with rigid coulpling shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals. (d) Minimum starting requirement for fluid coupling shall be 75% rated voltage at motor terminals. (i) Motor shall be capable of three equally spread starts per hour, two starts in quick succession from cold condition and one restart from hot condition. (ii) Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with shaft rotating at 125% rated speed in reverse direction. (c) The motors shall be designed to withstand 120% of rated speed for 2 minutes without any mechanical damage.	(a) Locked rotor current shall not exceed 600% of full load current inclusive of IS tolerance. (b) The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage. (c) Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals. (d) Two hot starts in succession with motor initially at normal running temperature. (e) Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with shaft rotating at 125% rated speed in reverse direction. (f)Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque. (g). Pull out torque at rated voltage shall not be less than 205% of full load torque. It (h). Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met. (i)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.
7	LOCKED ROTOR WITHSTAND TIME	(a) The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 2.5 seconds for motors up to 20 seconds starting time and by 5 seconds for motor with more than 20 seconds starting time and upto 45 secs starting time. (b)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.	i. For motors with starting time less than 20 secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs more than starting time. ii. For motors with starting time more than 20 secs and up to 45 secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs more than starting time. iii. For motors with starting time more than 45 secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.
8	ENCLOSURE	All motor enclosures shall conform to the degree of protection IPW-55 unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather-proof construction with canopy.	All motor enclosures for outdoor, semi-outdoor & indoor application shall conform to the degree of protection IP-55 (For Outdoor) and IP-54 (For Indoor) unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather-proof construction with canopy.
9	COOLING	(TEFC) or closed air circuit air- cooled (CACA). For large capacity motors, totally enclosed tube ventilation (TETV) cooling system shall be considered.	The motors shall be either totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. Motors with CACA heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate the following: a) Hot and cold air temperatures of the closed air circuit for CACA motors.
10	WINDING AND INSULATION	(a) All insulated winding shall be of copper. (b) All motors shall have class F insulation but limited to class B temperature rise. © Windings shall be impregnated to make them non-hygroscopic and oil resistant.	(a) Class F insulation but limited to class B temperature rise. (b) Windings shall be impregnated to make them non-hygroscopic and oil and flame resistant.
11	MOTOR TERMINAL BOX	(a) Motor terminal box shall be detachable type and located in accordance with Indian Standards clearing the motor base- plate/ foundation (b) Terminal box shall be capable of being turned 360 Deg. in steps of 900 Deg. for HT/LT motors . (C) The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec. (D) For 11000V and 3300V motor, the terminal box shall be phase-segregated type. The neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type) with shorting links for star connection.	(a) Motor terminal box shall be detachable type and located in accordance with Indian Standards clearing the motor base- plate/ foundation (b) Terminal box shall be capable of being turned 360 Deg. in steps of 180 Deg. for HT motors and 90 Deg. for LT motors unless otherwise approved. (c) The motor terminal box shall be suitable for withstanding the maximum system fault current (50 KA) for a duration of at least 0.25 seconds. (d) Terminal boxes shall be weatherproof and water-tight confirming to minimum IP-55 degree of protection with removable front cover for making connections.
12	MINIMUM PHASE TO PHASE & PHASE TO EARTH CLEARANCE FOR 415V	25 mm	Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows:- Motor MCR in KW Clearance (i) UP to 110 KW - 10mm (ii) Above 110 KW and upto 150 KW - 12.5mm (ii) Above 150 KW - 19mm

SL.NO.	PARAMETERS	SPECFIIC TECHNICAL REQUIREMENTS OF ELECTRICAL MOTOR (SPEC NO- PE-TS- 422/423/425-165-N002)	
		1X525 TUTICORIN TPS STAGE-IV	1X800 MW NORTH CHENNAI TPP STG-III & 2X800 MW UPPUR STPP UNIT#1&2
13	GROUNDING	The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.	The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.
14	GROUNDING CONDUCTORS		1) Above 100 KW upto200 KW -- 75x10 mm GI Flat 2) Above 55 KW upto 100 KW -- 40x6 mm GI Flat 3) Above 22 KW upto 55 KW -- 40x6 mm GI Flat 4) Above 5.5 KW upto 22 KW -- 25 x 6 mm GI Flat 5) Upto 5.5 KW -- 4 SWG GI Wire
15	TESTS	Routine and Type Tests are to be conducted in presence of customer's representative as per IS:325 and in addition,any special test called for in the driven equipment specification shall be performed and required copies of test certificates are to be furnished for approval. In addition, following Type tests shall have to be carried out in presence of Owner representative on all 3.3kV/11kV motors. a) Impulse test by 1.2 / 50 micro sec. On sample coil of Stator winding insulation as type test as per IEC-671/IS-14422 : 1995 test voltages as under : Voltage rating of motor Impulse Test Voltage 3.3 kV 18 kV peak 11 kV 49 kV peak b) Tan delta, charging current and dielectric loss measurements on each phase of motor stator winding as routine test. c) Polarization Index Test as per IS:7816 as routine test d) Test for suitability of IPW– 55(Weather proof) as per IS 4691 as type test. Type test certificate for first numeral shall be acceptable in lieu to test, provided the test motor is identical to motor being supplied. e) Fault Withstand Test for main terminal box as type test. Type test certificate shall be acceptable, if the test has been conducted on exactly identical terminal box. f) Test for noise level as routine test. g) Test for vibration as routine test. h) Tan delta measurement on coils. i) Surge withstand test for inter turn insulation. j) Test to diagnose rotor bar failure during manufacture. Tests indicated at (h), (i), (j) shall be carried out during manufacture of the coils and shall be furnished for verification.	Routine and Type Tests are to be conducted in presence of customer's representative as per IS:325 and in addition,any special test called for in the driven equipment specification shall be performed and required copies of test certificates are to be furnished for approval.
16	MINIMUM STARTING VOLTAGE FOR MOTOR		
17	SHORT TIME RATING FOR TERMINAL BOXEX	The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.	
18	SPACE HEATER		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.

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

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

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

(A) SYSTEM VOLTAGE CODES:
(ac) A = 11KV, B = 6.6KV, C = 3.3KV, D = 415V, E = 240V, F = 110V
(dc) G = 220V, H = 110V, J = 48V, K = +24V, L = -24V

(B) CABLE VOLTAGE CODES:
A = 11KV (Power cables)

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

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

(C) CABLE CODES

PVC Copper

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

PVC Aluminium

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

XLPE Copper

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

XLPE Aluminium

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

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

SUB-SECTION – IC

SPECIFIC TECHNICAL REQUIREMENTS (C &I)

SPECIFIC C&I TECHNICAL REQUIREMENTS
FOR COLTCS

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

1.2 These requirements are to be read in conjunction with detailed Technical specification enclosed in the specification. In case of any conflict and repetition of clauses in the specification, the more stringent requirement as per interpretation of Customer shall prevail without any commercial implication. No deviations shall be acceptable.

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

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

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

1.6 Type of control system shall be DDCMIS (Station C&I) based, located in Central Control Room in BHEL scope. Field instrumentation and starter panel for the package are in bidder's scope.

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

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

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

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

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

1.12 The Minimum requirement for sea water or saline water media is given below:

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

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

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

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

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

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

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

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

1.20 LVDT type instrument is not acceptable.

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

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

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

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

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

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

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

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

SPECIFIC C&I TECHNICAL REQUIREMENTS FOR COLTCS

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

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

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

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

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

1.33 Bidder shall provide an unlimited warranty on all equipment and software fo r three years after the start of the warranty period, i.e. after satisfactory co mpletion of initial operations. This warranty shall include repair, replaceme nt or correction of identified software or hardware discrepancies at no cost to owner.

1.34 Bidder to delegate /depute their persons/experts as per Customer's require ment.

1.35 Bidder must offer general tools and tackles and special calibration instrume nts required during start-up, trial run, operation and maintenance of the sys tem.

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

2.0 **Requirements for flanged remote seal diaphragm:**

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

SPECIFIC C&I TECHNICAL REQUIREMENTS
FOR COLTCS

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

SCOPE MATRIX - CONDENSER ONLOAD TUBE CLEANING SYSTEM (COLTCS)

S.No.	PROJECT	TUTICORIN	UPPUR	NORTH CHENNAI
1	**SYSTEM APPLICABLE: CONDENSER ONLOAD TUBE CLEANING SYSTEM (COLTCS)**	Y	Y	Y
2	**SYSTEM CONFIGURATION: UNITISED OR COMMON OR AS APPLICABLE**	UNITISED		
3	**CONTROL SYSTEM**	REFER NOTE-1		
4	**LOCATION OF CONTROL SYSTEM**			
5	**CONTROL SYSTEM SCOPE (BIDDER /BHEL/ CUSTOMER)**			
6	**CONTROL FROM PUSH BUTTONS ON STARTER PANEL**	Y; REFER NOTE 3		
7	**ANNUNCIATION ON STARTER PANEL (Y/N) -- IF Y, MIN NO. OF HARDWIRED ALARMS / INDICATIONS**	Y; REFER NOTE-4		
8	**MIMIC ON STARTER PANEL (Y/N)**	Y; REFER NOTE-5		
9	**POWER SUPPLY AVAILABLE FOR BALL MONITORING SYSTEM IN BIDDERS'S SCOPE (24V DC / 110 V AC UPS / 230 V AC UPS)**	To be finalised during detailed engg.	240 V AC UPS	
10	**PROTECTION CLASS FOR STARTER PANEL**	AS PER DATASHEET OF 'LOCAL CONTROL CUM STARTER PANEL' (herein also referred as 'Starter Panel' or 'Local Control Panel' or 'Switchgear Panel' interchangeably)		
11	**ACTUATOR WITH INTEGRAL STARTER (Y/N)**	Y	Y	Y
12	**DPG/ DPT PER COLTCS SYSTEM ***	DIFFERENTIAL PRESSURE TRANSMITTER = 2 nos. (Across each Filter) DIFFERENTIAL PRESSURE GAUGE = 1 no. (Across each Filter)		
13	**SEA WATER APPLICATION**	Y	Y	Y

	NOTES:
1	Type of control system shall be DDCMIS (Station C&I) based, located in Central Control Room in BHEL scope. Field instrumentation and starter panels for the package are in bidder's scope of supply.
2	2 Sets of COLTCS shall have one Common Switch Gear Panel for DCS based control system. However, separate Local Control Panel (Starter Panel) shall be provided near to each COLTCS for its operation.
3	Push buttons and indication lamps for Open/Close and Start/Stop of drives/equipments shall be provided on the starter panel. Remote and local indication, indicating lamps / LED cluster for instruments/drives/equipments status and critical alarms shall be provided on the starter panel. Nos. shall be decided during detailed engineering.
4	No. of facia on Starter panel shall be decided during detailed engineering.
5	Colored MIMICS on the panel is to be provided as per system flow diagram.

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

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

CHAPTER-3

FIELD & MEASURING INSTRUMENTS AND FLOW ELEMENTS

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

3.01.00 GENERAL REQUIREMENTS

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

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

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

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

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

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

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

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

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

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

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

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

viii. Tapping points/test points shall be provided.

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

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

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

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

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

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

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

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

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

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

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

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

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

Smart Transmitters of the electronic type shall be furnished.

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

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

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

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

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

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

Requirments for flanged remote seal diaphragm:

Maximum pressure rating : To meet 200 percent of process pressure

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

Single Capillary connection for pressure transmitters.

Capillary length : 6.0 m

Fill fluid : Suitable oil

Process connection size : 1 inch

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

Process fluid temperature : 25°C to 60°C

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

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

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

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

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

connection. Cabling need not terminated inside the switch. Cable ends are to be soldiered in connector and to be inserted for easy maintenance.

- Over range protection	:	One Fifty (150) percent of full scale
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1/2, Division 1 area)/Flame Proof (IEC – 79.1, Part I) as applicable.
IBR Requirement	:	For high pressure service, Process tapping and root valves are as per IBR rules and regulations.

Accessories

- 3 / 5 valve manifold	:	As applicable depending on type of switches
- Self cleaning type pulsation dampners/Snubber (Material SS316)	:	Pump and compressor discharge lines
- Syphon	:	For all steam lines
- Protective separating diaphragm	:	For fuel oil & corrosive liquid lines.
Mounting	:	Local (in LIE/LIR for BTG package only).

3.03.03 PRESSURE & DIFFERENTIAL PRESSURE GAUGES (PG & DPG)

Applicable standard	:	IS:3602-1966, IS/3624, ASME B 40.1
Type/Construction		
-760 mm to 1.0Kg/cm2	:	Bellows/Diaphragm
-Above1.0Kg/cm2	:	Bourdon Tube
- Suction side of pumps	:	Compound gauge

Materials

- Bourdon tube	:	316 SS
- Bellows	:	316 SS
- Movement	:	316 SS
- Case	:	SS 316/ Die-cast aluminum with stoved enamel black finish. Epoxy coating shall be provided for corrosive atmosphere.
- Protective Diaphragm	:	Teflon
Dial size	:	150mm with toughened shatter proof glass. 300 mm with toughened shatter proof glass for frame mounted gauges.
Scale Details	:	Graduations in black lines on white dial, on white dial, 270 Deg. pointer deflection scale provided with

		glass cover. Smallest scale division shall be one (1) percent of full scale value or smaller. Pointer stop for all gauges.
Accuracy	:	± One (1) percent or better
Connection - Instrument Process	:	1/2 inch NPT Male Bottom
Mounting	:	Local / Frame mounted.
	:	1/2 inch NPT Male (Back entry) mounted on local gauge board.
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)
IBR Requirement	:	For high pressure service, Process tapping and root valves are as per IBR rules and regulations.

Accessories

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

Other particulars

- External Zero adjustment	:	For all gauges
- Safety device		
Ranges 5 to 20 Kg/cm2	:	Rubber blow out disc with open front construction.
Ranges above 20 Kg/cm2	:	Neoprene safety diaphragm at the back with solid front construction.
- Over range protection	:	One Fifty (150) percent of full scale
Other Requirments	:	Movement mechanism shall be glycerin filled for oil services & vibration prone area.
	:	For Fuel oil & corrosive liquid lines diaphragm type sensors required. Armored capillary of 10 M for Fuel oil & Corrosive liquid service.
	:	Contact type pressure gauges are not acceptable for interlock & protection.
	:	For condensate storage tank and DM water storage tanks, the pressure

gauge in terms of 0-10000 mm wc or suitable range having **dial size of 300mm or bigger size** shall be provided.

3.03.36 **Solenoid Valves**

Solenoid valves shall be provided as per NAMUR standard with control valves / pneumatic control valves hooked up with process interlock requirements and where direct tripping is involved. The number of ways for solenoid valve shall be provided as indicated below:

(a) Two (2) way solenoid valves shall be provided, where process line of less than 50 mm with low pressure and temperature application.

(b) Three (3) way solenoid valve shall be provided commonly, where the pressure is admitted or exhausted from a diaphragm valve or single acting cylinder, e.g, Pneumatic operated spray water block valve.

(c) Four (4) way solenoid valve shall be provided for operating double acting cylinders, e.g, Pneumatically operated on-off type dampers.

(d) For operation of the fuel oil corner nozzle valves, fuel oil trip valves etc., **double coil solenoid valve** (latch coil & relatch coil) shall be adopted.
Single coil usage requires always power and loss of power leads to closure of above valves resulting the unit trip or loss of generation.

(e) Solenoid Valve coils insulation class shall be Class-H high-temperature or Class-F construction as applicable and shall be designed for continuous duty. Three-way solenoid valves shall be designed for universal operation so that the supply air may be connected to any port. Solenoid enclosures shall be NEMA-4)/ (Explosion proof for NEC Class-1/2, Division 1 area)/ flame proof (IEC-79.1, Part I) as applicable). Body material of solenoid valve shall be Brass or SS316 with epoxy paint as decided during engineering by owner. Material of wetted parts shall be SS316 only. Leakage class shall be class VI (Bubble tight).

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(f) All solenoid shall be with varister/RC circuit for EMI suppression, LED indication, surge

(g) Solenoid valve shall operate on 24 V DC, UPS 230 V AC or 220 V DC as per system requirements.

3.03.41 **Junction Boxes**

Type of Enclosure	:	Flame proof/weather proof IP-65/Explosion Proof as per area classification. Design as per NEC-370 Article 18, 19 & 20.
Material	:	6 mm min. thick FRP with protective Coating 3 mm min. thickness Die cast aluminum for Flame proof/Explosion proof area.
Cable entry	:	Bottom or Side
Cable glands	:	Double compression type – Nickel plated brass with PVC hoods.
Mounting	:	Indoor/Outdoor
No. of terminals	:	As required with standardization with 20% spare of each size & type.
Terminals	:	Phoenix/Wago (screw less cage clamp type spring loaded)
Grounding	:	Two terminals for body and shield ground
Door	:	Hinged, lockable type.
Accessories	:	Suitable mounting clamps and other accessories shall be in scope of bidder. The brackets, bolts, nuts, screws, glands, lugs required for erection shall be of brass, included in bidder scope of supply. High voltage & insulation resistance test shall also be conducted.

M6 Ni plated Brass earthing stud shall be provided (external 2 nos. internal 1 no.)
Gasket (Normal)- Neoprene/Polyurethene thickness 6.0 mm. Silicon for High Temperature area.

Colour : In General same as provided for control panels, and for special services, To be decided during detailed engineering & subject to owner's approval.

3.03.42 Cable Glands

Cables shall be terminated using double compression type cable glands. Cable glands shall conform to BS: 6121 & IP-67 and be of robust construction capable of clamping cable and cable Armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy-duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall be made of brass with nickel chrome plating Rubber components shall be of neoprene and of tested quality.

3.03.43 Interposing Relays (IPR)

Electromagnetic type IPRs with modular design, plug-in type connections, suitable for channel/DIN rail mounting in cabinets; coil rating 24V DC; 2 set of silver plated cadmium free with change over contacts rated for DC1 Breaking capacity of 0.5A 110 V DC/ 0.15 A 220 VDC and AC1 Capacity of 8/10 A 240 V AC. Capacity shall be as system requirements. Freewheeling diode across copper relay coil and self reset type status non-polarized LED indicator for the Coil (electronic) and a flag indicator for the Contacts (mechanical) shall be provided. Manual forcing/override facility is required. The insulation test voltage of 1.2/50 µs between the coil & contacts for relay shall not be less than 4 KV between adjacent contacts. The operating temperature of the Relay & Sockets shall be from –20 deg. C to 60 deg. C. The operating/release time of the relay shall not be more than 10/5 ms respectively.

The relay and DIN Rail sockets shall have the necessary approvals like UL/VDE and V0/V2 inflammability class in accordance with UL94", IEC60664/IEC60664A/DINVDE0110.

Facility to stimulate IPR manually shall be provided. The VA burden of relays shall be suitable to match the capacity of output modules. Interposing relay & sockets for mounting the interposing relay shall be of same make only and sockets shall have the plug in RC circuits/Varistors, required for EMI suppression.

3.03.45 PANEL MOUNTED DIGITAL INDICATOR

Type	:	**Programmable electronic digital indicator** with floating point decimal.
Input	:	4-20 mA DC/1-5V DC/RTD/T/C/Universal.
Number of inputs	:	One
Range	:	As per requirement/adjustable by end user through key pad available on the indicator.
Number of digits	:	Four plus sign
Digit height	:	50 mm or larger
Display	:	Fluorescent red (LED, Seven segment or dot matrix).
Input over range/open sensor (T/C)	:	All digits to flash
Input hold time	:	0.7 seconds max.
Accuracy	:	$\pm$0.25% of span
Power supply	:	240V AC, 50Hz from UPS

Mounting	:	Flush panel, compatible for mounting on mosaic grid panel
Size	:	288x144 mm
Other Particular	:	Indicator receiving thermocouple signal shall have automatic cold junction compensation.
	:	Retransmission Output 4-20 mA isolated required.
	:	24 V DC inbuilt power supply usable to transmitter
	:	Alarm contact with 2 NO/NC contact (rating 5A/230 V AC)
		Indicator shall be usable as 4 wire transmitter also.
Digital communication connectivity	:	Shall be capable of connecting RS485/Profibus/MODBUS for data transfer.

3.03.45.01 Wall Mounted Digital INDICATOR

Type	:	Programmable electronic digital Indicator with floating point decimal.
Input	:	4-20 mA DC/1-5V DC/RTD/T/C/Universal.
Number of inputs	:	One
Range	:	As per requirement/adjustable by end user through key pad available on the indicator.
Number of digits	:	Four plus sign
Digit height	:	150 mm or larger
Display	:	Fluorescent red (LED or seven segment).
Input over range/open sensor (T/C)	:	All digits to flash
Input hold time	:	0.7 seconds max.
Accuracy	:	$\pm$ 0.25% of span
Power supply	:	230V AC, 50Hz UPS
Mounting	:	Wall mounting.
Size	:	290 (H) x675 (W) mm minimum
Other Particular	:	Indicator receiving thermocouple Signal shall have automatic cold junction compensation.
	:	Retransmission Output 4-20 mA isolated required.
	:	24 V DC inbuilt power supply
	:	Alarm contact with 2 NO/NC contact (rating 5A/230 V AC)

3.03.46 RECEIVER INDICATORS (SINGLE/DUAL CHANNEL)

Type	:	Analogue indicator
Input Signal	:	Universal input (T/C, RTD,

		4-20 mA, Voltage)
Scale	:	Range fully configurable and programmable
Measurement Accuracy	:	$\pm$ 0.2% of span $\pm$ 1 count
Resolution	:	0.5% Span
Dead band	:	$\pm$ 0.2% of span
Repeatability	:	0.2% of span
Full scale response time	:	Less than two(2)seconds
Power Supply	:	240V AC, 50 Hz
Connection	:	Plug in type
Accessories	:	Mounting Bracket for Bins
Other Particulars	:	Indicator receiving thermocouple Signal shall have automatic cold junction compensation.
	:	Retransmission Output 4-20 mA isolated required.

3.03.48 AMMETERS (AMM)

Input	:	4-20 mA DC
Mounting	:	Flush panel, compatible for mounting on mosaic grid panel

Face Dimensions	:	96 x 96 mm
Scale/Type	:	Moving coil, circular, FSD 240 deg. With six times suppression scale
Zero adjustment	:	Screw on meter face
Accuracy	:	$\pm$ 1 percent (class 1)
Indication	:	Pointer with scale
Magnetic Shield	:	Shielded Case
Quantities	:	For all HT Motors & LT motor with rating $\geq$ 30 KW and other critical application motors/drives.

3.03.49 VOLTMETER:

Input	:	4 - 20 mA DC
Mounting	:	Flush Panel, compatible for mounting on mosaic grid panel
Face Dimension	:	96x96 mm
Range	:	As per requirement
Accuracy	:	$\pm$ < 1.0 %
Indication	:	Digital type 4 1/2 digit
Magnetic Shield	:	Shielded Case
Connection	:	Plug in type
Quantities	:	For 230 V AC input power supply, UPS power supply, 24 V DC interrogation voltage & 220 V DC.

3.03.50 FREQUENCY METER (DIGITAL)

Type	:	Electronic digital 7- segment with fluorescent display
Input	:	4 - 20 mA DC
Mounting	:	Flush Panel compatible for mounting On mosaic grid panel
Number of digits	:	41/2 digit
Face Dimension	:	192X192 mm
Digit size	:	Approximately 40 mm
Range	:	As per requirements
Accuracy	:	$\pm$ 0.2 Hz
Display	:	Red LED display.
Connection	:	Plug in type
Magnetic Shield	:	Shielded Case

3.03.51 AC CURRENT TRANSDUCERS

Input	:	0 - 1 A CT current
Output	:	Dual 4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	$\pm$ 0.25%

3.03.52 DC CURRENT TRANSDUCERS

Input	:	0 - 75 mV
Output	:	Dual 4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	± 0.25%

3.03.53 AC VOLTAGE TRANSDUCERS

Input	:	0 - 110 V PT, Volts
Output	:	Dual 4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	+ 0.25%

3.03.54 DC VOLT TRANSDUCERS

Input	:	System Voltage
Output	:	Dual 4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	± 0.25%

3.03.55 TRANSDUCERS FOR POWER

Input	:	CT and PT (1A) (110V)
Output	:	Dual 4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	± 0.25%

3.03.56 TRANSDUCERS FOR FREQUENCY

Input	:	110 V PT Volts
Output	:	Dual 4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	± 0.25%

3.03.57 TRANSDUCERS FOR POWER FACTOR

Input	:	PT (110V)
Output	:	Dual 4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	± 0.25%

3.03.58 TRANSDUCERS FOR MVAR

Input	:	CT & PT (110V/1A)
Output	:	Dual 4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	± 0.25%

3.03.59 DIFFERENTIAL FREQUENCY TRANSDUCERS (FOR SYNCHRONIZATION)

Input	:	110 V PT
Output	:	Dual 4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	± 0.25%

3.03.60 DIFFERENTIAL VOLT TRANSDUCERS (FOR SYNCHRONIZATION)

Input	:	System voltage
Output	:	Dual 4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	± 0.25%

3.03.61 DIFFERENTIAL FREQUENCY & DIFFERENTIAL VOLT INDICATORS

Input	:	4 - 20 mA DC
Mounting	:	Flush Panel, compatible for mounting on mosaic grid panel
Face dimension	:	96x96 mm
Scale	:	Horizontal with zero at centre - 10%, 0, ±10%
Range	:	- 10% - 0 - + 10% (for both)
Accuracy	:	± 1.0%
Magnetic Shield	:	Shielded Case

3.03.65 **POWER FACTOR METER (DIGITAL)**

Type	:	Electronic digital 7- segment with fluorescent display
Input	:	4 - 20 mA DC
Mounting	:	Flush Panel, compatible for mounting on mosaic grid panel
Number of digits	:	41/2 digit
Face Dimension	:	192X192 mm
Digit size	:	Approximately 40 mm
Range	:	- 1 - 0 - + 1
Accuracy	:	$\pm$ 0.25 %
Display	:	Red LED display
Connection	:	Plug in type
Magnetic Shield	:	Shielded Case

3.03.66 SYNCHROSCOPE

Synchroscope shall be designed to provide an illuminate and indication of phase and frequency difference between bus voltages and generator voltage. It shall denote the

actual frequency differeence corresponding to the inverse of time taken for one rotation of the illuminated vector spot. Synchroscope shall be designed as per IEC/DIN/BS standard.

Input	:	Differential frequency & Differential Voltage
Mounting	:	Flush Panel, compatible for mounting on mosaic grid panel
Face Dimension	:	96 x 96 mm
Accuracy	:	$\pm$ 0.5%
Magnetic Shield	:	Shielded Case

3.03.67 SYNCHRONIZING RELAYS

Synchronizing check relays with necessary ancillary equipment shall be provided, which shall permit breakers to close after checking the requirements of synchronizing of incoming and running supply. The phase angle setting shall not exceed 100 and this angle shall be adjustable and shall take the account the circuit breaker closing period. This relay shall have a reponse time of less than 200 milliseconds when the two system conditions are met within preset limits and with the timer disconnected. The relay shall have a frequency difference setting not exceeding 0.45% at rated value and at the minimum time setting. The relay shall have a continuously adjustable time setting range of 0.5-3 secs. Additionally, a guard relay shall be provided to prevent the closing attempt by means of synchronizing check relay when control switch is kept in closed position long before the two systems are in synchronism. The control voltage shall be 220 V DC and PT input voltage shall be 110 V AC.

3.03.68 PUSH BUTTONS (PB)/ ILPBs FOR ON/OFF, OPEN/CLOSE, START/STOP

Type	:	Momentary/Miniaturised Suitable for mosaic grid 24x48 Mm with 2 PB and 3 coloured LED.
Contact Configuration	:	2 NO + 2 NC
Contact Material	:	Hard Silver Alloy
Contact Rating	:	500V / 10 A
Insulation Voltage terminals and earth	:	2 KV for 1 minute between
Lamp Rating :-		
a) Voltage	:	240 V AC
b) Watt	:	2 Watt (approx.)

Colour

Red	– ON/Start/Open ILPB
Green	– OFF/Stop/Close ILPB
Red	- energized, running, Start, valve open LED/Lamp
Green	- de-energized, stopped, valve closed LED/Lamp
Light yellow	- abnormal, discrepancy LED/Lamp
Red	– OFF/Stop/Close PB
Green	– ON/Start/Open PB
Red	**-** Emergency trip push buttons with red flap / hinged

Transperent arylic cover.

3.03.69 **PUSH BUTTON FOR Control DESK** : **Momentary mosaic grid mounted** 24x48 mm size, single PB 18x40 mm

Colors

DESK RELEASE - Yellow
Desk Lamp test - Blue
Desk Acknowledge - Green

3.03.70 **PUSH BUTTON FOR SEQUENCE START/RELEASE** : Momentary (Miniaturised) suitable for mosaic grid 24x48 mm 3 PB + 5 LED

3.03.71 **PUSH BUTTON FOR ANNUNCIATION**

Contacts

- Number & Type : As per requirement
- Breaking capacity : 1 Amp, 220V DC
  10 Amp, 600V AC
  Different colours for Accept/Acknowledgr - Green, reset - Grey, Lamp test – Blue, System Test – Yellow
  & Audio Acknowledge - Black.

3.03.72 3 PB (Auto/Manual selection PB, lower PB & Raise PB) and 3 LED (Auto indication, manual indication & Fault/disturbance indication) module shall be provided on BUP for modulating type control valve.

In addition, dual indicator for position indicator & deviation indicator (between demand position & actual position) and process indicators shall also be provided on BUP for modulating type control valve.

1.All panels, cubicles, consoles, local control panels, GIU desk and enclosures furnished as per this specification shall be of free standing type and shall be constructed of specified gauge of steel plates i.e CRCA or SS316 depending upon location. The minimum sheet thickness of panels shall be as follows unless otherwise specified herein.
Top - not less than 1.6 mm.
Side, Door & mounting plate - 2.0 mm.
Base metal plate - 2.5 mm.
Gland plate - 3 mm
2.Desk & Panel material, Painting Process/procedure & Painting material shall be suitable for sea water and saline conditions at site in line with national and international standards like ASTM, ISO etc.

4.05.08 RELAY BASED LOCAL CONTROL PANEL/DESK

Local control panel shall be of 2.5 mm steel construction, free standing type, totally enclosed dust and vermin proof with enclosure protection class of IP-55 as per IS: 13947 and colour shall be as per shade no. RAL 7032/7035. Panel shall be mounted on vibration dampers secured to steel frame on to the floor. Equipment and relays mounted on the panel shall be easily accessible. The panel shall be supplied completely wired upto terminal blocks for connecting external cables entering the panel from the bottom. Blank removable gland plate shall be provided with double compression type cable glands/conduits knockout along with the panel.

Terminal block shall be rated 600 volts minimum and shall have strap cage clamp type screw less terminals suitable for connection with 2x2.5 sq mm copper conductors on each side. Terminal block shall be provided with white marking strips. Fuses shall not be mounted on terminal blocks. At least 20 percent spare unused terminals fully wired shall be provided on terminal block.

Contactors, Relays, timers and other devices mounted on the panel shall have clearly visible identification marking. Separate contactors shall be provided for start & stop

command. Common contactor for start & stop command are not acceptable. All fuses shall be HRC semiconductor type of AC supply. HRC link & fuse shall be of removable type having 45 kA rupturing capacity (min) for protection of various circuits.

The panel shall be provided with a 50x6 mm tinned copper earthing strip running throughout the length of the panel at the bottom. Panel shall be provided with space heaters with isolating DPN MCB, and thermostats. LED based illuminating lamps, complete with door switches; and 1 no. 6 pin 5/15amps sockets with DPN MCB. Separate power supply feeder shall be provided for utilities.

Panel shall be provided with LED illuminating lamps with door switch and 6 point 5/15A, 240V AC socket with switch for maintenance purposes. Panel shall have removable lifting eye bolts for safe lifting from top during handling.

Control power supply shall be provided from dual redundant UPS feeders with auto change over scheme, surge protection devices and Power/Volt/AM meter. In case UPS feeders are not available, control power supply shall be provided from dual non UPS single phase power supply feeders with dual transformers and with auto change over scheme, surge protection devices and Power/Volt/AM meter.

The panel shall be provided with push buttons, indicating lamps, annunciators, indicating instruments, interlock/ deinterlock switches etc., required for the complete system. General details as specified in chapter 6 shall also be referred for engineering and design of relay panel/desk.

Coloured Mimic with 6mm thickness sheet for respective plant lay out shall be provided as specified in Annexure A, control system philosophy.

20% spare relays of each type and rating shall be mounted and wired in relays control panel/Desk. All contacts of relays shall be terminated in terminal blocks of relay control panel/Desk, Additionally in the relay control panel/Desk, 20% spare terminal blocks shall be 'provided so that additional relays can be mounted and wired.

The annunciation system shall consist of panel mounted audio-visual windows of 50x75 mm provided with plug-in-type solid-state logic 16 nos. high intensity LEDs in parallel. EACH relay based control panel shall be provided with 30 nos min. facia windows. Initiating contacts may be either NO or NC; a jumper or switch shall be provided in each card to make it suitable for either type of contact. A set of acknowledge, reset and test push buttons shall be provided on the panel. All printed circuit boards shall be of epoxy fibre glass construction.

The sequence of annunciation shall be as follows:

Condition	**Visual**	**Audible**
Normal	OFF	OFF
Alarm	Flashing	ON
Acknowledge	Steady	OFF

Return to Normal:

a.	Before acknowledge	Flashing	ON
b.	After acknowledge	Steady	OFF

Reset:

a.	Alarm condition	No change	No change
b.	Return to normal	OFF	OFF

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

6.00.00 CONTROL BOARD

CONTROL DESK / CONSOLE / PANEL CONSTRUCTION

01.	Applicable for		:	Indoor Panel, Desk & console.
02.	Material of construction		:	Cold rolled steel sheet (Metal and plastic - Heat resistant, shrinkage free for mosaic tiles).
03.	Thickness of Sheet		:	a) 3.0 mm for faces supporting instruments / terminals. b) 2 mm for other sides and top.
04.	Construction		:	Welded throughout as per (metallic parts) approved National Standards.
05.	i)	Corners	:	7 mm inner radius
	ii)	Dimensional Tolerances	:	a) In height & length - 3 mm

			b) In height between adjacent sections - 2 mm.
			c) Total for a group - 6 mm
06.	Doors	:	Double, recessed, turned back edges
	i) Thickness of Sheet	:	2 mm
	ii) Hinges	:	Stainless steel
	iii) Door latches	:	Three point type
	iv) Door gaskets	:	Neoprene rubber on fixed frame to result dust proof / weatherproof enclosure.
	v) Opening of the doors	:	Outward
	vi) Louvers	:	With removable wire mesh to ensure dust and vermin proof.
07.	Color of interior	:	Brilliant white
08.	Colour external	:	Light grey 631 to shade IS5.
09.	Protection of painting	:	Epoxy Power Coated or Better.
10.	Gland plates	:	Removable 4 mm thick (bottom)
11.	Cable entry	:	Bottom
12.	Hardware	:	a) anti vibration pad-15mm.
			b) Predrilled base channel ISMC - 100 or equivalent for all sides.
			c) Stainless steel buff- finished 2 mm thick kick plate for all sides.
			d) Stainless steel scratch strips along desk edges fixed with pan-head recessed screws.
			e) Rubber strips to ensure air tightness between kick plate and finished floor.
			f) Lifting Hook / Eye Bolt.
			g). Drawing pocket.
			h) Door switch, lamps, thermostat, heaters and fans.

13.	Enclosure Protection Class	:	IP-42 or as per environment condition.

7.00.00 FIELD INSTRUMENTS / ANALYSERS / ELECTRICAL SYSTEMS METERS AND ACCESSORIES

7.01.00 FIELD INSTRUMENTS

This section provides general hardware guidelines for field instruments and equipment to be supplied under this specification.
Field transmitters shall be smart type with **HART** protocol. Temperature & Pressure switches shall be of Dual Snap type for vibration prone areas.

7.01.01 PRESSURE TRANSMITTER

01.	Working Principle	:	Smart(HART)
02.	Type	:	2 - Wire
03.	Output Signal	:	4-20mA DC with HART protocol.
04.	Signal Processing	:	Silicon solid state electronic circuitry
05.	Measuring Element	:	Capsule / Diaphragm
06.	Measuring element material	:	AISI-316 (Stainless Steel) or better.
07.	Static Pressure	:	150 % of maximum span continuously, without affecting the calibration.
08.	Turn-down ratio	:	100**:** 1 minimum.
09.	Span and Zero	:	Locally adjustable non-interacting. Facility for elevation and suppression by 100% of span.
10.	Enclosure Class	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
11.	Output Indicator (Digital display)	:	LCD type in % and engineering unit and LCD failure shall not affect the transmitter operation.
12.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
13.	Body	:	Forged Carbon Steel for air and flue gas applicat6ion and SS for other application.
14.	Operating Voltage	:	16 - 48 Volts D.C.
15.	Load	:	600 Ohms (min.) at 24 Volts D.C.
16.	Ambient Temperature	:	0 - 50 ^{O}C

17. Performance:

i) Accuracy : ± 0.1% of calibrated Span or better

ii) Repeatability : ± 0.05% of calibrated Span or better

iii) Response Time : 100msec or better.

iv) Warranty & stability : min. of 5 yrs or better

18. Sealing/Isolation : 6 meters SS armoured capillary with suitable fill fluid and flange remote seal diaphragm of SS 316 or suitable material as per application, for corrosive, viscous and dirty fluid application.

Flange size and pressure rating as per application.

19. Accessories :

a) Universal mounting bracket suitable for 2" pipe and wall mounting.

b) High tensile carbon steel U- bolts.

c) Installation accessories as per relevant installation drawing.

d) Syphons for steam and hot water services.

e) ½" NPT 2-valve stainless steel manifold, constructed from SS316 bar stock.

f) Companion flange with nuts, bolts and gaskets.

g) Hand held configuration kit for diagnostics and calibration of Smart Transmitter locally or in remote.

h) ¾" ET cable gland

i) Flushing facility at process end diaphragm.

j) Reverse polarity protection required.

7.01.02 DIFFERENTIAL PRESSURE TRANSMITTER/FLOW TRANSMITETR

01. Working Principle : Smart (HART)

02. Type : 2-Wire

03. Output signal : 4-10mA DC with HART protocol.

04.	Signal Processing Unit	:	Silicon solid-state electronic circuitry
05.	Measuring element	:	Capsule/Diaphragm
06.	Measuring element Material	:	AISI-316 (Stainless Steel) or better.
07.	Static Pressure/ Overload Pressure	:	Maximum line (or static) pressure on either side without permanent deformation or loss of accuracy
08.	Turn-down ratio	:	100: 1 minimum
09.	Span and Zero	:	Locally adjustable, non-interacting
10.	Enclosure class	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
11.	Zero suppression / Elevation	:	At least 100% of Span
12.	Output Indicator (Digital display)	:	LCD type in % and Engineering units
13.	Nameplate	:	Tag number and Service engraved in stainless steel tag plate
14.	Body	:	Forged Carbon Steel for air & flue gas application
15.	Ambient temperature	:	0 - 85 ^{O} C
16.	Operating Voltage	:	18 - 36 Volts DC
17.	Load	:	750 Ohms at 24 Volts DC
18.	Performance:-		
	i) Accuracy	:	± 0.1 % of calibrated span or better
	ii) Repeatability	:	± 0.05 % of calibrated span or better.
	iii) Response Time	:	100msec or better.
19.	Sealing/Isolation	:	6 meters SS armoured capillary with suitable fill fluid and flange remote seal diaphragm of SS 316 or suitable material as per application, for corrosive, viscous and dirty fluid application. Flange size and pressure rating as per application.

20.	Accessories	:	a) Universal mounting bracket suitable for 2” pipe and wall mounting.
			b) High tensile carbon steel U-bolts.
			c) Installation accessories as per relevant installation drawing.
			d) Syphons for steam and hot water services.
			k) ½” NPT 5-valve stainless steel manifold, constructed from SS316 bar stock.
			e) Companion flange with nuts, bolts and gaskets.
			f) Hand held configurator kit for diagnosis and calibration of Smart Transmitter.
			g) ¾” ET cable gland
			h) Flushing facility at process end diaphragm.

7.01.10 PRESSURE GAUGE AND DIFFERENTIAL PRESSURE GAUGE

01.	Type	:	Bourdon/Bellows/Diaphragm
02.	MOC Sensing & Socket	:	AISI-316 SS
03.	Movement Material	:	AISI-304 SS
04.	Case Material	:	Stainless steel. Enclosure IP-65.
05.	Dial Size	:	Generally 150 mm (100 mm for SWAS gauges)
06.	Scale	:	Black lettering on white background in 270 Deg. arcs.
07.	Window	:	shatterproof toughened glass
08.	Range Selection	:	Normal process pressure – 50 ~ 70 % of range (approximately).
09.	Over-range Protection	:	125% of maximum range by internal stop. External stop at zero
10.	Adjustment	:	Micrometer screw for zero adjustment. Internal micrometer screw for range adjustment.
11.	Element Connection	:	Argon welding
12.	Process Connection	:	1/2" NPT (M) Bottom connection for local mounting, back connection for panel mounting.
13.	Performance	:	Accuracy of $\pm$ 1.0 % of span or better.
14.	operating ambient Temperature	:	0 - 50 ^{O}C
15.	Safety Feature	:	Blow out disc. /diaphragm at the back

16.	Accessories	:	a) Snubbers and Glycerin filled for pulsating fluid applications and at pump discharge. b) Stainless steel 316 Diaphragm with Teflon coated seals for corrosive, viscous and solid-bearing or slurry type process fluids. c) 3-Way stainless steel Gauge cock for pressure gauges. Process connection ½" NPT. d) 5-valve SS316 manifold constructed from barstock for differential pressure gauge. Process connection ½" NPT. e) Union, nut & tail piece and other Installation accessories as required.
17.	Applicable standard	:	IS-3624 / 1996
18.	Electrical Contact rating	:	240V, 5A AC/ 220V, 0.5A DC (for gauges with alarm contact). Number of Contacts:2 SPDT
19.	Nameplate	:	Tag number, service engraved in stainless steel tag plate

2.08.05 ANNUNCIATION SYSTEM (LOCAL PANEL BASED SYSTEMS)

a) Minor modifications in the desk/panels, if required, shall be carried out.

b) Contractor shall check the facia inscriptions and their positions with respect to drawings and carry out any rearrangement or reallocation of existing fascia inscriptions.

c) Annunciation push buttons (Accept/Test/Reset) and hooters shall be mounted in position and wired up to fascia terminal block or logic cabinet, as required.

d) The testing of annunciation system shall comprise of -

- System test for sequence
- Point wise status acceptance test (initiation test)
- I.R. check at logic cabinet and fascia w.r.t ground
- Operation of push buttons and hooters.

7.04.00 ELECTRICAL SYSTEM METERS AND ACCESSORIES

7.04.01 PUSH BUTTON

01.	Type	:	Shrouded square format
02.	Face Dimension	:	32 x 32 mm (maximum)
03.	Contact Configuration	:	2 NO + 2 NC
04.	Contact Addition	:	Add-on block up to 4 each with 2 pairs of contacts
05.	Contact Material	:	Hard Silver Alloy
06.	Contact Rating	:	500V / 10 A
07.	Utilization Category	:	AC11 / DC11
08.	Insulation Voltage	:	2 KV for 1 minute between terminals and earth
09.	Mechanical Life	:	1 million operations
10.	Construction	:	Aluminum shrouding with plastic lens
11.	Colors	:	Red, Green, Yellow, Black, etc.
12.	Connection	;	Screw terminals
13.	Enclosure Class	:	IP-52
14.	Legend	:	Engraving.

7.04.02 ILLUMINATED PUSH BUTTON

01.	Type	:	Square format
02.	Face Dimension	:	32 x 32 mm (maximum)
03.	Contact Configuration	:	2 NO + 2 NC (minimum)
04.	Contact Addition	:	Add-on-Block up to 4 each with 2 pairs of contacts
05.	Contact Material	:	Hard Silver Alloy
06.	Contact Rating	:	500 V/ 10A
07.	Utilization Category	:	A C11 / DC11
08.	Insulation Voltage	:	2 KV for 1 minute between terminals and earth
09.	Mechanical Life	:	1 Million Operations
10.	Lamp	:	LED with built-in resistors as required
11.	Lamp Rating:-		
	a) Voltage	:	240 V AC
	b) Watt	:	2 Watt (approx.)
12.	Lamp and Lens Replacement	:	From front
13.	Construction	:	Transparent Plastic Lens
14.	Color	:	Red, Green, Amber, Yellow etc.
15.	Connection	:	Screw terminals
16.	Enclosure Class	:	IP-52
17.	Legend	:	Engraving

7.04.03 SELECTOR SWITCH

01.	Type	:	2/3/4 position stay put type with rotary lever actuator.
02.	Face Dimension	:	32 x 32 mm (maximum)
03.	Contact Configuration	:	4 pair of contacts
04.	Contact Addition	:	Add-on-Block up to 4 each with 2 pairs of contact

05.	Contact Material	:	Hard silver Alloy
06.	Contact Rating	:	500 V / 10 A
07.	Utilization Category	:	AC11 / DC11
08.	Insulation Voltage	:	2 KV for 1 minute between terminals and earth
09.	Mechanical Life	:	1 million operation.
10.	Construction	:	Aluminum shrouding.
11.	Connection	:	Screw terminals
12.	Enclosure Class	:	IP-52

7.04.04 INDICATING LAMP

01.	Type	:	LED with built-in resistor
02.	Face Dimension	:	32 x 32 mm (maximum)
03.	Voltage	:	230 V, 50 Hz, 1 Phase
04.	Watt	:	2.5 Watt (approximate)
05.	Lamp and Lens Replacement	:	From front
06.	Construction	:	Transparent Plastic lens
07.	Color	:	Red, Green, Amber, Yellow etc.
08.	Connection	:	Screw terminals
09.	Legend	:	Engraving

7.04.05 INDICATING METERS (A.C)

01.	Type	:	Rectifier type taut band
02.	Face Dimension	:	96 x 96 mm
03.	Scale	:	Radial arc of 240 Deg.
04.	Accuracy	:	1.5% of full scale. ±0.5 Hz for frequency meter
05.	Input	:	0-1/0-5A for current measurement, 0-240V, 50 ± 2.5 Hz for voltage measurement
06.	Zero Adjustment	:	Screw on meter face

07.	Enclosure	:	Shielded Case IP-52
08.	Mounting	:	Flush Panel
09.	End Scale Suppression	:	6 times the measuring range only for motor ammeters

7.04.06 INDICATING METERS (D.C)

01.	Type	:	Taut band moving coil
02.	Face Dimension	:	96 x 96 mm
03.	Scale	:	Radial arc of 240 Deg.
04.	Accuracy	:	1.5% of full scale
05.	Input	:	0-75 mV for current measurement. Direct reading for voltage measurement.
06.	Zero Adjustment	:	Screw on meter face
07.	Enclosure	:	Shielded case IP-52
08.	Mounting	:	Flush Panel
09.	End Scale Suppression	:	2 times the measuring range only for motor ammeters.

7.04.07 AUXILIARY RELAY

01.	Type	:	Electromagnetic.
02.	Coil voltage	:	240V AC / 220VDc. For any other voltage, bidder to make his own arrangement.
03.	Contact Configuration	:	2 NO & 2 NC (Minimum), additional contacts as per requirement with provision for additional contact block expansion.
04.	Contact rating	:	250V/5A (A.C/D.C.)
05.	Operating range	:	80 to 110% of rated voltage
06.	Insulation	:	2 KV for 1 minute between terminals & earth.
07.	Mechanical life	:	20 million operations
08.	Coil Protection	:	Diode / Surge suppressor.
09.	Connection	:	Screw terminals.
10.	Mounting	:	Projection mounting inside panel.

7.04.08 COUPLING RELAY

01.	Type	:	Miniature plug-in type/ DIN rail Mounting
02.	Coil voltage	:	24 V D.C. / 48V DC
03.	Contact	:	2 NO & 2 NC (Minimum)-Additional contact as per requirement
04.	Contact rating	:	250 V/5A (A.C)/220V/2A (D.C)
05.	Operating range	:	70 to 110% of rated voltage.
06.	Insulation	:	2 KV for 1 minute between terminal & earth.
07.	Mechanical life	:	20 million operations
08.	Coil protection	:	Diode
09.	Indication	:	Coil on LED
10.	Enclosure	:	Transparent cover
11.	Connection	:	Screw terminals.
12.	Mounting	:	Projection mounting inside panel / DIN rail mounting

7.04.09 DISTRIBUTION BOARDS

01.	Type	:	Fixed, Modular.
02.	Power distribution	:	Through MCCB
02.	Enclosure	:	Sheet Steel, IP54
03.	Mounting	:	Free standing (Can be attended from both front & back)

8.00.00 CONTROL AND INSTRUMENT CABLE

8.00.03 INSTRUMENTATION PAIR SIGNAL CABLE

01.	Conductor type	:	Stranded (7) annealed tinned copper
02.	Conductor size	:	0.5 / 1.0 / 1.5 Sq.mm (as required)
03.	Conductor resistance	:	39 Ω/Km/18 Ω/Km/12 Ω/Km
04.	Conductor Insulation	:	HR PVC Type-C (IS-5831,1984) 0.6 mm thick
05.	Operating Voltage	:	300 / 500V RMS (Core to earth / core to core)
06.	Twisting	:	Twin twisted with lay of 60 mm
07.	Twisting Direction	:	All pairs in the same direction. Lapped to form bunch with mylar tape.
08.	Screen (Pair & Overall)	:	Aluminium mylar tape with a thickness of 28 μm (min.) for individual pair screen and 60 μm (min.) for overall screen with 100% coverage and 25% overlapped edges. Over the individual pair screening tape two laps of 0.05 mm thick (min.) polyester tape shall be applied with minimum overlap of 25%.

			Metallic side of the screen shall be in contact with drain wire. * Analog signals- Individual pair & overall shield to be considered. * Binary signals- overall shield to be considered.
09.	Drain wire	:	Annealed tinned copper wire, stranded. Size 0.5 Sq. mm. (No. of strands / size:- 7 / 0.3mm)
10.	Inner Sheath	:	Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties) HR PVC Type ST2 of IS-5831,1984 Thickness as per IS-1554, Part-I 1976
11.	Rip Cord	:	Non metallic under sheath
12.	Armouring	:	GI wire / strip as per IS 3975
13.	Outer Sheath	:	Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties) HR PVC Type ST2 of IS-5831,1984 Thickness as per IS-1554, Part-I 1976
14.	Filler	:	Non hygroscopic with FRLS property.
15.	Temperature Range	:	85 ^{O}C
16.	Insulation at 20 Deg.C	:	100 MOhms/Km [Min]
17.	Capacitance at 800 Hz	:	120 nf/km
18.	Cross talk	:	60 dB
19.	Attenuation	:	1.2 dB/Km
20.	Codes & Standards	:	a) IPCEA-S-61-402 b) BS 5308 c) IEC 332-1 d) ASTM-B-33 e) IS-8130-1984 f) IS 1554 Part-1

g) IS 10810

21. Sheath colour : Inner- Black and Outer- Gray

22. Tests : a) Oxygen Index: Min.29 at room temp. (ASTM-D-2863)

b) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I

c) Temp Index : Min 250 ^{O} C at 21Oxy. Ind. (ASTM-D-2863)

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

e) Flammability Test : as per IEC 332 Part-I

f) Swedish Chimney Test-SS-424-1475 F3

g) Insulation Resistance 100 M Ohm / Km Min

h) High voltage test

Core to core- 1.5 KV for 1 min.

Core to screen- 1.0 KV for 1 min.

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

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

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

Above 4 Pairs, 4 Pairs making a unit shall have indelible printed colour coded bands like Pink for 1st unit, Orange for 2nd unit and Violet for 3rd unit and so on. In addition band marking, for example single band for 1st. unit, double band for 2nd. unit and so on, shall be provided on each conductor for identification of unit.

Band marking on individual core shall be provided at regular intervals not exceeding 50 mm.

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

9.00.00 ERECTION HARDWARE

9.01.00 ELECTRICAL JUNCTION BOX

01.	Type of Enclosure	:	Dust tight, Weatherproof and Waterproof, generally conforming to IP 65.
02.	Material	:	3mm sheet steel
03.	Type of Cover	:	Solid unhinged with retention chain
04.	Paint	:	631 IS:5 Epoxy Powder Coated.
05.	Mounting	:	Surface
06.	Cable Entry	:	3mm (mim) Gland plate.
07.	Gasket	:	Neoprene
08.	Grounding	:	Brass earth lug with green screw head External-2 Nos, Internal-1no.M6.
09.	Number of Drain Holes	:	Two at bottom capped.
10.	Tag Plate	:	a) JB Number b) Cable Numbers Tag c) Cable numbers with ferrules (side)
11.	Accessories	:	a) Rail mounted cage clamp type screw less terminals with markers. b) Cable gland c) Canopy at top.

9.02.00 Cable Gland

01.	Type	:	Double compression
02.	Entry Thread	:	NPT
03.	Material	:	Brass
04.	Finish	:	Cadmium Plated.

	05.	Protection	:	IP – 54 or better
	06.	Accessories	:	Neoprene gasket, locknuts, reducers etc.

9.03.00 CABLE TRAY

	01.	Material	:	Mild steel
	02.	Thickness	:	not less than 2.0 mm
	03.	Finish	:	Hot dip galvanized
	04.	Perforation	:	As per MFR standard.
	05.	Cover	:	Suitable for tray

FORM NO. PEM-6666-0

BHEL	**DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE FOR COLTCS**	SPECIFICATION NO.: PE-TS-XXX-145-I100
		VOLUME
		SECTION
		REV. NO. 00 / DATE: 03.04.2017
		SHEET 1 OF 3

TAG No. ……. Qty..... Data Sheet No.: **PE-DC-999-145-I026**

Data Sheet A & B

DATA SHEET-A FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

GENERAL	MANUFACTURER		
	MODEL NUMBER		
TECHNICAL	PRESSURE ELEMENT	■ BOURDON ■ DIAPHRAGM ■ BELLOW	
	MATERIAL	**THE MINIMUM REQUIREMENT FOR SEA WATER APPLICATION : ALL WETTED PARTS & DIAPHRAGM SHALL BE SUITABLE FOR SEA WATER (DUPLEX SS OR BETTER)**	
	A) BELLOW	■ 316 SS	
	B) BOURDON TUBE	■ 316 SS	
	C) MOVEMENT	■ 316 SS	
	D) CASE ENCLOSURE	■ 316 SS	
	E) PROTECTIVE DIAPHRAGM	■ TEFLON COATED SEALS	
	ENCLOSURE	■ IP-65 OR BETTER	
	DIAL	SIZE: ☐ 100MM ■ 150MM WITH SHATTER PROOF GLASS COLOR: WHITE NUMERALS: BLACK SCALE: ■ LINEAR, 270 DEG ARC GRADUATED IN METRIC UNITS	
	CASE	COLOUR : BLACK	
	MOUNTING	■ LOCAL / FRAME MOUNTED ■ INSTRUMENT RACK	
	OVER RANGE PROTECTION	☐ 115% OF MAX. OF SCALE ■ 150% OF MAX. OF SCALE	
	CAPILLARY LENGTH	■ MINIMUM LENGTH OF 15 M REQUIRED	
	BLOW OUT DISC	■ REQUIRED , WITH OPEN FRONT CONSTRUCTION OF SUITABLE MATERIAL	
	SWITCHING FACILITY	■ YES ☐ NO	
	TYPE	■ MICRO SWITCH ☐ OTHER	
	NO. / TYPE OF CONTACTS	2 NOS. SPDT	
	CONTACT RATING	5A 230V AC, 0.25A 220V DC	
	SETTING RANGE RANGE SELECTION	FIELD ADJUSTABLE OVER FULL RANGE; COVERS 125% OF MAX. OF SCALE	
	REPEATABILITY	± 1% OF FSR	
	POWER SUPPLY	■ 230V AC ■ 110V AC	
	OVER RANGE TEST	TEST PR. FOR THE ASSEMBLY SHALL BE 1.5 TO THE MAX. DESIGN PRESSURE AT 38 DEG C.	
	ZERO/ SPAN ADJUSTMENT	■ MICROMETER SCREW EXTERNAL FOR ZERO ADJUSTMENT ■ MICROMETER SCREW INTERNAL FOR RANGE ADJUSTMENT	

FORM NO. PEM-6666-0

	DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE FOR COLTCS	SPECIFICATION NO.: PE-TS-XXX-145-I100
		VOLUME
		SECTION
		REV. NO. 00 / DATE: 03.04.2017
		SHEET 2 OF 3

TAG No. ……. Qty..... Data Sheet No.: **PE-DC-999-145-I026**

Data Sheet A & B

DATA SHEET-A FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

PERFORMANCE	ACCURACY	± 1% OR BETTER OF FULL SCALE DEFLECTION	
CONNECTION	PROCESS	½ " NPT (M)	
	LOCATION	☐ BACK ☐ BOTTOM	
ACCESSORIES	NAME PLATE / METAL TAG	SS	
	MOUNTING	☐ WALL ☐ PIPE – U CLAMPS & BOLTS ☐ PANEL / RACK TO BE DECIDED DURING DETAILED ENGG.	
		3 WAY NEEDLE VALVE / MANIFOLDS PROTECTIVE SEPARATING, CHEMICAL SEAL DIAPHRAGM – FOR CORROSIVE LIQUID LINES Union, nut & tail piece and other Installation accessories as required. 3-Way SS316 Gauge cock for pressure gauges	

NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

FORM NO. PEM-6666-0

	DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE FOR COLTCS	SPECIFICATION NO.: PE-TS-XXX-145-I100
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		SHEET 1 OF 2

TAG No. ……. Qty..... Data Sheet No.: **PE-DC-999-145-I026**

Data Sheet C

DATA SHEET-C FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

GENERAL	MANUFACTURER	
	MODEL NUMBER	
TECHNICAL	PRESSURE ELEMENT	
	MATERIAL	
	ENCLOSURE	
	DIAL	
	CASE	
	ADJUSTMENT	
	MOUNTING	
	OVER RANGE PROTECTION	
	BLOW OUT DISC	
	SWITCHING FACILITY TYPE NO. / TYPE OF CONTACTS CONTACT RATING SETTING RANGE REPEATABILITY POWER SUPPLY	
PERFORMANCE	ACCURACY	
CONNECTION	PROCESS	
	LOCATION	
ACCESSORIES	NAME PLATE / METAL TAG	
	MOUNTING	
	OTHER	

NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

FORM NO. PEM-6666-0

	DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER FOR COLTCS	SPECIFICATION NO.: PE-TS-XXX-145-I100
		VOLUME
		SECTION
		REV. NO. 00 | DATE: 04.04.2017
		SHEET 1 OF 2

TAG No. ……. Qty..... Data Sheet No.: **PES-145-01-DS1-0**

Data Sheet A & B

DATA SHEET-A FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

	MANUFACTURER		
	MODEL NUMBER		
TECHNICAL	TYPE	■ CAPACITANCE ■ SILICON RESONANCE TYPE	SMART TRANSMITTER OF ELECTRONIC TYPE, MICROPROCESSOR BASED, HART COMPATIBLE
	POWER SUPPLY	■ 24V DC NOMINAL	
	TRANSMITTER MEASUREMENT	■ PRESSURE ■ DIFF. PRESSURE	
	OUTPUT SIGNAL	■ 4 to 20 m Amp. DC	
	NO. OF WIRE	■ TWO	
	ACCURACY	■ ± 0.04% OF SPAN OR BETTER	
	LINEARITY, HYSTERISIS, DEAD BAND AND REPEATABILITY	■ ± 0.05 % OF SPAN OR BETTER	
	STABILITY	■ ± 0.1 % OF URL FOR 10 YEARS	
	SENSITIVITY	■ ± 0.05% OF SPAN OR BETTER	
	MATERIAL	**THE MINIMUM REQUIREMENT FOR SEA WATER APPLICATION : ALL WETTED PARTS & DIAPHRAGM SHALL BE SUITABLE FOR SEA WATER (DUPLEX SS OR BETTER)**	
	A) BODY	■ 316 SS	
	B) ELEMENT	■ 316 SS	
	C) DIAPRAGM	■ 316 SS	
	C) SEAL	■ TEFLON	
	FLANGED REMOTE SEAL DIAPHRAGM	AS REQUIRED	
	CAPILLARY LENGTH	■ MINIMUM LENGTH OF 15 M REQUIRED	
	CONTINUOUSLY ADJUSTABLE SPAN AND ZERO ADJUSTMENT PROVIDED	■ YES, Locally adjustable, non-interacting ☐ NO	
	MOUNTING	☐ WALL/PIPE STAND ■ INSTRUMENT RACK	
	ENCLOSURE	☐ NEMA-4 ☐ NEMA-7 ■ IP-65 WITH CORROSION RESISTANCE EPOXY COATING	
	PAINT	■ EPOXY COATING FOR ALL C&I EQUIPMENT ■ Anticorrosive paint shall be applied to field mounted enclosures / instruments.	
	TURN DOWN RATIO	■ 100:1 in general	

FORM NO. PEM-6666-0

BHEL	**DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER FOR COLTCS**	SPECIFICATION NO.: PE-TS-XXX-145-I100 VOLUME SECTION REV. NO. 00 DATE: 04.04.2017 SHEET 2 OF 2

TAG No. ……. Qty..... Data Sheet No.: **PES-145-01-DS1-0**

Data Sheet A & B

DATA SHEET-A FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER (TO BE FILLED BY PURCHASER)		DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
INSULATION RESISTANCE	TO BE SPECIFIED BY BIDDER	
OVER PRESSURE	■ 150% OF MAX. OPR. PRESS	
ZERO SUPPRESSION/ ELEVATION RANGE	■ ATLEAST 100% OF SPAN	
INTEGRAL INDICATOR	■ YES, LCD indicator (5 digit) with scale of Engg. unit ☐ NO	
RESPONSE TIME	■ 150 msec.	
TRANSMITTER SHALL BE ABLE TO DRIVE LOAD IMPEDANCE OF 500 OHMS (min.) WITH DRIVE CAPABILITY OF 600 OHMS NOMINAL	■ YES ☐ NO	
ELECTRICAL CONNECTION	■ PLUG & SOCKET TYPE	
PROCESS CONNECTION	■ I/2 " NPT (F)	
ZERO & SPAN DRIFT	■ ± 0.015 % PER DEG.C AT MAX. SPAN ■ ± 0.11 % PER DEG.C AT MIN. SPAN	
DIAGNOSTICS	■ SELF INDICATING FEATURE	
MANIFOLD		
a) NAME PLATE / METAL TAG	SS	
b) PRESSURE MEASUREMENT	■ 2 WAY ■ MATERIAL: 316 SS	
c) DIFFERENTIAL PRESSURE MEASUREMENT	■ 5 WAY ■ MATERIAL: 316 SS	
CABLE ENTRY DETAIL	SUITABLE FOR DIA OF 17.5 mm	

NOTES:

1. TRANSMITTERS SHOULD NOT BE MOUNTED DIRECTLY ON MANIFOLD. MANIFOLD SHOULD BE NON-INTEGRAL AND STAND ALONE TYPE.
2. TRANSMITTERS TO BE EQUIPPED WITH MOUNTING BRACKETS.
3. UNION, NUT,PIPE-U CLAMPS,BOLTS & TAIL PIECE AND OTHER INSTALLATION ACCESSORIES AS REQUIRED.

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

FORM NO. PEM-6666-0

	DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER FOR COLTCS	SPECIFICATION NO.: PE-TS-XXX-145-I100
		VOLUME
		SECTION
		REV. NO. 00 | DATE: 04.04.2017
		SHEET 1 OF 2

TAG No. ……. Qty..... Data Sheet No.: **PES-145-01-DS2-0**

Data Sheet C

DATA SHEET-C FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

MANUFACTURER	
MODEL NUMBER	
TYPE	
POWER SUPPLY	
TRANSMITTER MEASUREMENT	
OUTPUT SIGNAL	
NO. OF WIRE	
ACCURACY	
LINEARITY, HYSTERISIS, DEAD BAND AND REPEATABILITY	
STABILITY	
SENSITIVITY	
MATERIAL	
A) BODY	
B) ELEMENT	
C) DIAPRAGM	
C) SEAL	
CONTINUOUSLY ADJUSTABLE SPAN AND ZERO ADJUSTMENT PROVIDED	
MOUNTING	
ENCLOSURE	
PAINT	
TURN DOWN RATIO	
INSULATION RESISTANCE	
OVER PRESSURE	
ZERO SUPPRESSION/ ELEVATION RANGE	

FORM NO. PEM-6666-0

	DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER FOR COLTCS	SPECIFICATION NO.: PE-TS-XXX-145-I100
		VOLUME
		SECTION
		REV. NO. 00 | DATE: 04.04.2017
		SHEET 2 OF 2

TAG No. ……. Qty..... Data Sheet No.: **PES-145-01-DS2-0**

Data Sheet C

DATA SHEET-C FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

INTEGRAL INDICATOR	
RESPONSE TIME	
TRANSMITTER SHALL BE ABLE TO DRIVE LOAD IMPEDANCE OF 500 OHMS(min.) WITH DRIVE CAPABILITY OF 600OHMS NOMINAL	
ELECTRICAL CONNECTION	
PROCESS CONNECTION	
ZERO & SPAN DRIFT	
DIAGNOSTICS	
MANIFOLD	
d) PRESSURE MEASUREMENT	
B) DIFFERENTIAL PRESSURE MEASUREMENT	
CABLE ENTRY DETAIL	

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

FORM NO. PEM-6666-0

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR FOR COLTCS	SPECIFICATION NO.: PE-DG-XXX-145-I902
		VOLUME II B
		SECTION D
		REV. NO. 00 DATE: 01.04.2017
		SHEET 1 OF 4

Data Sheet A & B

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

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR FOR COLTCS**	SPECIFICATION NO.: PE-DG-XXX-145-I902 VOLUME II B SECTION D REV. NO. 00 DATE: 01.04.2017 SHEET 2 OF 4

Data Sheet A & B

		DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
	@ ENCLOSURE CLASS OF MOTOR	■ IP 68 ☐ 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	

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR FOR COLTCS	SPECIFICATION NO.: PE-DG-XXX-145-I902
		VOLUME II B
		SECTION D
		REV. NO. 00 DATE: 01.04.2017
		SHEET 3 OF 4

Data Sheet A & B

		DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty & other specific applications)	■ REQUIRED ☐ NOT REQUIRED	
	MFR & MODEL NO.	BIDDER TO SPECIFY	
	TYPE	☐ ELECTRONIC (2 WIRE) R/I CONVERTER ■ ELECTRONIC (2 WIRE) CONTACTLESS	
	SUPPLY	■ 24V DC ☐	
	OUTPUT	■ 4-20mA	
	ACCURACY	± 1% FS	
SPACE HEATER	@SPACE HEATER	REQUIRED	
	@ POWER SUPPLY (NON INTEGRAL)	■ 230V AC,1 PH.,50 Hz ■ 240V 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/ 11 PIN) (FOR COMMD, LS/TS FEED BACK, PoT)	■ REQUIRED ☐ NOT REQUIRED ■ 2 NOS. ☐ ----------	
CABLE GLANDS	@ POWER CABLE GLAND	SIZE: suitable for 3Cx2.5sq mm Cu	
	@ SPACE HEATER CABLE GLAND		
	OTHER CONTROL CABLE GLANDS-1	1 no. for BFV of CW pump (Cable size 2PX1.5mm2)	
	OTHER CONTROL CABLE GLANDS-2	1 no. suitable for 8Px0.5 sq m Additional 1 no. suitable for 2P x 0.5 sq mm.	

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR FOR COLTCS**	SPECIFICATION NO.: PE-DG-XXX-145-I902	
		VOLUME II B	
		SECTION D	
		REV. NO. 00	DATE: 01.04.2017
		SHEET 4	OF 4

Data Sheet A & B

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

WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY	_____ Kg.

NOTES:

1. **SCOPE**: DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.
2. **CODES & STANDARDS**: DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATION STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH:
   IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722
3. **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.
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.
11. IT SHOULD BE POSSIBLE TO OPERATE THE ACTUATOR LOCALLY. LOCKABLE LOCAL/REMOTE SELECTION SHALL BE PROVIDED ON THE ACTUATOR.
12. POSITION INDICATOR SHALL BE PROVIDED FOR 0 TO 100 % TRAVEL
13. WIRING SHALL BE SUITABLE VOLTAGE GRADE COPPER WIRE 1.5 SQ. MM.
14. THE MOTOR SHALL BE CAPABLE OF STARTING AT 85 PERCENT OF RATED VOLTAGE AND RUNNING AT 80 PERCENT OF RATED VOLTAGE AT RATED TORQUE AND 85 PERCENT RATED VOLTAGE AT 33 PERCENT EXCESS RATED TORQUE FOR A PERIOD OF 5 MINUTES EACH.
15. THE ACTUATORS SHALL BE DESIGNED TO BE SELF-LOCKING UPON LOSS OF POWER. MOTOR SHALL BE DESIGNED TO CLOSE IN 30 SECS. FROM FULL OPEN POSITION AND SHALL HAVE ADEQUATE CAPACITY TO OPEN AND CLOSE UNDER FULL UNBALANCED DESIGN PRESSURE.
16. ALL SIX (6) LIMIT SWITCHES SHALL BE CHANGEOVER TYPE AND ADJUSTABLE BESIDES HAVING THE SNAP FACILITY.
17. THE INTEGRAL STARTER WHICH SHALL HAVE SOPHISTICATED ELECTRONIC CONTROLS WITH FIELD PROGRAMMING FEATURE. IT SHALL BE DESIGNED FOR REMOTE CONTROL FROM DCS/RESPECTIVE CONTROL SYSTEM. REQUIRED INTERPOSING RELAYS FOR RECEIVING OPEN/CLOSE/STOP COMMAND FROM DCS/RESPECTIVE CONTROL SYSTEM SHALL BE PROVIDED. POTENTIAL FREE CONTACTS AND TRANSDUCERS SHALL BE PROVIDED TO PROVIDE STATUS INDICATION AT REMOTE DCS/RESPECTIVE CONTROL SYSTEM.
18. THE REMOTE COMMAND SIGNAL (OPEN-STOP-CLOSE) FROM DCS/RESPECTIVE CONTROL SYSTEM/CONTROL PANEL SHALL BE ISOLATED FROM CONTROL ELECTRONICS THROUGH OPTO-ISOLATOR.
19. THE FOLLOWING INDIVIDUAL STATUS ANNUNCIATION LED'S (COLOUR-GREEN) SHALL BE PROVIDED LOCALLY (INTEGRAL TO ACTUATOR) TO ANNUNCIATE THE FOLLOWING FOR EASY LOCAL MONITORING.

    ACTUATOR IN LOCAL MODE
    ACTUATOR IN REMOTE MODE
    ACTUATOR RUNNING IN OPEN DIRECTION
    ACTUATOR RUNNING IN CLOSE DIRECTION
    ACTUATOR IN INCHING MODE
    ACTUATOR IN SELF-RETAINING MODE
    LIMIT SWITCH OPEN TRIP
    LIMIT SWITCH CLOSE TRIP
    CONTROL VOLTAGE AVAILABILITY

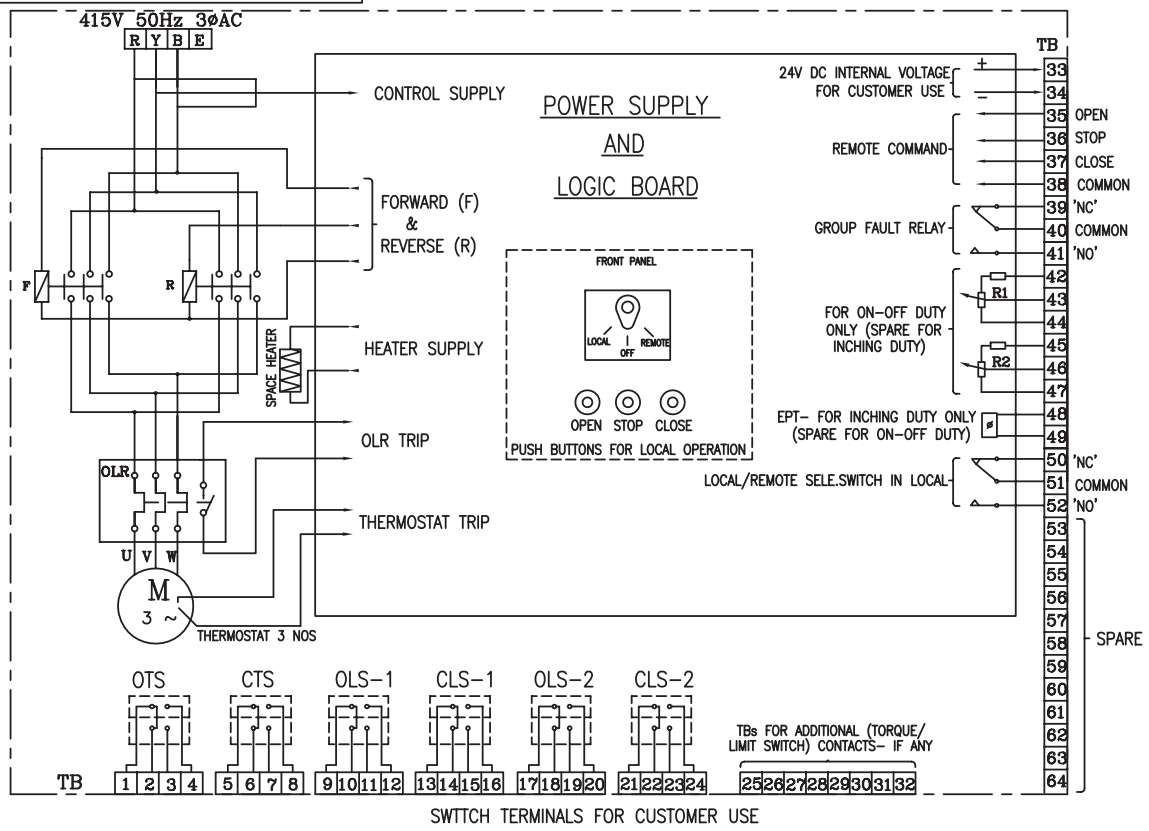
$$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE.

EPOXY PAINT OR BETTER IS RECOMMENDED FOR COASTAL AREAS/ SEA WATER APPLICATIONS.

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

ALL DIMENSIONS ARE IN MILLIMETRES. FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER RELEVANT QCP / QP.

DRAWING NO. 3-V-MISC-24227



SWTTCH TERMINALS FOR CUSTOMER USE

CONTACT DEVELOPMENT DIAGRAM

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

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

INDICATES CONTACT CLOSED

INDICATES CONTACT OPEN

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

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

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

- CLS NOT TO BE CONNECTED IN TRIP CIRCUIT

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

NOTE:-

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

REV	DATE	ALTERED
		CHD & APPD

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

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

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

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

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

CARD CODE: U 01

DRAWING NO.: 3-V-MISC-24227

REV: 0

Size A3

BHEL	**DATA SHEET FOR LOCAL CONTROL CUM STARTER PANELS FOR COLTCS**	SPECIFICATION NO.: PE-SS-999-145-054A
		VOLUME
		SECTION
		REV. NO. 00 / DATE: 04.04.2017
		SHEET 1 OF 3

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

Data Sheet A & B

			DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
GENERAL	MANUFACTURER			
	CONSTRUCTION		■ FOLDED ☐ WELDED	
	ENCLOSURE SHEET THICKNESS	FRONT	■ 3.0 mm	
		OTHER	■ 2.0 mm	
		DOOR	■ 2 mm	
		HEIGHT	■ 2365 mm for stand-alone panels (THIS SHALL BE DECIDED BY BHEL DURING DETAILED ENGG.)	
		OTHER	■ Load bearing sheet front shall have 3mm thickness	
TECHNICAL	INPUT POWER SUPPLY * (ANY OTHER POWER REQUIREMENT TO BE DERIVED FROM THIS SUPPLY ONLY)		☐ 240V 50 Hz AC ☐ 220V DC ■ 415V 3 PHASE Kindly refer Electrical scope sheet	
	NO. OF FEEDERS		☐ ONE ■ TWO	
	STARTER WITH MCC		■ REQUIRED ☐ NOT REQUIRED	
	IPR POSITION		☐ MCC ■ CONTROL PANEL	
	CONTACT RATING OF RELAY		■ 5 Amp, 230 V AC ■ 0.25 Amp, 220V DC	
	CONTROL SUPPLY		☐ 10V AC ☐ 220V AC ■ 220V DC ☐ Other. (As per requirement)	
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)		■ REQUIRED 20 nos. Actual no. shall be decided during detailed engg.	
	TEMP SCANNER (IF REQUIRED –NO. OF CHANNELS TO BE SPECIFIED UNDER SEC-C)		☐ REQUIRED ■ NOT REQUIRED	
	PAINT TYPE		■ EPOXY ENAMEL ☐ EPOXY POWDER COATED OR BETTER	
	MIMIC (TYPE OF MIMIC- MATERAIL, THICKNESS TO BE SPECIFIED DURING DETAILED ENGG.)		■ REQUIRED ☐ NOT REQUIRED	
	PANEL COLOUR (EXTERNAL)		☐ LIGHT GREY (Shade 631 IS-5) ☐ OPALINE GREEN (Shade 275) ☐ RAL 7032 SHALL BE DECIDED DURING DETAILED ENGINEERING	
	FINISH (EXTERNAL)		☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY	
	PANEL COLOUR (INTERNAL)		☐ WHITE ☐ CREAM ☐ OFF WHITE SHALL BE DECIDED DURING DETAILED ENGINEERING	
	FINISH (INTERNAL)		☐ MATT ■ GLOSSY ☐ SEMI GLOSSY SHALL BE DECIDED DURING DETAILED ENGINEERING	

BHEL	**DATA SHEET FOR LOCAL CONTROL CUM STARTER PANELS FOR COLTCS**	SPECIFICATION NO.: PE-SS-999-145-054A VOLUME SECTION REV. NO. 00 DATE: 04.04.2017 SHEET 2 OF 3

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

Data Sheet A & B

	DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)		DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
	CLASS OF PROTECTION	☐ IP-66 (FOR OUTDOOR LOCATIONS) ■ IP-55 (FOR INDOOR LOCATIONS) THE PANEL SHALL BE NEMA 4X WITH A SUITABLE CANOPY AT THE TOP.	
	CONTROL HARDWARE	☐ RELAY BASED	
	FOUNDATION ARRANGEMENT	☐ FOUNDATION BOLTS ☐ ANCHOR FASTENERS	
	WEIGHT OF PANEL (Kg.)	……(Vendor to specify)	
	PANEL TYPE	☐ PRESSURISED ■ UNPRESSURISED As per Requirement	
	CABLE GLAND	■ DOUBLE COMPRESSION	
	AMMETER (TYPE OF INPUT)	☐ 1 Amp CT ☐ 4-20 Ma NOT REQUIRED BELOW 30KW.	
	SCOPE OF SUPERVISION FOR ERECTION & COMMISSIONING	☐ APPLICABLE ☐ NA	

	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL
NAME				NAME:
DESIGNATION				
SIGNATURE				SIGNATURE:
DATE				DATE:

BHEL	**DATA SHEET FOR LOCAL CONTROL CUM STARTER PANELS FOR COLTCS**	SPECIFICATION NO.: PE-SS-999-145-054A VOLUME SECTION REV. NO. 00 DATE: 04.04.2017 SHEET 3 OF 3

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

Data Sheet C

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

GENERAL	MANUFACTURER			
	CONSTRUCTION		☐ FOLDED ☐ WELDED (As per requirement)	
	ENCLOSURE SHEET THICKNESS	FRONT		
		OTHER		
		DOOR		
		HEIGHT		
		OTHER		
TECHNICAL	INPUT POWER SUPPLY			
	NO. OF FEEDERS			
	CONTACT RATING OF RELAY			
	TEMP SCANNER			
	CONTROL SUPPLY			
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)			
	PAINT TYPE			
	PANEL COLOUR (EXTERNAL)			
	FINISH (EXTERNAL)			
	TYPE OF MIMIC MATERIAL OF MIMC THICKNESS OF MIMIC			
	PANEL COLOUR (INTERNAL)			
	FINISH (INTERNAL)			
	CLASS OF PROTECTION			
	CONTROL HARDWARE			
	FOUNDATION ARRANGEMENT			
	WEIGHT OF PANEL (Kg.)			
	PANEL TYPE			
	CABLE GLAND			

FORM NO. PEM-6666-0

	DATA SHEET FOR LOCAL CONTROL CUM STARTER PANELS FOR COLTCS	SPECIFICATION NO.: PE-SS-999-145-054A
		VOLUME
		SECTION
		REV. NO. 00 / DATE: 04.04.2017
		SHEET 3 OF 3

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

Data Sheet C

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

	AMMETER (TYPE OF INPUT)		
	SCOPE OF SUPERVISION		

	PREPARED BY	**CHECKED BY**	**APPROVED BY**	COMPANY SEAL
NAME				NAME:
SIGNATURE				SIGNATURE:
DATE				DATE:

SUB-SECTION – ID

DATASHEET-A

	DATA SHEET - A	SPECIFICATION NO.: PE-TS- 422/423/425-165-N002
	CONDENSER ON LINE TUBE CLEANING SYSTEM(COLTCS)	REV. NO.: 00. DATE : 05/08/2017
	FOR SEA WATER APLICATION	SECTION : I. SUB-SECTION : ID

SL NO	DESCRIPTION	UNITS	1X525 TUTICORIN TPS STAGE-IV	1X800 MW NORTH CHENNAI TPP STG-III & 2X800 MW UPPUR STPP UNIT#1&2
1.00	**GENERAL**			
1.1	Nos. of tube cleaning systems sets required for station	Nos.	Two (02) Nos. for station viz. One independent set for each half of condenser	Six (06) Nos. for three Units. viz. One independent set common for each half of two condensers placed in series There are 2 nos. condenser per Unit in Series, i.e. Balls from one Separator/ Collector has to pass through two nos. Condensers placed in Series.
1.2	Liquid Handled		Sea water (Refer enclosed water analysis at Annexure II)	Sea water (Refer enclosed water analysis at Annexure II)
1.3	Size of COLTCS (Ball separator)	NB	2200	2700
1.4	Length of Ball Separator	mm	3900 Note: 1. Scope of Ball Separator counter flange is in Purchaser's scope. (Associated Gaskets, nuts and bolts are in Bidder's Scope) 2. Ball Separator shall be mounted directly on the existing Butterfly valve - Refer Annexure III. 3. Flap of butterfly valve shall be extended to approx 1200 mm inside the Ball separator.	4350 Note: 1. Scope of Ball Separator counter flange is in Purchaser's scope. (Associated Gaskets, nuts and bolts are in Bidder's Scope) 2. Ball Separator shall be mounted directly on the existing Butterfly valve - Refer Annexure III. 3. Flap of butterfly valve shall be extended to 1300-1400 mm inside the Ball separator.
2	**DESIGN DATA**			
2.1	Operating pressure at Condenser inlet flange	kg/cm2 (g)	Approx 1.5 to 2.5	Approx 1.5 to 2.5
2.2	Design Pressure for ball separator	kg/cm2 (g)	5.0 kg/cm² (g)	5.0 kg/cm² (g)
2.3	Design Mechanical temperature	Deg. C	60	60
2.4	Condenser Details			
	a) Type of condenser		Double Pass	Single pass
	b) No. of Condenser sections	Nos.	Two (2)	Two (2)
	c) No. of passes per condenser section (viz. condenser half)	Nos.		One (1)
	d) No. of tubes per condenser	Nos.	24398	2 X 24156
	• Condensing zone	Nos.	22688	2 X 23744
	• Air Cooling zone	Nos.	1710	2 X 412
	e) Tube Dia. OD x Thickness			
	• Top two rows	mm x mm	31.75 x 0.889	28.575 x 0.889
	• Remaining	mm x mm	31.75 x 0.7112	28.575 x 0.7112
	f) Length of tubes between ends.	mm		14742
	g) Tube material		Welded Titanium (SB338 - Gr 2)	Welded Ti (SB338 - Gr 2)
	h) Pressure drop across condenser - At Normal flow (between Inlet and Outlet flanges of condenser)	MWC	4.0 MWC (However the actual value can vary +/-20% of the design value)	2 X 2.5 MWC (EXCL. INTERCONNECTION PIPES BETWEEN TWO CONDENSERS) (However the actual value can vary +/-10% of the design value)

2.5	CW flow rate through each ball separator			
	- Normal	cu.m/hr	29850	45000
	- Maximum	cu.m/hr	35820	54000
2.6	Design differential pressure for ball separator strainer/screen	kg/cm2 (g)	0.3	0.3
2.7	Pressure drop across ball separator i.e. between inlet & outlet flanges in clean condition at normal flow.	MWC	0.2	0.2
2.8	Pressure drop across ball separator in choked condition when strainer backwashing starts	MWC	Not to exceed 0.30	Not to exceed 0.30
2.9	No. of balls required for COLTCS per condenser section		Minimum 10% of number of condenser tubes	Minimum 10% of number of condenser tubes
3	**CONNECTING PIPE DETAILS**			
3.1	Condenser inlet pipe			
	a) Material		Carbon Steel to IS – 2062 Gr. B rolled & welded conforming to IS:3589 Internally lined with Polyurethane (PU) as per AWWA C-222	Carbon Steel to IS – 2062 Gr. B rolled & welded conforming to IS:3589 Internally lined with Poly Urea/CorroCoat Coating inside of 2000 Microns DFT
	b) O.D. X Thickness		2235 X 18	2740 X 20
3.2	Condenser outlet pipe			
	a) Material		Carbon Steel to IS – 2062 Gr. B rolled & welded conforming to IS:3589 Internally lined with Polyurethane (PU) as per AWWA C-222	Carbon Steel to IS – 2062 Gr. B rolled & welded conforming to IS:3589 Internally lined with Poly Urea/CorroCoat Coating inside of 2000 Microns DFT
	b) O.D. X Thickness		2235 X 18	2740 X 20
3.3	Manhole		Yes, 600 NB size	Yes, 600 NB size
4	**MATERIALS OF CONSTRUCTION**			
4.1	BALL SEPARATOR			
	a) Body / housing		Carbon Steel to IS -2062 Gr.B. Rubber Lined inside (with minimum housing thickness same as connecting pipe thickness)	Carbon Steel to IS -2062 Gr.B. Rubber Lined(Min. 5mm thick) inside (with minimum housing thickness same as connecting pipe thickness)
	b) Screen / Strainer		Duplex SS	Duplex SS (UNS 32205/31803)
	c) Strainer shaft		Duplex SS	Duplex SS (UNS 32205/31803)
	e) Internal Hardware in contact with circulating water including nuts, bolts , etc.		Duplex SS	Duplex SS (UNS 32205/31803)
	f) Site Glass provision		YES	YES
4.2	BALL RECIRCULATING PUMP			Non clog type
	a) Casing		Duplex SS	Duplex SS (UNS 32205/31803)
	b) Impeller		Duplex SS	Duplex SS (UNS 32205/31803)
	c) Shaft		Duplex SS	ASTM A276 UNS 31803
4.3	BALL COLLECTOR			
	a) Body / housing		Carbon Steel to IS -2062 Gr.B. Rubber Lined inside (Min. 5mm thick)	Carbon Steel to IS -2062 Gr.B. Rubber Lined(Min. 5mm thick) inside
	b) Screen / Strainer/other internals		Duplex SS	Duplex SS (UNS 32205/31803)
	c) Site Glass Provision		YES	YES
4.4	Differential pressure measuring system		Duplex SS	Duplex SS
4.5	Injection nozzle		Duplex SS	Duplex SS (UNS 32205/31803)
4.6	Valves			

4.6.1	Check Valves (65 NB & Above)			For sizes 65 NB and above:- Swing check or dual plate type.
	a) Body & Bonnet		DI to ASTM-A-439 Grade D2 or Duplex SS	Duplex SS, Flanged Ends
	b) Disc for Check Valve		DI to ASTM-A-439 Grade D2 or Duplex SS	Duplex SS
	c) Stem		DI to ASTM-A-439 Grade D2 or Duplex SS	Duplex SS
4.6.2	Check Valves (50 NB & Below)			For size 50 NB and below-Piston type
	a) Body & Bonnet		DI to ASTM-A-439 Grade D2 or Duplex SS	Duplex SS, Screwed Ends
	b) Disc for Check Valve		DI to ASTM-A-439 Grade D2 or Duplex SS	Duplex SS
	c) Stem		DI to ASTM-A-439 Grade D2 or Duplex SS	Duplex SS
4.6.3	Gate/ Globe Valves 50 Nb & Below			
	Body & Bonnet		DI to ASTM-A-439 Grade D2 or Duplex SS	Duplex SS, Screwed Ends
4.6.4	Gate/Globe Valves (65NB & above)			
	➢ Body & Bonnet		DI to ASTM-A-439 Grade D2 or Duplex SS	Duplex SS
	➢ Disc		DI to ASTM-A-439 Grade D2 or Duplex SS	Duplex SS
	➢ Stem		DI to ASTM-A-439 Grade D2 or Duplex SS	Duplex SS
	➢ Companinon Flange		Carbon steel as per IS 2062 internally lined/coated in line with connecting pipe material lining/coating	Same as Connecting Pipe MOC
4.6.5	BFV Valves (65NB & above)		BFV (Above 200 Nb)	
	➢ Body & Disc		18% Ni Ductile Iron To ASTM A439 Gr. D2	Duplex SS
	➢ Sealing, Retaining segment & internals		Duplex SS	Duplex SS
	➢ Bearing		Self lubricating type	Self lubricating / Seal Lubricated
	➢ Companinon Flange		Carbon steel as per IS 2062 internally lined/coated in line with connecting pipe material lining/coating	Same as Connecting Pipe MOC
4.6.6	Ball valves			
	i) Body		Duplex SS	Duplex SS
	ii) Ball		Duplex SS	Duplex SS
	iii) Stem		Duplex SS	Duplex SS
4.7	Interconnecting Piping		By Purchaser	By Purchaser
	Maretial		a) PIPING UPTO 300Nb SHALL BE DUPLEX SS (AS PER SCH 40S FOR PIPE UPTO 50 NB & SCH 10S FOR PIPE SIZE ABOVE 50 NB) b) PIPING 300 NB AND ABOVE SHALL BE CARBON STEEL AS PER IS 3589 FABRICATED FROM IS 2062 PLATES INTERNALLY LINED WITH POLYURETHANE INSIDE	a) PIPING UPTO 300Nb SHALL BE DUPLEX SS (AS PER SCH 40S FOR PIPE UPTO 50 NB & SCH 10S FOR PIPE SIZE ABOVE 50 NB) b) PIPING 350 NB AND ABOVE SHALL BE CARBON STEEL AS PER IS 3589 FABRICATED FROM IS 2062 PLATES INTERNALLY LINED WITH CORROCOAT OR POLYUREA COATING INSIDE OF 2000 MICRONS DFT.
5	**COUNTER FLANGES FOR BALL SEPERATOR**			
5.1	MATERIAL			
	a) Flanges		Carbon Steel to IS -2062 Gr.B. or eq (Internally Lined with PolyUrethane), for thickness, drilling etc refer Annexure II in section C1 (In Purchaser's Scope)	Carbon Steel to IS -2062 Gr.B. or eq(Internally Lined with CorroCoat or PolyUrea) or Duplex SS, for thickness, drilling etc refer Annexure II in section C1 (In Purchaser's Scope)
	b) Fasteners		SS 316 L (In Bidder's scope).	SS 316 L (In Bidder's scope).
	c) Gaskets		Min 4 mm thick rubber (In Bidder's scope).	Min 4 mm thick rubber (In Bidder's scope).

5.2	Drilling Standard			
6	**OTHER COUNTER FLANGES**		(for interconnecting piping, valves, bends, fittings, distributors, nozzles & support installation materials)	(for interconnecting piping, valves, bends, fittings, distributors, nozzles & support installation materials)
6.1	MATERIAL			
	a) Flanges		Duplex SS	Duplex SS
	b) Fasteners		SS 316L	SS 316L (Non-Wetted)
	c) Gaskets		Min 4 mm thick rubber	Min 4 mm thick rubber
7	**Material of Other components not specified above**		1. All Non-wetter Fastners in Bidder's Scope shall be of SS316L material. 2. Suitable for intended duty and shall be subject to Purchasers approval during detailed engg. In the event of order.	1. All Non-wetter Fastners in Bidder's Scope shall be of SS316L material. 2. Suitable for intended duty and shall be subject to Purchasers approval during detailed engg. In the event of order.
8	**PAINTING**			
8.1	External Surface			
	a) Surface preparation		SA - 2.5 of Swedish Specn. SIS-05-59-00-1967 / By Sand Blasting	SA - 2.5 of Swedish Specn. SIS-05-59-00-1967 / By Sand Blasting
	b) Primer		Two (2) coats of Epoxy primer coats with minimum thickness of 35 microns dft of each coat.	Two (2) coats of Epoxy primer coats with minimum thickness of 35 microns dft of each coat.
	c) Intermediate		Epoxy based TiO2 pigmented coat	Epoxy based TiO2 pigmented coat
	d) Final paint		Two (2) coats of High build Epoxy paint with minimum thickness of 35 microns dft of each coat.	Two (2) coats of High build Epoxy paint with minimum thickness of 35 microns dft of each coat.
8.2	Internal Surface			
	a) Surface preparation		SA - 2.5 of Swedish Specn. SIS-05-59-00-1967 / By Sand Blasting	SA - 2.5 of Swedish Specn. SIS-05-59-00-1967 / By Sand Blasting
	b) Primer		Two coat of Epoxy Resin based Zinc Phosphate epoxy primer	Two coat of Epoxy Resin based Zinc Phosphate epoxy primer
	c) Final paint		Adequate no. of coats of coal tar epoxy paint to achieve total dry film thickness of 200 to 250 microns	Adequate no. of coats of coal tar epoxy paint to achieve total dry film thickness of 200 to 250 microns
9	Adequate provision for future installation of cathodic protection		YES (Along with Sacrificial type anodic protection by Bidder)	YES (Along with Sacrificial type anodic protection by Bidder)
10	Flow straightener for streamlining the CW flow in ball collecting strainer		If required as per bidder's design – the same to be incorporated by bidder in its constructional feature.	If required as per bidder's design – the same to be incorporated by bidder in its constructional feature.
11	The tube cleaning system shall be designed for following operation modes			
	a) Automatic start up initiated by push button		YES	YES
	b) Automatic shut down with ball collection effected by : i. Push button ii. Adjustable timer iii. Ball monitoring system		YES	YES
	c) Automatic backwashing of ball separator with ball collection effected by : a. Push button b. Adjustable timer c. Diff. Pressure measuring system		YES	YES
	d) Automatic emergency backwashing of ball separator effected by diff. Pressure measuring system		YES	YES

	e) Automatic ball sorting initiated by push button		YES	YES
	f) Provision for manual operation of complete tube cleaning system in case of control system failure		YES	YES
	g) Whether the contacts for DPG, DPS and DPT are independent		YES	YES
	h) Timer for Backwashing		YES	YES
	i) Whether the ball monitoring system is designed to perform the following functions : i. Continuously counting the balls in circulation and giving an alarm calling for investigation of ball losses when the number of balls falls below a set value ii. Continuously measuring the size of the balls in circulation and initiating the shutdown of the tube cleaning system with alarm calling for replacement of balls when the no. of oversized balls falls below a set value		YES	YES
	j) Whether the electronic processor of the ball monitoring system is provided with the following : i. Indicators for required basic ball charge ii. Indicators for recirculating ball quantity iii. Indicators for oversized ball quantity iv. Time counters for total cleaning system operating hours v. Time counters for cleaning system operating hours with sufficient no. of oversized balls vi. Recorders for ball consumption		YES	YES
	k) Whether provision for self-testing and self-calibration are made		YES	YES
12	**MANDATORY SPARES** - to be supplied under this specification –		NA	YES (As indicated in ANNEXURE-I)

ANNEXURE I

1X800 MW NORTH CHENNAI STG III
Mandatory Spares List for COLTCS Package

	Spare Description	Unit	Quantity
1	Ball Circulating Pump (Complete)	Set	1 Set
2	**415 V Motor**		
2.1	Terminal plates	Nos.	10 Nos. each for small motors upto 30 kW & 4 Nos. each for more than 30 kW
2.2	Heaters	Set	2 Sets
2.3	Greasing arrangements	Set	4 sets each type of motor
2.4	Motor of each type and rating	Nos.	10% of the installed quantity or minimum 1 number whichever be higher
2.5	Bearings (DE and NDE) for each type and rating of motor	Set	4 Sets
3	**C&I Spares**		
3.1	Each type of lamps, PBs, ILPBs, fuse, MCB, MCCB used in the equipment/system.	Nos.	20% of installed of each type
3.2	Measuring Instruments - Indicators, Recorders, Electrical Metering and Skid Mounted Instruments		
3.2.1	Indicators, recorders and meters offered from each model for the project. These instruments shall be supplied with three sets of blank scales.	Nos.	10 % of Installed of each type/Model or a minimum of one number for each model and type, whichever is more
3.2.2	Skid mounted instruments (if any)	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
3.3	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.

ANNEXURE I

1X800 MW NORTH CHENNAI STG III
Mandatory Spares List for COLTCS Package

3.4	Relay based Control Panels		
3.4.1	LEDs for indicating lights	Nos.	10% of qty installed.
3.4.2	Control circuit fuses/MCB/MCCB	Nos.	Three times, 300% of installed of each current rating.
3.4.3	Relays modules & contactors.	Nos.	20% spare of qty Installed of each type
3.5	Alarm Annunciation System		
3.5.1	logic modules, group card modules, power supply modules, Hooters and any other electronic module.	Nos.	20% spares of each type installed
3.5.2	un-engraved window boxes complete with LED etc.	Nos.	5% spares of each type installed
3.5.3	LEDs for annunciation facia windows and LEDs box assemblies offered for the project	Nos.	20% of qty installed
3.5.4	Annunciator hooter	Nos.	One (1) No. of each type
3.6	Erection Hardware		
3.6.1	Instrument valves, manifold for each type, rating, model number and size of devices supplied for the project	Nos.	Ten (10) percent of each type & Size installed
3.6.2	Condensate pots of each type & Size installed	Nos.	Ten (10) percent of total number of Installed or four numbers whichever is higher .
3.6.3	Fittings	Nos.	Ten (10) percent of each type & Size installed

Notes for Mandatory Spares:

1. For C&I Mandatory Spare not covered above: Bidder to supply 10% or 1 no. (whichever is more) of each type of sensor/instrument, analyzers /special instruments/Electronic card, instrumentation/mechanical fittings etc. for any other electronic system, feeder control cabinets, hydra step (EWLI), Vibration Monitoring System, CCTV, C&I Lab Instruments, On line Carbon in Ash analyser system, On line Coal mass flow/speed measurement system, On line secondary air flow measurement system Mass Flow meter, Solid flow meter, 3 D Acoustic type level transmitters, Nucleonic & non nucleonic density transmitter etc.
2. Spares not applicable for the Package to be specifically quoted as “NOT APPLICABLE”
3. In case if such items of spares indicated as “not applicable” by bidder in its offer, are found applicable at a later date during execution of the project, such items of spares are to be supplied within the ordered cost of the mandatory spares

ANNEXURE I

1X800 MW NORTH CHENNAI STG III
Mandatory Spares List for COLTCS Package

4. Wherever quantity has been specified as percentage (%), it shall mean percentage (%) of the total population of the item in the station (project), unless specified otherwise and the fraction will be rounded off to the next higher whole number.
5. In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with Quantities generally in line with the specification.
6. In respect of quantity mentioned as 'Set' means the total quantity of all the components/items used in particular equipment unless otherwise specified.
7. Each spare shall be clearly marked and labeled on the outside of the packing with its description. When more than one spare part is packed in single case, a general description of the contents shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purpose of identification.

	2X800 MW UPPUR TPP BTG		ANNEXURE I
	MANDATORY SPARES LIST -COLTCS		
Sl. No	**DESCRIPTION OF EQUIPMENT / ITEM Spares to be supplied under this**	**UNIT**	**QUANTITY FOR 2x800 MW**
1.1	Sponge rubber balls for condenser on-load tube cleaning system	Nos.	50,000
1.2	Abrasive balls for condenser on-load tube cleaning system	Nos.	20,000
1.3	Worm gear assembly for Ball separator screen	Set	1
1.4	Ball separator screen	Set	1
2.0	**C&I Spares**	**As per attached Annexure I-A**	

ANNEXURE I-A

List of Control & Instrumentation Mandatory Spares

S. No.	Description	Unit	Quantity
1.00.00	**INSTRUMENTATION**		**Quantities are per unit. In case of common system, quantities shall be doubled.**
1.00.01	**Measuring and Field Instruments**		The quantity of mandatory spares indicated herein shall be as per package basis
1.00.01.01	**Indicators, Recorders, Electrical Metering and Skid Mounted Instruments**		
(i)	Indicators, recorders and meters offered from each model for the project. These instruments shall be supplied with three sets of blank scales.	Nos.	10 % of Installed of each type/Model or a minimum of one number for each model and type, whichever is more.
(ii)	For skid mounted instruments	Nos.	10% of total number of instruments, valves, C&I equipment, C&I item etc. for each Type and model or a minimum of one number for each model and type, whichever is more.

ANNEXURE I-A

List of Control & Instrumentation Mandatory Spares

S. No.	Description	Unit	Quantity
1.00.01.03	**Temperature Transmitters and Electronic Transmitters (For Pressure, DP, Temp, Flow, Level), Process Transmitters, Level & Flow Transmitter for each type, Rota meters, Sight Flow indicators, Temperature, Pressure, Flow & Level Switch, safety & Protection switches, Gauges, Process meters, Junction Boxes, Position Transmitters/switches, Analysers, Transducer or any other instrument etc.**	Nos.	i.) 10% of total number of each item offered for each model and type for the project or a minimum of one number, whichever is more. ii.) 10% of Electronic card/PCB assembly and power supply card/module for each type, model & rating of Transmitter, analysers & Flow Meters.

ANNEXURE I-A

1.00.03.22	Pressure gauge, solenoid valves, temperature gauge, Back Pressure regulating valves, 3 way grab valves, needle valves, isolation valves, PRV, flow switch, flow indicator and temperature switch, erection hardware's, valves in SWAS.	Nos.	Two (2) no. of each type
1.00.03.23	Primary coolers/secondary coolers.	Nos.	Three (3) No of each type
1.00.04	**Relay based Control Panels**		
1.00.04.01	LEDs for indicating lights	Nos.	100% of qty installed.
1.00.04.02	Control circuit fuses/	Nos.	300% of installed of each type, current rating.

ANNEXURE I-A

BID SPEC No. SE/E/T&H(P)/OT No.01 /2015-16.

Attachment – 1 – Revised List of Control & Instrumentation Mandatory Spares

S. No.	Description	Unit	Quantity
1.00.04.03	Relays modules & contactors.	Nos.	20% spare of qty Installed of each type & rating.
1.00.04.04	MCB/MCCB of each current rating	Nos.	Ten percent of each current rating required
1.00.04.05	Cooling Fans of each type, model and rating.	Nos.	20% or 2 nos. of each type and rating, (whichever is more).
1.00.04.06	Push buttons, ILPBs	Nos.	Ten (10) percent or 2 nos (whichever is more) of each type.
1.00.04.07	Electric meter.	Nos.	Ten (10) percent or 2 nos (whichever is more) of each type
1.00.04.08	Power supply modules.	Nos.	Ten (10) percent or 2 nos (whichever is more) of each type
1.00.05	**Alarm Annunciation System**		
1.00.05.01	logic modules, group card modules, power supply modules, Hooters and any other electronic module.	Nos.	20% spares of each type installed
1.00.05.02	un-engraved window boxes complete with LED etc.	Nos.	5% spares of each size installed
1.00.05.03	LEDs for annunciation facia windows and LEDs box assemblies offered for the project	Nos.	20% of qty installed
1.00.05.04	Annunciator hooter	Nos.	One (1) No. of each type
1.00.06	**Un-interrupted Power Supply System and DC Control Power Supply System**		
1.00.06.01	As per Manufacturer's Recommendation for Three Years Continuous Operation or minimum quantities indicated as below (whichever is more)		

ANNEXURE I-A

List of Control & Instrumentation Mandatory Spares

S. No.	Description	Unit	Quantity
1.00.18	**IDENTIFICATION**		
	Each spare shall be clearly marked and labeled on the outside of the packing with its description. When more than one spare part is packed in a single case, a general description of the contents shall be shown on the outside of such case and a detailed list enclosed. All cases, containers, and other packages must be suitably marked and numbered for the purpose of identification.		
1.00.19	**CONTRACT-QUANTITIES**		
	The quantities & mandatory spares shall be as specified herein. Any other mandatory spares not listed above however required for any instrumentation item shall also be supplied by bidder. The final quantities may require addition/deletion during the contract stage. The Bidder shall furnish unit price for each mandatory spare under appropriate schedules which shall be used for adjusting the contract price in the event of addition/deletion from contract quantities specified herein.		
1.00.20	**DOCUMENTATION**		
	Bidder shall furnish detailed catalogue, part number and subassembly/assembly drawings with manufacturer's cross reference for each spare part. The data and information furnished shall be of nature and content as per owner's approval to enable owner procurement of these spare parts directly from the respective manufacturer.		

1.00.21 Notes:

1. Wherever quantity has been specified percentage (%) the quantity of mandatory spares to be provided by the bidder shall be distributed into various ranges/size/rating/type (as the case may be) in the same proportion of the main population. In case the quantity so calculated happens to be fraction, the same should be rounded off to next higher whole number.
2. Wherever the quantities have been indicated for each type, size, thickness, material, radius, range etc., these shall cover all items supplied and installed and the breakup for these shall be furnished in the bid.

ANNEXURE I-A

List of Control & Instrumentation Mandatory Spares

3. Incase spares indicated in the list are not applicable to the particular design offer by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed in the above list.

4. Interchangeability and Packings:

All spares supplied under this contract shall be strictly interchangeable with parts for which they are intended for replacements. These spares shall include all mounted accessories like components, boards, add or items, fittings, connectors etc. and be complete in all respects so that the replacement of the main items by these spares does not require additional item. All electronic modules should be pre set and/or preprogrammed for ready use at site. Alternatively, suitable instruction sheet indicating the details of required PCB jumper position, BCD which is setting, EPROM/ROM listing etc should be packed along with each module. Also a caution mark sign should be put on all such module which needs pre setting/ re programming before putting them in to service. The spare shall be treated and properly packed for long term storage.

5. Identification:

Each spare shall be clearly marked and labeled on the outside of the packing with its description. When more than one spare part is packed in single case, a general description of the contents shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purpose of identification.

Kindly mention this Note:-
For C&I Mandatory Spare not covered above: Bidder to supply 10% or 1 no. (whichever is more) of each type of sensor/instrument, analyzers /special instruments/Electronic card, instrumentation/ mechanical fittings etc.

ANNEXURE II

1.10 Source Of Water

1.10.1 Source

The raw water intake shall be from Bay of Bengal.

1.10.2 Chemical analysis of Sea Water:

S.No.	Parameters	Value (ppm)
1.	Total Solids	35,000
2.	Dissolved solids	21,620
3.	Suspended Solids	580
4.	Ignited residue	17,500
5.	Volatiles Solids	4,700
6.	Acid Insolubles	112
7.	Chlorides (as Cl)	20,232
8.	Sulphates (as SO_4)	1,457
9.	Iron (as Fe)	70
10.	Total alkalinity (as $CaCO_3$)	525
11.	Alkalinity due to Normal Carbonates (as $CaCO_3$)	Nil
12.	Alkalinity due to bi-Carbonates (as $CaCO_3$)	525

13.	Total hardness (as $CaCO_3$)	8,155
14.	Permanent hardness (as $CaCO_3$)	6,200
15.	Temporary hardness (as $CaCO_3$)	1,955
16.	Calcium hardness (as $CaCO_3$)	1,255
17.	Magnesium hardness (as $CaCO_3$)	6,900
18.	P_H	8.2

ANNEXURE-II

SEA WATER ANALYSIS

Sl. No	PARAMETERS	UNIT	RESULT
1.	pH	-	7.9
2.	Conductivity	µ mhos/cm	53700
3.	Temperature	^{0} C	33
4.	Turbidity	NTU	14.8
5.	Salinity		35.4
6.	Total Suspended Solids	mg/l	8
7.	Total Organic Carbon	mg/l	Less than 5
8.	Calcium as Ca	mg/l	400
9.	Magnesium as Mg	mg/l	1270
10.	Sodium as Na	mg/l	12500
11.	Potassium as K	mg/l	376
12.	Ammonia as NH_3	mg/l	BDL (DL: 0.01)
13.	Strontium as Sr	mg/l	1.76
14.	Barium as Ba	mg/l	BDL (DL: 0.41)
15.	Total Aluminium as Al	mg/l	BDL (DL: 0.03)
16.	Dissolved Aluminium as Al	mg/l	BDL (DL: 0.03)
17.	Total Manganese as Mn	mg/l	BDL (DL: 0.02)
18.	Dissolved Manganese as Mn	mg/l	BDL (DL: 0.02)
19.	Total iron as Fe	mg/l	0.33
20.	Dissolved iron as Fe	mg/l	0.17
21.	Chloride as Cl	mg/l	20987
22.	Sulfate as SO_4	mg/l	3000
23.	Nitrate as NO_3	mg/l	1.21
24.	Nitrate as NO_2	mg/l	0.008
25.	Bicarbonate as HCO_3	mg/l	137
26.	Carbonates as CO_3	-	Nil
27.	Fluoride as F	mg/l	1.2
28.	Boron as B	mg/l	1.36
29.	Phosphate as PO_4	mg/l	0.08
30.	Sulfide as H_2S	mg/l	BDL (DL: 0.01)
31.	Total silica s SiO_2	mg/l	0.4
32.	Dissolved Silica as SiO_2	mg/l	0.2
33.	Dissolved Oxygen	mg/l	5.4
34.	BOD @ 27°C for 3 days	mg/l	9
35.	Phenols	mg/l	BDL (DL: 0.001)
36.	COD	mg/l	53
37.	Oil & Grease	mg/l	Less than 1
38.	Zinc as Zn	mg/l	0.1
39.	Copper as Cu	mg/l	BDL (DL: 0.006)
40.	Nickel as Ni	mg/l	BDL (DL: 0.008)
41.	Cadmium as Cd	mg/l	BDL (DL: 0.003)
42.	Lead as Pb	mg/l	BDL (DL: 0.01)
43.	Mercury as Hg	mg/l	BDL (DL: 0.001)

ANNEXURE II

ATTACHMENT – M3

SEA WATER ANALYSIS

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

ANNEXURE II

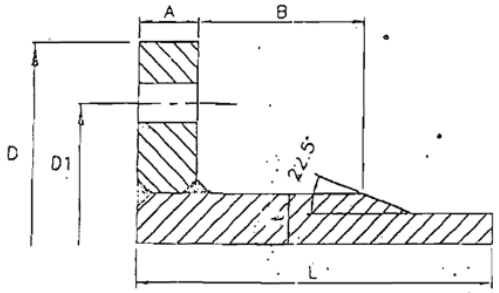
ATTACHMENT – M3

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

FIRST ANGLE PROJECTION ALL DIMENSIONS ARE IN MM

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

ANNEXURE-II



NOTES:-

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

PIPE SIZE	PIPE THK.	FLANGE OD 'D'	Bolt PCD 'D1'	WELD NECK FLANGE				SLIP-ON FLANGE THICKNESS
				FLANGE THK. 'A'	NECK THK. 't'	NECK Length 'B'	Appx. Total Length 'L'	
1200	10-12	1465	1380	40	24	70	200	90
1400	14	1675	1590	50	24	70	200	100
1600	14	1915	1820	60	32	80	220	110
1800	14-16	2115	2020	70	32	90	250	120
2200	18	2550	2420	80	36	100	300	140
2300	20			90	38	110	325	150
2500	20			90	38	110	325	150
2700	20			90	38	110	325	150

— TENTATIVE

DRAWING FOR BAI. SEPARATOR COUNTER FLANGE

REV.	DATE	ALTD	CHD	APPD

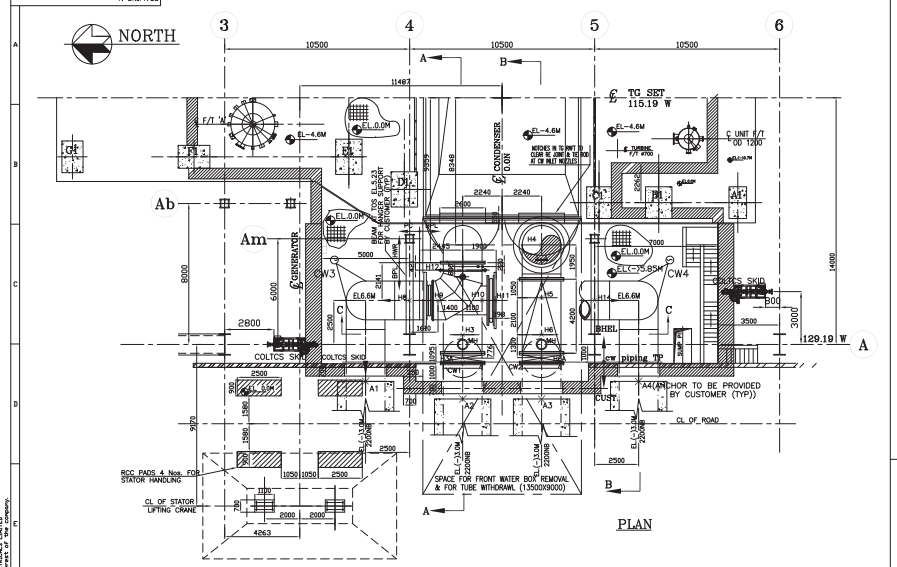
JOB NO. 999
STATUS: -
DISTRIBUTION

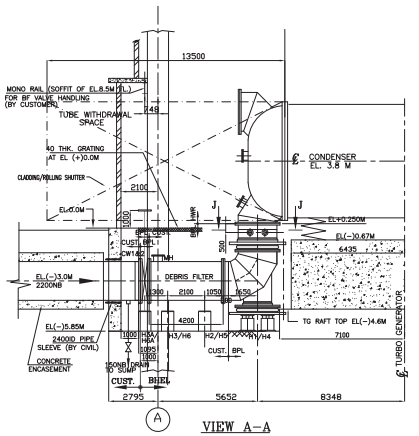
BHARAT HEAVY ELECTRICALS LTD
POWER GROUP
PROJECTS ENGINEERING MANAGEMENT
PPEI, NOIDA

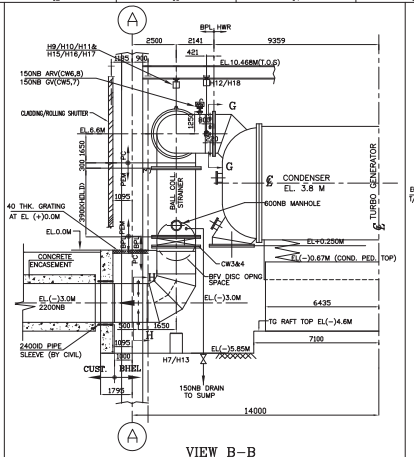
DEPT CODE	NAME	SIGN	DATE
DRN	PR		25.06.07
DSGN	PM		25.06.07
CHD	SPV		25.06.07
APPD	SM		25.06.07

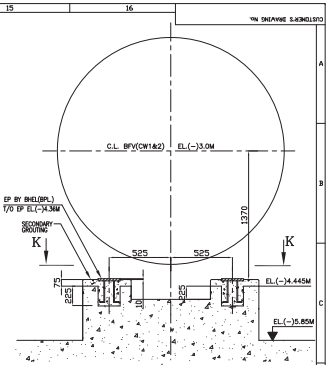
TITLE
COUNTER FLANGE DETAILS

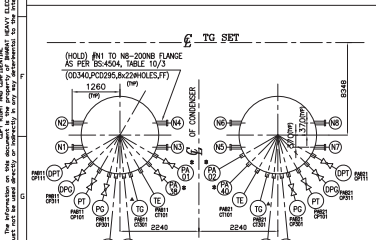
DRAWING NO. PE-DG-999-141-M017
SHEET 01 OF 01 REV 00

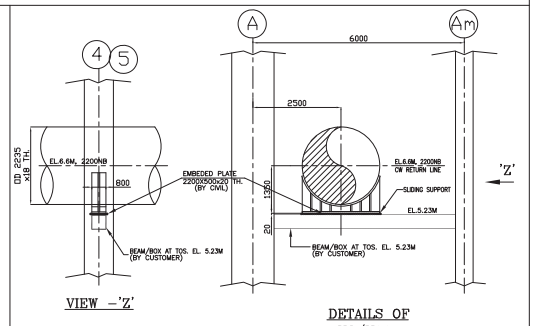


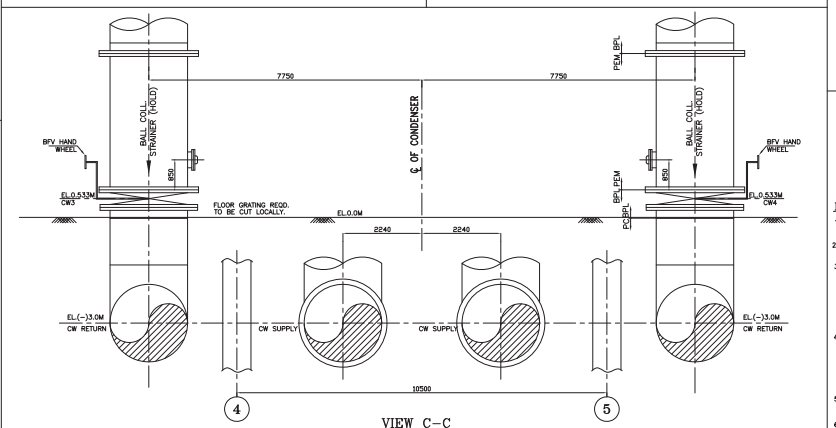


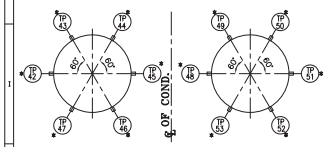


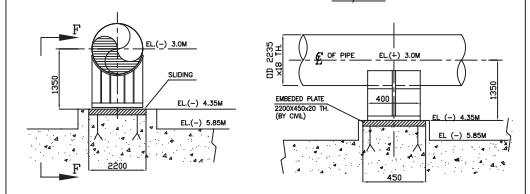


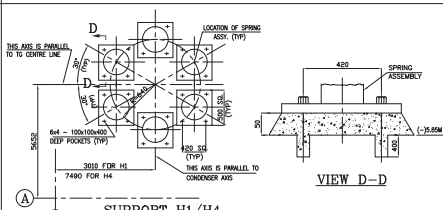


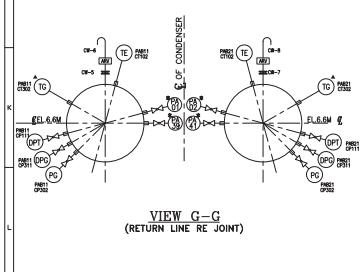


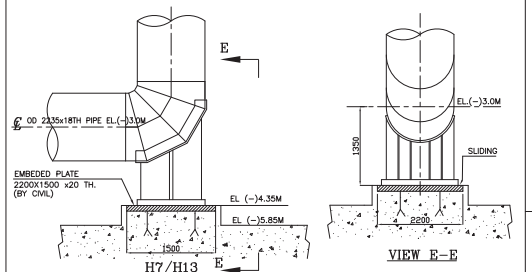












LOAD DETAILS FOR SUPPORTS:–

SL. No.	HANGER/ SUPPORT No.	LOAD(TONNE) Fx	Fy	Fz	REMARKS
1.	H–1, H–4	–	(–)21	–	
2.	H–2, H–5	0.5	(–)48	11	
3.	H–3, H–6	0.5	(–)11	2	
4.	H–7, H–13	6/(–)6	(–)65	16	
5.	H–8, H–14	–	(–)22	–	
6.	H–9, H–15	–	(–)2.4	–	TO BE SUPPORTED FROM 10.5M STRUCTURE
7.	H–10, H–16	–	(–)3.6	–	
8.	H–11, H–17	–	(–)13.9	–	
9.	H–12, H–18	–	(–)2.8	–	
10.	H–3A, H–6A	1	(–)18	5	

LOAD AT INTERFACE POINTS FROM CW PIPING INSIDE TG HALL:–

SL. No.	INTERFACE POINTS	LOAD(TONNE) Fx	Fy	Fz	MOMENTS(T–m) Mx	My	Mz
11.	A1–ANCHOR	6.0	(–)24	(–)21	43.9	4.5	(–)16.5
12.	A2–ANCHOR	0.5	(–)6.0	(–)21	2.5	16	(–)5.0
13.	A3–ANCHOR	0.5	(–)6.0	(–)21	2.5	4.5	(–)2.0
14.	A4–ANCHOR	(–)5.6	(–)24	(–)20	43.9	(–)4.5	16.5

(+)X=>TS to GS; (+)Y=>Vertically Upwards ; (+)Z=>"A" Row to "B" Row

VALVE DETAILS:– (HOLD)

SL No.	VALVE TAG No.	SIZE (NB)	TYPE	END TYPE	LENGTH (MM)	SUPPLIED	QTY.
1.	CW1, CW2, CW3 & CW4	2200	BFV (MO)	FLANGED	1106	BHEL–BHOPAL	4
2.	CW6, CW8	150	ARV	ANSI FLGD. CL. #150,FF	–	PEM	2
3.	CW5, CW7	150	GV	ANSI FLGD. CL. #150,FF	203	TRY	2
4.	CW DRAIN VALVE	150	GV	ANSI FLGD. CL. #150,FF	203	TRY	4
5.	R.E.JOINT INLET & OUTLET ASSY.	2200	'REJ'	FLANGED	–	BHEL–BHOPAL	2

● WITH MATING FLANGE AND NECK PIECE

HOLD–UPs

1. 2200NB BUTTERFLY VALVE
2. BALL COLLECTING STRAINER
3. COLTS SOD & NOZZLEs
4. TRY SCOPE VALVE DETAILS
4. ARV & GV VALVE DETAILS

ANNEXURE-III

BOM OF LOOSELY SUPPLIED DRAINS, VENTS & IMPULSE PIPES (UP TO ROOT VALVES)

1. 150NB PIPE = 60M
2. 150NB ELBOW = 12Nos.
3. 150NB EQUAL TEE = 2Nos.
4. 150NB FLANGE WITH FASTENERS = 8Nos.
5. 15NB PIPE = 50M
6. 15NB COUPLING = 10Nos.
7. FASTENERS (NUTS, BOLTS & GASKETS) FOR 150NB ARVs & BFVs

NOTES:–

1) ALL DIMENSIONS ARE IN MM AND ELEVATIONS IN METRES UNLESS STATED OTHER WISE.

2) ALL ELEVATIONS MARKED ARE W.R.T. TG HALL FINISHED FLOOR ELEVATION AS 0.0M, WHICH IS 3.5M ABOVE MSL.

3) DESIGN PARAMETERS :
DESIGN PRESSURE : 5 kg /sq.cm (g) FOR CW SYSTEM
DESIGN PRESSURE : 7.5 kg /sq.cm (g) FOR ACW SYSTEM.
DESIGN CW INLET TEMP. TO CONDENSER & ACW TO VACUUM PUMP H.E.=33°C.
DESIGN ACW INLET TEMP. TO PHE'S =36°C.
DESIGN MECHANICAL TEMPRATURE : 60°C
QUALITY OF WATER : SEA WATER WITH COC 1.3

4) PIPE SPECIFICATION & SIZE:
i) PIPING BELOW 2200NB SHALL BE SS 316L/EQUIVALENT OR SUPERIOR.
ii) PIPING 2200NB & ABOVE SHALL BE CONFORMING TO IS:3589 WITH POLYURETHANE (PU) COATING INTERNALLY AS PER AWWA–C–222.
iii) INTERCONNECTING PIPING FOR COLTCS AND DEBRIS DISCHARGE PIPING FOR SCS SHALL BE AS PER IS:3589 WITH POLYURETHANE (PU) COATING/ RUBBER LINED INTERNALLY OR SS 316L OR SUPERIOR.

5) FOR PAINTING/ PROTECTION DETAILS, PLEASE REFER PAINTING SCHEDULE DOCUMENT FROM BHEL PIPING CENTRE.

6) ALL BENDS ARE OF MITRE TYPE WITH RADIUS = 1650mm FOR 2200NB PIPES.

7) INSTRUMENTS MARKED WITH * ARE FOR PERFORMANCE GUARANTEE TEST.

8) MATING FLANGES FOR BFVs & BALL COLLECTING STRAINERS ARE WITH NECK PIECES AND SHALL BE SUPPLIED WITH RESPECTIVE EQUIPMENT.

9) CW PIT GRATING SUPPORT STRUCTURE AT EL.0.0M IS TO BE ERECTED AFTER CW PIPING ERECTION IN CW PIT AREA.

REF. DRGS. :–

1) TG EQUIPMENT LAYOUT PLAN AT EL.0.0M ; DRG. NO. PE–DG–422–100–M001 (PEM)
2) P & ID CW AND ACW SYSTEM ; DRG. NO. PE–DG–422–165–N001 (PEM)
3) PG TEST INSTRUMENTATION SCHEME ; DRG. NO. PE–DG–422–100–N298 (PEM)
4) CONDENSER ASSY. (G.A.) ; DRG. NO. 0160107007421 6 (2–SHEETS) (HWR)
5) G.A. OF C.W.PIT ; DRG. NO. PE–DG–422–611–C00X (PEM)
6) ARRGT. OF Ø2200 B.F. VALVE (CW INLET) ; DRG. NO. XXXXXXXXXXXX (BPL)
7) ARRGT. OF Ø2200 B.F. VALVE (CW OUTLET) ; DRG. NO. XXXXXXXXXXXX (BPL)
8) G.A. DRAWING OF R.E. JOINT AT CONDENSER INLET/OUTLET ; BP–DG–422–101–0001 (2 Shts)(BPL)
9) INSTRUMENT STUB DETAIL (PRES/TEMP). ; DRG. NO. PE–DC–422–145–1102 (PEM)

CUSTOMER DRAWING NUMBER :– 3044–M11–DE–DG–K–1072

OWNER	SEPC POWER PRIVATE LIMITED S–2, Technocrat Indl. Estate, Balanagar, Hyderabad
OWNER'S CONSULTANT	Fichtner Consulting Engineers (India) Pvt Ganesh Chambers, 64, Eldams Rd, Teynampet, Chennai,Tamil Nadu–600018
CONTRACTOR	Megha Engineering & Infrastructures L S–2, Technocrat Indl. Estate, Balanagar, Hyderabad
CUSTOMER'S CONSULTANT	TPSC (INDIA) PRIVATE LIMITED (Wholly owned subsidiary of Toshiba Plant systems & Services Corporation, Tokyo, Japan) A–1 Module, 3–Quadrant, 2nd & 9th Floor, Cyber Towers, Hi–Tec City, Madhapur, HYDERABAD – 500 081, INDIA.
PROJECT	1X525 MW TUTICORIN TPS, STAGE–IV (UNIT–1) THOOTHUKUDI DISTRICT, TAMILNADU
ISSUED BY	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA

JOB NO. 422
STATUS CONTRACT
DISTRIBUTION

REV.	DATE	ALT'D	CHD	APPD

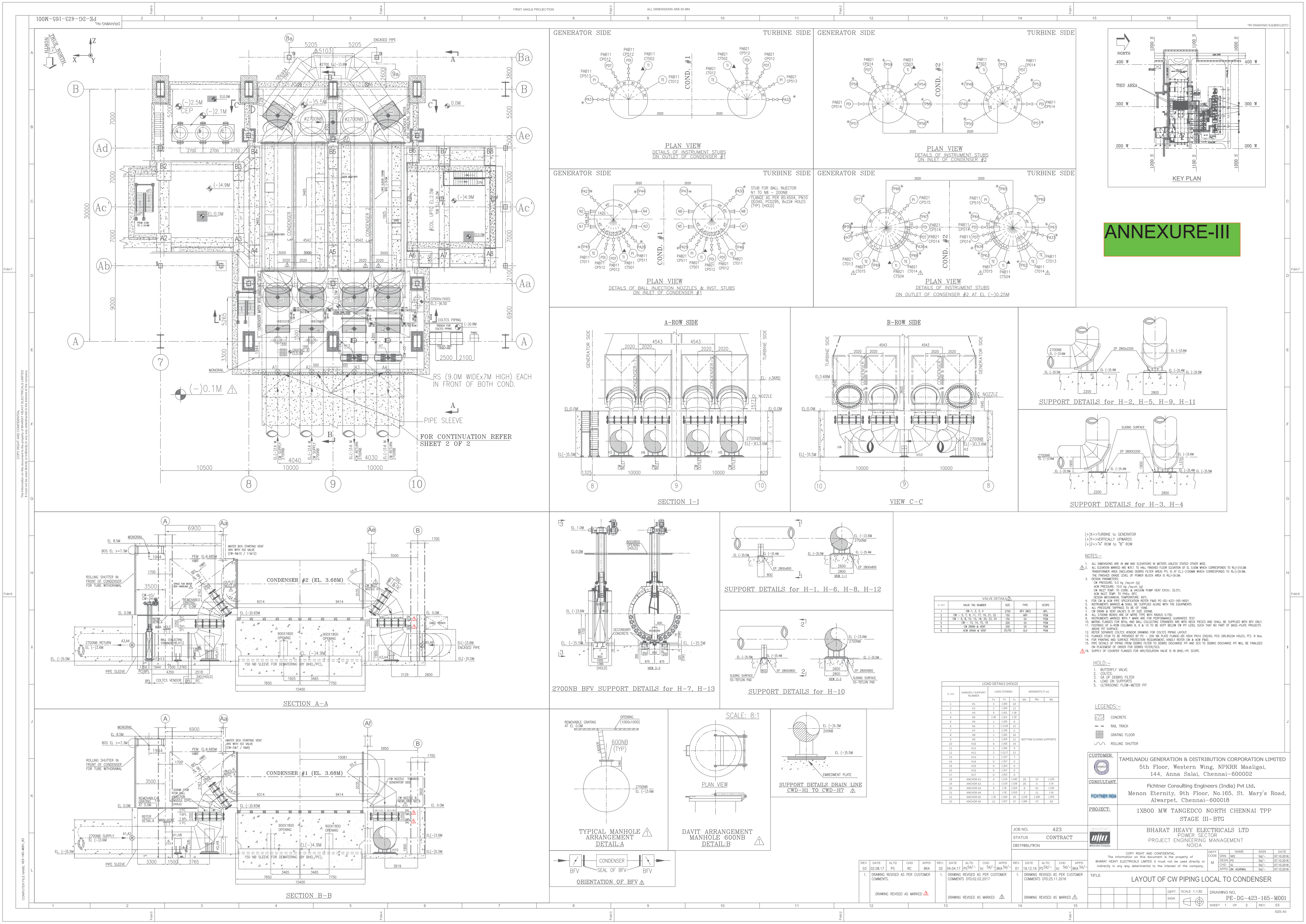
DEPT CTRS	NAME	SIGN	DATE
DESN	JNS		05.10.2016
CHD	GR		05.10.2016
APPD	SK		05.10.2016

TITLE
CW PIPING LAYOUT INSIDE TG HALL

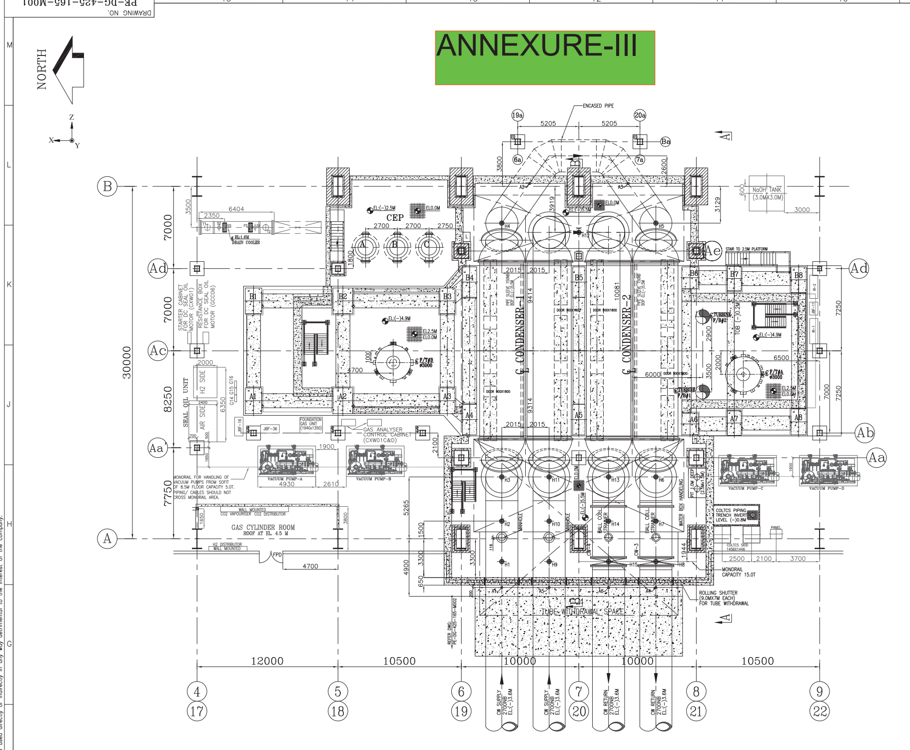
DEPT. SCALE: 1:100 SIGN
BHEL DRAWING NO.
PE–DG–422–165–M001
SHEET 1 OF 1 REV. 1a
SIZE–A0

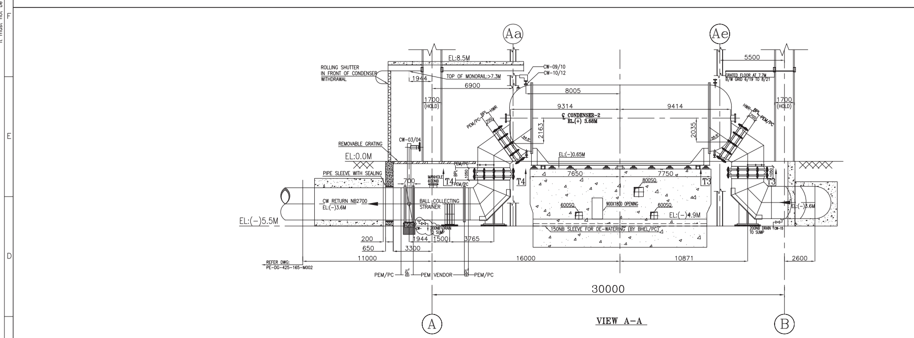
DRAWING No. PE–DG–422–165–N001

COMPUTER FILE NAME: PE–DG–422–165–M001_R1a.dwg

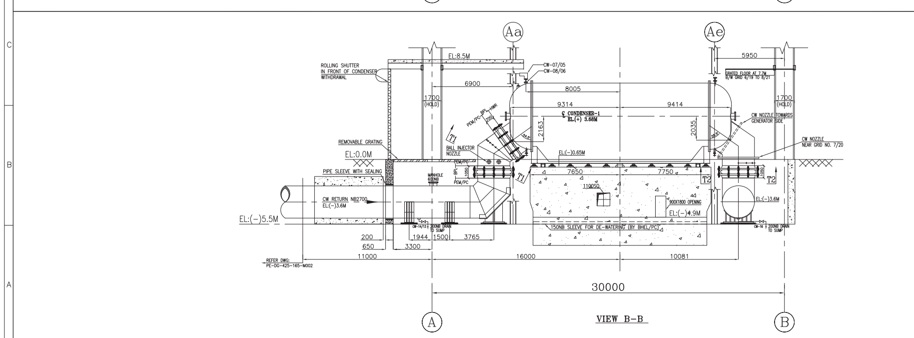

ANNEXURE-III
FIRST ANGLE PROJECTION
ALL DIMENSIONS ARE IN MM
KEY PLAN
THIS AREA
PLAN VIEW
DETAILS OF INSTRUMENT STUBS ON OUTLET OF CONDENSER #1
PLAN VIEW
DETAILS OF INSTRUMENT STUBS ON INLET OF CONDENSER #2
PLAN VIEW
DETAILS OF BALL INJECTION NOZZLES & INST. STUBS ON INLET OF CONDENSER #1
PLAN VIEW
DETAILS OF INSTRUMENT STUBS ON OUTLET OF CONSENSER #2 AT EL (-)0.25M
GENERATOR SIDE
TURBINE SIDE
A-ROW SIDE
B-ROW SIDE
SECTION I-I
VIEW C-C
SUPPORT DETAILS for H-2, H-5, H-9, H-11
SUPPORT DETAILS for H-3, H-4
SUPPORT DETAILS for H-1, H-6, H-8, H-12
SUPPORT DETAILS for H-10
2700NB BFV SUPPORT DETAILS for H-7, H-13
TYPICAL MANHOLE ARRANGEMENT DETAIL:A
DAVIT ARRANGEMENT MANHOLE 600NB DETAIL:B
SUPPORT DETAILS DRAIN LINE CWD-H1 TO CWD-H7
ORIENTATION OF BFV
SECTION A-A
SECTION B-B
CONDENSER #2 (EL. 3.68M)
CONDENSER #1 (EL. 3.68M)
RS (9.0M WIDEx7M HIGH) EACH IN FRONT OF BOTH COND.
PIPE SLEEVE
FOR CONTINUATION REFER SHEET 2 OF 2
VALVE DETAILS
LOAD DETAILS (HOLD)
NOTES:-
HOLD:-
1. BUTTERFLY VALVE.
2. COLTCS.
3. GA OF DEBRIS FILTER
4. LOAD ON SUPPORTS
5. ULTRASONIC FLOW-METER PIT
LEGENDS:-
CONCRETE
RAIL TRACK
GRATING FLOOR
ROLLING SHUTTER
CUSTOMER:
TAMILNADU GENERATION & DISTRIBUTION CORPORATION LIMITED
5th Floor, Western Wing, NPKRR Maaligai,
144, Anna Salai, Chennai-600002
CONSULTANT:
Fichtner Consulting Engineers (India) Pvt Ltd.
Menon Eternity, 9th Floor, No.165, St. Mary's Road,
Alwarpet, Chennai-600018
PROJECT:
1X800 MW TANGEDCO NORTH CHENNAI TPP
STAGE III-BTG
BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA
JOB NO. 423
STATUS CONTRACT
DISTRIBUTION
TITLE
LAYOUT OF CW PIPING LOCAL TO CONDENSER
SCALE 1:130
DRAWING NO.
PE-DG-423-165-M001
SHEET 1 OF 2
REV. 03

ANNEXURE-III

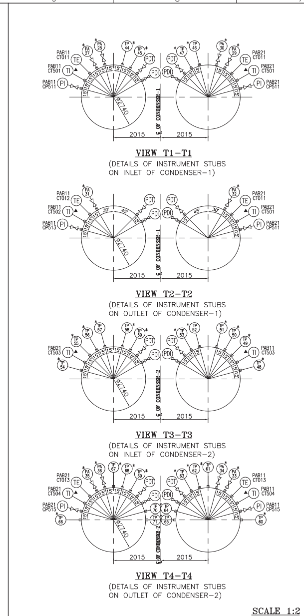




VIEW A-A



VIEW B-B



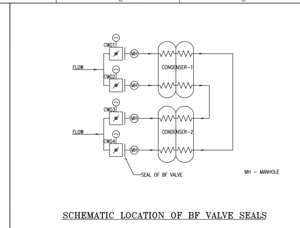
VIEW T1-T1 (DETAILS OF INSTRUMENT STUBS ON INLET OF CONDENSER-1)

VIEW T2-T2 (DETAILS OF INSTRUMENT STUBS ON OUTLET OF CONDENSER-1)

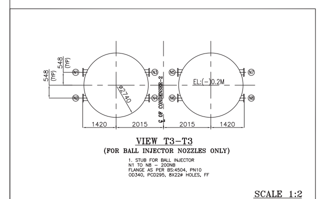
VIEW T3-T3 (DETAILS OF INSTRUMENT STUBS ON INLET OF CONDENSER-2)

VIEW T4-T4 (DETAILS OF INSTRUMENT STUBS ON OUTLET OF CONDENSER-2)

SCALE 1:2



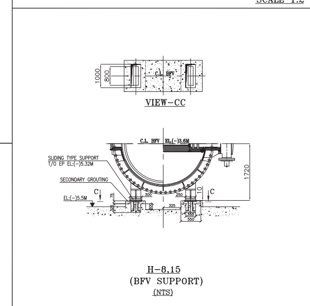
SCHEMATIC LOCATION OF BF VALVE SEALS



VIEW T3-T3 (FOR BALL INJECTOR NOZZLES ONLY)

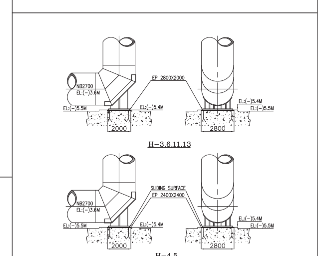
1. STUB FOR BALL INJECTOR
N1 TO N8 - 200NB
FLANGE AS PER BS:4504, PN10
OD340, PCD295, 8X22ø HOLES, FF

SCALE 1:2



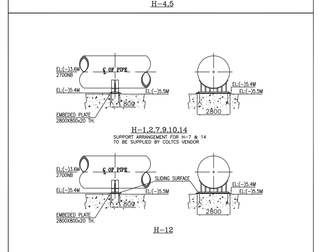
VIEW-CC

H-8,15 (BFV SUPPORT) (NTS)



H-3,6,11,13

H-4,5



H-1,2,7,9,10,14

SUPPORT ARRANGEMENT FOR H-7 & 14 TO BE SUPPLIED BY COLTCS VENDOR

H-12

NOTES

1. ALL DIMENSIONS ARE IN MM'S AND LEVELS ARE IN METRES.
2. ALL ELEVATIONS INDICATED IN THE DRG. ARE W.R.T. POWER HOUSE GROUND FLOOR ELEVATION AS EL:0.00M, WHICH CORRESPONDS TO RL.(+)5.8M.
3. DESIGN PARAMETERS:
PRESSURE : 5 kg /sq.cm (g) FOR CW & 10 kg /sq.cm (g) FOR ACW SYSTEM.
DESIGN COOLING WATER INLET TEMPERATURE TO CONDENSER & VACUUM PUMP H.E : 32.5°C.
DESIGN COOLING WATER INLET TEMPERATURE TO PHE : 36°C.
DESIGN MECHANICAL TEMPERATURE : 60°C.
HYD. TEST PRESSURE : 7.5kg/sq.cm. FOR CW SYSTEM & 15kg/sq.cm. FOR ACW SYSTEM.
4. PIPE SPECIFICATION:
A) PIPING UPTO & INCLUDING 150NB SHALL BE DUPLEX SS (AS PER SCH 40S FOR PIPE UPTO 50NB & SCH 10S FOR PIPE SIZE ABOVE 50NB).
B) PIPING 200NB & 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.
C) 2700NB: OD 2740MM X THK. 20MM
5. FOR PAINTING/ PROTECTION OF PIPEWORK, KINDLY REFER CW-ACW SYSTEM P&ID.
6. ALL BENDS ARE OF MITRE TYPE WITH RADIUS = 2025 mm.
7. MATING FLANGES FOR BFVs, BALL COLLECTING STRAINERS ARE WITH NECK PIECES AND SHALL BE SUPPLIED WITH BFVs ONLY.
8. INSTRUMENTS STUBS WILL BE REVIEWED AFTER FINALISATION OF SCHEMES.
9. DRAIN & VENT CONN. ON CW PIPES ARE TO BE PROVIDED WITH WIRE MESH TO PREVENT THE ESCAPE OF TUBE CLEANING BALLS FROM THE SYSTEM.
10. ALL PRESSURE STUBS & ROOT VALVES SHALL BE 15NB, DRAIN VALVES 200NB & VENT VALVES 200NB.
11. INSTRUMENTS MARKED ▲ SHALL BE SUPPLIED ALONGWITH THE EQUIPMENTS.
12. INSTRUMENTS MARKED WITH ✱ ARE FOR PERFORMANCE GUARANTEE TEST.
13. COMPANION FLANGES FOR BUTTERFLY VALVES SUPPLIED BY BHEL/BPL ARE SUPPLIED ALONG WITH VALVES & FOR VALVES PROCURED BY BHEL/PEM COMPANION FLANGES TO BE SUPPLIED BY PC.
14. REFER COLTCS VENDOR DRAWING FOR COLTCS PIPING LAYOUT.
15. FOOTINGS OF A-ROW COLUMNS 6/19, 7/20, 8/21 TO BE KEPT BELOW CW PIT LEVEL SUCH THAT NO PART OF BASE PLATE PROJECTS ABOVE PIT SURFACE.

REFERENCE DRAWING

SL. NO.	TITLE	NUMBER	UNIT
1.	P&ID - CW & ACW SYSTEM	PE-DG-425-165-N001	PEM
2.	PG TEST INSTRUMENTATION SCHEME	-	PEM
3.	T.G. EQUIPMENT LAYOUT PLAN AT EL. 0.0M	PE-DG-425-100-M003	PEM
4.	CONDENSER GENERAL ASSEMBLY	01601070073C216	HWR
5.	ARRGT. OF 2700NB B.F. VALVE	-	BPL
6.	GA OF COMPENSATING RE JOINT	-	BPL
7.	GA OF COLTCS PIPING INSTALLATION PLAN	-	PEM
8.	GA & RCC DETAILS OF CW PIT	-	PEM
9.	GA & RCC DETAILS OF CEP PIT	-	PEM
10.	CW PIPING OUTSIDE TG HALL	PE-DG-425-165-M002	PEM

LEGEND:

- CHEQUERED PLATE FLOORING
- REMOVABLE CHEQUERED PLATE
- GRATED FLOORING
- REMOVABLE GRATING
- CONCRETE BLOCK
- HAND RAILING
- PARAPET WALL
- GLASS PARTITION
- CUT OUTS
- BRICK WALL
- LADDER

VALVE DETAILS

SI. NO.	VALVE TAG NO.	SIZE (NB)	TYPE	END CONN.	LENGTH (MM)	SUPPLIED BY
1	CW-03	2700	BFV	F	700	BPL ◎
2	CW-04	2700	BFV	F	700	BPL ◎
3	CW-05	200	ARV	F	-	PEM
4	CW-06	200	GV	F	-	TRY
5	CW-07	200	ARV	F	-	PEM
6	CW-08	200	GV	F	-	TRY
7	CW-09	200	ARV	F	-	PEM
8	CW-10	200	GV	F	-	TRY
9	CW-11	200	ARV	F	-	PEM
10	CW-12	200	GV	F	-	TRY

◎ WITH MATING FLANGE AND NECK PIECE

LOAD DETAILS (HOLD)

SI. NO.	HANGER/ SUPPORT NO.	LOAD (TONNE)			MOMENT (T-M)		
		Fx (T)	Fy (T)	Fz (T)	Mx (T-M)	My (T-M)	Mz (T-M)
1	H-1	1	(-)37	3			
2	H-2	2	(-)80	10			
3	H-3	2	(-)59	12			
4	H-4	7	(-)56	(-)7			
5	H-5	(-)7	(-)56	(-)8			
6	H-6	1	(-)59	11			
7	H-7	1	(-)84	20			
8	H-8	1	(-)37	6			
9	H-9	1	(-)37	3			
10	H-10	1	(-)80	10			
11	H-11	1	(-)59	11			
12	H-12	4	(-)63	59			
13	H-13	2	(-)59	12			
14	H-14	3	(-)84	20			
15	H-15	1	(-)37	6			
16	A1 (ANCHOR)	4	(-)3	(-)42	20	42	(-)31
17	A2 (ANCHOR)	(-)3	(-)41	28	(-)18	(-)59	(-)83
18	A3 (ANCHOR)	10	(-)56	25	(-)63	32	69
19	A4 (ANCHOR)	1	(-)3	(-)58	20	9	(-)6
20	A5 (ANCHOR)	1	(-)3	(-)40	19	6	(-)5
21	A6 (ANCHOR)	5	(-)3	(-)57	20	44	(-)28

(+)X=>TS to GS; (+)Y=>Vertically Upwards; (+)Z=>"A" Row to "B" Row.

Forces & moments on anchor are for piping from RE Joint upto anchor.
For design of anchor, forces & moments from outside piping is to be considered in addition to above mentioned loads (Refer PE-DG-425-165-M002).

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

ELECTRONIC FILE NAME: PE-DG-425-165-M001-R0

CUSTOMER	TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LIMITED
CUSTOMER'S CONSULTANT	LAHMEYER INTERNATIONAL (INDIA) PVT. LTD.
JOB NO. 425	2X800MW UPPUR STPP (UNIT#1&2) IN RAMANATHAPURAM DISTRICT, TAMILNADU
STATUS CONTRACT	
DISTRIBUTION	

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE: M

	NAME	SIGN	DATE
DRN	ARVIND		31.01.2017
DESN	ARVIND		31.01.2017
CHD	SANJAY KUMAR		31.01.2017
APPD	JACOB JAMES		31.01.2017

TITLE: LAYOUT OF CW PIPING LOCAL TO CONDENSER

SCALE: 1:150

DRAWING NO. PE-DG-425-165-M001

SHEET 1 OF 2 REV. 00

FORMAT SIZE A0

SUB-SECTION - IIA

STANDARD TECHNICAL SPECIFICATION (MECHANICAL)

STANDARD TECHNICAL SPECIFICATION FOR COLTCS

STANDARD QUALITY PLANS

1.00.00 **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 condenser on-load tube cleaning system (sponge rubber balls type) complete with all accessories as specified hereinafter. Each half of the condenser shall be provided with an independent tube cleaning system.

2.00.00 **CODES AND STANDARDS**

2.01.00 The design, materials, manufacture, inspection and testing of the condenser on-load tube cleaning system complete with all accessories, shall comply with the requirements of the latest versions of the following appropriate codes and standards.

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

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

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

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

3.00.00 **DESIGN AND CONSTRUCTION**

3.01.00 General Requirements

3.01.01 Unless otherwise necessary, manufacturer's standard and proven models of the tube cleaning system shall be supplied.

3.01.02 The tube cleaning system shall be capable of safe, continuous and trouble-free operation for removal of fouling and scaling materials from condenser tubes. Vibration, noise, mechanical stresses shall be kept within allowable limits specified by relevant codes/standards. In design, due attention shall be given to ease of maintenance, repair and cleaning.

3.01.03 Suitable Corrosion allowance shall be provided whenever necessary. Adequate provision for future installation of cathodic protection shall be provided.

3.01.04 The tube cleaning system shall consist of ball separator at condenser outlet, recirculating pump, ball collector, differential pressure measuring system for ball separator, ball monitoring system, cleaning balls, piping valves, distributors, injection nozzles, instrumentations, control panel, interconnecting cables and others as necessary. The configuration of the tube cleaning system shall be as described in section C and / or as per the scheme enclosed.

3.02.00 DELETED

3.03.00 **Operational Requirements**.

The tube cleaning system and other accessories shall be designed for the following operation modes :

3.03.01 Complete automatic start-up of tube cleaning system initiated by pressing the push button (manual command).

3.03.02 Complete automatic shut-down of tube cleaning system with ball collection, effected by the following :

- Push button (manual command).
- Adjustable timer (after a defined cleaning period).
- Ball monitoring system (when the number of oversized balls falls below a set value).

3.03.02 Complete automatic backwashing of ball separator with ball collection, effected by the following :

- Differential pressure measuring system at a pre-determined differential across the ball separating strainer/ screen.
- Adjustable timer
- Push button

3.03.04 Complete automatic emergency backwashing of ball separator with alarm, indication, effected by differential pressure measuring system.

3.03.05 Manual operation for start-up, shut-down with ball collection backwashing of ball separator, flushing of differential pressure measuring system etc., in case of failure of control system.

3..04.00 **Ball Separator**

3.04.01 Ball separator body shall be of rigid construction and shall be designed and manufactured as per the applicable codes for pressure vessels. It shall house the ball separating screen / strainer and shall have flanged inlet, outlet, ball extraction opening and pressure measuring tappings etc. Body shall be designed and manufactured as per the applicable codes for pressure vessels and to take care of forces and moments as enclosed in the specification. However in no case thickness of housing/body shall be less than the connecting pipe thickness as specified in data sheet A

3.04.02 The ball separator shall be provided with manhole with bolted cover and sight glass to observe its internals.

3.04.03 If specified in Data Sheet -A, ball separator body shall be Epoxy lined.

3.04.04 The ball seperating screen / strainer shall be designed for the maximum differential pressure across the separator and shall be securely mounted in the body. Screen / strainer shaft shall be sized adequately considering the overloading of screens / strainer due to debris accumulation.

3.04.05 The ball separating strainers / screens shall have electric actuators for swivelling to allow for their backwashing. Also suitable hand wheels shall be provided to enable manual swivelling of strainers / screens.

3.05.00 **Ball Recirculating Pump**

3.05.01 The ball recirculating pump shall be horizontal centrifugal type. The casing shall be designed to withstand 1.5 times the shut-off pressure or twice the operating pressure, whichever is higher.

3.05.02 The impeller shall be non-clog type and shall be contoured suitably to avoid damage to the cleaning balls. 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.

3.05.03 Replaceable type wearing ring shall be provided to prevent damage to the casing and impeller.

3.05.04 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.

3.05.05 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.

3.05.06 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

3.05.07 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.

3.05.08 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.

3.05.09 All rotating components shall be statically and dynamically balanced.

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

3.05.11 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.

3.05.12 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.

3.05.13 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.

3.05.14 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.

3.05.15 The pump shall be capable of being started with discharge valve fully opened. Motor rating shall be adequate for this condition. The output KW rating of the pump drive motor shall not be less than the larger of the following :

a) Maximum power input to the pump over the entire range for maximum flow to shut-off condition.
b) 125% of power input to the pump at duty point corresponding to 103% of the rated speed.

3.06.00 **Ball Collector**

3.06.01 The body of the ball collector shall be designed to withstand 2.0 times the operating pressure or 1.5 times the recirculating pump shut-off pressure, whichever is higher. The ball collector shall be designed and manufactured as per the applicable codes for pressure vessels.

3.06.02 Ball collector shall be provided with an inspection window/sight glass for visual inspection of the cleaning balls.

3.06.03 Ball collector shall be provided with suitable ports with covers for ball feeding and removal.

3.06.04 The ball collector shall be provided with vent and drain connections with isolating valves.

3.06.05 Provision shall be made in the ball collector for separating the undersized balls and ball collector shall have a separate chamber for collecting the undersized balls.

3.06.06 If specified in Data Sheet -A, ball collector body shall be lined with suitable resilient material.

3.06.07 The differential pressure measuring system shall be provided with D.P. transmitter ,DPS & DPGof remote seal arrangement.

3.07.00 **Differential Pressure Measuring System.**

3.07.01 The ball separator shall be provided with a measuring system for differential pressure across the ball separating strainer/screen, to check debris accumulation and to initiate ball catching and backwashing operations. This shall consist of a differential pressure switch/transmitter for automatic backwashing operation, a differential pressure guage for manual observation with adequate number of tappings with isolating valves.

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

3.07.03 The differential pressure measuring system shall be with remote seal arrangement .

3.08.00 **Ball Monitoring System**

3.08.01 Ball monitoring system shall be provided for continuously monitoring the quantity and size of the cleaning balls in circulation. The monitoring system shall perform the following functions :

a) Continuously counting the oversize balls in circulation and giving an alarm calling for investigation of ball losses, when the number of oversize circulating balls falls below a set valve.

b) Continuously measuring the size of the balls in circulation and initiating the shut-down of the tube cleaning system with alarm calling-for replacement of balls when the number of oversized balls falls below a set valve.

c) Bidder's if not manufacturing ball oversized monitor, can supply automatic ball sorter in lieu of same for automatic sorting of the undersized balls.

3.08.02 The monitoring system shall be of proven and reliable design and shall be complete with necessary transducers, amplifiers, transmission lines, power cables and electronic processor etc.

3.08.03 The electronic processor of the ball monitoring system shall be housed in the control panel and shall consist the following : -

a) Indicators for
- ♦ required basic ball charge.
- ♦ recirculating ball quantity.
- ♦ oversized ball quantity.

b) Time counters for
- ♦ total cleaning system operating hours.
- ♦ cleaning system operating hours with sufficient number of oversized balls.

c) Recorder for ball consumption.

3.08.04 The ball monitoring system shall have provisions for self-testing and self-calibration.

3.09.00 **Cleaning Balls**

3.09.01 The sponge rubber cleaning balls shall be slightly oversized to the internal diameter of condenser tubes and should be able to remove all fouling and scaling deposits in the condenser tubes.

3.09.02 The specific gravity of the cleaning balls shall be such that good distribution of balls across the tube sheet and cleaning of all tubes are ensured.

3.09.03 The composition of the cleaning balls shall be based on natural rubber and shall be suitable for temperature upto 100^0C. Hardness of the cleaning balls shall be compatible to tube material and corrosion/fouling behaviour. If cleaning balls consist of abrasive coated balls, the abrasive material shall also be compatible for use with the tube material.

3.09.04 Calculations and basis for selection of cleaning balls circulation quantity, type, size, hardness, cleaning frequency etc., shall be furnished during contract stage.

3.10.00 **Piping, Valves, Distributors and Injection Nozzles.**

3.10.01 Interconnecting piping, valves, injection 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.

3.10.02 Interconnecting piping shall be sized and routed optimally. Velocity in the pipe work shall be less than 1.5 m/s for pump suction and less than 2.2 m/s in other pipe work.

3.10.03 Necessary isolation valves, vent and drain valves for various equipments shall be provided. Valves shall conform to appropriate standards. Valves provided in ball transport piping shall be ball type. Gland packing of all valve shall be of superior quality to avoid leakage. All valves upto 150 Nb shall be ball valves. For higher sizes , gate / globe /B.F. valves shall be provided. All instrument valves shall be needle valves.

3,10.04 Adequate number of ball injection nozzles shall be provided for proper distribution of cleaning balls in condenser inlet. Ball injection nozzles shall be flanged type and shall have two sets of flanges, one for connecting to ball transport pipe and other for connecting to the stub on condenser inlet pipe for ease of removal during repairs or checking.

3.10.05 Distributors (if applicable) with sight glass shall be provided wherever ball transport

piping branching out or joining together for proper guidance of cleaning balls.

3.10.6 Type of valves shall be ball valves, no diaphragm type valve shall be used.

3.11.00 **Actuators**

3.11.00 Tube cleaning 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 handwheel for manual operation in the event of control system failure.

3.12.00 **Electric Motors**

The drive motors for recirculating pump and differential pressure measuring system flushing pump shall conform to the requirements of the enclosed specification.

3.13.00 **Instrumentation and Control System.**

3.13.01 Complete instrumentation and control system for automatic operation of tube cleaning system, protection, interlocking, indication / annunciation of differential pressure and other malfunctions etc., shall be provided. This shall consist of adequate operational hardware, local control panel (As applicable) and interconnecting control and power cabling between the control panel and various equipments in the tube cleaning system.

3.13.02 The control panel shall house all necessary instruments, indicating / annunciation lamps, alarms, differential pressure indicator, timer, function selection switches, ball monitoring system processor, 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.

3.13.03 Pressure guages shall be provided at recirculating pump suction and discharge. All instrumentation shall be of reputed make and shall meet the requirements of the enclosed specifications.

3.14.00 **Other Accessories.**

3.14.01 Counter flanges, complete with gaskets, bolts and nuts etc., shall be supplied for ball separator inlet, outlet connections and all other terminal points Fabrication, dimensions and drilling of the flanges shall conform to the codes/standards specified in Data Sheet-A / Section -C.

3.14.02 Ball recirculating pump, ball collector with interconnecting piping and valves, shall be mounted on a frame. For fixing the frame, necessary foundation plates, bolts, nuts etc. shall be provided.

3.14.03 Suitable lifting arrangement shall be provided for various equipments of the tube cleaning system, for handling during erection and maintenance.

4.00.00 DELETED

5.00.00 **SHOP INSPECTION AND TESTS**

5.01.01 **General**

5.01.01 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 tube cleaning system shall conform to the requirements of this specification and of the applicable codes / standards.

5.01.02 All materials used for manufacture /fabrication of the various equipments of the tube cleaning 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.

5.01.03 All shop tests shall be conducted as per approved quality plan and test certificates / reports for the same shall be furnished to BHEL for approval.

5.01.04 Qualification of welding procedures and welders shall be as per ASME B&PV code, Section - IX / applicable codes.

5.2.00 **Ball Separator**

5.02.01 Chemical analysis, mechanical tests shall be carried out on materials used for body, strainer / screen, strainer / screen shaft and other appurtenances as per the applicable material specification standards.

5.02.02 All butt welded joints shall be subjected to radiographic/ ultrasonic testing as per applicable codes. However, all welded joints shall be subjected to 100% magnetic particle / penetrant testing to ensure freedom from defects.

5.02.03 Strainer / screen shaft shall be subjected to ultrasonic test as per ASTM-A388 for subsurface defects with acceptance norms as per ASME B&PV code, Section VIII, Division 1.

5.03.00 **Ball Recirculating Pump**

5.03.01 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.

5.03.02 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.

5.03.03 Pump shaft and sleeves shall be subjected to ultrasonic test as per ASTM - A388 for sub-surface defects and penetrant test after finish machining as per ASTM-E165 for surface defects.

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

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

5.04.00 **Ball Collector**

5.04.01 Chemical analysis, mechanical tests shall be carried out on materials used for body and other appurtenances / accessories as per the applicable material specification standards.

5.04.02 All but 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.

5.05.00 **Piping, Valves, Distributors, and Injection Nozzles.**

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

5.05.02 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.

5.05.03 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.

5.05.04 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.

5.06.00 **Rubber Lining (as applicable)**

Rubber lining shall be subjected to surface crack test, 100% spark and hardness tests and shall be checked for layer thickness, defects etc.

5.07.00 **Flanges**

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

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

per ASME B&PV code, Section VIII, Division 1.

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

5.07.04 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.

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

5.08.00 **Dimensional Checks.**

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

5.09.00 **Hydrostatic Test**

Hydrostatic test shall be conducted on various assemblies / equipments / components of the tube cleaning system at a pressure of 1.5 times and design pressure. The duration of the test shall be minimum 30 minutes.

5.10.00 **Leakage Test**

Leakage test shall be conducted at the design pressure on all assemblies of the tube cleaning system to demonstrate that the assemblies are leak tight and no water seepage shall take place at various nozzles and valve connections.

5.11.00 **Performance Test on Recirculating Pump**

Performance test on recirculating pump with drive motor shall be conducted as per BS-599 / ASME PTC 8.0. Performance curves i.e., discharge flow Vs head, discharge flow Vs power consumption and discharge flow Vs efficiency shall be plotted and acceptance norms shall be as per BS-599 / ASME PTC 8.0. Vibration and noise shall be measure and acceptance norms shall be as per Hydraulic Institute (USA) standard.

5.12.00 **Functional Tests**

Various assembles / equipments / components of the tube cleaning system shall be subjected to functional tests and the following shall be checked.

5.12.01 Smooth and free operation of all movable parts.

5.12.02 Interlock and sequential operation.

5.12.03 Satisfactory operations of ball monitoring system.

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

6.00.00 **TESTING AT SITE**

After completion of installation at site, the tube cleaning system will be tested to check that the tube cleaning 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.

7.00.00 **QUALITY ASSURANCE & QUALITY PLAN**

7.01.00 The tube cleaning system and other accessories to be supplied, shall have assured quality and workmanship.

7.02.00 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 tube cleaning system being offered.

8.00.00 **NAME PLATE AND TAG NUMBERS**

8.01.00 Ball separator, recirculating pump, ball collector shall be provided with a permanently attached brass or stainless steel plate indicating the following details :-

a) Design and maximum flow rates.
b) Design and test pressures.
d) Design temperature.
e) Empty and operating weights.

8.02.00 Each valve in the tube cleaning system shall be provided with a name plate indicating the following :-

a) Service.
b) Design and test pressures.
c) Maximum flow and flow direction.
d) Size.
e) Tag Number.

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

8.03.00 Each motor shall be provided with a name plate indicating the following details:

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

	TITLE : DATA SHEET - C CONDENSER ON - LOAD TUBE CLEANING SYSTEM (Sponge Rubber Ball Type)	SPECIFICATION NO.PE-TS-999-165-N001	
		VOLUME : II B	
		SECTION : D	
		REV. NO. 01	DATE :20.06.16
		SHEET 1 OF 2	

1.00.00 **DRAWING, DATA & INFORMATION TO BE SUBMITTED AFTER THE AWARD OF CONTRACT**.

After the award of contract, the following drawings, data and information is to be submitted for review / approval of BHEL.

1.01.00 The drawings to be submitted by bidder in event of award of contract shall be as per cl. 10.0 (b), sub-section-1A.

1.01.01 Data sheet (s) - B.

1.01.02 Final versions of the following drawings to enable BHEL to finalise the layout and to design foundations and structures:-

a) General arrangement / installation drawings of ball separator, ball recirculating unit, control panel each complete with all accessories, incorporating the principal dimensions and weights of equipment offered, size and location of various nozzle connection, supporting arrangement (wherever applicable) and scope of supply etc.

b) Foundation arrangement drawings (wherever applicable) showing load data on supports, size and location of anchor bolts etc.

c) General arrangement drawing indicating the layout of the equipments and interconnecting piping with pipe supports.

1.01.03 Bar chart and inspection schedule.

1.02.00 Within the stipulated time period as per Vendor's drawing /document list, the following shall be submitted.

1.02.01 Cross Sectional/ detailed drawing of ball separator, recirculating pump, ball collector, differential pressure measuring system, ball monitoring system distributors, injection nozzles actuators, motors, control panel etc, indicating bill of quantities and materials of construction.

1.02.02 Final versions of calculations and basis for selection of cleaning balls circulation quantity, type, size, hardness, cleaning frequency etc.

12.2.03 Flow and control logic diagrams for various operations of the tube cleaning system.

1.02.04 Detailed schedule of valves indicating Tag numbers, type, make size, pressure and temperature ratings, materials etc.

1.02.05 Detailed schedule of instruments indicating tag numbers, type, make, materials , of construction, range and accuracy etc.

1.2.6 Detailed schedule of piping and fittings indicating sizes, materials, maximum working pressure and temperatures etc.

1.02.07 Control panel layout and list of instruments provided on control panel.

1.02.08 List of annunciations, protections and interlocks provided.

1.02.09 Detailed drawings of flanges.

1.02.10 Ball recirculating pump performance characteristic curves.

1.02.11 Write-up and instruction manuals for erection, operation and maintenance.

1.02.12 Storage instructions.

1.02.13 Vendor to send 3 sets of final documents (O&M manual, GA drg, P&ID) direct to site under intimation to PEM.

Manufacturer's Name & Address	STANDARD QUALITY PLAN	BHEL Doc No.:	PE-QP-999-165-N008 REV-01
		Vendor Q.P. NO.	PROJECT:
	INDEX	PACKAGE : COLTCS	CUSTOMER:
		Date :	PURCHASER:
		Page 01 of 15	CONSULTANT:
			P.O. No.

Note :Items not included in quality plan to be inspected as per approved data sheet/drawings

ANNEXURES

DRY RUN TEST PROCEDURE FOR BALL SEPERATOR
HYDRO STATIC TEST PROCEDURE
LEAK TIGHTNESS TEST PROCEDURE
PACKING PROCEDURE

LEGEND

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Manufacturer / Sub-Contractor	Contractor		Reviewed By	Name & Sign. Of approving authority & Seal
Signature				

Manufacturer's Name & Address

P.O. No.

STANDARD QUALITY PLAN

Item : Ball Separator

Vendor Q.P. NO:
PACKAGE : COLTCS
Date :
Page 02 of 15

BHEL Doc No.: PE-QP-999-165-N008
PROJECT:
CUSTOMER:
PURCHASER:
CONSULTANT:

Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	D*	Agency M **	Agency C	Agency O	Remarks
1	2	3	4	5	6	7	8	9	D*	**	10		11
1.0.0	**Ball Separator**												
1.1.0	Raw Material												
[a]	Housing Shell, Nozzle flanges	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample/cast / heat / batch	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / Lab test report/Raw material flow sheet	*	P	V	V	
		Surface defects	Minor	Visual	100%	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report/ Raw material Flow sheet	–	P	V	V	
		Sub Surface Defects	Major	Ultrasonic test	100%	ASME SA 435	ASME SA 435	Inspection report	*	P	V	V	Plates > 20mm Thk only (UT - Full Volume)
[b]	Nozzle Pipes	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample/heat	Approved drg/Data sheet	Approved drg/Data sheet	Mill.Test Certificate / Lab test report/Raw material flow sheet	*	P	V	V	
		Surface defects	Minor	Visual	100%	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report/ Raw material Flow sheet	–	P	V	V	
		Leak Tightness	Major	Hydrostatic test	100%	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate	*	P	V	V	
[c]	Main Flange	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample/cast / heat / batch	Approved drg/Data sheet	Approved drg/Data sheet	Manufacturer's Test Certificate	*	P	V	V	
		Heat treatment (Normalising)	Major	Verification	HT Chart	Approved drg/Data sheet	Approved drg/Data sheet	Manufacturer's Test Certificate	*	P	V	V	if casting
		Surface defects	Critical	Magnetic particle test	100%	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report	*	P	V	V	if casting
		Sub-surface defects	Critical	Ultrasonic test	100%	ASME SA609 / SA 435	ASME SA609 Level II / SA 435 / SA 388	Inspection report	*	P	V	V	
[d]	Screen Shaft	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample/heat	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / Lab test report/Raw material flow sheet	*	P	V	V	

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Manufacturer / Sub-Contractor	Contractor		
Signature		Reviewed By	Name & Sign. Of approving authority & Seal

	BHEL	Manufacturer's Name & Address			STANDARD QUALITY PLAN				BHEL Doc No.:				PE-QP-999-165-N008
							Vendor Q.P. NO:		PROJECT:				
		P.O. No.			Item : Ball Separator		PACKAGE : COLTCS		CUSTOMER:				
							Date :		PURCHASER:				
							Page 03 of 15		CONSULTANT:				

Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record		Agency			Remarks
										M	C	O	
1	2	3	4	5	6	7	8	9	D*	**	10		11
		Surface defects on machined area	Critical	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	*	P	V	V	
		Sub-surface defects	Critical	Ultrasonic test	100%	ASME SA745	ASME SA745	Inspection report	*	P	V	V	
[e]	Screen ribs	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample / heat	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / Lab test report/Raw material flow sheet	*	P	V	V	
		Corrosion Resistance	Major	IGC	One/Heat	ASTM A 923	ASTM A 923	Test Report/Lab test report	*	P	V	V	
		Surface Defects	Minor	Visual	100%	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report/ Raw material Flow sheet	–	P	V	V	
[f]	Ball Extraction Nozzle Pipe [Duplex Stainless Steel]	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample / cast/heat/ batch	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / Lab test report/Raw material flow sheet	*	P	V	V	
		Surface Defects	Minor	Visual	100%	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report/ Raw material Flow sheet	–	P	V	V	
		Leak Tightness	Major	Hydrostatic Test	100%	Approved drg/Data sheet	Approved drg/Data sheet	Manufacturer's Test Certificate	*	P	V	V	
1.2.0	**Inprocess Quality Control**												
1.2.1	Welding procedure specification	Correctness	Critical	Scrutiny	100%	ASME Sec.IX	ASME Sec.IX	QW 482 of ASME Sec.IX	*	P	V	V	
1.2.2	Welding procedure qualification	Weld soundness	Critical	Physical test	100%	ASME Sec.IX	ASME Sec.IX	QW 483 of ASME Sec.IX	*	P	V	V	Welding procedure already approved by BHEL/LRQA/GL/DNV/TUV shall be employed for this job.
1.2.3	Welder performance qualification	Weld soundness	Critical	Radiography	100%	ASME Sec.IX	ASME Sec.IX	QW 484 of ASME Sec.IX	*	P	V	V	Welders already qualified by BHEL/LRQA/GL/DNV/TUV shall be employed for this job.
1.2.4	Fit-up of butt weld	Alignment.and dimensions	Major	Template, visual	100%	Manufacturing Drawing	ASME Sec VIII Div.1	Log book		P	W/V	--	BHEL to witness > 20mm thick butt joint
1.2.5	Fit-up of shell flange and nozzle assembly to shell	Orientation,alignment and dimensions	Major	Template, visual	100%	Manufacturing Drawing	ASME Sec VIII Div.1	Log book		P	--	--	

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Signature				

	BHEL	Manufacturer's Name & Address			STANDARD QUALITY PLAN				BHEL Doc No.:				PE-QP-999-165-N008	
							Vendor Q.P. NO:		PROJECT:					
		P.O. No.			Item : Ball Separator		PACKAGE : COLTCS		CUSTOMER:					
							Date :		PURCHASER:					
							Page 04 of 15		CONSULTANT:					

Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record		Agency			Remarks
										M	C	O	
1	2	3	4	5	6	7	8	9	D*	**	10		11
1.2.6	**Weld quality for Pressure Parts**												
	[a] Root run	Surface defects	Major	Penetrant test / Visual	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Operation Process Sheet	–	P	V	V	
1.2.7	[a] Completed butt welds	1.Surface defects	Major	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	*	P	V	V	
		2.Sub-surface defects	Critical	Radiography test	10% of total weld length & 100% T Joints	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 4 / UW 52	Radiographs & inspection report	*	P	V	V	RT films will be reviewed by BHEL
	[b] Completed fillet welds	Surface defects	Major	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	*	P	V	V	
1.2.8	Fabricated Shell (Prior to sand blasting)	1.Dimensions, Orientation	Major	Measurement by visual	100%	Manufacturing Drawing	Manufacturing Drawing	Inspection report	*	P	V	V	
		2. Hydro test	Critical	Hydrostatic Pr. @ 1.5 times design pr. (positive) Duration 30 minutes	100%	ASME Sec.VIII Div.1	No Leakage	Inspection report	*	P	W	V	
1.2.9	Pickling and Passivation	Protection Layer	Major	Visual	100%	IS : 10117	IS : 10117	Log Book	–	P	--	--	
1.2.10	Final tests (completed equipments) - After assembly	1.Dimensions, orientation, workmanship & finish	Major	Measurement by visual	100%	G.A.drawing	G.A.drawing	Inspection report	*	P	W	W	
		2.Leak tightness for assembly	Critical	Leak Tightness @ design pr. (positive) Duration 30 minutes	100%	ASME Sec.VIII Div.1	No Leakage	Inspection report	*	P	W	W	
		3.Dry function test for Ball Separator	Critical	Operational test	100%	Approved procedure	Approved procedure	Inspection report	*	P	W	W	

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Manufacturer / Sub-Contractor	Contractor		Reviewed By	Name & Sign. Of approving authority & Seal
Signature				

	BHEL	Manufacturer's Name & Address			STANDARD QUALITY PLAN				BHEL Doc No.:				PE-QP-999-165-N008	
							Vendor Q.P. NO:		PROJECT:					
		P.O. No.			Item : Ball Separator		PACKAGE : COLTCS		CUSTOMER:					
							Date :		PURCHASER:					
							Page 05 of 15		CONSULTANT:					
Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record		Agency			Remarks	
										M	C	O		
1	2	3	4	5	6	7	8	9	D*	**	10		11	
1.3.0	**Rubber Lining for ball Seperator Shell, V-Piece & skid IC Pipe.**													
1.3.1	Rubber formulation	Tensile elongation and hardness	Major	Physical test	One per lot	Manufacturer's procedure	BS 6374/Equivalent	Manufacturer's test certificate		P	V	V		
		Polymer Identification	Major	Flame test	One per lot	For Semi Ebonite	For Semi Ebonite	Inspection report	*	P	V	V		
						Ebonite Polymer catches fire; catches fire and On removal from fire it continues to burn	Ebonite Polymer catches fire; catches fire and On removal from fire it continues to burn							
		% Change in weight after 24 hrs immersion in sea water at 70 degrees	Major	Immersion test (bleeding test)	One per lot	ASTM D 471	+ / - 1 %	Inspection report	*	P	V	V		
1.3.2	Surface preparation of items to be lined	Free from rust , scale, dust and grease	Major	Visual	100%	SA 2.5	SA 2.5	Manufacturer"s Internal inspection		P	-			
1.3.3	Vulcanising	Temperature, Pressure and time	Major	Process monitoring	100%	Manufacturer's procedure	Manufacturer's procedure	Process Procedure		P	-	-		
1.3.4	Vulcanised rubber lined items	a) Chip test	Major	Chip test	One per lot	Approved drawing and BS 6374/Equivalent	BS 6374/Equivalent	Inspection report	*	P	V	V		
		b)Adhesion, Visual defects, thickness and hardness	Major	Measurement,visual inspection	100% visual. Thickness0hardness at random	Approved drawing and BS 6374/Equivalent	BS 6374/Equivalent	Inspection report	*	P	V	V		
		c)Spark test for Pin holes at 5 kv/mm	Major	Spark test for Pin holes	100%	Approved drawing and BS 6374/Equivalent	BS 6374/Equivalent	Inspection report	*	P	V	V		

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Manufacturer / Sub-Contractor	Contractor		Reviewed By	Name & Sign. Of approving authority & Seal
Signature				

		Manufacturer's Name & Address			**STANDARD QUALITY PLAN**				BHEL Doc No.:				PE-QP-999-165-N008	
							Vendor Q.P. NO:		PROJECT:					
		P.O. No.			**Item : WORM GEAR & ACTUATORS**		PACKAGE : COLTCS		CUSTOMER:					
							Date :		PURCHASER:					
							Page 06 of 15		CONSULTANT:					
Sl. No.	**Component / Operation**	**Characteristics Checked**	**Class**	**Type of Check**	**Quantum of Check**	**Reference Documents**	**Acceptance Norms**	**Format of Record**		**Agency**			**Remarks**
										M	**C**	**O**	
1	2	3	4	5	6	7	8	9	D*	**	10		11
1.4.0	**Complete Unit of Worm gear**	Reduction Ratio	Critical	Functional Test	100%	Approved Data Sheet	Approved Data Sheet	Manufacturer test certificate	*	P	V	V	
		Angle of Rotation											
		Input Torque											
		Output Torque											
		Degree of protection	Critical	Water & Dust ingress tests	Type test	Approved Data Sheet	Approved Data Sheet	Type test certificate	*	V	V	V	
1.5.0	**Actuators**	Routine Test	Major	Electrical test	100%	Supplier catalogue	Supplier catalogue / ADS	Manufacturer TC	*	V	V	V	Review of TCs
		Make, Range, Model	Major	Visual	100%								
		Assembly check alongwith ball valves	Major	Visual	100%	Supplier catalogue	Supplier catalogue / ADS	Inspection Report	_	P	--	--	
		Functional check alongwith settings/auxillary contacts	Major	Visual	100%								
		Note: ADS - APPROVED DATA SHEET											
			LEGEND										
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Signature								Reviewed By					**Name & Sign. Of approving authority & Seal**

		Manufacturer's Name & Address			**STANDARD QUALITY PLAN**				BHEL Doc No.:				PE-QP-999-165-N008	
	BHEL						Vendor Q.P. NO:		PROJECT:					
		P.O. No.			**Item : Ball Recirculation Skid & Ball Vessel**		PACKAGE : COLTCS		CUSTOMER:					
							Date :		PURCHASER:					
							Page 07 of 15		CONSULTANT:					
Sl. No.	**Component / Operation**	**Characteristics Checked**	**Class**	**Type of Check**	**Quantum of Check**	**Reference Documents**	**Acceptance Norms**	**Format of Record**		**Agency**			**Remarks**	
										M	**C**	**O**		
1	2	3	4	5	6	7	8	9	D*	**	10		11	
2.0.0	**Complete Skid**													
	Recirculating Skid with ball vessel and ball oversize monitor	Completeness, Correctness, Orientation, Dimensions	Major	Visual & Measurement	100%	Approved Drawing	Approved Drawing	Inspection report	*	P	V	V		
	Ball Vessel													
2.1.0	Raw Material													
[a]	Housing Shell, Nozzle flanges and dished end	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample/heat	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / lab test report / raw material flow sheet	*	P	V	V		
		Surface defects	Minor	Visual	100%	Approved drg/Data sheet	Approved drg/Data sheet	Mill TC/Inspection report	*	P	V	V		
		Sub-surface defects	Major	Ultrasonic test	100%	ASME SA 435	ASME SA 435	Inspection report	–	P	V	V	Plates > 20mm Thk only (UT - Full Volume)	
2.2.0	**Inprocess Quality Control**													
2.2.1	Welding procedure specification	Correctness	Critical	Scrutiny	100%	ASME Sec.IX	ASME Sec.IX	QW 482 of ASME Sec.IX	*	P	V	V		
2.2.2	Welding procedure qualification	Weld soundness	Critical	Physical test	100%	ASME Sec.IX	ASME Sec.IX	QW 483 of ASME Sec.IX	*	P	V	V	Welding procedure already approved by BHEL/LRQA/GL/DNV/TUV shall be employed for this job.	
2.2.3	Welder performance qualification	Weld soundness	Critical	Radiography	100%	ASME Sec.IX	ASME Sec.IX	QW 484 of ASME Sec.IX	*	P	V	V	Welders already qualified by BHEL/LRQA/GL/DNV/TUV shall be employed for this job.	
2.2.4	Dished end for ball vessel	Dimensions	Major	Template	100%	Manufacturing Drawing	ASME Sec VIII Div.1	Inspection report	–	P	V	V		
		Surface defects	Critical	Penetrant test	100%	ASME Sec VIII Div.1	ASME Sec VIII Div.1 Appendix 8	Inspection report	–	P	V	V		
			LEGEND											
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			C : Contractor		O : Owner									
Manufacturer / Sub-Contractor		Contractor	Indicate : "P" - Perform, "W" - Witness and "V" - Verification											
Signature								Reviewed By					Name & Sign. Of approving authority & Seal	

		Manufacturer's Name & Address			STANDARD QUALITY PLAN		Vendor Q.P. NO:		BHEL Doc No.:				PE-QP-999-165-N008	
		P.O. No.			Item : Ball Vessel & Ball Injection Pipe		PACKAGE : COLTCS		PROJECT:					
							Date :		CUSTOMER:					
							Page 08 of 15		PURCHASER:					
									CONSULTANT:					

Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record		Agency			Remarks
										M	C	O	
1	2	3	4	5	6	7	8	9	D*	**	10		11
2.2.5	Fit-up of butt weld	Alignment.and dimensions	Major	Measurement	100%	Manufacturing Drawing	ASME Sec VIII Div.1	Log book	–	P	W/V	--	BHEL to witness >20mm thick butt joint.
2.2.6	Fit-up of shell flange and nozzle assembly to shell	Orientation,alignment and dimensions	Major	Template, visual	100%	Manufacturing Drawing	ASME Sec VIII Div.1	Log book	–	P	--	--	
2.2.7	**Weld quality for Pressure Parts**												
	[a] Root run	Surface defects	Major	Penetrant test / Visual	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Operation Process Sheet	*	P	V	V	
2.2.8	[a] Completed butt welds	1.Surface defects	Major	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	*	P	V	V	
		2.Sub-surface defects	Critical	Radiography test	10% of total weld length & 100% T Joints	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 4 / UW 52	Radiographs and inspection report	*	P	V	V	RT films will be reviewed by BHEL
	[b] Completed fillet welds	Surface defects	Major	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	*	P	V	V	
2.2.9	Fabricated Shell	1.Dimensions, Orientation	Major	Measurement	100%	Manufacturing Drawing	Manufacturing Drawing	Inspection report	*	P	V	V	
		2. Hydro test for Ball Vessel	Critical	Hydrostatic Pr. @ 1.5 times design pr. (positive) [Duration 30 minutes]	100%	ASME Sec.VIII Div.1	No leakage	Inspection report	*	P	W	V	Hydrostatic test shall be conducted along with Recirculating skid Assly for Ball Vessel.
2.2.10	Pickling and Passivation	Protection Layer	Major	Visual	100%	IS : 10117	IS : 10117	Log Book		P	--	--	
2.2.11	**Ball Injection Pipe**	Chemical & Physical properties	Major	Chemical & mechanical tests	One sample/heat	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / lab test report / raw material flow sheet	*	P	V	V	
		Surface defects	Minor	Visual	100%	Approved drg/ Data sheet	Approved drg/ Data sheet	MTC / Inspection report	–	P	V	V	
		Leak Tightness	Major	Hydrostatic test	100%	Approved drg/Data sheet	Approved drg/Data sheet	Manufacturer's Test Certificate	*	P	V	V	

LEGEND

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Manufacturer / Sub-Contractor	Contractor	Reviewed By	Name & Sign. Of approving authority & Seal
Signature			

		Manufacturer's Name & Address			STANDARD QUALITY PLAN				BHEL Doc No.:				PE-QP-999-165-N008	
		P.O. No.			Item : RECIRCULATING PUMP		Vendor Q.P. NO:		PROJECT:					
							PACKAGE : COLTCS		CUSTOMER:					
							Date :		PURCHASER:					
							Page 9 of 15		CONSULTANT:					
Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record		Agency			Remarks	
										M	C	O		
1	2	3	4	5	6	7	8	9	D*	**	10		11	
2.3.0	**Raw material control**													
2.3.1	Casing	Chemical,Physical properties	Major	Chemical & Physical analysis	One Sample/Cast / Heat	Approved drg/ Data sheet	Approved drg/ Data sheet	Manufacturer's Test Certificate	*	P	V	V		
		Surface defects	Minor	Visual	100%	Approved drg/ Data sheet	Approved drg/ Data sheet	MTC / Inspection report	–	P	V	V		
2.3.2	Impeller, Sleeve	Physical,and Chemical properties	Major	Physical and Chemical analysis	One Sample/Cast / Heat	Approved drg/ Data sheet	Approved drg/ Data sheet	Manufacturer's Test Certificate	*	P	V	V		
2.3.3	Shaft	Physical,and Chemical properties	Major	Physical and Chemical analysis	One Sample/Cast / Heat	Approved drg/ Data sheet	Approved drg/ Data sheet	Manufacturer's Test Certificate	*	P	V	V		
		Sub-Surface defects	Major	Ultrasonic Test	100%	ASME SA 745	ASME SA 745	MTC / Inspection report	*	P	V	V	Only for shaft >= 50mm	
2.3.4	**In-process control**													
2.3.5	Casing	Leak tightness	Critical	Hydro.test @ 1.5times design pr. (positive) (Duration 30 minutes)	100%	Manufacturing Standard	No Leakage	Inspection report	*	P	V	V		
2.3.6	Shaft	Surface defects	Critical	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	*	P	V	V		
2.3.7	Impeller	Residual,static, dynamic unbalance	Major	Static,dynamic balancing	100%	ISO:1940	ISO:1940, Gr 6.3	Inspection report	*	P	V	V		
2.3.8	All components	Workmanship, finish and dimensions	Major	Measurement, visual examination	100%	Manufacturing drawing	Manufacturing drawing	Log book / job card	–	P	--	–		
2.3.9	**Assembly, control, final inspection / test**													
	Performance Test	a) Q Vs. Head, Q Vs. Pumps efficiency / overall efficiency, Q Vs. Power, Vibration and Noise	Critical	Performance test	100%	Approved curve, approved data sheet, IS:5120	Approved data sheet	Inspection report, plotted curves	*	P	V	V		
		b) Dimensions, workmanship and finish	Major	Measurement, visual	100%	Data sheet	Data sheet							
		c) Noise level	Major	–	–	–	85 db at 1 meter distance							
2.3.10	Complete pump	Completeness, correctness, cleanliness	Major	Visual examination	100%	Approved data sheet / Mfg. Drg.	Approved data sheet / Mfg. Drg.	Check list / inspection report	*	P	V	V		

LEGEND

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Manufacturer / Sub-Contractor	Contractor	Reviewed By	Name & Sign. Of approving authority & Seal
Signature			

Manufacturer's Name & Address	STANDARD QUALITY PLAN		BHEL Doc No.: PE-QP-999-165-N008
		Vendor Q.P. NO:	PROJECT:
P.O. No.	Item : BALL VALVES	PACKAGE : COLTCS	CUSTOMER:
		Date :	PURCHASER:
		Page 10of 15	CONSULTANT:

Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	D*	Agency M	Agency C	Agency O	Remarks
1	2	3	4	5	6	7	8	9	D*	**	10		11
2.4.0	**Ball valves**												
2.4.1	**Materials**												
	Body and Tail end pieces	Chemical,Physical properties	Major	Chemical & Physical analysis	One Sample/Cast / heat	Approved drg/ Data sheet	Approved drg/ Data sheet	Manufacturer's T.C.	*	P	V	V	
2.4.2	Ball	Chemical,Physical properties	Major	Chemical & Physical analysis	One Sample/Cast / heat	Approved drg/ Data sheet	Approved drg/ Data sheet	Manufacturer's T.C.	*	P	V	V	
2.4.3	Stem	Chemical,Physical properties	Major	Chemical & Physical analysis	One Sample/Cast / heat	Approved drg/ Data sheet	Approved drg/ Data sheet	Manufacturer's T.C.	*	P	V	V	
2.4.4	**In-process inspection**												
2.4.5	Machining of body, end, pieces, ball	Dimension	Major	Measurement	100%	Approved drg/Data sheet	Approved drg/Data sheet	Log book	–	P	V	V	
2.4.6	Ball	a) Surface defects	Critical	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	*	P	V	V	
		b) Hardness	Major	Hardness testing	Random	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report	*	P	V	V	
2.4.7	**Assembly**	a) Dimensions	Major	Measurement	100%	EN ISO 17292	EN ISO 17292	Manufacturer's T.C.	*	P	V	V	
		b) Opening / Closing	Major	Operation	100%	---	As per approved data sheet	–	–	P	V	V	Test at works for opening / closing time of actuator operated valves.
2.4.8	**Testing**												
	[a] Body	Leakage	Critical	Hydraulic test	100%	EN 12266-1&2/API 598/Appd data sheet	EN 12266-1&2/API 598 & Appd. Data sheet	Manufacturer's T.C.	*	P	V	V	
	[b] Seat test	Leakage	Critical	Hydraulic test	100%	EN 12266-1&2/API 598/Appd data sheet	EN 12266-1&2/API 598 & Appd. Data sheet	Manufacturer's T.C.	*	P	V	V	
	[c] Seat	Leakage	Critical	Air test	100%	EN 12266-1&2/API 598/Appd data sheet	EN 12266-1&2/API 598 & Appd. Data sheet	Manufacturer's T.C.	*	P	V	V	

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Manufacturer / Sub-Contractor	Contractor	Reviewed By	Name & Sign. Of approving authority & Seal
Signature			

		Manufacturer's Name & Address			**STANDARD QUALITY PLAN**				BHEL Doc No.:				PE-QP-999-165-N008	
	BHEL						Vendor Q.P. NO:		PROJECT:					
		P.O. No.			**Item : RECIRCULATING PUMP MOTOR**		PACKAGE : COLTCS		CUSTOMER:					
					V PIECE		Date :		PURCHASER:					
							Page 11 of 15		CONSULTANT:					
Sl. No.	**Component / Operation**	**Characteristics**	**Class**	**Type of**	**Quantum of**	**Reference**	**Acceptance**	**Format of**		**Agency**			**Remarks**	
		Checked		**Check**	**Check**	**Documents**	**Norms**	**Record**		**M**	**C**	**O**		
1	2	3	4	5	6	7	8	9	D*	**	10		11	
2.5.0	**Motor**	Routine test, No Load test & IR	Major	Electrical test	100% test	IS:325	IS:325	Manufacturer test certificate	*	P	V	V	Review of supplier TC	
		Make , Rating	Major	Verification	100%	Appd drg/Data sheet	Appd drg/Data sheet	Inspection report	*	V	V	V		
		Degree of Protection	Critical	Verification	Type test	IP 55	IP 55	Manufacturer's test Certificate	*	V	V	V		
3.1.0	**V - Piece**													
	Raw material inspection	Chemical & Physical properties	Major	Chemical & mechanical tests	One sample/heat	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / lab test report / raw material flow sheet	*	P	V	V		
	In process inspection	b) Surface defects	Major	Visual	100%	Approved drg/ Data sheet	Approved drg/ Data sheet	MTC / Inspection report	*	P	V	V		
		c)Sub-surface defects	Critical	Radiography test	10% of total butt weld length	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 4	Radiographs and inspection report	*	P	V	V		
		d) Hydro Static Test	Critical	Hydrostatic Pr. @ 1.5 times design pr. (positive) [Duration 30 minutes]	100%	ASME Sec.VIII Div.1	No leakage	Inspection report	*	P	V	V		

			LEGEND											
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Manufacturer / Sub-Contractor		Contractor	Indicate : "P" - Perform, "W" - Witness and "V" - Verification											
Signature								Reviewed By		Name & Sign. Of approving authority & Seal				

		Manufacturer's Name & Address			STANDARD QUALITY PLAN				BHEL Doc No.:				PE-QP-999-165-N008	
							Vendor Q.P. NO:		PROJECT:					
		P.O. No.			Item : BaIII Monitoring System (Ball Oversize Monitor)		PACKAGE : COLTCS		CUSTOMER:					
							Date :		PURCHASER:					
							Page 12 of 15		CONSULTANT:					
Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record			Agency			Remarks
										M	C	O		
1	2	3	4	5	6	7	8	9	D*	**	10			11
4.1.0	**Raw Material** Housing shell, Flanges	Chemical properties	Major	Chemical Analysis	One sample/heat	Approved drg/Data sheet	Approved drg/Data sheet	Mill test Certificate / lab test report/raw material flow sheet	*	P	V	V	if fabricated type	
		Physical properties	Major	Physical test	One sample / cast/heat/ batch	Approved drg/Data sheet	Approved drg/Data sheet	Mill test Certificate / lab test report/raw material flow sheet	*	P	V	V		
		Surface defects	Minor	Visual	100%	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate/Inspection report	*	P	V	V		
		Sub-surface defects	Major	Ultrasonic test	100%	ASME SA 435	ASME SA 435	Mill Test Certificate	*	P	V	V	Plates > 20mm Thk only (UT - Full Volume)	
4.2.0	**Inprocess Quality Control**													
4.2.1	Welding procedure specification	Correctness	Critical	Scrutiny	100%	ASME Sec.IX	ASME Sec.IX	QW 482 of ASME Sec.IX	*	P	V	V		
4.2.2	Welding procedure qualification	Weld soundness	Critical	Physical test	100%	ASME Sec.IX	ASME Sec.IX	QW 483 of ASME Sec.IX	*	P	V	V	Welding procedure already approved by BHEL/LRQA/GL/DNV/TUV shall be employed for this job.	
4.2.3	Welder performance qualification	Weld soundness	Critical	Radiography	100%	ASME Sec.IX	ASME Sec.IX	QW 484 of ASME Sec.IX	*	P	V	V	Welders already qualified by BHEL/LRQA/GL/DNV/TUV shall be employed for this job.	
4.2.4	Fabricated Shell	1.Surface defects (fillet welds)	Major	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	*	P	V	V		
		2.Dimensions, Orientation	Major	Measurement by visual	100%	Approved doc./ Data sheet	Approved documents / Data sheets	Inspection report	*	P	V	V		
		3. Hydro test	Critical	Hydrostatic Pr. @ 1.5 times design pr. (positive) [Duration 30 minutes]	100%	ASME Sec.VIII Div.1	No leakage	Inspection report	*	P	W	V	Hydrostatic test shall be conducted alongwith Recirculating skid assembly	
		4. Functional Test	Major	Functional	100%	Approved procedure	Approved procedure	–	–	P	V	V	Functional test to be done at site	

			LEGEND											
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Manufacturer / Sub-Contractor		Contractor	Indicate : "P" - Perform, "W" - Witness and "V" - Verification											
Signature								Reviewed By		Name & Sign. Of approving authority & Seal				

		Manufacturer's Name & Address			**STANDARD QUALITY PLAN**				BHEL Doc No.:				PE-QP-999-165-N008	
							Vendor Q.P. NO:		PROJECT:					
					Item : Pressure Gauge, DP Gauge, DP Switch, DP Transmitter		PACKAGE : COLTCS		CUSTOMER:					
		P.O. No.					Date :		PURCHASER:					
									CONSULTANT:					
					Cleaning Balls									
					All components & Equipments		Page 13 of 15		**PACKAGE : COLTCS**					

Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record		Agency M	Agency C	Agency O	Remarks
1	2	3	4	5	6	7	8	9	D*	** 10			11
5.0.0	**In process quality control**	Make, Range and Model	Critical	Visual	100%	Approved Data Sheet	Approved Data Sheet	Manufacturer test certificate	*	P	V	V	
		Calibration	Critical	Calibration test	100%	Approved Data Sheet	Approved Data Sheet	Manufacturer test certificate	*	V	V	V	
		Degree of Protection	Critical	-	Type.Test Certificate	Approved Data Sheet	Approved Data Sheet	Manufacturer test certificate	*	V	V	V	For Pressure guage, DP Guage, DP Switch
6.0.0	**Cleaning Balls**												
	– Normal balls – Abrasive balls	Dimensions	Critical	Measurement	Random	Approved Data	Approved Data Sheet	Manufacturer's test certificate	*	P	V	V	Quantity and type of balls to be checked with datasheets
		Type				Sheet							
		Size											
7.0.0	**All Components / Equipments**	Painting Dry film thickness and visual	Major	Measurement	Random	Painting schedule	Painting schedule	Inspection report	*	P	V	V	
		Packing	Major	Measurement	100%	MFG. Procedure	MFG. Procedure	Inspection report	*	P	V	_	

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Signature				

		Manufacturer's Name & Address			**STANDARD QUALITY PLAN**					BHEL Doc No.:				PE-QP-999-165-N008
					Item : Starter Panel		Vendor Q.P. NO:			PROJECT:				
							PACKAGE : COLTCS			CUSTOMER:				
		P.O. No.					Date :			PURCHASER:				
							Page 14 of 15			CONSULTANT:				
Sl. No.	**Component / Operation**	**Characteristics Checked**	**Class**	**Type of Check**	**Quantum of Check**	**Reference Documents**	**Acceptance Norms**	**Format of Record**		**Agency**			**Remarks**	
										M	**C**	**O**		
1	2	3	4	5	6	7	8	9		**	10		11	
8.0.0	**Starter panel**													
08.1.0	**Incoming Material**													
08.1.1	Fabricated & Painted Panel	Dimension	Major	Measurement	100%	Approved Drgs.	Approved Drgs.	Inspection report	_	P	--	--		
		Panel G.A.	Major	Measurement	100%	Approved Drgs.	Approved Drgs.	Inspection report	_	P	--	--		
		Paint colour	Major	Visual	100%	Approved Drgs.	Approved Drgs.	Inspection report	_	P	--	--		
		Paint thickness	Major	Measurement	100%	Approved Drgs.	Approved Drgs.	Inspection report	_	P	--	--		
		Paint Shade, Adhesion	Major	Visual	Sample	Approved Drgs.	Approved Drgs.	Inspection report	_	P	--	--		
08.1.2	Wire	Size / Colour / Rating / Surface Defects	Major	Visual / Dimension	Sample	IS 694	Specification / drawings	Inspection report	_	P	--	--	ISI Marked wire	
08.1.3	Panel Mounting	Make, Functional, Type & Rating	Major	Visual / Electrical	100%	Approved BOM	Approved BOM	---		P	V	V		
08.2.0	**In Process Inspection**													
10.2.1	Name Plate, Component Mounting, Etc.	Workmanship, Finish, Correctness	Major	Visual	100%	Approved Drgs.	Approved drawings	Inspection report	_	P	--	--		
08.2.2	Electrical Wiring of Panels	Continuity, Colour of wires, Bunching and Grouping	Major	Visual	100%	Mounting Drawing	Approved drawings	Inspection report	_	P	--	--		
08.2.3	Ferruling of Cables	Start & End	Major	Visual	100%	Manufacturer's drawing	Manufacturer's drawing	Inspection report	_	P	--	--		
08.3.0	**Final Inspection**									P	--	--		
08.3.1	Workmanship, Finish & Paint shade / Thickness	Visual	Major	Visual	100%	G.A Drawing	Approved drgs.	Inspection report	*	P	W	V		
08.3.2	Overall Dimension, G.A of starter panel	Measurement	Major	Visual	100%	G.A Drawing	Approved drgs.	Test Certificate	_	P	W	V		
08.3.3	Component Identification	Visual	Major	Visual	100%	G.A Drawing	Approved drgs.	Inspection report	_	P	W	V		
08.3.4	Degree of Protection	Ingress Protection IP55	Critical	Environmental	Verification	Approved drgs.	IS 2147	Inspection Report		P	V	V	for enclosure	
08.3.5	IR - HV - IR	Electrical	Critical	Electrical	100%	Approved Procedure	Approved Pocedure	Inspection report	_	P	V	V		
08.3.6	Functional & Continuity	Functional	Major	Functional	100%	Appd Drawing	Appd Drawing	Inspection report	*	P	W	W		

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

Manufacturer's Name & Address

P.O. No.

STANDARD QUALITY PLAN

Item : FASTENERS

Vendor Q.P. NO:
PACKAGE : COLTCS
Date :
Page 15 of 15

BHEL Doc No.: PE-QP-999-165-N008
PROJECT:
CUSTOMER:
PURCHASER:
CONSULTANT:

Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	D*	Agency M **	Agency C	Agency O	Remarks
1	2	3	4	5	6	7	8	9	D*	10			11
9.1.0	**Internal Fasteners (Duplex Steel)**	Chemical & Physical properties	Major	Chemical & Mechanical analysis	1 Per heat/HT Batch	Approved drg/Data sheet	Approved drg/Data sheet	Mfr TC / Lab report	*	P	V	V	
		Visual & workmanship finish	Major	Visual	Sample	Approved drg/Data sheet	Approved drg/Data sheet		_	P	V	V	
		Dimensions	Major	Measurement	Sample	Approved drg/Data sheet	Approved drg/Data sheet		_	P	V	V	
9.2.0	**Main Fasterners**	Visual	Major	Visual	Sample	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report / Mfr TC	*	P	V	V	
		Dimensions	Major	Measurement	Sample	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report / Mfr TC	*	P	V	V	
		Chemical & Physical properties	--	Chemical & Physical test a) Tensile b) Yield c) Elongation d) Proof load	1 sample per heat	Approved drg/Data sheet	Approved drg/Data sheet	Mfr TC/Lab report	*	P	V	V	

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Manufacturer / Sub-Contractor	Contractor		
Signature		Reviewed By	Name & Sign. Of approving authority & Seal

SUB-SECTION - IIB

STANDARD TECHNICAL SPECIFICATION (ELECTRICAL)

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

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

1.0 INTENT OF SPECIFIATION

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

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

2.0 CODES AND STANDARDS

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

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

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

3.0 DESIGN REQUIREMENTS

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

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

3.3 Starting Requirements

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

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

The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.

3.3.3 The following frequency of starts shall apply

i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.

ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)

iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for mimimum 20,000 starts during the life time of the motor

3.4 **Running Requirements**

3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.

3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.

3.5 **Stress During bus Transfer**

3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechanical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.

3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.

3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.

4.0 **CONSTRUCTIONAL FEATURES**

4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy

4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.

Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled

4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.

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

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

4.6 In case Class 'F' insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation.
In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.

4.7 **Terminals and Terminal Boxes**

4.7.1 Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.

Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet "A".

4.7.2 unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.

4.7.3 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively.

4.7.4 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.

4.7.5 Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.

4.7.6 Degree of protection for terminal boxes shall be IP 55 as per IS 4691.

4.7.7 Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.

4.7.8. Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.

4.7.9 Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.

4.8 Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.

4.9 **General**

4.9.1 Motors provided for similar drives shall be interchangeable.

4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.

4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.

4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.

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

4.9.6 Name plate with all particulars as per IS: 325 shall be provided

4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.

5.0 INSPECTION AND TESTING

5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.

5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.

5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.

5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.

6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT

a) OGA drawing showing the position of terminal boxes, earthing connections etc.
b) Arrangement drawing of terminal boxes.
c) Characteristic curves:
(*To be given for motor above 55 kW unless otherwise specified in Data Sheet*).

i) Current vs. time at rated voltage and minimum starting voltage.
ii) Speed vs. time at rated voltage and minimum starting voltage.
iii) Torque vs. speed at rated voltage and minimum voltage.
For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.
iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.

	QUALITY PLAN		CUSTOMER :			PROJECT-2X660MW ENNORE TPP TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION TITLE			
	SHEET 1 OF 2		SYSTEM			ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	2	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1		NOTE -1 & NOTE-3
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	NOTE -1 & NOTE-3
	BHEL		**PARTICULARS**		**BIDDER/VENDOR**							
			NAME									
			SIGNATURE									

	QUALITY PLAN	CUSTOMER :			PROJECT-2X660MW ENNORE TPP TITLE			SPECIFICATION : NUMBER :			
		BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION : TITLE :			
	SHEET 2 OF 2	SYSTEM			ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	

NOTES:

1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON

2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.

3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.

Legends for Inspection agency

1. BHEL/CUSTOMER
2. VENDOR (MOTOR MANUFACTURER)
3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)

P. PERFORM
W. WITNESS
V. VERIFY

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

SUB-SECTION - IIC

STANDARD TECHNICAL SPECIFICATION (C &I)

1.0 SCOPE

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

2.0 CODES AND STANDARDS

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

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

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

3.0 TECHNICAL REQUIREMENTS

3.1 Panel Construction

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

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

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

3.1.4 The salient features of construction shall be:

Sheet material: Cold rolled sheet steel
Frame thickness: Not less than 3.0mm
Enclosure thickness: Not less than 2.5 mm for load bearing sections (Mounted with instruments)
1.6 mm for doors and Not less than 2.0 mm for others
Panel Height: Not less than 2365 mm (Refer data sheet-A (No. PES-145A-DS1-0)
Gland plate thickness: 3.0mm
Base channel: ISMC 100 with anti-vibration mounting & foundation bolts.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3.2 Hazardous Area Panel Requirement

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

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

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

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

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

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

3.3 Control & Monitoring devices

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

3.3.2 Alarm Annunciator System

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

3.3.3 Relays

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

3.3.4 Timers

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

3.3.5 Control / Selector Switches

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

3.3.6 Push Buttons / Indicating Lights

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

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

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

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

3.3.7 Ammeters

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

3.3.8 Miniature Circuit Breaker (MCB)

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

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

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

4.0 TESTING AND INSPECTION

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

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

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

4.3.1 Routine Tests

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

4.3.2 Type Tests

1. Enclosure Class Test

5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

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

5.2. Mandatory Spares

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

5.3. Recommended Spares

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

6.0 DRAWINGS AND DOCUMENTS

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

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

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

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

7.0 MARKING AND PACKING

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

8.0 APPLICABLE DATA SHEET FORMS

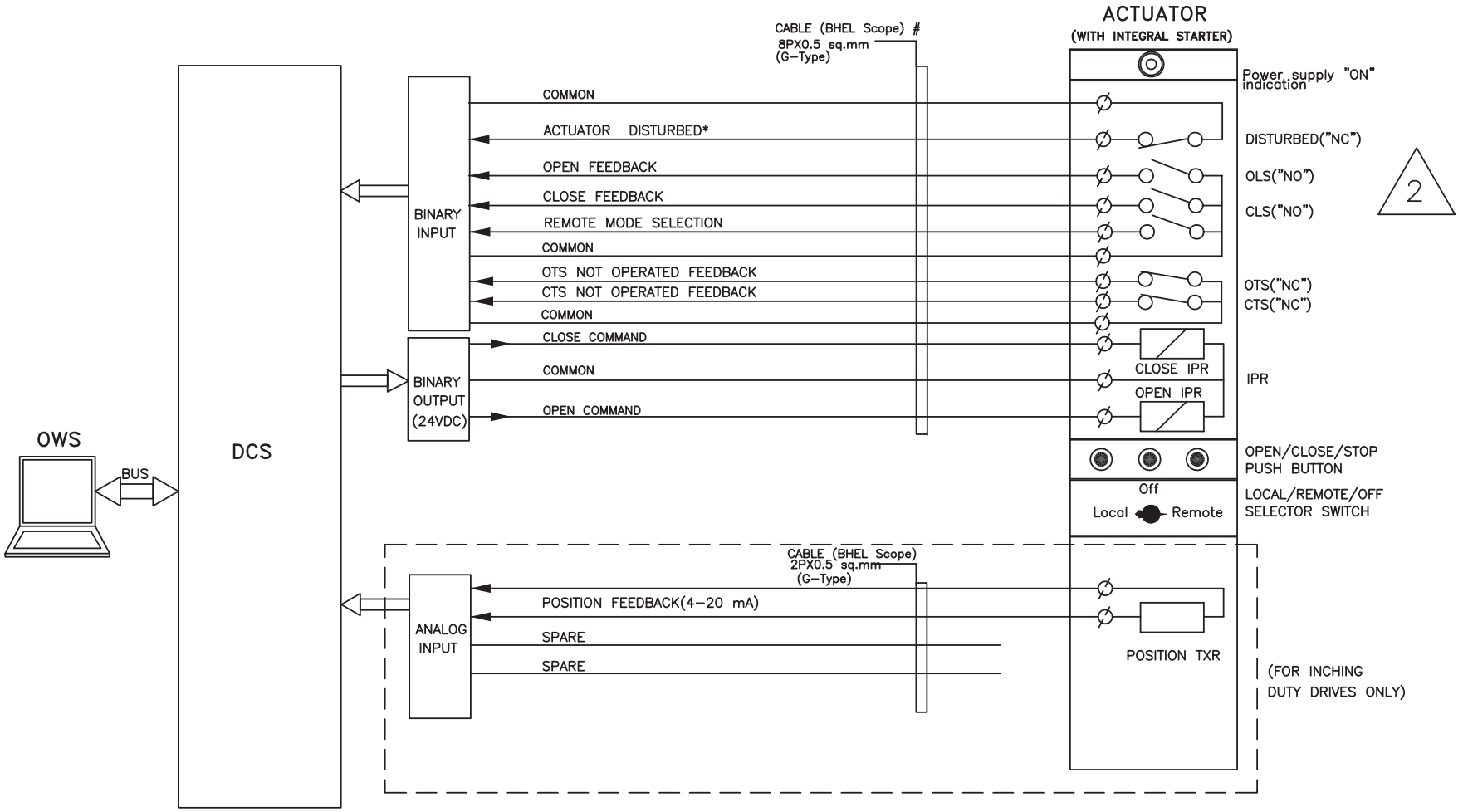
This document shall be read with one or more of the following data sheet forms :

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

`

DRIVE CONTROL PHILOSOPHY

DCS INTERFACE FOR BIDIRECTIONAL DRIVE(WITH INTEGRAL STARTER)



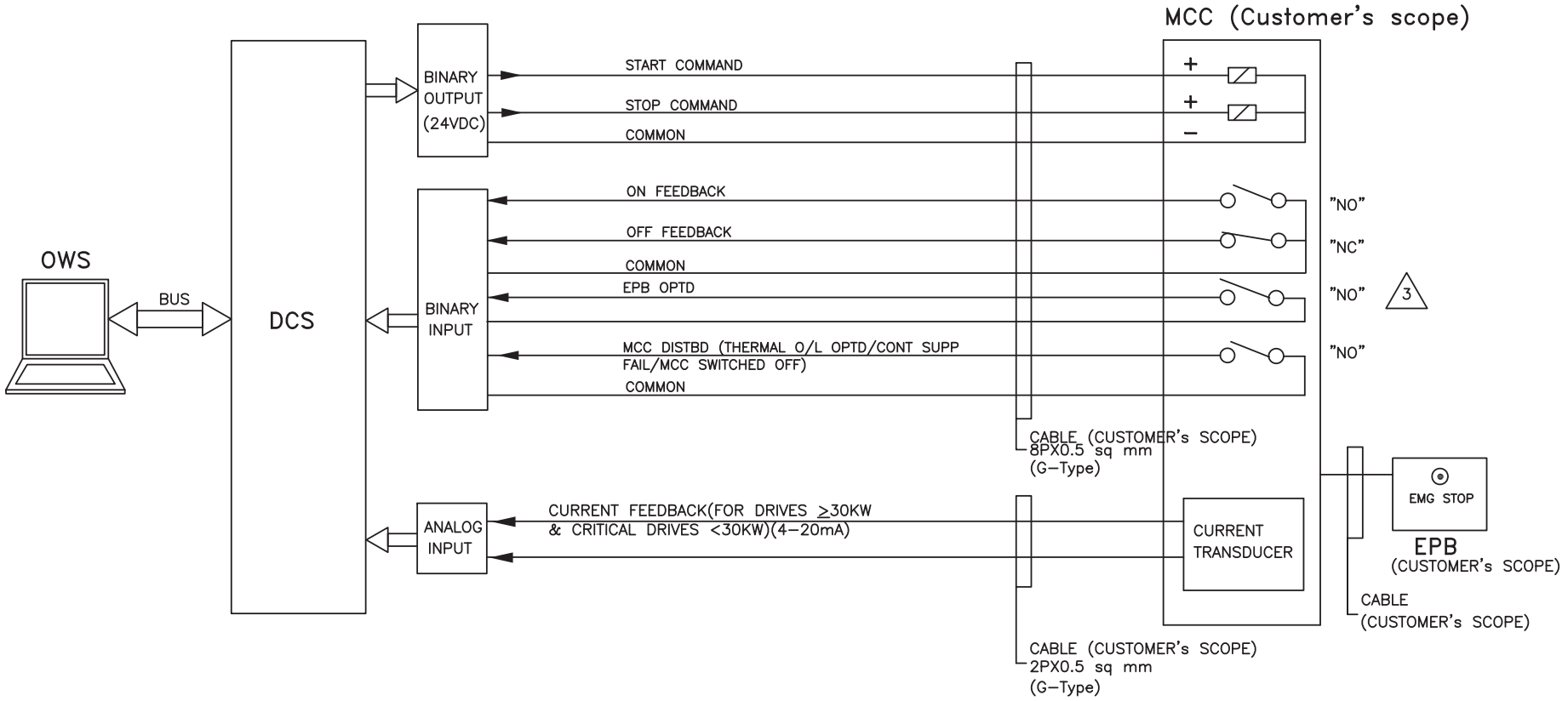
NOTE:

* ACTUATOR DISTURBED= Loss of Power supply (1 Phase/3 Phase)/
Loss of control supply/ Motor thermostat trip/
Thermal over load relay trip

\# ACTUATOR & TERMINATION SHALL BE WITHOUT ANY PIN CONNECTOR

PROJECT:	1X525MW TUTICORIN TPS,STAGE-IV,UNIT-I THOOTHUKUDI DIST, TAMILNADU	DRG.NO.	PE-DM-422-145-I002
		DATE	03.01.2017
TITLE	DDCMIS INTERFACE FOR BIDIRECTIONAL DRIVE	REV.NO.	03
		SHT	7 OF 12

DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE (CONTRACTOR OPERATED)



BHEL	PROJECT: 1X525MW TUTICORIN TPS,STAGE-IV,UNIT-I THOOTHUKUDI DIST, TAMILNADU	DRG.NO.	PE-DM-422-145-I002
		DATE	03.01.2017
	TITLE DDCMIS INTERFACE FOR UNIDIRECTIONAL LT DRIVE	REV.NO.	03
		SHT	8 OF 12

	1X525 MW TUTICORIN TPS,STAGE-IV	
	TECHNICAL SPECIFICATION (C&I) FOR CONDENSER ON LOAD TUBE CLEANING SYSTEM	

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QUALITY ASSURANCE FOR INSTRUMENTS & LCP

PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	1 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
	INCOMING											
1.0	Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	IS:1079 IS:513	IS:1079 IS:513	Test Certificate	3	---	2	
		2. Bend Test	CR	Mech. test	Sample	IS:1079 IS:513	IS:1079 IS:513	Log Book	2	---	---	
		3. Surface finish	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---	
		4. Waviness	MA	Visual	100%	Factory Standard	No Waviness	Log Book	2	---	---	
		5. Thickness	MA	Measurement	100%	BHEL Spec.	BHEL Spec.	Log Book	2	---	---	
		6. Mill marking	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	1	
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	IS:2062	IS:2062	Log Book	2	---	---	
		2. Surface Defects	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---	
		3. Straightness	MA	Measurement	100%	Factory Std.	Factory Std.	Log Book	2	---	---	
		4. Mill marking	MA	Visual	100%	IS:2062	IS:2062	Log Book	2	---	1	
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		2. IR and HV	MA	Electrical	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics

$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.

1 - BHEL 2 - Vendor 3 - Sub-vendor

PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	2 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
		3. Conductor a) Resistance b) Size c) Sheet colour	 MA MA MA	 Electrical Measurement Visual	 100% 100% 100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	3	---	2	
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type	CR	Visual	Sample	BHEL Spec. and BOM	BHEL Spec. and BOM	Log Book	2	---	---	
		2. Verification of Test Certificates	CR	Scrutiny of Type / Routine T.Cs.	100%	Relevant IS	Relevant IS	Log Book	2	---	---	
		3. Operation / Functional check	CR	Electrical	Sample+ 100%@	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---	+ for relay & contactors only
		4. I.R.	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---	@ for all components except relays & contactors.
		5. H.V.	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---	
		6. Calibration	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	1	
		7. Pick up / Drop off Voltage	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---	

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics

$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.

1 - BHEL 2 - Vendor 3 - Sub-vendor

PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		2. Surface defects	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		3. IR / HV on Terminal Blocks	MA	Electrical	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
	IN PROCESS											
6.0	Blanking / Bending / Forming	1. Dimensions	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Surface defects after bending	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	---	
7.0	Nibbling / Punching	1. Cutout Sizes	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Deburring	MA	Visual	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
	ASSEMBLY											
8.0	Frame Assembly & Sheet fixing	1. Dimensions	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		2. Alignment	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		3. Welding Quality	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		4. Surface defects	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
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	

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
10.	Panel Wiring	1. Wiring Layout	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		2. Wiring Termination (Crimped Lugs)	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		3. Ferrule numbers	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		4. Colour of wiring	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
		5. Size of Conductor	MA	Measurement	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
11.	Component Mounting	1. Correct components	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
		2. Fixing	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
	FINAL											
12.	Final Inspection	1. Workmanship	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.
		2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		3. Components identification Marking / Name plates	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
		5. Dimensions	MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	
		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	At Random by BHEL, based on 100 % internal test reports by Mfr.
		10. Wiring Layout	MA	Visual	100%	BHEL approved drg.	BHEL approved drg.	Inspection Report	2	1	1	
		11. Wire Termination	MA	Pulling manually	Sample	-----	Firm termination	Inspection Report	2	1	1	
		12. Continuity	MA	Electrical	100%	-----	Continuity OK	Inspection Report	2	1	1	

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	Type Test Certificate	3	---	1	
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant IS.	BHEL approved spec., drg., BOM & relevant IS.	Test Report	2	1	1	
15	FUCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		2. Instrument Calibratio	CR	Electrical	10%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		3. Temperature rise	CR	Electrical	100%	BHEL approved spec/drg. & relevant IS.	BHEL approved spec/drg & relevant IS.	Inspection Report	2	1	1	

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STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR ANNUNCIATORS

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE/ MODEL						
	DIMENSIONS OF HARDWARE						
	MODULARITY						
	SEQUENCE						
	FACIA DETAILS						
2	FUNCTIONAL TEST	100%		P	W	V	
3	IMMUNE TO STEP VARIATIONS IN THE POWER SUPPLY	SEE NOTE-1 BELOW		P	W	V	
4	DEGREE OF PROTECTION FOR ENCLOSURE	TYPE TEST		P	W	V	
5	I/R CHECK	SEE NOTE-1 BELOW		P	W	V	
6	RESPONSE			P	W	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR PRESSURE & DP GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	SENSOR TYPE						
	DIAL SIZE						
	MODEL NO/TAG NO						
	RANGE/SCALE						
	SWITCH CONTACT RATING & NOS.						
	END CONNECTION						
2	CALIBRATION			P	W	V	
	ACCURACY						
	REPEATABILITY						
	SET POINT ADJUSTMENT						
3	OVER PRESSURE & LEAK TEST			P	W	V	
4	OPERATION OF PRESSURE. RELIEF DEVICE	ONE		P	W	V	
5	REVIEW OF TC FOR	FOR LOT		V	V	V	
	MATERIALS OF SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. When material corelation is not available, MFR's compliance to be provided
5. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

PEM :: C&I

STANDARD QUALITY PLAN FOR PRESSURE / DP/LEVEL TRANSMITTER

QUALITY PLAN NO.:	**PE-QP-999-145-I001**
VOLUME	IIB
SECTION	D
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SHEET	1 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
1.0	**RAW MATERIAL INSPECTION**											
1.1	Body/Casing, Cable Gland and Mounting Bracket	1. Chemical & Mech. Properties	MA	Analysis	1 / Lot	Tech. Specn. Data Sheet, Mfr. standard	Tech. Specn. Data Sheet, Mfr. standard	Test certificate	3	---	2	Compliance report verification by BHEL.
		2. Dimensions	MA	Measurement	10% Min. 3 Nos.	Manufacturer drg.	Manufacturer drg.	Log Book	2	---	---	
		3. Visual	MA	Visual	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Log Book	2	---	---	
		4. Degree of Protection (If applicable)	CR	IS-2147 IS-2148	1 / Type	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Test certificate	3	---	2	
		5. Leak Tightness	MA	Hydro Test	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Log Book	2	---	---	
1.2	Sensor (Diaphragm, Capsule, Bellows, Strain, Gauge, Capacitance etc.)	1. Material Properties (Chemical & Mechanical)	MA	Analysis	1 / Lot	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Test certificate	3/2	---	2	
		2. Dimension	MA	Measurement	1 / Lot	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Test certificate	2	---	---	
		3. Performance	CR	Function	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Test certificate	2	---	---	
		4. Type Test	CR	Mech. & Elect.	1/Type	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Test certificate	3/2	---	2	

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PEM :: C&I

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
1.3	Gasket	1. Dimension	MA	Measurement	Sample	Manufacturer standard	Manufacturer standard	Test certificate	3/2	---	2	
		2. Sheer Hardness	MA	Analysis	Sample	Manufacturer standard	Manufacturer standard	Test certificate	3/2	---	2	
1.4	Electrical & Electronic Components	1. Marking & Rating	MA	Visual	10%	Manufacturer standard	Manufacturer standard	Log Book	2	---	---	
		2. Electrical Parameters	CR	Electrical Tests	10%	Manufacturer standard	Manufacturer standard	Log Book	2	---	---	
		3. Dimensions	MA	Measurement	10%	Manufacturer standard	Manufacturer standard	Log Book	2	---	---	
		4. Solderability	MA	Electrical	3 / Type	Manufacturer standard	Manufacturer standard	Log Book	2	---	---	
1.5	PCBs	1. Visual	MA	Visual	100%	---	---	---	3/2	---	2	
		2. Dimensions	MA	Measurement	10%	Manufacturer standard	Manufacturer standard	Log Book	3/2	---	2	
		3. Type Test	CR	Mech. & Elect. Tests	1 / Type / Batch	IS:7405 BS:4025	IS:7405 BS:4025	Test certificate	3/2	---	2	

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PEM :: C&I

STANDARD QUALITY PLAN
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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
2.0	**In-Process Inspection**											
2.1	Electrical Unit											
2.1.1	Etched PCB	1. Dimension – Trade width, Gap etc.	MA	Measurement	Sample	Manufacturer standard	Manufacturer standard	Inspection report	2	---	---	
		2. Defect of undercuts	MA	Visual	Sample	Manufacturer standard	Manufacturer standard	Inspection report	2	---	---	
		3. Quality and plating of plating through holes.	CR	Visual	100%	Manufacturer standard	Manufacturer standard	Inspection report	2	---	---	
		4. Screen printing	CR	Visual	100%	Manufacturer standard	Manufacturer standard	Inspection report	2	---	---	Compliance verification report by BHEL
2.1.2	Component Mounting and soldering	1. Correctness of components	MA	Visual	100%	Manufacturer standard	Manufacturer standard	Inspection report	2	---	---	
		2. Mounting and orientation	MA	Visual	100%	Manufacturer standard	Manufacturer standard	Inspection report	2	---	---	
		3. Soldering defects and finish	CR	Visual	100%	Manufacturer standard	Manufacturer standard	Inspection report	2	---	---	
2.1.3	Assembled PCBs	Functional check	CR	Electrical checks before & after soaking*	100%	Manufacturer standard	Manufacturer standard	Inspection report	2	---	---	

*Soaking means subjecting PCB (Assembled) at 70 Deg. C for 72 hours at energised condition and rapid temperature cycle test at 70 Deg. C and (-) 20 Deg. C for 30 minutes at each temp. (Five such cycles).

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
2.1.4	Conformal coating	Uniformity and finish of conformal coating on both sides	CR	Visual	100%	Manufacturer standard	Manufacturer standard	Inspection report	2	---	---	
2.2	Mounting, Fitting, Assembly of various mechanical parts	1. Correct Mounting	MA	Visual	100%	Manufacturer standard	Manufacturer standard	Log Book	2	---	---	
		2. Defects	MA	Visual	100%	Manufacturer standard	Manufacturer standard	Log Book	2	---	---	Compliance verification report by BHEL
		3. Dimensions	MA	Measurement	100%	Manufacturer standard	Manufacturer standard	Log Book	2	---	---	
2.3	Interconnection – Sensor to Electronic unit	Correctness of Interconnection	MA	Visual	100%	Manufacturer standard	Manufacturer standard	Log Book	2	---	---	
2.4	Interconnection – Pneumatic unit / Electronic unit and output / Local indicator.	Correctness of Interconnection	MA	Visual	100%	Manufacturer standard	Manufacturer standard	Log Book	2	---	---	

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
3.0	**Complete Transmitter**	1. Workmanship	MA	Visual	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report / Log Book	2	1	---	
		2. Dimension	MA	Measurement	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report / Log Book	2	1	---	
		3. Type / Model	CR	Visual	10%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report / Log Book	2	1	---	
		4. Range	CR	Visual	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report / Log Book	2	1	---	
		5. Calibrated Range	CR	Visual	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report / Log Book	2	1	---	
		6. Local Indicator / Scale marking	MA	Visual	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report / Log Book	2	1	---	
		7. Process connection type	CR	Measurement	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report / Log Book	2	1	---	
		8. Wetted parts material	MA	Analysis (Chemical, Mechanical)	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report / Log Book	2	---	1	
		9. Mounting bracket type	MA	Visual / Dimension	10%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report / Log Book	2	1	---	
		10. Calibration	CR	Electrical / Pneumatic	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report / Log Book	2	1	---	
		11. Soaking	CR	Electrical	100%	BHEL Spec	BHEL Spec.	Inspection report / Log Book	2	1	---	

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
3.2	Acceptance Tests	1. Accuracy	CR	Electrical	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report	2	1	1	
		2. Repeatability	CR	Electrical	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report	2	1	1	
		3. Dead Band	CR	Electrical	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report	2	1	1	
		4. Hysterisis	CR	Electrical	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report	2	1	1	
		5. HV & IR	CR	Electrical	100%	Manufacturer standard	Manufacturer standard	Inspection report	2	1	1	
		6. Linearity	CR	Electrical	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report	2	1	1	
		7. Supply voltage variation effect	CR	Electrical	100%	BHEL Spec.	BHEL Spec.	Inspection report	2	1	1	
		8. Temperature variation effect over range	CR	Electrical	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report	2	1	1	
		9. Over range	CR	Electrical	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report	2	1	1	

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 or their agent; 2 - Vendor; 3 - Sub-vendor

PEM :: C&I

STANDARD QUALITY PLAN FOR PRESSURE / DP/LEVEL TRANSMITTER

QUALITY PLAN NO.:	**PE-QP-999-145-I001**
VOLUME	IIB
SECTION	D
REV. NO.	00 DATE: 12.10.99
SHEET	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 $ P	Agency $ W	Agency $ V	Remarks
3.3	Type Test	1. Surge withstand capability	CR	Elect. & Mech	1 / Type	ANSI-C.37	ANSI-C.37	Inspection Report	3	---	2,1	
		2. Radio frequency interference	CR	Elect. & Mech	1 / Type	ANSI-C.37	ANSI-C.37	Inspection Report	3	---	2,1	
		3. Vibration effect	CR	Elect. & Mech	1 / Type	BHEL Spec.	BHEL Spec.	Inspection Report	3	---	2,1	
		4. Electro Magnetic field effect	CR	Elect. & Mech	1 / Type	BHEL Spec.	BHEL Spec.	Inspection Report	3	---	2,1	
		5. Degree of protection	CR	Mech. & Elect.	1 / Type	IS:2147	BHEL Spec.	Inspection Report	3	---	2,1	
		6. Explosion proofnexx (If applicable)	CR	Mech. & Elect.	1 / Type	IS:2148	BHEL Spec.	Inspection Report	3	---	2,1	
		7. Dry Heat	CR	Thermal	1 / Type	IS:9000	ANSI-C.37	Inspection Report	3	---	2,1	85 Deg. C for 16 Hrs.
		8. Damp Heat	CR	Thermal	1 / Type	IS:9000	ANSI-C.37	Inspection Report	3	---	2,1	40 Deg. C; 6 cycle
4.0	**Packing**	1. Packing Material	MA	Visual	100%	Manufacturer standard	Manufacturer standard	Log Book	2	---	2	
		2. Packeging and Marking	MA	Visual & Measurement	100%	Manufacturer standard	Manufacturer standard	Log Book	2	---	2	

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 or their agent; 2 - Vendor; 3 - Sub-vendor

SECTION III

DOCUMENTS TO BE SUBMITTED BY BIDDER

	TITLE : SCHEDULE OF PERFORMANCE GUARANTEES FOR CONDENSER ON LOAD TUBE CLEANING SYSTEM (COLTCS)	SPEC. NO. PE-TS- 422/423/425-165-N002
		VOLUME : III
		Sheet 1 of 1 Date- 06.01.2017

S.NO.	DESCRIPTION	UNITS	1X525 TUTICORIN TPS STAGE-IV	1X800 MW NORTH CHENNAI TPP STG-III	2X800 MW UPPUR STPP UNIT#1&2
1.	Pressure drop across the ball collecting Strainers (i.e. between inlet & outlet nozzle) under clean condition and Normal flow condition	MWC			
2	Percentage of ball recovery (minimum)	%			
3	Life of sponge rubber balls	Weeks			

PARTICULARS OF BIDDER/ AUTHORISED REPRESENTATIVE				
NAME	DESIGNATION	SIGNATURE	DATE	COMPANY SEAL

COMPLIANCE CERTIFICATE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate and furnish same with the offer.

a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions with regard to same.

b) There are no other deviations w.r.t. specification other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'

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

d) Any drawing/ document/ data-sheet/ calculation/ Quality plan/ Instrumentation etc. submitted along with the offer shall be considered for reference only, same shall be subject to BHEL/ Customer/Customer's Consultant approval in the event of order.

e) The offered materials shall be either equivalent or superior to those specified in the specification. For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.

f) The commissioning spares including balls shall be supplied on 'As Required Basis' and to be supplied at the time of commissioning of COLTCS system & prices for same included in the base price itself.
Prices for special tools & tackles, if any, shall also be included in the base price.
Recommended spares for 3 years shall be quoted separately with price indicated separately.

g) Charges for Installation Checks, Commissioning of equipments, Trial runs and Performance Testing at site shall be included by bidder as per the price format.

h) The main flanges for Ball separator shall be suitable for the forces and moments as per the specification.

j) Injection nozzles – 2/4 numbers of stubs of 100 NB or size as informed by bidder shall be provided by BHEL. The injection nozzles, counter flanges for the stubs along with nuts, bolts and gaskets shall be supplied by the bidder.

k) Number of balls (Normal as well as abrasive) for COLTCS shall be as specified i.e Number of balls per charge shall be @ 10% of no. of tubes per condenser section.

l) The hydrostatic test pressure shall be 1.5 times the design pressure.

m) All sub - vendors shall be subject to BHEL/ Customer/Customer's Consultant approval in the event of order.

n) The Performance guarantees of equipments shall stand valid till the satisfactory completion of performance testing & its acceptance by BHEL/ Customer/Customer's Consultant.

o) The orientation of piping around COLTCS shall be finalised during detailed Engg.

p) Electrical/ C&I :

- All selected motor ratings have minimum 15 % margin over maximum continuous demand of the driven equipment including voltage and frequency variations, temperature rise and other factors.
- Supply of electrical viz. LT power cables, instrumentation and control cables, cable glands, lugs, cable trays etc. shall be as per specification. Their erection shall be done by BHEL
- The junction boxes for termination of DPT/ DPS/ Actuator LS/ solenoid valves/ Ball oversize monitor/ Ball recirculating monitor are included in bidder's scope. The instrumentation cable and cabling from instruments/ actuators to junction boxes is also included in bidder's scope.
- Valve actuators and controls shall be provided as specified in Data Sheet-A and Project specific requirements as specified in 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.

	Title	SPECIFICATION NO.
BHEL	**DATA SHEET - B** **CONDENSER ON LOAD TUBE CLEANING SYSTEM** (SPONGE RUBBER BALL TYPE)	**PE-TS-999-165-N001** VOLUME **III** PART **A** SHEET 1 OF 13

INSTRUCTION TO BIDDER

1. This data sheet shall be read in conjunction with Specification No. PE-TS-412-165-N002.
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO. PARTICULARS	ITEM		UNIT
1.0	**General :**		
1.1	Number of Tube Cleaning System sets being supplied.	Nos.	
1.2	Type		
1.3	Liquid handled		
1.4	Manufacturer		
1.5	Country of origin		
2.0	**Design :**		
2.1	Design Pressure	Bar (g)	
	a) Ball Separator		
	b) Ball Recirculating Pump		
	c) Ball Collector		
	d) Piping		
	e) Valves		
	f) Distributors		
	g) Injection Nozzles		
2.2	DesignTemperature	°C	
2.3	Operating pressure at condenser inlet	Bar (g)	
2.4	Design differential pressure	Bar (g)	
2.5	Flow rate through ball seperator	M^3/hr	
	a) Normal		
	b) Maximum allowable		
2.6	Flow rate through ball collector	M^3/hr	
	a) Normal b) Maximum allowable		

Name of Bidder/ Vendor					
Revision Number	**0**	**1**	**2**	**3**	**4**
Signature of Bidder/ Vendor Authorised Representative					
Date :					

	Title	SPECIFICATION NO.
BHEL	**DATA SHEET - B** **CONDENSER ON LOAD TUBE CLEANING SYSTEM** (SPONGE RUBBER BALL TYPE)	**PE-TS-999-165-N001** VOLUME **III** PART **A** SHEET 2 OF 13

INSTRUCTION TO BIDDER

1. This data sheet shall be read in conjunction with Specification No. PE-TS-412-165-N002.
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO. PARTICULARS	ITEM		UNIT
3.0	**Guaranteed Performance**		
3.1	Whether condenser back pressure/ overall heat transfer coefficient is guaranteed that it will be permanently maintained as long as the tube cleaning system is in operation.		YES/NO
3.2	Pressure drop across the ball separator (i.e., between inlet and outlet connections) :		
	a) Normal flow condition		
	b) Maximum allowable flow condition		
3.3	Power consumption by ball recirculating pump during :	KW	
	a) Normal operation b) Ball collection operation c) Ball sorting operation		
3.4	Quantity of cleaning balls required per set for an operating period of one year	Nos.	
4.0	**Operation :**		
	Whether tube cleaning system is designed for the following operation modes :		
4.1	Automatic start-up initiated by push button.		YES/NO
4.2	Automatic shut-down with ball collection effected by :		
	a) Push button		YES/NO
	b) Adjustable timer		YES/NO
	Ball monitoring system		YES/NO

Name of Bidder/ Vendor					
Revision Number	**0**	**1**	**2**	**3**	**4**
Signature of Bidder/ Vendor Authorised Representative					
Date :					

INSTRUCTION TO BIDDER

1. This data sheet shall be read in conjunction with Specification No. PE-TS-412-165-N002.
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO. PARTICULARS	ITEM		UNIT
4.3	Automatic backwashing of ball separator with ball collection effected by :		
	a) Differential pressure measuring system		YES/ NO
	b) Adjustable timer		YES/ NO
	c) Push button		YES/ NO
4.4	Automatic emergency backwashing of ball separator effected by differential pressure measuring system.		YES/ NO
4.5	Automatic flushing of differential pressure measuring system.		YES/NO
4.6	Automatic ball sorting initiated by push button.		YES/NO
4.7	Whether provision for manual operation of the complete tube cleanaing system is made in case of control system failure.		YES/NO
5.0	**Ball Separator :**		
5.1	Make		
5.2	Nos. provided per set	Nos.	
5.3	Code/ Standard		
5.4	Body outer diameter	mm	
5.5	Body thickness	mm	
5.6	Manhole type & size	mm	
5.7	Whether sight glass is provided		
5.8	No. of screens/ strainers provided per each ball separator	Nos.	
5.9	Type of arrangement provided to prevent lodging of the debris at the entrance of ball extraction pipes.		

Name of Bidder/ Vendor					
Revision Number	**0**	**1**	**2**	**3**	**4**
Signature of Bidder/ Vendor Authorised Representative					
Date :					

	Title	SPECIFICATION NO.
BHEL	**DATA SHEET - B** **CONDENSER ON LOAD TUBE CLEANING SYSTEM** (SPONGE RUBBER BALL TYPE)	**PE-TS-999-165-N001** VOLUME **III** PART **A** SHEET 4 OF 13

INSTRUCTION TO BIDDER
1. This data sheet shall be read in conjunction with Specification No. PE-TS-412-165-N002.
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO. PARTICULARS	ITEM		UNIT
5.10	Clearance between screen/ strainer bars.	mm	
5.11	Materials :		
	a) Body/ Housing		
	b) screen/ Strainer section		
	c) Screen/ Strainer shaft		
	d) Hardware for fixing the screen/ Strainer		
	e) Other internal hardware		
	f) External hardware		
5.12.	Lining material (if applicable)		
6.0	**Ball Recirculating Pump :**		
6.1	Make		
6.2	Nos. provided per set	Mos.	
6.2	Design discharge flow	M^3/hr	
6.4	Design discharge pressure	Bar	
6.5	Design pump Speed	RPM	
6.6	Design pump efficiency	%	
6.7	Seal for the pump		
6.8	Materails :		
	a) Casing		
	b) Impeller		
	c) Shaft		
7.0	**Ball Collector :**		
7.1	Nos. provided per set	Nos.	

Name of Bidder/ Vendor					
Revision Number	**0**	**1**	**2**	**3**	**4**
Signature of Bidder/ Vendor Authorised Representative					
Date :					

	Title	SPECIFICATION NO.
BHEL	**DATA SHEET - B** **CONDENSER ON LOAD TUBE CLEANING SYSTEM** (SPONGE RUBBER BALL TYPE)	**PE-TS-999-165-N001** VOLUME **III** PART **A** SHEET 5 OF 13

INSTRUCTION TO BIDDER

1. This data sheet shall be read in conjunction with Specification No. PE-TS-412-165-N002.
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO. PARTICULARS	ITEM		UNIT
7.2	Code/ Standard		
7.3	Whether inspection window/ sight glass is provided.		YES/ NO
7.4	Materials :		
	a) Shell/ Body		
	b) Internals		
7.5	Lining material (if applicable)		
7.6	Whether provision for separating and collecting the undersized balls, is made		YES/ NO.
8.0	**Differential Pressure Measuring System:**		
8.1	Differential Pressure Switch/ Transmitter		
	a) Type		
	b) Make and Model		
	c) Range		
	d) Accuracy		
	e) Material of sensing element		
	f) No. of contacts	Nos.	
	g) Contact rating		
	h) Enclosure		
	i) Mounting		
8.2	Whether differential Pressure gauge is provided for manual observation.		
8.3	Diffrential Pressure Gauge :		
	a) Type		
	b) Make and Model		
	c) Range		

Name of Bidder/ Vendor					
Revision Number	**0**	**1**	**2**	**3**	**4**
Signature of Bidder/ Vendor Authorised Representative					
Date :					

INSTRUCTION TO BIDDER

1. This data sheet shall be read in conjunction with Specification No. PE-TS-412-165-N002.
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO. PARTICULARS	ITEM		UNIT
	d) Accuracy		
	e) Material of sensing element		
	f) No. of contacts	Nos.	
	g) Dial size	mm	
	h) Enclosure		
	i) Mounting		
8.4	Whether the contacts for differential pressure gauge and switch/ transmitter are independent.		YES/ NO
9.0	**Timer for Backwashing**		
9.1	Timer make		
9.2	Range of duration setting		
9.3	Range of frequency		
10.0	Ball Monitoring System :		
10.1	Type		
10.2	Maake & Model		
10.3	Whether ball monitoring system is designed to perform the following functions :		
	a) Continuously counting the balls in circulation and giving an alarm calling for investigation of ball losses, when the number of circulating balls falls below a set value		YES/ NO
	a) Continuously measuring the size of the balls in circulation and initiating the shut-down of the tube cleaning system with alarm calling for replacement of balls, when the number of oversized balls falls below a set value.		

INSTRUCTION TO BIDDER

1. This data sheet shall be read in conjunction with Specification No. PE-TS-412-165-N002.
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO. PARTICULARS	ITEM		UNIT
10.4	Whether electronic processor of the ball monitoring system is provided with the following		
	a) Indicators for		
	♦ Required basic ball charge		YES/ NO
	♦ Recirculating Ball quantity		YES/ NO
	♦ Oversized ball quantity		YES/ NO
	b) Time counters for		
	♦ Total cleaning system operating hours		YES/ NO.
	♦ Cleaning system operating hours with sufficient number of oversized balls		YES/NO
	c) Recorder for ball consumption		YES/NO
10.5	Whether provision for Self-testing and Self Calibration are made		YES/NO
11.0	**Cleaning Balls :**		
11.1	Type		
11.2	Size	mm	
11.3	Specific gravity		
11.4	Material		
11.5	Hardness		
11.6	Total Ball recirculation quantity per set	Nos.	
11.7	abrassive coated ball recirculation quantity per set - (if any)	No.s	
12.0	**Piping :**		
12.1	Ball Extraction Piping		

INSTRUCTION TO BIDDER

1. This data sheet shall be read in conjunction with Specification No. PE-TS-412-165-N002.
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO. PARTICULARS	ITEM		UNIT
	a) OD x thicknes	mm x mm	
	b) Material		
	c) Length of piping being supplied	M	
12.2	Ball Transport Piping		
	a) OD x thicknes	mm x mm	
	b) Material		
	c) Length of piping being supplied	M	
12.3	Differential pressure measuring system flushing piping.		
	a) OD x thicknes	mm x mm	
	b) Material		
	c) Length of piping being supplied	M	
12.4	Any other		
13.0	**Valves (Indicate Type of Valves)**		
13.1	Sizes	: mm	
13.2	Nos. provided per set	Nos.	
13.3	Materials		
	a) Body		
	b) Disc/ Trim		
	c) Shaft		
14.0	**Distributors**		
14.1	Nos. provided per set	Nos.	
14.2	Materials :		
	a) Body		
	b) Sight glass		
	c) Sight glass flanges		
	d) Internal parts		

Name of Bidder/ Vendor					
Revision Number	**0**	**1**	**2**	**3**	**4**
Signature of Bidder/ Vendor Authorised Representative					
Date :					

INSTRUCTION TO BIDDER

1. This data sheet shall be read in conjunction with Specification No. PE-TS-412-165-N002.
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO. PARTICULARS	ITEM		UNIT
14.3	Lining material (if applicable)		
15.0	**Injection Nozzles :**		
15.1	Nos. provided per each CW inlet pipe	Nos.	
15.2	Size of the stubs to be provided in CW inlet pipe for installing the injection nozzles.	mm	
15.3	Material		
15.4	Lining material (if applicable)		
16.0	**Actuators :**		
16.1	Actuators for ball separator :		
	a) Nos. provided per ball separator	No.s	
	b) Type & make		
	c) Motor rating	KW	
16.2	Actuators for ball collector		
	a) Nos. provided per ball collector	No.s	
	b) Type & make		
	c) Motor rating	KW	
16.3	Actuators for Valves:		
	a) Nos. provided per set	No.s	
	b) Type & motor		
	c) Motor rating	KW	
16.4	Any other		

Name of Bidder/ Vendor					
Revision Number	**0**	**1**	**2**	**3**	**4**
Signature of Bidder/ Vendor Authorised Representative					
Date :					

	Title	SPECIFICATION NO.
BHEL	**DATA SHEET - B** **CONDENSER ON LOAD TUBE CLEANING SYSTEM** (SPONGE RUBBER BALL TYPE)	**PE-TS-999-165-N001** VOLUME **III** PART **A** SHEET 10 OF 13

INSTRUCTION TO BIDDER
1. This data sheet shall be read in conjunction with Specification No. PE-TS-412-165-N002.
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO.	PARTICULARS ITEM		UNIT
17.0	**Electric Drive Motors**		
17.1	Drive motor for recirculating pump :		
	a) Type and make		
	b) Rating	KW	
17.2	Drive motor for differential pressure measuring system flushing pump (if applicable)		
	a) Type and make		
	b) Rating	KW	
17.3	Any other.		
18.0	**Control Panel**		
18.1	Type		
18.2	Model & Manufacturer		
18.3	Operating Voltage/ frequency	V/ Hz	
18.4	Control Voltage/ frequency	V/ Hz	
18.5	Materials of housing and door		
18.6	Protections/ interlocks provided for :		
18.7	Class of Protection		
18.8	Control Hardware		
18.8	Alarms/ Annunciations provided for :		
18.9	Indicators provided for :		
18.10	Whether interconnecting control and power cabling between the control panel and various drive is included in the offer.		
19.0	**Pressure gauges :**		
19.1	Manufacturer & Type, Model		

Name of Bidder/ Vendor					
Revision Number	**0**	**1**	**2**	**3**	**4**
Signature of Bidder/ Vendor Authorised Representative					
Date :					

INSTRUCTION TO BIDDER

1. This data sheet shall be read in conjunction with Specification No. PE-TS-412-165-N002.
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO. PARTICULARS	ITEM		UNIT
19.2	Nos. provided per set	Nos.	
19.3	Location		
19.4	Dial size	mm	
19.5	Range & Accuracy		
19.6	Materials of construction : a) Sensing element b) Movement c) Casing		
19.7	Enclosure		
19.8	Mounting		
20.0	**Counter Flanges** :		
20.1	Whether counter flanges complete with gaskets, bolts and nuts etc. for all terminal points are included in the offer.		YES/ NO
20.2	Type		
20.3	Rating		
20.4	Materials a) Flanges b) Bolts and Nuts c) Gaskets		
20.5	Code/ Standard		
21.0	Whether lifting arrangement is provided for various equipments.		YES/ NO.
22.0	Whether ball recirculating pump, ball collector with interconnecting piping and valves are mounted on a single frame.		YES/ NO
23.0	Whether supports (wherever necessary) complete with foundation plates, bolts, nuts, inserts etc. are included in the offer.		YES/ NO

Name of Bidder/ Vendor					
Revision Number	**0**	**1**	**2**	**3**	**4**
Signature of Bidder/ Vendor Authorised Representative					
Date :					

INSTRUCTION TO BIDDER

1. This data sheet shall be read in conjunction with Specification No. PE-TS-412-165-N002.
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO. PARTICULARS	ITEM		UNIT
24.0	**Shop Inspection and Tests**		
24.1	Whether all the tests and inspections as detailed in the specification/ quality plan are carried out.		YES/ NO
24.2	Hydrostatic Test :		
	a) Test Pressure	Bar (g)	
	♦ Ball Separator ♦ Recirculating Pump ♦ Ball Collector ♦ Distributors ♦ Injection nozzles ♦ Piping & Valves		
	a) Test duration	Minutes	
24.3	Lekage Test :		
	a) Test Pressure b) Test duration	Bar (g) Minutes	
25.0	**Painting :**		
25.1	External Surfaces :		
	a) Surface Preparation b) Primer c) Finish		
25.2	Internal Surfaces :		
	a) Surface Preparation b) Primer c) Finish		
26.0	**Weights :**		
26.1	Empty Weight	Kg.	
	a) Ball Separator		

Name of Bidder/ Vendor					
Revision Number	**0**	**1**	**2**	**3**	**4**
Signature of Bidder/ Vendor Authorised Representative					
Date :					

INSTRUCTION TO BIDDER

1. This data sheet shall be read in conjunction with Specification No. PE-TS-412-165-N002.
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO. PARTICULARS	ITEM		UNIT
	b) Recirculating pump c) Ball collector d) recirculating unit		
26.2	Operating weight a) Ball Separator b) Recirculating pump c) Ball collector d) recirculating unit	kg	
26.3	Weight of the heaviest equipment/ assembly to be handled.	kg.	
27.0	**Overall Dimensions**		
27.1	Ball Separator		
27.2	Recirculating Unit		
28.0	Other information (if any)		

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Name of Bidder/ Vendor					
Revision Number	**0**	**1**	**2**	**3**	**4**
Signature of Bidder/ Vendor Authorised Representative					
Date :					