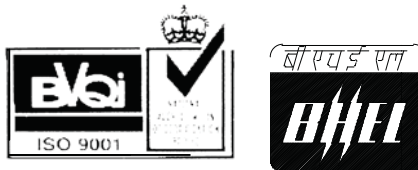


2 X 660 MW SURATGARH STPS, STAGE- V


TECHNICAL SPECIFICATION FOR CONDENSER ON LOAD TUBE CLEANING SYSTEMS (COLTCS).

Specification No. : PE-TS- 392-165-N002 (REV. 0)

VOLUME -IIB



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

	TITLE : TECHNICAL SPECIFICATION FOR CONDENSER ON LOAD TUBE CLEANING SYSTEMS (COLTCS). PREAMBLE	SPEC. NO. PE-TS- 392-165-N002	
		VOLUME : II B	
		REV. NO. 0	DATE :27.11.13
		SHEET 1 OF 2	

1.0

The tender document contains three (3) volumes. The bidder shall meet the requirements of all the three volumes.

1.1

Volume -I CONDITIONS OF CONTRACT

This consists of four parts as below :

Volume - I A

:

This part contains instructions to bidders for making bids to BHEL.

Volume - I B

:

This part contains general commercial conditions of the tender and include provision that vendor shall be responsible for the quality of item supplied by their sub-vendors.

Volume - I C

:

This part contains special conditions of contract.

Volume - I D

:

This part contains commercial conditions for erection and commissioning site work, as applicable.

1.2

Volume - II TECHNICAL SPECIFICATIONS

Technical requirements are stipulated in Volume II which comprises of :

Volume - II A

:

General Technical Conditions

Volume - II B

:

Technical specification including drawings, if any

1.2.1

Volume - II B :

This volume is sub-divided into following sections:

Section - A

:

This section outlines the scope of enquiry.

Section - B

:

This section provides “Project Information”

Section - C

:

This section indicates technical requirements specific to the contract, not covered in Section-D.

Section - D

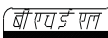
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This section comprises of standard technical specifications of equipments complete with data sheet A, B & C.

Data sheet-A specifies data and other requirements pertaining to the equipment.

Data sheet - B specifies data to be filled by the bidder (Data Sheet B is contained in Volume - III)

Data sheet - C indicates data documents to be furnished after the award of contract as per agreed schedule by the vendor (as applicable).

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1.2.2 **Volume - III TECHNICAL SCHEDULES**

- 1.0 This volume contains technical schedules and Data Sheets - B, which are to be duly filled by the bidder and the same shall be furnished with the technical bid as per instructions given in Document No.PES-100-901 in Volume-III.
- 2.0 The requirements mentioned in Section C/Data Sheets-A of Section-D shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the descriptive portion in Section -D.



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SECTION	TITLE
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A	SCOPE OF ENQUIRY
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B	PROJECT INFORMATION
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C	SPECIFIC REQUIREMENTS
---	------------------------------

C1	SPECIFIC TECHNICAL REQUIREMENTS FOR CONDENSER ONLOAD TUBE CLEANING SYSTEMS .
----	---

C2	SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)
----	--

C3	SPECIFIC TECHNICAL REQUIREMENTS (C&I)
----	---------------------------------------

D	STANDARD TECH. SPECIFICATIONS
---	--------------------------------------

D1	CONDENSER ON LOAD TUBE CLEANING SYSTEMS
----	---

- ◆ STANDARD TECHNICAL
SPEC.NO. PE-TS-999-165-N001
- ◆ DATA SHEET-A
- ◆ DATA SHEET-C
- ◆ QUALITY PLAN

D2	ELECTRICAL SYSTEMS
----	--------------------

D3	CONTROL & INSTRUMENTATION SYSTEMS
----	-----------------------------------



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SECTION - A
SCOPE OF ENQUIRY



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1.00.0 SCOPE

This enquiry covers the design, manufacture, assembly, inspection and testing at manufacturer's and/or his sub-contractors works properly packed for delivery of the items as follows:

1.01.0 Condenser On Load Tube Cleaning Systems :

Condenser On Load Tube Cleaning Systems (COLTCS) complete with all accessories as per the requirements specified in different sections of this specification **for :**

- **2 X 660 MW – SURATGARH STPS, STAGE- V.**

The bidder's scope also includes installation checks, commissioning, trial runs & PG Testing at site of COLTCS.

1.01.0 The bids shall be evaluated as per NIT.

2.00.0 GENERAL TECHNICAL INSTRUCTIONS:

2.01.00 It is not the intent to specify herein all the details of design and manufacture. However the equipment shall conform in all respects to high standard of design, engineering and workmanship, and shall be capable of performing the required duties in a manner acceptable to Engineer/ Owner, who will interpret the meaning of drawing and specifications, and shall be entitled to reject any component or material, which in his judgement is not in full accordance herewith.

2.02.00 The omission of specific reference to any component/ accessory necessary for the proper performance of the equipment's shall not relieve the bidder of the responsibility of providing such facilities to complete the supply of the equipment's at quoted prices.

2.03.00 In case of any deviation from this Technical specification (Vol. IIB) and General Technical Conditions (Vol. IIC), the same shall be indicated in the schedule of deviations enclosed in Volume-III, Part-A. In the absence of duly filled schedules it will be assumed that the bid strictly conforms to the specification.

2.04.00 BHEL's/ Customer's representatives shall be given full access to the shop in which the equipment's are being manufactured or tested and all test records shall be made available to him.

2.05.00 The equipment's covered under this specification shall not be despatched unless the same have been finally inspected, accepted and shipping release issued by BHEL/ Customer

2.06.00 Un-priced copy of price bid shall be furnished along with the technical bid.



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SECTION – B

PROJECT INFORMATION

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED		VOLUME II SECTION – B
	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan GENERAL PROJECT INFORMATION		SHEET 1 OF 3

1.0	Owner	Rajasthan Rajya Vidyut Utpadan Nigam Ltd., Jaipur
2.0	Consulting Engineer	TATA Consulting Engineers Ltd. 73/1, St. Marks Road, Bangalore – 560 001 Tel : 080 – 6622 6000 Fax : 080 – 22274874
3.0	Location of the plant	Prabat Nagar, Suratgarh Sriganganagar district, Rajasthan.
4.0	Latitude and longitude	Latitude : 29 deg. 10 min. N Longitude : 74 deg.01 min. E
5.0	Elevation above mean sea level	186 m (approximate)
6.0	Climatic conditions	
6.1	Temperatures : Monthly basis	
	Mean of daily max.	32.8 deg.C (in the month of May)
	Mean of daily min.	17.6 deg.C (in the month of Jan)
6.2	Temperatures : Annual basis	
	Mean of daily max.	32.3 deg.C
	Mean of daily min.	19.6 deg.C
	Highest temperature recorded	50 deg.C
	Lowest temperature recorded	(-) 2.8 deg.C
	Design Ambient Temperature for Electrical Equipment design	50 deg C
6.3	Relative humidity	Varies between 21% and 81%
6.4	Annual average rain fall	312 mm
6.5	Annual mean wind speed :	4 km / hr.
7.0	Wind load	

ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED		VOLUME II SECTION – B
	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan GENERAL PROJECT INFORMATION		SHEET 2 OF 3

	Calculations for wind effect shall be in accordance with IS:875-1987(Part-3) taking into account the following:	
	a) Basic wind speed = 47 m/sec	
	b) Factor K1 = 1.07	
	c) Category of terrain = Category 2	
	d) K3 – as per IS 875	
8.0	Seismic data (As per IS: 1893 latest issue)	
	a) Zone	Zone II
	Designs & design coefficients shall be based on IS 1893:2002	
	Design condenser cooling water inlet temperature	33 Deg C
9.0	Auxiliary power supply:	
	Auxiliary electrical equipment to be supplied against this specification shall be suitable for operation on the following system:	
	a) For motors rated 160 kW and below.	415V AC, 3-phase, 3-wire effectively earthed.
	b) For motors rated above 160 kW and up to 1500 kW	6600V AC, 3-phase, 3-wire, 50 Hz, non-effectively earthed
	c) For motors rated above 1500kW	11000V AC, 3-phase, 3-wire, 50 Hz, non-effectively earthed
	d) For motor control centres	415V AC, 3-phase, 3/4-wire effectively earthed.
	e) DC motor starters, DC solenoids, DC alarm control and protection	220 V DC, 2-wire unearthed
	f) AC control & protective devices	110 V 1 phase, 50Hz, 2 wire AC supply. The single phase 110V AC supply shall be derived by VENDOR by providing 415V / 110 V Control transformers of adequate rating with MCCB / MCB on both the primary and secondary sides.
	g) Uninterrupted power supply	230 V, 1-phase, 50 Hz, 2-wire, AC

ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED		VOLUME II SECTION – B
	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan GENERAL PROJECT INFORMATION		SHEET 3 OF 3

		supply (For all instrumentation and control system equipment and solenoid valves)
--	--	---

g) Lighting fixtures and space heaters 240 V, 1 phase, 2 wire, 50Hz,solidly earthed system

h) Construction supply 415 V, 3 phase, 4 wire, 50Hz AC supply with neutral lead solidly earthed.

i) The above voltages may vary as follows :

All devices shall be suitable for continuous operation over the entire range of voltage and frequency indicated below without any change in their performance.

AC supply	Voltage variation $\pm 10\%$ Frequency variation $\pm 5\%$
DC supply	Combined voltage & frequency variation 10% Voltage variation +10% , -15%

j) For instrument and control system of steam generator and steam turbine generator. 230 V $\pm 5\%$ AC UPS, 1-phase, 50 Hz, 2-wire. The 24 V DC required for control system shall be generated from this UPS.

10.0 All the electrical equipment shall be designed for 50° C reference ambient temperature.

ISSUE
R1

CLARIFIED WATER ANALYSIS

SL. NO.	Constituent	Unit	Value
1.	pH	-	8.5
2.	Color and Odor		
3.	Oil and grease	mg/l	ND
4.	BOD		3
5.	COD		20
6.	Suspended solids	mg/l	<15
7.	Turbidity	NTU	<15
8.	Calcium hardness as CaCO ₃	mg/l	74
9.	Magnesium hardness as CaCO ₃	mg/l	52
10.	Sodium as Na	mg/l	61
11.	Potassium	mg/l	-
12.	Chloride as cl	mg/l	39
13.	Sulphate as So ₄	mg/l	48
14.	Sulphide	mg/l	-
15.	M- Alkalinity as CaCO ₃	mg/l	140
16.	P-Alkalinity as CaCO ₃	mg/l	Nil
17.	Nitrates as No ₃	mg/l	17
18.	Nitrite	mg/l	Nil
19.	Silica as SiO ₂ – Dissolved	mg/l	15
20.	Silica as SiO ₂ – Colloidal	mg/l	0.6
21.	Iron as Fe-dissolved	mg/l	0.5
22.	Iron as Fe-suspended	mg/l	0.1
23.	Total dissolved solids	mg/l	393
24.	Conductivity at 250C	-mho/cm	500
25.	Dissolved Oxygen as O ₂	mg/l	5.0
26.	Carbon dioxide free	mg/l	5



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SECTION – C

SPECIFIC REQUIREMENTS

SECTION C1 : CONDENSER ONLOAD TUBE CLEANING

SECTION C2 : ELECTRICAL SYSTEMS

SECTION C3 : C&I SYSTEMS



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SECTION C1

CONDENSER ONLOAD TUBE CLEANING SYSTEMS

(MECHANICAL DETAILS)



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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-D) and Data Sheet-A enclosed herewith. In addition the requirements of this section C shall also be complied with. However, wherever the details given in Section-D and Data Sheet-A are different, the requirements of Data Sheet-A shall prevail. Similarly in the event of contradictions between Section-C & Section-D/ Data Sheet-A, Section-C shall prevail.

Section C consists of 3 parts viz. Sec. C1, C2 and C3 for Mechanical, Electrical and C&I respectively, the requirements of all 3 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 in project information in section B.

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

3.1 The scope of supply for COLTCS covered under this specification is as under.

The size, MOC's and other particulars of the equipments for various projects are detailed in Data Sheet A annexed with Section – D of the specification.

SL.NO.	PROJECT	COLTCS
1.	2 X 660 MW SURATGARH STPS ,STAGE V	2 SETS PER UNIT viz. TOTAL 4 SETS FOR BOTH UNIT.



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

3.2.1 Each set of COLTCS for each projects shall comprise of 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 of an independent balls recirculation monitor and an independent balls oversize monitor. If bidder is not manufacturing Ball oversize monitor then they can offer other alternatives like automatic ball sorter etc.
- g) Length of Ball separator, Scope of Counter Flange, Nuts and bolts shall be as per Annexure- I of section C1.
Thickness of body flange and counter flange shall be as per Drg no PE-DG-999-141-MO17 enclosed at enclosures at Annexure-II.
- h) Complete Pipe work, including interconnection piping, flanges/counter flanges for valves & pipes, bends, fittings, distributors, nozzles and support installation materials shall be in Bidder's scope. Bidder shall finalize the pipework to suit the layout at contract stage in such a way that no site welding is required for his pipework otherwise the same shall be carried out by bidder at site.
- 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:
 - a) 2 Sets of COLTCS shall have one Common Starter Panel (Switch Gear Panel) for DCS based control system.



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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 switchgear 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".
- o) Set of mandatory spares as indicated in Data Sheet A.
- 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.

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 for respective projects

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



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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.

The no. of visits may be suitably assessed by bidders as per their experience with site stay periods on as required basis.

In the event of order number of visits as follows shall be made as a minimum with charges included in the bidder's base price itself.

- **For drawings/documents approval**

In the event of order all drawings / documents in soft as well as hard copy shall be submitted as per NIT.

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 :**

- i. No. of site visits for combined activities of erection checks and commissioning for COLTCS as applicable shall be one per unit - for both sets of equipments of one unit. Time duration for erection and commissioning shall be "on as required basis" with equipments run for trial operation thereafter for requisite period to demonstrate satisfactory operation.

However the no. of visits may be suitably assessed by bidders as per their experience with site stay periods on as required basis.

- ii. Bidder shall demonstrate guarantees including balls recovery, life of balls, pressure drops, etc. at site during subsequent visit for COLTCS of each unit.
- iii. For trouble shooting on "as required basis".



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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 with for packages/ projects under scope of this specification:

- 6.1 For COLTCS - Layout Piping Arrangement Drg. is enclosed in the specifications at Annexure-III.
- 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.
- 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 Adequate provision for future installation of Cathodic Protection for COLTCS (Sacrificial type) shall be kept 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.
- 6.7 Velocity in the pipe work shall be less than 1.5 m/ sec for pump suction and less than 2.5 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.



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7.0 Performance Guarantee and Testing :

The Tube Cleaning Systems shall be guaranteed to meet the performance requirements specified in Section-D and also for trouble free operation after commissioning. Schedule of performance guarantees (enclosed in Volume III) duly filled and signed shall be furnished with the bid.

The Performance guarantees of equipments shall stand valid till the satisfactory completion of performance testing & its acceptance by BHEL/ Consultant/Customer. If the guarantee period specified in the Commercial Specification is higher, same shall prevail.

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

8.1 Condenser On Load Tube Cleaning Systems.

8.1.1a Performance Parameters to be guaranteed by bidders for COLTCS-under penalty (Liquidated damages) shall be as under :

- i) Pressure drop in ball separator in clean condition (test to be conducted along with commissioning of COLTCS).

The cl. No. 8.1.2 in subsequent paragraphs shall be referred regarding liquidated damages.

8.1.1b Performance Parameters to be guaranteed by bidders for COLTCS-under demonstration category under compulsory corrections shall be as under:

- ii) Percentage recovery of balls (min. 90% recovery for 3 weeks with 8 hrs operation of COLTCS per day)
- iii) Life of Sponge Rubber Ball (Min. 3 weeks with 8 hrs operation of COLTCS per day).

For demonstrating the parameters at sl. No. (ii) & (iii) above, the COLTCS system shall be operated 24 hrs per day for one week.

Any deviation to above balls life and percentage recovery 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 outrightly.



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8.1.1 Bidder to note that bids shall be evaluated on account of pressure drop across ball collecting strainer (in clean condition) and liquidated damages on account of not meeting the same during PG test shall be in accordance with following:

A) Bid Evaluation Criteria & Liquidated Damages:

The bids received shall be evaluated for Pressure drop across balls collecting strainers:

- The permissible limit of pressure drop across balls collecting strainers in clean condition shall be 0.15 MWC.
- If the pressure drops quoted are higher than above limit, the bids shall be technically loaded @ Rate as mentioned in Data Sheet-A on pro-rata basis for respective projects per **0.05 MWC** pressure drop across each balls collecting strainer.
- However no advantage shall be given for pressure drops quoted less than above permissible limit.
- The maximum acceptable limit for pressure drop across balls collecting strainer shall be (with technical loadings) 0.2 MWC.
The bids will be technically rejected for pressure drops quoted higher than above maximum limit.
- The guaranteed pressure drops shall be demonstrated at site by bidder and if found higher shall be subject to LD @ twice the bid evaluation factor as above.

9.0 SPARES :

9.1 Recommended Spares :

The supply of spare parts as necessary recommended by the manufacture for three (3) years of reliable operation and maintenance of COLTCS of respective projects shall be supplied. List of such spares along with the unit price shall not be included in base price but indicated separately in the schedule of prices for recommended spares enclosed in Vol. -III.

9.2 Mandatory Spares

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

10.0 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. Witness for all the test identified under agency "C" & "N" in Quality plan shall be by third party.



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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 for each project shall be as per NIT.
- b. The drawings to be submitted by bidder in event of award of contract for COLTCS for each project shall be as follows:
 - Technical Data Sheets, P&ID, Installation Plan, for COLTCS.
 - GA drawings, Details of BR Skid and C& I Document (Part-I & II) of COLTCS as applicable.
 - Quality Plan.
 - O & M Manual.
- c. Drawings submission schedule shall be as per NIT/as advised by Project Group.:

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" any thing 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 Schedules).
- Guarantee schedule duly signed and stamped (Enclosed at Schedules).
- GA drawings of following with empty/ filled-ups.
 - Balls Collecting Strainers (as applicable).
 - Balls recirculating Skids.
 - Other equipments considered necessary for Layout/ Civil.



**TITLE : TECHNICAL SPECIFICATION
FOR
CONDENSER ON LOAD TUBE CLEANING
SYSTEMS (COLTCS)**

SPEC. NO: PE-TS-392-165-N002

VOLUME : II B

SECTION:C1

REV. NO. 0

DATE : 27.11.13

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- Electrical Load Data (Enclosed at Vol. III of Specification)
- Schedule of Deviation (Enclosed at Schedules).

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.



**TITLE : TECHNICAL SPECIFICATION
FOR
CONDENSER ON LOAD TUBE CLEANING
SYSTEMS (COLTCS)**

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ANNEXURE- I

COLTCS

SL.NO.	Projects	Size (NB)	Length of Ball Separator (Excluding Counter Flange)	Scope of Counter Flange	Scope of nuts and bolts.
1	2 X 660 MW SURATGARH STPS STAGE V	2500 NB	4000 mm	In Purchaser's Scope.	In Bidder's Scope

Notes:

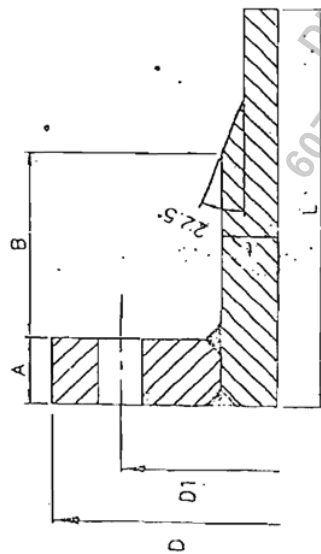
1. Ball separator shall be mounted directly on the existing Butterfly valve.
2. Flap of butterfly valve shall be extended to 1000 mm inside the Ball separator (GA of Butterfly valve has been enclosed).

ANNEXURE II

ALL DIMENSIONS ARE IN MM

FIRST ANGLE PROJECTION

L10M-141-666-9D-3D 0M 0MAY88



NOTES:-

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

PIPE SIZE	PIPE THK.	FLANGE OD 'D'	Bolt PCD 'D1'	FLANGE THK. 'A'	WELD NECK THK. 't'	NECK Length 'L'	SLIP-ON FLANGE THICKNESS
1200	10-12	11465	1380	40	24	70	90
1400	14	1675	1590	50	24	70	100
1600	14	1915	1920	60	32	80	110
1800	14-16	2115	2020	70	32	90	120
2200	18	2550	2420	80	36	100	140
2300	20			90	38	110	150
2500	20			90	38	110	150
2700	20			90	38	110	150

— TENTATIVE

DRAWING FOR BAI' SEPARATOR COUNTER FLANGE

REV.	DATE	ALT	CHK	APPD	JOB NO.	999
STATUS			DISTRIBUTION			
<div> </div>						
<div> BHARAT HEAVY ELECTRICALS LTD POWER GROUP PROJECTS ENGINEERING MANAGEMENT PPEU, NOIDA </div>						
<div> SCPT CODE DESG PGM CDB APPD SIGN DATE 23.06.07 23.06.07 23.06.07 23.06.07 </div>						
<div> DRAWING NO. PE-DG-999-141-M017 </div>						
<div> SHEET 01 OF 01 REV 00 </div>						

COUNTER FLANGE DETAILS

TITLE



**TITLE : TECHNICAL SPECIFICATION
FOR
CONDENSER ON LOAD TUBE CLEANING
SYSTEMS (COLTCS)**

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SECTION C2

CONDENSER ONLOAD TUBE CLEANING SYSTEMS

ELECTRICAL DETAILS



TECHNICAL SPECIFICATION FOR
COLTCS, SCS & DF
(ELECTRICAL PORTION)

SPECIFICATION NO.
VOLUME II B
SECTION-C
REV 0 DATE 27.05.13
PAGE 1 OF 1

SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER/ PURCHASER

- 1.1 Scope for supply, and erection & commissioning of various equipment forming part of electrical system for this package shall be as per Annexure-I to Section – C [Scope of Work (Electrical)].
- 1.2 Make of various equipment/ items in the scope of bidder shall be to approval of owner during detailed engineering stage without any commercial implications.
- 1.3 Bidder shall furnish all AC as well as DC loads required for the system at different voltage levels (e.g. 415V AC, 240 V AC, 220 V DC etc.) of all types, such as motor feeders, supply feeders in PEM format along with the offer.
- 1.4 All electrical equipment shall be suitable for the power supplies, fault levels and climatic conditions indicated in project information enclosed with the specification.
- 1.5 All drawings, data sheets, Quality Plan, calculations, test reports, test certificates, etc. shall be submitted during detailed engineering stage as per formats enclosed. The same shall be subject to approval without any commercial implications.
- 1.6 Technical requirements shall be as per specifications listed in Clause 4.1, 4.2 & 4.3 below.

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

- 3.1 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/ quality assurance requirements stipulated. In line with this, the bidder as technical offer shall furnish two signed and stamped copies of the following:
 - a) A copy of this sheet "Electrical Equipment Specification for COLTCS & DF" and sheet "Electrical Scope between BHEL and Vendor" with bidder's signature and company stamp.
 - b) List of Erection and Commissioning spares.
 - c) List of Erection & Maintenance tools & tackles.
 - d) Electrical load requirement in the load data format.
 - e) Motor data sheets A & C
 - f) QPs
- 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

- 4.1 Electrical scope between BHEL & vendor (Annexure-I).
- 4.2 Technical specification no. PE-SS-999-506-E101, Data Sheets (A & C) for 415V Electric Motors.
- 4.3 Quality Plan for motors.
- 4.4 Load data format (Annexure-II).

ANNEXURE – I TO SECTION – C : STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR
PACKAGE : COLTCS / SCS

PROJECT : 2X660 MW SURATGARH STPS

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V starter Cum control panel (SCCP)	VENDOR	VENDOR	BHEL will provide 2 nos. (1W+1S) 3 phase 3 wire, 415 V supply feeders only. Further complete electrical distribution for the skid including changeover between feeder/starters/LCP/inter-locks/protection devices / any other supply etc. shall be in bidder's scope.
2	Local Push Button Station (for motors)	VENDOR	VENDOR	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. Incoming cable to SCCP from Customer supplied MCC & screened control cable between DCS & field equipment will be supplied by BHEL. Vendor shall provide lugs and glands accordingly. 2. Laying of cables by BHEL. 3. Termination at BHEL equipment terminals by BHEL. 4. Termination at Vendor equipment terminals by Vendor.
4	Any special type of cable like compensating, co-axial, prefab, MICC, fibre optical etc.	Vendor	Vendor	
5	Cable trays, accessories & cable trays supporting system	BHEL	BHEL	
6	Cable glands and lugs for equipments supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power cables 3. Solder less crimping type heavy duty copper lugs for control cables.
7	Conduit and conduit accessories for cabling between equipments supplied by vendor	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537. Makes of conduits shall be subject to customer/ BHEL approval at contract stage.
8	Lighting	BHEL	BHEL	
9	Equipment grounding & lightning protection	BHEL	BHEL	
10	Below grade grounding	BHEL	BHEL	
11	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
12	Recommended O & M spares, E & C spares, erection & maintenance tools & tackle.	Vendor	-	As per specification
13	Any other equipment/material/service required for completeness of system but not specified above (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
14	a) Input cable schedules (C & I)	Vendor	-	Cable listing for C & I systems for vendor supplied equipment shall be

ANNEXURE – I TO SECTION – C : STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR
PACKAGE : COLTCS / SCS

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
	b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor	- -	furnished during detail engineering by vendor in soft copies in the BHEL cable schedule format.
15	Equipment layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipments requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Electrical equipment layout drawing shall be to BHEL approval.
16	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

1. Make of all electrical equipments/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. For skid mounted system, 2 nos. (1W+1S) supply of 415 V, 3 phase 3 wire AC shall be provided by BHEL. Complete electrical distribution for the skid including changeover between feeder/starters/LCP/inter-locks/protection devices / any other supply etc. shall be in bidder's scope.



TITLE

**COLTCS/SCS
2X660 MW SURATGARH STPP
LV MOTORS
DATA SHEET-A**

SPECIFICATION NO. PE-TS-392-165-0001

VOLUME II B

SECTION D

REV NO. 00 DATE 24.05.2013

SHEET 1 OF 1

- | | | | |
|------|---|---|--|
| 1.0 | Design ambient temperature | : | 50 °C |
| 2.0 | Maximum acceptable kW rating of LV motor | : | 160 KW |
| 3.0 | Type of motor | : | 3-Phase squirrel cage Energy efficient class IE-3 inline with IS-12615-2011. |
| 4.0 | Installation (Indoors/ Outdoors) | : | As required |
| 5.0 | Details of supply system | | |
| | a) | Rated voltage (with variation) | : 415V \pm 10% |
| | b) | Rated frequency (with variation) | : 50 Hz \pm 5% |
| | c) | Combined voltage & freq. variation | : 10% (sum of absolute values) |
| | d) | System fault level at rated voltage | : 50 kA for 1 sec |
| | e) | Short time rating for terminal boxes | |
| | | o 90 kW and upto 160kW (Breaker controlled) | : 50 KA for 1 sec. |
| | | o 50 kW and upto 90kW (MCCB controlled) | : 50 KA for 0.25 sec. |
| | | o Below 50kW (MPCB controlled) | : 50 KA for 0.25 sec. |
| | f) | LV System grounding | : Effectively grounded |
| 6.0 | Class of insulation | : | Class 'F', with temp rise limited to class B. |
| 7.0 | Minimum voltage for starting (As percentage of rated voltage) | : | 85% of rated voltage |
| 8.0 | Power cables data | : | Shall be given during Detailed engg |
| 9.0 | Earth Conductor Size & Material | : | Shall be given during Detailed engg |
| 10.0 | Space heater supply | : | 240 V, 1 ϕ , 50 Hz |
| 11.0 | Rating up to which Single phase motor | : | Shall be given during Detailed engg. |
| 12.0 | Locked rotor current | | |
| | a) | Limit as percentage of FLC | : 600% (including 20% tolerance) |
| 13.0 | Additional tests | : | As per QP |
| 14.0 | Flame-proof motor | | |
| | a) | Enclosure suitable (As per IS:2148) | : As per requirement |
| | b) | Classification of Hazardous area (As per IS: 5572 part-I) | : As per requirement |
| 15.0 | Makes | : | ABB / CGL/ KEC/ Siemens/ ALSTOM |



TITLE

COLTCS/SCS
2X660 MW SURATGARH STPP
LV MOTORS
DATA SHEET-A

SPECIFICATION NO. PE-TS-392-165-0001

VOLUME II B

SECTION D

REV NO. 00 DATE 24.05.2013

SHEET 1 OF 1

16.0 Paint shade : Shade 631 of IS 5

17.0 Degree of Protection of enclosure(motors): IP 55 (for outdoor motors)
IP 54 (for indoor motors)

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D13
PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan MOTOR & ACTUATOR	SHEET 1 OF 7
<p>1.0 <u>AC & DC MOTORS</u></p> <p>1.1. HT motors of rating above 1500kW shall be suitable for 11kV, 3 phase, 50Hz power supply. Motors above 160kW and up to 1500kW shall be suitable for 6.6kV, 3 phase, 50Hz. Motors rated 160kW and below shall be suitable for 415V, 3 phase, 50 Hz power supply.</p> <p>1.2. LT motors for continuous duty (S1) operation & S3 (intermittent periodic duty) with a cyclic duration factor of 80% or higher, shall be energy efficient class IE-3 in line with IS-12615-2011. However, the starting current shall be limited to 600%(inclusive of 20% tolerance)of full load current.</p> <p>1.3. The motor rating shall be arrived at considering 15% margin over the duty point input or 10% over the maximum demand of the driven equipment, whichever is higher, considering highest system frequency. Motors shall be capable of starting and accelerating the load with the applicable method of starting without exceeding acceptable winding temperatures when supply voltage is 80% of the rated voltage for HT motors and 85% for LV motors. HT motors shall also be capable of satisfactory operation at full load at a supply voltage of 80% of the rated voltage for 5 min. commencing from hot condition. DC motors shall be suitable for the DC system voltage of 220V. Motor shall be capable of starting and accelerating the load with the applicable method of starting, without exceeding acceptable winding temperatures, when the supply voltage is in the range of 85% to 110% of rated motor voltage.</p> <p>1.4. Motors shall be capable of running for one second if the supply voltage drops to 70% of the rated voltage. If such operation is envisaged for a period of one second, the pull out torque of the motor shall be at least 205% of full load torque.</p> <p>1.5. Motors shall withstand for 1 second the voltage and torque stresses developed due to the vector difference between the motor residual voltage and the incoming supply voltage equal to 150% of the rated voltage during fast changeover of buses.</p> <p>1.6. Locked rotor current of the HT motors rated 1500 kW and below shall be limited to 600% (inclusive of 20% tolerance) of the full load current of the motors and motor rated above 1500 kW shall be limited to 450% (inclusive of 20% tolerance) of full load current of the motor.</p> <p>1.7. The locked rotor withstand time under hot condition at 110% rated voltage shall be more than the starting time at minimum permissible voltage specified above by at least three seconds or 15% of the accelerating time whichever is greater. Provision of speed switch shall be avoided to the extent possible.</p> <p>These motors shall be designed to withstand at least 5% harmonics in the supply voltage.</p> <p>1.8. The degree of protection for the motor enclosure (including terminal box) shall be IP-55 for outdoor. For single core cable termination, gland plates shall be of non-magnetic material. All motors located in hazardous area shall have flame proof enclosure.</p>		
		ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D13
PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan MOTOR & ACTUATOR	SHEET 2 OF 7
<p>1.9. All HT motors shall be provided with vibration pads for mounting vibration detectors. Vibration monitoring devices shall be provided on DE and NDE side in X & Y direction with remote DCS monitoring, alarms and tripping</p> <p>1.10. Motors rated 1000kW and above shall be provided with differential protection. These motors shall be provided with star connected stator windings. The 3 nos. current transformers, one for each phase shall be mounted in a separate compartment in the neutral side terminal box. The three phases shall be connected to form the star point after they pass through the CTs. The CTs shall be of relay accuracy and the CT characteristics shall be compatible with the differential relay. The additional 3 nos. CTs of identical characteristics shall be provided in the 11kV/6.6 kV switchgear panel.</p> <p>1.11. The terminal box of motor shall be of suitable size, suitable to terminate and maintain the cables easily. Terminal box shall be suitable to rotate at 90 degrees.</p> <p>1.12. The ring oiling system shall be adequate for starting and continuous operation of the motor for at least one half hour without pressure oiling system in operation.</p> <p>1.13. For 11kV & 6.6 kV motors, 6-nos. duplex RTD s for winding shall be provided for remote monitoring, alarm and tripping at DCS. Each bearing shall be provided with one duplex RTD for temperature remote monitoring, alarm and tripping at DCS. 6 nos. spare RTDs shall be provided for winding in HT motors.</p> <p>1.14. The maximum double amplitude vibrations for motors shall be as per IS 12075.</p> <p>1.15. Maximum noise level measured at a distance of 1.5 meter from the outer surface of the motor shall not exceed 85 db (A).</p> <p>1.16. Cable boxes of all 11kV & 6.6 kV motors shall be Phase segregated & shall be provided with quick disconnecting type terminal connectors to facilitate easy disconnection and removal of the motors without requiring unsealing or otherwise disturbing the external cable connections and leaving the phase segregated terminal box intact. The terminal boxes shall have fault withstand capacity equal to at least rated short circuit level of system voltage for 0.25 sec. The terminal boxes shall be reversible to suit cable entry from top or bottom and suitable for termination of FRLS, XLPE armoured cables.</p> <p>1.17. The star connection side terminal box should have sufficient capacity to accommodate CT's for differential protection for motor above 1000kW.</p> <p>1.18. The insulation system for 11000 V AC & 6600 V AC motors shall withstand the negative or positive 0.3 / 3.0 microsecond wave (2.7 pu rated peak line to earth operating voltage) switching surges originating from non-effectively earthed power system. All 11000V AC & 6600 V AC motors shall have BIL and power frequency withstand voltage as per relevant standards.</p> <p>1.19. Motor bearing shall be insulated wherever required.</p> <p>1.20. All HT motors shall be with VPI insulation or better</p>		
		ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D13
PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan MOTOR & ACTUATOR	SHEET 3 OF 7
<p>1.21. All HT motors / LT motors 15 kW and above shall be provided with external greasing arrangement</p> <p>1.22. CACW motor shall be provided with water leakage detector with remote alarms and tripping.</p> <p>1.23. All HT motors / LT motors 30 kW and above shall be provided with space heaters using 240 V AC supply. However, for all the actuators, irrespective of its rating, space heaters shall be provided using 240V AC supply.</p> <p>1.24. All motors below 15 kW shall be provided with sealed ZZ bearings</p> <p>1.25. Each motor shall have two earthing terminals.</p> <p>1.26. All motors for outdoor duty shall have detachable metal canopy.</p> <p>1.27. HT motors shall be designed for operation as follows:</p> <ol style="list-style-type: none"> Upto 1000kW – Vacuum circuit breakers/SF6. Above 1000kW-Vacuum circuit breakers/SF6. All motors shall be suitable for DOL starting. <p>1.28. Separate terminal boxes to be provided for space heater, RTDs for windings/bearings, vibration monitors etc. All terminal boxes shall be provided with two earth studs for termination of protective earth conductor. Double compression type brass cable glands and crimping type copper lugs shall be provided for termination.</p> <p>1.29. Provision shall be made at DCS to monitor, integrate running hours, nos. of starts and stop recording for all motors.</p> <p>1.30. The terminals of all motors shall be suitable for terminating Aluminium conductor, XLPE insulated, armoured cables, the sizes of which will be intimated by the Purchaser.</p> <p>2.0 <u>ACTUATOR</u></p> <p>2.1. GENERAL TECHNICAL REQUIREMENT</p> <p>2.1.1. Actuator shall be weatherproof type with enclosure conforming to IP-64 degree of protection. It should be suitable for out-door use without the need for canopy. If the IP-68 degree of protection is required due to occasional submergence, the purchaser shall specify the depth and duration of such submergence.</p> <p>2.1.2. The actuator shall be suitable for installation in any position without lubrication leakage or other operational difficulty.</p> <p>2.1.3. All actuators shall be supplied with non integral starters for open & close. The main gearbox of the actuator shall be special grease filled.</p> <p>2.1.4. Each actuator should have a hand wheel for emergency manual operation. Clockwise operation of hand wheel shall cause clockwise movement of the</p>		
		ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D13
PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan MOTOR & ACTUATOR	SHEET 4 OF 7
<p>output drive. The hand wheel shall be clearly marked with an arrow and the word CLOSE.</p> <p>2.1.5. The hand wheel shall automatically disengage when the power to the motor is restored i.e. power drive shall have a preference over manual drive.</p> <p>2.1.6. The manual effort should not exceed 400 N (push / pull). A top bevel gear set (side mounted hand wheel) shall be employed to reduce the manual effort.</p> <p>2.1.7. Each actuator shall have a local mechanical position indicator. It should be suitable to indicate 0 - 100% position of the valve (continuous type).</p> <p>2.1.8. In order to minimise the amount of spare parts required, parts and sub-assemblies limit / torque switches, limit switch counter gear assembly, torque switch drive assembly, mechanical position indicator assembly etc. individually interchangeable / replaceable throughout the models selected.</p> <p>2.1.9. The actuator shall be painted with corrosion resistant epoxy resin paint. Paint shade shall be Grey (Shade 631) as per IS-5.</p> <p>2.1.10. In order to prevent condensation, a space heater shall be provided in the switch compartment, suitable for continuous operation. Actuator mounting dimensions shall be according to ISO-5210. For rising stem applications, the design must allow the removal of actuator from the output drive without disturbing the function of valve.</p> <p>2.2. LIMIT AND TORQUE SWITCHES</p> <p>2.2.1. Independent torque and limit switches shall be provided in the actuator. A minimum of two position limit switches and two torque switches, one each for each direction of travel, having 4 NO + 4 NC potential free contacts, shall be supplied. If called for in the data sheet, two additional limit switches shall be provided for intermediate positions.</p> <p>2.2.2. Torque switch dial shall be graduated directly in "kg-m" for easy setting to desired value within the range specified. Separate dials shall be provided for CLOSE and OPEN torque switches.</p> <p>2.2.3. Two additional limit switches with 2NO + 2NC contacts, each adjustable at any intermediate position, shall be provided in the actuator.</p> <p>2.2.4. The rating of both torque and limit switches shall be 240 V AC, 5 Amps. The switches shall individually be enclosed to a minimum of IP-64 protection class.</p> <p>2.2.5. Torque and limit switches shall have only stainless steel flaps for better protection against environmental condition.</p> <p>2.2.6. Limit switches shall be operated by gear driven cams, which are mechanically linked to the driving devices. The counter gear used for counting and tripping the limit switches shall be of metallic construction like brass etc. No plastic gearing shall be allowed.</p>		
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SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D13
PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan MOTOR & ACTUATOR	SHEET 5 OF 7

2.2.7. To guarantee proper function under high ambient temperatures, torque and limit switch sensing shall be of mechanical type.

2.3. ELECTRIC DRIVE FOR ACTUATOR (MOTOR)

2.3.1. All motors shall be specifically designed for valve actuator operation, which is characterised by high starting torque, low stall torque & low inertia. All motors shall be high starting torque type to facilitate 'unseating' of valve.

2.3.2. Motor shall be suitable for power supply of 415 V, 3 ph, 50 Hz, AC.

2.3.3. Motor shall be squirrel cage induction type and shall generally conform to IS-325.

2.3.4. Motor shall have minimum class 'F' insulation with temperature rise restricted to class 'B' under the design ambient temperature.

2.3.5. Motor shall be of totally enclosed surface cooled (TESC) type with IP-67 protection class after mounting on actuator.

2.3.6. Motor shall have three thermostats connected in series, one in each phase of stator winding, for protection against overheating.

2.3.7. Motor shall be suitable for operation under voltage variation of + 10%, frequency variation of + 5% and combined voltage & frequency variation of 10% absolute.

2.3.8. Motor shall be suitable for direct on-line (DOL) starting and starter shall be non integral to the motor.

2.3.9. It should be possible to separate the motor from the lubricant filled gearing of the actuator allowing easy replacement of motor without losing any lubricant regardless of mounting position.

2.3.10. Finish shall be provided on the motor body to ensure better heat dissipation.

2.3.11. It shall be possible to change the output rpm of the actuator, if required, at the site at a later date, without hampering the mounting arrangement and loss of any lubricant.

2.4. CODES & STANDARDS

All the equipment specified herein shall comply with the requirements of the latest issue of the relevant National & International standards.

The design and materials used for the components shall also comply with the relevant National & International standards.

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

Electric motor operated actuators:IS 9334

ISSUE
R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D13
PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan MOTOR & ACTUATOR	SHEET 6 OF 7
<p>Degrees of protection provided by enclosures at low:IS 2147 voltage switch gear and control gear</p> <p>Flame Proof enclosure at electrical apparatus:IS 2148 Specification for three phase induction motors:IS 325</p> <p>AC contactor for voltages not exceeding 1000 V:IS 2959</p> <p>Degree of protection provided by enclosures for :IS 4691 Rotating electrical machinery</p> <p>Specification for rotating electrical machines:IS 4722 For other code refer Section D28.</p> <p>2.5. OTHER REQUIREMENTS OF ACTUATOR.</p> <p>2.5.1. Common potential free contact shall be available to annunciate the fault condition to the remote control station or DCS.</p> <p>2.5.2. The following individual relay / potential free contacts shall be provided for the remote indication:-</p> <ul style="list-style-type: none"> - Actuator OPEN. - Actuator CLOSE - Actuator fault feed-back - Thermal overload relay shall be provided to trip the actuator in case of overload <p>2.6. The DC and AC actuator shall be provided with accessories viz., Torque limit switch, end of travel switch, adjustable limit switch, hand wheel motor, thermostat, etc. Complete actuator shall be tested at factory as per IS 9334. All actuators should have minimum 2 limit switches for each position, and should have position transmitters wherever required.</p> <p>3.0 TESTS</p> <p>3.1. All routine & acceptance tests as per relevant IS shall be conducted on motors. For all AC and DC motors of rating below 100kW, type test certificates shall be furnished. If the test reports are not found in order by Purchaser then these tests shall be conducted by the Vendor without any cost implication.</p> <div>ISSUE R1</div>		

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PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan MOTOR & ACTUATOR	SHEET 7 OF 7
<p>3.2. Type test shall be carried out on one no. of each type and rating of motor of rating 100kW and above, which shall be witnessed by Purchaser.</p> <p>3.3. Efficiency and loss measurements shall be done for all LT motors as per relevant standard (Being energy efficient motors.) as routine test.</p> <p>3.4. For 11000V AC & 6600V AC motors, in addition to all the tests specified above, polarisation index test shall be carried out as a routine test on each motor (the minimum value of polarisation index for all motors shall be 2 when determined according to IS: 7816).</p> <p>3.5. Noise level measurement test shall be conducted on one motor of each type.</p> <p>3.6. Vibration measurement shall be taken for each motor of 45kW & above.</p> <p>3.7. Dielectric tests to establish the insulation withstand level of motors as indicated above shall be performed on a sample coil (identical to those to be used in the motor quoted for) for each type of motor. These tested sample coils shall not be used in the motors to be supplied.</p> <p>4.0 For technical particulars refer datasheet-A.</p>		
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PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan DATA SHEET-A MOTOR & ACTUATOR	SHEET 1 OF 6

Sr. No.	Descriptions	Unit	Client specification
1.	Applications		*
2.	Manufacturer		*
3.	Frame Size		*
4.	Quantity		*
5.	Model No. of motor		*
6.	Supply Conditions		*
	(a) Allowable variation in		*
	(i) Voltage AC/DC	%	$\pm 10/ +10\%$ to -15%
	(ii) Frequency	%	± 5
	(iii) Combined	%	10
	(b) Permissible unbalance in supply voltage		*
7.	Speed	rpm	*
8.	Rated voltage a)HT motors b)LT motors c)UPS supplied d)Single phase e)DC motors		a)11000V & 6600V AC b)415V AC c)230V AC d)240V AC e)220V DC
9.	Number of phase		3-Phase
10.	Rated frequency for AC motor	Hz	50
11.	Normal winding connection	Star / Delta	*
12.	Method of starting a)AC motors b) DC motors		a)DOL (preferably) b) Resistance start
13.	Temperature rise above ambient of 50 deg. by Resistance method	Deg. C	HT motors – Shall be limited to Class B LT motor – Class B

REV. NO.	R0	R1	JOB NO. TCE - 5750A	CLIENT : RRVUNL
PPD. BY :	UM	SK		
CKD. BY :	MSVM	MSVM		
DATE	NOV'2009	JUN'2012		PROJECT : 2 x 660 MW, Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan

SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D13
PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan DATA SHEET-A MOTOR & ACTUATOR	SHEET 2 OF 6

Sr. No.	Descriptions	Unit	Client specification
14.	Type of rotor (Slip ring/ squirrel cage)		Squirrel cage
15.	Type of duty		*
16.	Duty designation		*
17.	Synchronous speed a) Constant speed b) Variable speed (for VFD)		*
18.	Starting time at specified minimum starting voltage	Sec	*
19.	Starting torque	% of FLT	*
20.	Pull out torque	% of FLT	*
21.	Class of insulation		HT motors- Class F LT motors including actuator motors-Class F.
22.	Ref. Ambient temperature	deg. C	50
23.	Location considered – Hazardous area division		*
24.	Installation		
24.1.	Location		Indoor/Outdoor
24.2.	Hazardous area division (IS:5572 or equivalent)		*
24.3.	Atmosphere considered- Chemical/Dusty/Salt laden		*
25.	Type of cooling (IS: 6362) LT motors HT motors		TEFC TEFC / TETV / CACW

REV. NO.	R0	R1	JOB NO. TCE - 5750A	CLIENT : RRVUNL
PPD. BY :	UM	SK		
CKD. BY :	MSVM	MSVM		
DATE	NOV'2009	JUN'2012		PROJECT : 2 x 660 MW, Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan

SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D13
PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan DATA SHEET-A MOTOR & ACTUATOR	SHEET 3 OF 6

Sr. No.	Descriptions	Unit	Client specification
26.	Degree of protection		IP 55 – Outdoor IP 54 - Indoor
27.	Rotation as seen from Non-drive end		Clockwise/Anti-Clockwise
28.	Main terminal box		
28.1.	Terminal box Short time rating a) HT for 0.25 sec b) LT for 0.25 sec Dynamic rating a) HT b) LT	KA KA KA peak KA peak	40 (minimum) 50 (minimum) 102 (minimum) 127.5 (minimum)
28.2.	Location as seen from non- drive end:		TOP/RIGHT/LEFT
28.3.	Phase Segregated	YES/N O	*
28.4.	Terminal box degree of rotation	Degree	90
29.	Weather motor is suitable for VFD drive		*
30.	Details of bearing		*
31.	Color shade of paint		Shade 631 of IS-5
32.	Whether CT for differential protection required		*
32.1.	C.T. PARTICULARS :		
32.2.	3 CTs, one in the neutral lead of each phase		
32.3.	Ratio		
32.4.	Class	PS	

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PPD. BY :	UM	SK		
CKD. BY :	MSVM	MSVM		
DATE	NOV'2009	JUN'2012		PROJECT : 2 x 660 MW, Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan

SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D13
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Sr. No.	Descriptions	Unit	Client specification
32.5.	Knee point voltage	KPV	*
32.6.	MAX. R.C.T. secondary winding resistance	OHMS	*
32.7.	MAX. exciting current AT 1/2 KPV		*
32.8.	Class of Insulation		*
33.	Whether vibration detectors required		*
34.	Details of winding / space heaters		*
35.	Guaranteed Efficiency of motor a) At full load b) At duty point c) At no load		*
36.	Guaranteed Power factor of motor a) At full load b) At duty point c) At no load		*
37.	Current at a) Starting b) Full load c) Duty point d) Full load & 70 % of rated supply voltage.		*
38.	Quantity & type of temperature detectors for all HT motors a) Winding hot spot b) Bearing		Minimum 6 Duplex RTD Minimum two thermocouple per bearing.
39.	Details of accessories a) Fans		*

REV. NO.	R0	R1	JOB NO. TCE - 5750A	CLIENT : RRVUNL
PPD. BY :	UM	SK		
CKD. BY :	MSVM	MSVM		
DATE	NOV'2009	JUN'2012		PROJECT : 2 x 660 MW, Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan

SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D13
PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan DATA SHEET-A MOTOR & ACTUATOR	SHEET 5 OF 6

Sr. No.	Descriptions	Unit	Client specification
	b) Temperature gauge c) Bearing d) Cooling motors e) Cooling water parameters f) Heaters g) Lube oil system details		
40.	Maximum size & number of cables that can be accommodated in motor terminal box.		*
41.	Thermal capability curve to be attached		*
42.	Relay co-ordination guide to be attached.		*
43.	Min. voltage required under starting conditions to accelerate driven equipment to rated speed.	Volts	*
44.	Locked rotor current withstand time (safe stall time) at 110 % rated voltage a) At rated temp. (hot) b) When cold	sec sec	*
45.	Stator thermal time constant	sec	*
46.	Permissible no. of equally spread starts per hour a) Normal service conditions b) In quick succession with cold M/C at room temp. c) Hot restarts		*
47.	Method of Starting and maximum starting current inclusive of tolerances AC HT Motors a) DOL		450 % above 1500 kW & 600 % all other.

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PPD. BY :	UM	SK	TCE -	
CKD. BY :	MSVM	MSVM	5750A	
DATE	NOV'2009	JUN'2012		PROJECT : 2 x 660 MW, Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan

SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D13
PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan DATA SHEET-A MOTOR & ACTUATOR	SHEET 6 OF 6

Sr. No.	Descriptions	Unit	Client specification
	b) Soft starters		*
	AC LT Motors		
	c) DOL		600 %
	d) Star Delta		200 %
	e) Star Delta with series resistance		200%
	f) Soft Starters		*
	DC Motors		
	a) Resistance starting		200%
	b) Soft starters		200%
	c) Any other		*

REV. NO.	R0	R1	JOB NO.	CLIENT : RRVUNL
PPD. BY :	UM	SK	TCE -	
CKD. BY :	MSVM	MSVM	5750A	
DATE	NOV'2009	JUN'2012		PROJECT : 2 x 660 MW, Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D15
PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan CONTROL PANELS / STARTER PANEL /JB / PB	SHEET 1 OF 4

1.0

CONTROL PANELS & CABINETS AND MISCELLANEOUS ELECTRICAL EQUIPMENT

1.1.

Indoor control panels provided for control of miscellaneous systems in the plant viz., CW System, Coal Handling System, Ash Handling System, RW System, DM Plant, Compressor control, cooling control system, lube oil system, EOT crane and Hoist electrics, trolley lines and power supply arrangement, Electrics for ventilation, air-conditioning, DG AMF Panel, etc. as applicable shall comply with the requirements outlined under clause 1.8 below.

1.2.

All the meters provided on the panel shall be digital type meters in 96 W x 48H with accuracy class better than 1.

1.3.

For motor circuits, ammeters shall have a suppressed extended scale to indicate the motor starting current.

1.4.

The facia annunciation windows if provided on the panel, shall conform to requirements outlined under instrumentation and control section.

1.5.

All live parts shall be provided with at least phase to phase & phase to earth clearances in air of 25mm & 20mm respectively.

1.6.

The required 240 V, 1 phase AC supply required for panel illumination and receptacle shall be derived in the control panel itself. However 240V, 1 Phase AC supply for space heating of panel shall be fed from a separate 1-Phase ACDB.

1.7.

Technical Requirements

SI. NO.	DESCRIPTION	REQUIREMENTS
1.0	Location	Indoor/Outdoor depending on location
2.0	Type of mounting	Wall/Floor
3.0	Cable entry	Top/bottom depending on layout
4.0	Paint Finish: Outside/Inside	Siemens Grey RAL 7032/ /Glossy white.
5.0	Supply voltage	415V, 3 phase, 3 wire/4 wire
6.0	Control transformer	By Vendor to derive 110V control supply
7.0	Space heater, lighting supply voltage	240V, 1 phase AC
8.0	Degree of protection of	Non-AC rooms-IP 54 class

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	Enclosure for Electrical panels/cabinet enclosure	AC rooms- IP 42 class Outdoor-IP 55 class plus canopy
9.0	Sheet steel thickness	Cold rolled sheet steel not less than 2.5mm for front & rear & 2mm for side, top & bottom portion with gland plate of 3mm thick.
10.0	Name plate	Black letter engraved on stainless steel plate. Should indicate the tag number and description of the service.
11.0	Door/Cover	Shall be pad lockable.
12.0	Safety	All live parts shall be shrouded. No live parts shall be accessible after opening the door/cover. Danger warning plates to be provided. Doors shall be pad lockable and interlocked with Power switch.
13.0	Earthing	2 earthing terminals to be provided for connection to the grid.
14.0	Wiring	Refer specification , Section on panel wiring

2.0 Following miscellaneous equipment shall be included in BIDDER's scope.

2.1. Starter Panel for DC Motors

2.2. Local push button stations.

2.3. Junction boxes (JBs)

2.4. Danger boards

2.5. Rubber mats

3.0 **STARTER PANEL FOR DC MOTORS**

3.1. Starter panel when included in motor Bidder's scope shall meet the following requirements.

3.2. The constructional features of these panels shall be as per cl.no.1.8 above. Please also refer to Section D.10.

4.0 **LOCAL PUSH BUTTON STATIONS (LPB)**

4.1. Local push button station shall be provided for all the drive motors of the plant (415V motors & 6.6kV/11kV motors) (start / stop push buttons for unidirectional motors, start/stop/reverse push buttons for bi-directional motors & only start push button for emergency motors) as per scheme requirement.

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<p>4.2. Start/ Forward/ Open PBs shall have green coloured actuator and Stop/Reverse/Close PBs shall have Red coloured actuator.</p> <p>4.3. The degree of protection of LPBs shall be IP65 with both canopy and lid for outdoor and IP54 with lid and hinged door for indoor applications.</p> <p>4.4. All PBs shall be push to actuate type.</p> <p>4.5. Emergency local stop push button should be lockable in the STOP position. Emergency push buttons shall be stay put type</p> <p>4.6. All push buttons shall be provided with 2 nos. NO and 2 nos. NC contacts for various interlocking purposes. One contact of stop PB shall be directly wired to the switchgear module for direct tripping and another contact to control system.</p> <p>4.7. Terminal block of stud type are to be provided in the LPB station. Terminals to be suitable for 2 cores of 2.5 sq mm conductors with 20% spare terminals.</p> <p>4.8. All LPBs shall be of Poly Carbonate/ FRP/Di-cast aluminium.</p> <p>4.9. Name plate with Tag number and description of the service controlled by the LPB shall be provided on the front.</p> <p>4.10. LPBs shall be suitable for wall/column mounting. Covers shall be provided with captive screws.</p> <p>4.11. The Cable size to be used for LPB connection shall take in to account the voltage drop in the cable between the LPB and the Switchgear/MCC/DCS.</p> <p>5.0 JUNCTION BOXES (JBs)</p> <p>5.1. Junction boxes as required for the power plant shall be supplied :</p> <p>5.2. The JBs used in outdoor areas shall be weatherproof type and coated with epoxy paint. enable running a large core cables from (JB/MB) to control panels, terminal cabinets, etc.</p> <p>5.3. All JBs, shall be of polycarbonate /FRP/ Di-cast aluminium.</p> <p>5.4. Danger boards shall be provided in line with the statutory requirements.</p> <p>5.5. Rubber mats shall be provided to meet the safety and other statutory requirements.</p> <p>5.6. Spacing of 250 MM between two rows of Terminal blocks and between the gland plate and the bottom most terminal block to be provided.</p> <p>5.7. Gland plate to be of removable type and made out of 3 mm thick sheet steel.</p> <p>6.0 TESTING</p> <p>The following testing shall be conducted on all equipments at works and necessary test certificates shall be furnished.</p> <p>(a) IR (Insulation resistance) test before and after HV test.</p>		
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<p>(b) HV test at 2.5kV for 1 Minute.</p> <p>(c) Electrical Functional test.</p> <p>(d) Mechanical operation of the components.</p> <p>(e) Visual check for compliance as per approved drawings.</p> <p>Note: The international standards such as IEC, which are equivalent to IS, may also be applicable for the above mentioned testing.</p>		
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SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION:D9
PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan 415V SWITCHGEAR/ DISTRIBUTION BOARDS/MCC	SHEET 1 OF 16
<p>1.0 415 V Switchgear, PMCCs and MCCs required for feeding the all the entire Plant Loads (except River water System) shall be supplied. These shall include as a minimum the following boards for 2 Units:-</p> <ul style="list-style-type: none"> a) Turbine PCC b) Turbine MCC c) Boiler PCC d) Boiler MCC e) Soot blower MCC f) ESP MCC g) Mill MCCs h) TVDB i) BVDB j) Hydrogen Plant MCC k) AC & DC distribution boards l) AC & ventilation MCC m) Normal emergency switchgear n) DC Switchgears o) Emergency Switchboards (D.G) p) Cooling Tower MCCs. q) Intake Water MCCs. r) Ash handling Plant PMCC s) Ash water/Silo/Slurry MCC- As required. t) Fly Ash MCC- 3 Nos. u) Ash dyke MCC v) Coal Handling Plant MCCs- As required w) Wagon tippler MCCs- One MCC per Wagon tippler. x) Bunker Floor PMCCs- As required y) Water system switchgear. z) DM Plant MCC aa) Chemical House MCC bb) River water MCC cc) Electro Chlorination Plant MCC. 		
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SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION:D9
PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan 415V SWITCHGEAR/ DISTRIBUTION BOARDS/MCC	SHEET 2 OF 16
<div> dd) Clarified water MCC ee) Effluent treatment plant MCC ff) Guard Pond MCC gg) LDO MCC hh) HFO MCC ii) Fuel oil unloading PH MCC A, B jj) Switchyard PMCC A, B. kk) Station switchyard auxiliary swbd PMCC 1 , 2 ll) Fire water PH switchgear 1A,1B. mm) Site office switchgear. nn) Compressor MCC 1A,1B oo) Air washer MCC 1A, 1B. pp) C.W Pump House MCC qq) Station ACDB 1A,1B. rr) Work Shop MCC ss) Admin building PCC tt) Service building AC and Ventilation MCC uu) ESP Control Room AC and Ventilation MCC vv) Receptacle Welding DBs. ww) Space Heater DB – As required. 1.1 415 V systems shall be 3 phase, 3-wire, solidly grounded system except for those listed in cl.no.1.2 which shall be with 4-wire system. All MCC shall derive power from power source as per Key One line diagram 5750A-738-AU-3001 attached. 1.2 Following PCC/MCC/Distribution Boards shall be of 4-wire type. Incomer and bus coupler SFU/MCCB/ACB of all 4 wire PCC/MCC/DB shall be of 4 pole type: a) Welding receptacle DBs b) Space Heater DBs c) Workshop MCC d) Admin building MCC e) Site Office switchgear f) Service building and Ventilation MCCs </div>		
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<p>g) Station building DBs</p> <p>h) Switchyard DBs</p> <p>i) All PCCs</p> <p>1.3 For codes & standards refer section D28 of this volume.</p> <p>2.0 <u>FEEDER DETAILS</u></p> <p>2.1 Each of the switchgear shall be provided with two bus sections, two incomers and a bus coupler each rated for 100% of the loads connected to the switchgear.</p> <p>2.2 The switchgears shall be provided with suitable number and type of outgoing feeders for the respective auxiliary loads of the system/area. Additionally following shall be provided in all Switch boards.</p> <p>(a) Spare feeders:</p> <ul style="list-style-type: none"> • 4 Nos. of 400A outgoing feeders shall be provided in station auxiliary service switchgear for Owner's use by the EPC Contractor scope. • In addition, 20% spares of each rating and type of module shall be considered with a minimum of one number. Any additional quantity required for any increase/ changes during detailed engineering stage shall also be duly considered. <p>(b) Bus VT module – 1 per bus section.</p> <p>(c) Control transformer module – 1 per bus section. Where there is no bus section (only one bus) and for the N/E Switchgear bus section, 2 nos. Control Transformers are to be provided. Control transformers shall be located in Physically separate modules. Each Control transformer shall be sized for complete load of the Switchgear/MCC. i.e., Control Transformers shall be of 2 X100 % capacity with manual and auto changeover facility in case of any one Transformer supply failure.</p> <p>(d) 240V, 1 phase space heating. 1 per bus section.</p> <p>(e) Control supply (AC and DC) changeover scheme module.</p> <p>(f) Each bus section shall have the following feeders for Purchaser's use:</p> <p>32A – 3 Nos.</p> <p>63A – 2 Nos.</p> <p>100A – 2 Nos.</p> <p>160A – 2 Nos.</p> <p>(g) Essential / critical loads to receive supply from the Normal-Emergency Switchgear and 220V DCDB.</p>		
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PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan 415V SWITCHGEAR/ DISTRIBUTION BOARDS/MCC	SHEET 4 OF 16
<p>3.0 <u>SHORT CIRCUIT CURRENTS</u></p> <p>3.1 The fault level on the 415V buses shall be calculated based on transformer contribution and motor contribution and shall be limited to 50kA inclusive of 10 % margin. The minimum short time current rating shall be 50 kA for 1 second.</p> <p>3.2 It is the responsibility of the Vendor to co-ordinate operation of all the ACBs and MCCBs for short circuit condition so that discrimination in operation is provided. Co-ordination and relay setting is in Vendor's scope.</p> <p>4.0 <u>CONTINUOUS CURRENTS</u></p> <p>The continuous current rating of the bus bars, the incomers, bus couplers of the switchgear, which are fed by the transformers shall be rated at the LV side full load current of the corresponding transformers with 20% margin rounded off to the next higher standard rating.</p> <p>5.0 <u>SPECIFIC REQUIREMENTS</u></p> <p>5.1 All the 415V equipments/devices like bus support insulators, CBs, CTs, PTs etc mounted inside the switchgear shall be suitable for continuous operation and satisfactory performance under the following supply conditions.</p> <p style="padding-left: 40px;">(a) Variation in supply voltage $\pm 10\%$</p> <p style="padding-left: 40px;">(b) Variation in supply frequency $\pm 5\%$</p> <p style="padding-left: 40px;">(c) Combined voltage and frequency variations: 10% absolute.</p> <p>5.2 All bus bar, bus-taps shall be insulated with close fitting sleeve of PVC insulation with high dielectric strength.</p> <p>5.3 The switchgears shall be totally enclosed, metal clad, sheet steel fabricated, indoor, floor mounted fully draw-out modular type construction, dust and vermin proof of uniform height of not more than 2450mm, easily extendable on one side having switchgear designation indicating label's on front and rear, in single/ double front execution in totally draw out. Proper gasketing shall be provided all around the perimeter of the adjacent panels, panel and base frame, removable cover and doors. The switchboard shall be fully compartmentalized. Incomers to the switchgear shall be of cable/ Non-segregated phase busbuct. The switchgear shall be capable for the suitable termination.</p> <p>5.4 Operating devices shall be incorporated only in front of the switchgear.</p> <p>5.5 Switchgear shall be divided in to distinct vertical section consisting of :-</p> <p style="padding-left: 40px;">(a) Completely Enclosed busbar compartment running horizontally.</p> <p style="padding-left: 40px;">(b) Individual feeder modules in multi tier arrangements.</p> <p style="padding-left: 40px;">(c) Enclosed vertical bus bars serving all modules in vertical section.</p>		
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PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan 415V SWITCHGEAR/ DISTRIBUTION BOARDS/MCC	SHEET 5 OF 16
<p>(d) Vertical cable alley covering entire height and minimum 300 mm wide and shall have hinged doors.</p> <p>(e) A horizontal separate enclosure for all-auxiliary power and control bus as required.</p> <p>5.6 All modules of identical size & type shall be fully interchangeable without any modifications.</p> <p>5.7 The sheet steel to be used for the metal enclosed switchgear shall be minimum 2.5 mm thick hot rolled or 2 mm cold rolled.</p> <p>5.8 The cable entry shall be bottom/top with separate gland plate for power and control cable. In case of single core cables, gland plate shall be of non magnetic material. The exact cable entry shall be finalised during detailed engineering.</p> <p>5.9 All Air circuit breakers (ACBs) and Moulded case circuit breakers shall be of short circuit performance category P2 as per IS:2516 Parts I & II.</p> <p>5.10 The MCCBs shall be of current limiting type. When MCCB's are used as short circuit protection devices for motor modules they shall provide type C co-ordination with associated contactor and thermal overload relay as per IS: 8544 under all operating conditions for the all currents up to the design fault current. The MCCBs on upstream and downstream shall be co-ordinated.</p> <p>5.11 Test reports to prove the requirements of Type-C Co-ordination shall be furnished.</p> <p>5.12 There shall be two number 220V DC control supply for each switchgear. Auto and manual changeover scheme for changeover of supply- 1 to 2 and vice versa shall be provided. Necessary voltage monitoring contactors (for remote alarm) and indication lamps shall be provided.</p> <p>5.13 Minimum of one NO and one NC spare contacts of all contactors, relay devices shall be wired to terminal block. All spare contacts of all contactors relay terminals shall be wired up to the terminal block.</p> <p>5.14 For CT & VT circuits disconnecting type of terminals shall be provided.</p> <p>5.15 Power cable terminal arrangement and size shall be suitable to accommodate two or more number of cables based on requirements and shall facilitate easy maintenance.</p> <p>5.16 Terminal arrangements shall be such that all terminals at switchgear ends, which are to be connected to remote alarms and indication at DCS, shall be separated out and shall be kept isolated from other Terminals. 240V AC, 110V AC, 24V DC, 220V DC & other voltages shall be segregated to avoid mix up of voltages. This is specifically required to avoid mixing of switchgear high voltage to C & I low voltage system.</p>		
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<p>5.17 Meters shall be Digital type. For MCC verticals, CT pertaining to a particular module should be mounted in the respective with drawable module it self. CT should not be mounted in cable alley.</p> <p>5.18 Switchgear shall be suitable for easy extension on one side. It shall be possible at a later stage to add cubicles to the switchgear by extending the bus bars.</p> <p>5.19 Secondary of CTs & VTs shall be made through disconnecting type terminals with necessary shorting and earthing facilities. All the control wiring shall be through stud type terminal.</p> <p>5.20 The breaker ratings indicated in the data sheets referred to the nominal rating of the breaker. However, Breakers shall be capable of carrying continuously at least 120% of circuit breaker current at an ambient temperature of 44 deg. and with breaker mounted inside the panel. If a higher rated breaker is necessary to meet this, the same shall be used.</p> <p>5.21 Dummy cubicles with horizontal bus bars, power control and annunciation cable running through the panel, if necessary, to avoid beam interfering with cable openings and to facilitate easy maintenance shall be provided.</p> <p>5.22 All the bolted joints in body of the switchgear shall be earthed through flexible jumpers.</p> <p>5.23 All indicating and integrating instruments, protection and alarm relays , operating and indicating devices shall be visible/ accessible without opening the instrument compartment door. All the hand reset relays shall be mounted on the panel at a conventional height for operation.</p> <p>5.24 All the internal wiring shall be carried out using 1100V grade, stranded copper conductor with PVC insulation and shall be flame, vermin and rodent proof. The minimum size of the copper conductor used for panel wiring shall be as follows:</p> <ul style="list-style-type: none"> ➤ All circuit except CT &PTs: 1.5 sq mm per lead. ➤ CTs/PTs : 2.5 sq mm/per lead. <p>5.25 The minimum number of strands per conductor shall be 07. Double flexible wire shall be used for internal wiring of devices mounted on moving parts of Cu conductor of size as mentioned at a) & b) above.</p> <p>5.26 Following colour coding shall be used for internal wiring:-</p> <ul style="list-style-type: none"> ➤ Red, Yellow & Blue: For respective phase /PT wires. ➤ Black : for neutral wires. ➤ Green : For Earth wires ➤ Red ferruled wires for trip circuit. ➤ All other with grey coloured wires. 		
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<p>5.27 The inter panel wiring shall be brought out to a separate set of terminal blocks located near the slots meant for inter panel connecting wires.</p> <p>5.28 At least 20% spare spare terminations of CT, PT & others shall be provided on each panel'. and these spare terminals shall be uniformly distributed on all rows of terminal blocks. A clearance of 250 mm shall be maintained between terminal blocks and gland plate and 150 mm between two rows of terminal blocks. at least 20%</p> <p>5.29 All the electrical equipment shall be fed from main MCC only and if any specific arrangement is needed, separate panel for that shall be provided in switchgear room.</p> <p>5.30 All LT panels shall be mounted at least on ISMC (Indian Standard Medium Channel) or other applicable 100 channels to prevent ingress of water.</p> <p>5.31 All hardware required for meeting the functional requirements stated above, whether specifically listed out in the specification or not, shall be included in the scope of supply.</p> <p>5.32 Current transducers, power transducers and Voltage transducers shall be provided.</p> <p>5.33 The cable terminations inside the cable alley shall be completely shrouded so that it shall be possible to work on any one of the terminations by switching OFF the corresponding feeder switch only.</p> <p>5.34 All bezels, handles, screws, bolts, washers, hinges, etc. shall be of the best quality electro galvanized or passivated to withstand attach from corrosive atmosphere.</p> <p>5.35 Horizontal busbar chambers shall be at the top of the board for bottom cable entry. Busbars shall be completely shrouded to prevent metal pieces falling on the busbar during maintenance.</p> <p>5.36 In case of copper to aluminium connections, proper treatment shall be given to minimise the bimetallic effect. That is, all joint surfaces at aluminium to copper joints shall be silver / tin plates, alternatively Cu-Al washers (bimetallic washers) can be used..</p> <p>5.37 On- line energy monitoring system shall be provided on all drives above 80kW rating which will help in preventive maintenance.</p> <p>5.38 All MCC feeders of 80kW and above rating shall have Ampere,kVA, kW transducers for communicating the data to PLC system for auxiliary consumption analysis.</p> <p>5.39 Outgoing feeders of rating 200A and above upto 630A (other than motor feeders) shall have MCCBs only with Short-circuit and Earth fault protection. Feeders of rating less than 200A shall be SFU. This is not applicable for feeders feeding other MCCs and switchboards.</p>		
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<p>5.40 Welding Distribution Boards shall be provided with the following:</p> <ul style="list-style-type: none"> a) It shall be with isolating transformer on the incomer with ACB with Over current and Earth fault protections. b) It shall be provided with maximum 12 nos. Of outgoing feeders. c) Quantity of Welding receptacles: <ul style="list-style-type: none"> (i) One (1) no. in each ESP and Boiler Platform. (ii) One (1) no. every 50m in each floor of TG building. (iii) Two (2) nos. each in every building in the power plant other than Admin Building. (iv) One (1) no. for every 60M in Switchyard and Main Transformer yard. (v) Looping of welding receptacles not allowed. <p>6.0 <u>INCOMERS & BUS COUPLERS.</u></p> <p>6.1 Incoming/ Bus coupler/ Outgoing feeders of rating 200A and above up to 630A (other than motor feeders) shall have MCCBs only with Short-circuit and Earth fault protection. Feeders of rating less than 200A shall be SFU. Feeders rated above 630A shall have ACBs.</p> <p>6.2 The following minimum protections shall be provided for incomers and bus coupler for switchgears.</p> <ul style="list-style-type: none"> ➤ phase inverse time over current relays ➤ Earth fault relay (for incomer only) ➤ Numerical relays shall be provided for all protection. <p>6.3 The incomer modules & bus coupler modules of PMCC as well as important MCC's as mentioned in clause 6.5 irrespective of loads shall be equipped with fully draw out air circuit breaker protected with relays.</p> <p>6.4 All incomers and outgoing feeders of various loads shall have digital energy meter for energy accounting. The energy Meters of Incomers shall be of the Tri Vector Meter type (TVM) with recording and download facility.</p> <p>6.5 Important MCCs shall be controlled from remote DCS & ECP. They shall be with ACBs, closing coil, shunt trip coil and relays irrespective of the current ratings.</p> <p>6.6 The incomer modules shall be interlocked with their upstream breaker such that they can be closed only when upstream breaker is closed and trip automatically when upstream breaker is tripped.</p> <p>6.7 Each circuit breaker cubicle shall be complete with following minimum accessories:-</p>		
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<p>a) One spring return Trip normal close (TNC) switch.</p> <p>b) Large size cluster LEDs for following condition of breaker/contactors:-</p> <p>(i) "ON"(Red)</p> <p>(ii) "OFF" (Green)</p> <p>(iii) Trip relay supervision (White).</p> <p>(iv) Spring charged (Blue)</p> <p>(v) DC supply supervision (Violet)</p> <p>(vi) Trip on fault (Amber)</p> <p>c) Limit switches for test and service position interlocking.</p> <p>d) Double pole switch for DC control supply and spring charging motor with HRC fuses or MCB will be provided (Fuse or MCB shall be provided for DC control supply which shall be decided during detailed engineering).</p> <p>e) Anti pumping relay.</p> <p>f) Sufficient terminal blocks.</p> <p>g) Auxiliary relays as required for contact multiplication.</p> <p>h) Breaker operation counter.</p> <p>i) Numerical Protective relays along with trip circuit supervision relay and master trip relay.</p> <p>j) Meters as indicated elsewhere.</p> <p>k) Required CTs/PTs.</p> <p>l) Space heaters.</p> <p>m) One Local/Remote Switch.</p> <p>n) Required number of 24 V DC DC Interposing Relays.</p> <p>o) 4-20 mA output Transducers for current, power and voltage.</p> <p>p) Other associated equipment.</p> <p>6.8 All the circuit breakers shall be of fully draw out execution with "Test", "Service " & " Fully withdrawn " positions.</p> <p>6.9 Double tier arrangement shall not be provided for incomers and bus coupler. In case of motor feeders, double tier arrangement may be provided but two breakers of same application motor shall not be provided in one vertical.</p> <p>6.10 Breakers shall be with motor wound spring operating mechanism, 220 V DC operated Closing and tripping coils.</p> <p>6.11 Closing action of the CB shall compress the opening spring ready for tripping.</p>		
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<p>6.12 Proper mechanical indication shall be provided to locate these three positions without opening of the compartment door.</p> <p>6.13 It shall be possible to bring the circuit breaker to isolated position with the help of external lever without opening the compartment door.</p> <p>6.14 A stop block shall be provided on the slide rails to prevent the movement of the circuit breaker out of the compartment when it reaches the isolated position so that any accidental fall can be avoided.</p> <p>6.15 No control & metering equipments should be mounted on breaker compartment door (i.e access to control & metering equipments should be available at all time without opening Breaker Compartment door).</p> <p>6.16 It shall not be possible to close the Breaker if stored energy mechanism is not charged.</p> <p>6.17 In case of MCCBs, it shall not be possible to close the Breaker if under-voltage relays release is not energised (if present).</p> <p>6.18 Movement of the circuit breaker truck from service to test or test to isolated position OR in reverse order shall be possible only when circuit breaker is off.</p> <p>6.19 It shall not be possible to withdraw the breaker when it is in closed position.</p> <p>6.20 Opening of compartment door with breaker / isolating switch in Service & Intermediate and ON position and vice versa shall not be possible.</p> <p>6.21 It shall not be possible to close the Breaker if closing coil is energized.</p> <p>6.22 It shall not be possible to close the Breaker if OFF – Push Button is locked in off position.</p> <p>6.23 It shall not be possible to close the Breaker if crank hole is open.</p> <p>6.24 The Circuit Breaker shall be provided with mechanical ON/OFF, TRIP and SPRING CHARGED, DISCHARGED READY TO CLOSE AND BREAKER POSITION indication, mechanical trip push button.</p> <p>6.25 The circuit breaker shall be provided with automatic safety shutters, so that before the breaker reaches 'isolated' position the main isolating contacts are completely shrouded. In the draw-out condition, it shall be possible to inspect the Breaker fixed contacts condition by lifting the shutters.</p> <p>6.26 The protective relays and instruments shall be mounted in separate compartment. This compartment shall be along side and immediately next to the controlled breaker</p> <p>6.27 Contact erosion indicator shall be provided on Moving contacts of Breaker for visual indication of contact life.</p> <p>6.28 All the non conducting metal parts of the circuit breaker trolley shall be bonded together and shall make perfect electrical connection to earth through substantial sliding contacts, at service and test positions. Such sliding</p>		
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<p>contacts shall be arranged to make before power plug in and interrupt after power draw out.</p> <p>7.0 <u>BUS AND LINE PTs</u></p> <p>Bus PT over voltage factor shall be 1.9 for 08 hours. 3 Nos. single phase PTs shall be connected up to form a 3 phase unit.</p> <p>Each PT cubicle shall be complete with following minimum accessories</p> <ul style="list-style-type: none"> (a) PTs shall be fully draw out type with required no of cores and ratios as specified elsewhere. (b) Voltmeter with selector switch. (c) Separate Under voltage (2 nos.) and No voltage relays (2 nos.) with timers and fuse fail relays. (d) Required auxiliary relays. (e) LEDs for voltage indication. (f) Auxiliary PTs, as required. (g) DC and AC control supply and changeover switches with Short Circuit protection. <p>8.0 <u>MOTOR MODULES</u></p> <p>8.1 All LT motors shall be controlled as follows:</p> <ul style="list-style-type: none"> a) Up to 50kW: - MPCB + Contactor (MPCB shall be with adjustable S/C and O/L protection). b) 50kW to 90kW shall have MCCB+ contactor+ bimetallic relay. c) 90Kw to 160kW shall have ACB +motor protection relay (MPR). <p>8.2 All motor feeder shall be complete with following minimum accessories.</p> <ul style="list-style-type: none"> (a) Interlocking schemes for Space heating arrangements (space heating for motors above 30KW). (b) 3 position selector switch-Local (switchgear)/Field/Remote (DCS/PLC) (c) Test services position switches and associated contactors for interlocking. (d) Power contactors and MPCB or breaker. (e) Bi-metal relay or Motor Protection relay. (f) CTs as specified elsewhere. (g) Local indication lamp for ON, OFF & TRIP/Fault indication. 		
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<p>(h) Relays as required.</p> <p>(i) ON & OFF PBs, for testing in Test Position.</p> <p>(j) 24 V DC Interposing relays to accept remote start and stop signals .</p> <p>8.3 All the motors rated 30 kW and above shall be provided with a CT, ammeter and a current transducer with remote metering in DCS. Further important motor like ID/FD/PA fan, LOP motors, HP/LP bypass motor, mill feeders motor, APH motor, air conditioning motor etc shall also be provided with CT, ammeter and a current transducer with remote metering in DCS irrespective of kW.</p> <p>8.4 The incomer/bus coupler, module, MPCB/MCCB feeder etc shall confirm to the attached M2 series of schematic drawings.</p> <p>9.0 <u>ACTUATORS.</u></p> <p>All actuators to be supplied with non integral starters.</p> <p>10.0 <u>METERING.</u></p> <p>10.1 Each incomer feeder to all PMCC/PCC/MCCs shall have Voltage, Ampere, kVA, kW, transducers for communicating the data to DCS/PLC system for auxiliary consumption analysis and these parameters voltage, current, kW and kVA of each incomer also shall be available on respective ECP.</p> <p>10.2 Meters shall be Digital type. All CT s/ PT s, transducers and meters (Energy accounting and audit meters) on 415 V system shall be class 1.0. Metres for motor feeders shall be with suppressed scale.</p> <p>10.3 All MCC feeders (except motor feeders) of 80kW and above rating shall have Ampere, kVA, kW transducers for communicating the data to DCS/PLC system for auxiliary consumption analysis.</p> <p>10.4 All the motors rated 30 kW and above shall be provided with a CT, ammeter and a current transducer with remote metering in DCS. Further important motor like ID/FD/PA fan, LOP motors, HP/LP bypass motor, mill feeders motor, APH motor, air conditioning motor etc shall also be provided with CT, ammeter and a current transducer with remote metering in DCS irrespective of kW.</p> <p>10.5 The Energy accounting and audit meters as required by CEA shall be on a separate core and shall be installed at following locations to facilitate the accounting of the energy generated, transmitted, distributed and consumed in various segments of the power system and the energy loss, namely</p> <ul style="list-style-type: none"> • Low voltage side of each incoming transformer feeder of low voltage (415V) buses, and <p>This CT core and the meters shall have an accuracy of 0.2S for this purpose and PT cores shall have an accuracy class of 0.2 for this purpose.</p>		
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11.0 **ALARMS/INDICATION/SER POINTS**

11.1 **INCOMERS AND BUSCOUPLER CONTROL.**

11.1.1 Incomers/Bus couplers/Ties from/to the various Switchboards (with ACB and MCCB as incomers) listed in Clause 1.0 shall be controlled from DCS/PLC (as applicable) and ECP as explained in clause no. 2.1.1 of section D2.

11.1.2 Interconnecting cables to DCS and required interposing relays (24 V DC) are in Vendor's scope. Interposing relays are to be located in the Switchgear.

11.1.3 Each ECP shall have all the instruments as explained in clause no. 2.1.2 of section D2.

11.1.4 It shall be possible to control every breaker in the test position both from Switchgear as well as remote (DCS) for testing purpose.

11.1.5 **ALL OTHER SERVICES.**

All the motors / Valves and other equipment shall be controlled from respective process control panels/DCS to be supplied by Vendor.

Emergency stop pushbutton shall be provided near all drives except emergency drives and shall be wired directly to MCC. In case of emergency drives, emergency start PB only shall be provided.

11.1.6 The control room shall provide indication & alarms for the 415V auxiliary supply as given below. Any additional indications/alarms considered necessary during detailed engineering also shall be provided. Some of these shall be selected for sequential event recording. For each breaker and bus, grouped alarm for any abnormal conditions shall be provided in the control desk. For all breaker (ACB/MCCB) fed switchgear, status indications shall be available on CRT in form of SLD.

		MCC	DCS / PLC	ECP
STATUS INDICATION				
(a)	Incomer & Bus coupler breaker (ACB/MCCB) feeders			
	➤ Breaker ON	✓	✓	✓
	➤ Breaker OFF	✓	✓	✓
	➤ Breaker in local	✓	✓	✓
	➤ Breaker in remote	✓	✓	✓
	➤ Breaker in service	✓	✓	✓
	➤ Breaker in test	✓	✓	✓
	➤ DC supply healthy	✓	✓	✓

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		MCC	DCS / PLC	ECP
	➤ Breaker spring charged	✓	✓	✓
	➤ Trip Relay supervision	✓	✓	✓
(b)	Incomer & Bus coupler breaker (SFU) feeders			
	➤ Incomer /Bus coupler ON	✓	✓	✓
(c)	Motor Feeders			
	➤ Motor ON	✓	✓	✗
	➤ Motor OFF	✓	✓	✗
	➤ Motor Auto trip.	✓	✓	✗
	➤ Motor Local Emergency PB pressed	✗	✓	✗
	➤ Feeder Fault	✗	✓	✗
	➤ Breaker in Remote	✗	✓	✗
	➤ Breaker in Field	✗	✓	✗
	➤ Breaker in Local	✓	✓	✗
	➤ Breaker in service	✓	✓	✗
	➤ Breaker in test	✓	✓	✗
	➤ Breaker spring charged	✓	✓	✗
	➤ Trip Relay supervision	✓	✓	✗
ALARM SIGNALS				
(d)	Incomer & Bus coupler breaker (ACB/MCCB) feeders			
	➤ Breaker auto tripped/L/O Relay operated	✗	✓	✓
	➤ Sources paralled beyond pre-set time	✗	✓	✓
	➤ Common outgoing feeder fault	✗	✓	✓
	➤ Incoming 220 V DC control supply failed	✗	✓	✓
(e)	Incomer & Bus coupler breaker (SFU)			

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		MCC	DCS / PLC	ECP
	feeders			
	➤ Incomer/Bus coupler Fuse blown	✓	✓	✓
(f)	BUS/Line PT			
	➤ Bus under voltage	✓	✓	✓
	➤ Bus PT fuse failed	✓	✓	✓
	➤ BUS PT not in service	✓	✓	✓
(g)	Motor Feeders			
	➤ Overload alarm	x	✓	x
	➤ Feeder fault / closing permissive not available	x	✓	x
	➤ Breaker trip circuit trouble	x	✓	x
	➤ Trip through process interlock.	x	✓	x
	➤ Local push button pressed	x	✓	x
	➤ Breaker spring not charged alarm	x	✓	x

11.1.7 The current, voltage, Power measurements for each bus shall be available both on control room as indicated in this section and elsewhere in the specification. Also for specific motors where the current transducers are indicated, the measurement shall be available at the DCS.

11.1.8 Each remote controlled feeder including spare feeders shall be provided with 2nos interposing relays for start & stop.

11.1.9 The operation, indications and fault alarms for the motors of the auxiliaries shall be displayed as covered in the specification as part of C&I requirements.

12.0 **TESTS**

12.1 Switchgear shall be subjected to all routine tests as per relevant standards along with following tests:

- Mechanical operation test
- Insulation resistance and 500V DC Megger before/ after 1 minute HV test
- Electrical control, interlock and sequential operation tests

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<p>(d) Verification of wiring as per approved schematic.</p> <p>12.2 Temperature rise test on each type and rating of Breaker and associated panels shall be carried out by the Vendor on breaker/Panel to be supplied for this project.</p> <p>12.3 For all other type tests BIDDER shall submit valid type test reports for similar switchgear and ratings of breakers included in the offer. If these tests are not done or test results are not found satisfactory by the PURCHASER then such tests shall be carried out by Vendor without any cost implication.</p> <p>12.4 Routine tests shall be carried out on all associated equipment supplied with switchgear as per relevant standards. Type test certificates of all associated equipment shall be furnished.</p> <p>12.5 Valid type and routine test certificates shall be submitted by the VENDOR before despatch of the switchgear.</p> <p>13.0 For technical particulars refer datasheet-A.</p>		
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Sr. No.	Description	unit	Client specification
1.0	Manufacturer's name		*
2.0	Make of major components (ACB, Contactor, MCCB , CTs, PTs)		*
3.0	Type & model number of panel		*
4.0	Applicable standard.		*
5.0	Nominal system voltage, phase & frequency	V	415 V, 3 phase, 50 Hz, 3-wire/ 4- wire
6.0	System neutral earthing considered		Effectively earthed
7.0	Maximum system voltage	V	456.5
8.0	One minute power frequency withstand voltage	Power circuits	KV rms 2.5
		Control circuits	1.5
		Aux. circuits connected to secondary of CTs	2.0
9.0	Short circuit withstand capability a) Short time for 1 sec b) Dynamic rating	KA rms	Min. 50 KA
		KA peak	Min. 127.5KA
10.0	Reference ambient temperature	Deg. C	50
11.0	Continuous current rating under site reference ambient condition	A	*
12.0	Maximum temperature of Bus Bars, dropper, connectors & contacts at continuous current rating under site reference ambient temperature	Deg C	90 deg. C for non silver plated joints
			105 deg. C for silver plated

REV. NO.	R0	R1	JOB NO. TCE - 5750A	CLIENT : RRVUNL
PPD. BY :	UM	SK		
CKD. BY :	MSVM	MSVM		
DATE	NOV'2009	JUN'2012		PROJECT : 2 x 660 MW, Super-Critical TPS Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan

SPEC. NO. TCE.5750A-H-500-001		TATA CONSULTING ENGINEERS LIMITED		VOLUME IV SECTION: D9	
PART B		RRVUNL, 2 x 660 MW, Super-Critical TPS Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan DATA SHEET-A 415V MCC			SHEET 2 OF 6

			joints
13.0	Material of bus bars considered		Copper / Aluminum Alloy
14.0	Cable entry		Bottom only
15.0	Degree of protection		IP- 52 upto 1600A and IP-42 above 1600A.
16.0	Thickness of sheet steel enclosures / doors.		
	Cold Rolled		2mm
	Hot rolled		2.5mm
17.0	Shade of paints		Powder coated paint of shade RAL 7032 (Siemens Grey)
18.0	Earthing bus bar size & material considered		75 x12 mm (min) , GS
19.0	Clearance in air of live parts a) phase to phase b) phase to earth		25 mm 19 mm
20.0	Circuit breaker a) Type b) Rated operating duty c) Rated current at site reference ambient temp. A d) Rated breaking current e) Rated making current f) Short time current withstand capacity for 1	KA rms KA peak KA	* O-3min-CO-3min- CO * *

REV. NO.	R0	R1	JOB NO. TCE - 5750A	CLIENT : RRVUNL PROJECT : 2 x 660 MW, Super-Critical TPS Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan
PPD. BY :	UM	SK		
CKD. BY :	MSVM	MSVM		
DATE	NOV'2009	JUN'2012		

SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D9
PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan DATA SHEET-A 415V MCC	SHEET 3 OF 6

	sec duration	rms	
	g) Asymmetrical breaking current		*
	(1) AC component		*
	(2) DC component	KA rms	as per IEC – 62271
	h) operating time		*
	(1) opening time		*
	(2) closing time		
	i) Closing and opening coil particulars.	Cycle s	220V DC
	j) Switching over voltage factor	Cycle s	2.2
21.0	Trip free operating mechanism type		Motor charged spring (manual trip & close facility to be provided)
22.0	Auxiliary control voltage for trip, close, annunciation and spring charging.		220 V DC (+/- 15 %)
23.0	Auxiliary control voltage for space heater, DC failure annunciation, motor winding / space heaters, lighting etc		240V AC, 1-Ph, 2 wire, 50 Hz
24.0	Breakers application		
	a) Incomer s		Yes
25.0	Details of contactors/ Switches/Fuses.		*
	• Type		
	• Rated operating duty		

REV. NO.	R0	R1	JOB NO.	CLIENT : RRVUNL
PPD. BY :	UM	SK	TCE -	
CKD. BY :	MSVM	MSVM	5750A	
DATE	NOV'2009	JUN'2012		PROJECT : 2 x 660 MW, Super-Critical TPS Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan

SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED		VOLUME IV SECTION: D9
PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan DATA SHEET-A 415V MCC		SHEET 4 OF 6

	<ul style="list-style-type: none"> Rated current at site reference ambient temp. Rated breaking current Rated making current Short time current withstand capacity for 1 sec duration Asymmetrical breaking current <ul style="list-style-type: none"> AC component DC component Operating time <ul style="list-style-type: none"> opening time closing time 		
26.0	Details of CTs <ul style="list-style-type: none"> Type Ratio Burden Accuracy class Knee point voltage Magnetizing current at $V_k/2$ Secondary resistance Class of insulation Short time & dynamic current rating Applicable standard 		(Cast resin, Class E or Better) **

REV. NO.	R0	R1	JOB NO. TCE - 5750A	CLIENT : RRVUNL
PPD. BY :	UM	SK		
CKD. BY :	MSVM	MSVM		
DATE	NOV'2009	JUN'2012		PROJECT : 2 x 660 MW, Super-Critical TPS Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan

SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D9
PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan DATA SHEET-A 415V MCC	SHEET 5 OF 6

	<ul style="list-style-type: none"> No. of cores 		
27.0	Details of VTs <ul style="list-style-type: none"> Type Ratio Burden Accuracy class Magnetizing characteristic Method of connection Class of insulation Rated voltage factor (continuous & 8 hours) Applicable standard No. of cores 		(Cast resin Class E or Better , Overvoltage factor 1.5 continious,1.9 for 08 hours) **
28.0	Particular of meters		*
29.0	Particular of relays		*
30.0	Panels construction details		*
31.0	STARTERS		
31.1.	Type		DOL/Soft Starters
31.2.	Contactor rated duty as per IS:13947		Uninterrupted
31.3.	Utilisation category as per IS:13947		AC 3 for non reversible AC 4 for reversible

REV. NO.	R0	R1	JOB NO. TCE - 5750A	CLIENT : RRVUNL
PPD. BY :	UM	SK		
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DATE	NOV'2009	JUN'2012		PROJECT : 2 x 660 MW, Super-Critical TPS Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan

SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D9
PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan DATA SHEET-A 415V MCC	SHEET 6 OF 6

31.4.	Control scheme & bill of material enclosed	YES/ NO	Yes
	CONTROL TRANSFORMER : A) Separate for each module B) Common for each switchgear section with 100% standby	YES/ NO YES/ NO	NO YES
31.5.	Single phasing preventer required	YES/ NO	Yes

NOTE :

- 1.0 '**' Information shall be filled furnished by BIDDER in contract document.
- 2.0 '***' BIDDER shall furnish these details after award of contract.

REV. NO.	R0	R1	JOB NO. TCE - 5750A	CLIENT : RRVUNL
PPD. BY :	UM	SK		
CKD. BY :	MSVM	MSVM		
DATE	NOV'2009	JUN'2012		PROJECT : 2 x 660 MW, Super-Critical TPS Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan

SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D16
PART B	RRVUNL, 2 x 660 MW Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan CABLE & CABLE CARRIER SYSTEM	SHEET 1 OF 9
<p>1.0 <u>CABLES</u></p> <p>1.1 H T POWER CABLES</p> <p>System cables shall be 11kV (UE) and 6.6 kV (UE) grade suitable for use in medium resistance earthed system, stranded & compacted aluminium conductor, extruded semi conducting screen over conductor, XLPE insulated, semi-conducting followed by copper tape screened, extruded PVC Type ST – 2 inner sheathed, aluminium/GS wire armoured, overall FRLS PVC outer sheathed, conforming to IS 7098 (Part II), IEC-502 for constructional details and tests.</p> <p>1.2 L T POWER CABLES</p> <p>LV Power Cables shall be 1100 V grade, single / multi core, stranded aluminium conductor, XLPE insulated, with PVC inner sheath, armoured and outer sheath made of FRLS PVC compound, generally conforming to IS 7098 (for XLPE). The cables used for DC system shall be of single core type. Minimum conductor cross section of power cables shall be 6-sq. mm for aluminium cables.</p> <p>1.3 CONTROL CABLES</p> <p>Control cables shall be 1100 V grade, multi core, minimum 1.5 sq. mm cross section, stranded copper conductor having minimum 7 strands, PVC insulated, PVC inner sheathed / galvanised steel wire armoured, overall FRLS PVC outer sheathed generally conforming to IS 1554 Part-I. In situations where accuracy of measurement or voltage drop in control circuit warrants, higher cross sections as required shall be used.</p> <p>1.4 INSTRUMENTATION CABLES</p> <p>The instrumentation cables shall be Annealed, tinned stranded copper conductor, 0.5 sq mm , twisted into pairs, overall screened (I1 type) for digital signals, individual and overall screened (for I2 type) for low level analog signals, individual triplet and overall screened (type I3), PVC insulated , inner PVC sheathed, GS wire armoured and overall sheathed with FRLS PVC. The insulation shall be strippable manually as well as by mechanical stripping devices without damage to the conductor.</p> <p>1.5 TRAILING POWER AND CONTROL CABLES FOR MOBILE EQUIPMENT.</p> <p>11 kV(UE) and 6.6 kV (UE) and 1100V-(E) grade power & control flexible trailing, annealed tinned copper conductor, EPR insulated, EPR inner sheathed, CSP outer sheathed and shall have conductor screen of rubber. Cables shall conform to IS requirements and any other applicable standards.</p> <p>1.6 FIRE SURVIVAL CABLES</p> <p>1.6.1 Power and control, single/multi, stranded copper conductor fire survival cables complying with IEC-60331 shall be provided for following systems as per CEA guidelines.</p>		
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SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D16
PART B	RRVUNL, 2 x 660 MW Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan CABLE & CABLE CARRIER SYSTEM	SHEET 2 OF 9
<p>(a) DC emergency lube oil pumps</p> <p>(b) DC seal oil pumps</p> <p>(c) DC emergency lighting cables for main building</p> <p>(d) Batteries to chargers and DC distribution boards</p> <p>(e) Turbine lube oil pumps</p> <p>(f) Jacking oil pumps</p> <p>(g) Emergency turbine trip by pushbutton in control room</p> <p>(h) Boiler Turbine: Generator inter trip which includes the interconnecting cables between:</p> <ul style="list-style-type: none"> – Boiler master fuel trip and turbine trip relays – Generator trip relays and turbine trip relays – Generator trip relays and 400kV breakers – Generator trip relays and generator field breakers – Generator trip relays and ST and UT breakers <p>1.6.2 FS cables shall have following properties:</p> <p>(a) Excellent fire resistance characteristics</p> <p>(b) Cables shall have features of nontoxic and low smoke generation</p> <p>(c) Flame non-propagation property</p> <p>(d) Ability to withstand burning & continue to function during and after fire</p> <p>(e) Low smoke emission & low halogen property to maintain circuit integrity to essential services under severe fire condition.</p> <p>1.6.3 Construction of FS cables</p> <p>(a) Conductor- Copper stranded</p> <p>(b) Fire proof layer- heat barrier based</p> <p>(c) Insulation- elastomer rubber</p> <p>(d) Fire proof layer- same as 2 above but optional – natural or synthetic, fibre or elastomer</p> <p>(e) Filler- suitable filler optional</p> <p>(f) Binder tape – two layers of glass fibre tape</p> <p>(g) Inner sheath- HOFR FRLS elastomer (heat & oil flame retardant)</p> <p>(h) Armouring/screening – suitable wire</p> <p>(i) Over all sheath – HOFR FRLS</p>		
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SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D16
PART B	RRVUNL, 2 x 660 MW Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan CABLE & CABLE CARRIER SYSTEM	SHEET 3 OF 9
<p>1.7 Cables for the fire detection and alarm system and communication system shall be as described else where.</p> <p>2.0 <u>CABLE PROPERTIES</u></p> <p>2.1 All single core power cables shall have wire / strip armouring of aluminium, whereas multi core power cable shall have galvanised steel wire / strip armouring.</p> <p>2.2 The sheath shall be resistant to water, UV radiation, fungus, termite and rodent attack.</p> <p>2.3 The outer sheath of FRLS PVC compound shall meet the following performance requirements:</p> <p>(a) The critical oxygen index value shall be minimum 29 when tested at $27 \pm 2^{\circ}\text{C}$ as per ASTM-D-2863-77 and the temperature index shall be minimum 250°C at oxygen index value of 21 when tested as per ASTM-D-2863.</p> <p>(b) The maximum acid gas generation as determined by titration method shall be less than 20% by weight when tested as per IEC-60754-1 (1994). Halogen acid content in outer sheath in FS cables shall not be more than 2%.</p> <p>(c) Flammability</p> <p>(i) Cables shall pass tests under fire condition as per IS-10810-Part-53.</p> <p>(ii) Cables shall also pass tests as per IS-10810 Part-61 & Part-62. Category group shall be considered as Category 'A'.</p> <p>(iii) Fire survival cables in addition to tests (i) and (ii) above shall pass tests as per IEC-331.</p> <p>(d) The smoke generation under fire shall have maximum smoke density rating of 60% when tested as per ASTM-D-2843-77 (1977). Smoke density in FS cables shall not exceed 20%.</p> <p>(e) The cables shall pass the ultraviolet tests as per DIN 53387.</p> <p>(f) The cables shall pass the tests for Water absorption tests as per IS 10810.</p> <p>2.4 The finished cable shall pass the flammability test as per IEC-322-1 (1993) and IEEE-383. In addition, it shall also pass flammability test as per Class F3 of Swedish Standard SS-424-1475 (1977).</p> <p>2.5 In addition, cables for devices mounted on or near hot surfaces of Steam Generators, Turbine Generators, Main steam etc shall have heat resistance type outer sheath.</p> <p>2.6 All LT cable shall have embossing at interval of 1 meter for owner name, size/ core type and length.</p>		
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SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D16
PART B	RRVUNL, 2 x 660 MW Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan CABLE & CABLE CARRIER SYSTEM	SHEET 4 OF 9
<p>2.7 All cables shall be embossed with the name of RVUNL in addition to what is specified in the standards.</p> <p>3.0 <u>DESIGN CRITERIA FOR CABLE SIZING</u></p> <p>3.1 POWER CABLES</p> <p>Power cable sizes shall be selected on the following basis:</p> <p>3.1.1 Power cables shall carry the full load current of the circuit continuously under site conditions considering the condition listed below:-</p> <ul style="list-style-type: none"> (a) Ambient design temperature 50 deg. C. (b) Maximum allowable temperature under normal full load condition and under short circuit condition based on material selected (XLPE). (c) Maximum short circuit fault current. (d) Ambient temperature for underground cables, 50 deg. C. (e) De-rating factors as per IS/IEC and manufacturer's standard catalogues. <p>3.1.2 Power cables shall withstand the fault current of the circuit for the duration not less than the maximum time taken by the primary protective system to isolate the fault. Fault clearing times for ties between two 6.6 kV switchgears shall be considered as 1 sec. Fault clearing times for ties between two 415V switchgears shall be considered as 0.5 sec.</p> <p>3.1.3 For the cables to 415 V motors and feeders protected by fuses, the cross section shall be chosen according to the cut-off current of the fuse and its fusing time.</p> <p>3.1.4 Voltage drop from transformer secondary to motor terminals during starting of motors will be limited to the following values:</p> <ul style="list-style-type: none"> (a) For HV motors (except MDBFP motor) – 15% of the rated voltage (b) For MDBFP motors – 20% of the rated voltage (c) For LV motors – 15% of the rated voltage. <p>3.1.5 Voltage drop in feeder cables shall be limited to 3% during full load running condition. Voltage drop from transformer secondary to motor terminals during full load running of motors shall be limited to 5 % of rated voltage.</p> <p>3.1.6 For power supply to valve actuator motors, actuators of various isolating and regulating dampers and exhaust fans, 3 core 2.5 sq. mm stranded copper conductor cable may be used in view of ease of termination. These cables shall be in other respects similar to cables described in Clause 1.2 above.</p> <p>3.1.7 Design Calculation for arriving at cable size shall be submitted for purchaser's approval.</p> <p>3.1.8 DC System Cables:-</p>		
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<p>3.1.8.1 1100 V grade, single core cables as specified in LT power cables shall be used from batteries/ battery chargers to main DCDB, between main Distribution Board, from main Distribution Board to sub distribution board, main DC supply to various system cabinets/panels, Switchgears etc and for critical auxiliaries. Flexible cables with PVC insulation shall be used where termination of XLPE/PVC insulated cables is difficult.</p> <p>3.1.8.2 Voltage drop in cables between battery to DCDB and battery charger to DCDB shall be limited to 2%. Voltage drop in cables between DCDB and loads shall be limited to 3%.</p> <p>3.1.8.3 Design Calculation for arriving at cable size shall be submitted for purchaser's approval.</p> <p>3.2 <u>CONTROL CABLES</u></p> <p>3.2.1 Current transformer leads shall be checked for the lead burden vis-a-vis the current transformer VA capacity. In case 2.5 sq. mm conductor impose unacceptably high burden on CTs, 4.0-sq. mm conductor shall be used. The conductor material shall be copper.</p> <p>3.2.2 Voltage transformer leads shall be checked for voltage drop which shall be limited to within 1% for all cases other than tariff metering. For tariff metering the voltage drop shall be limited to 0.2%. In case the voltage drop with 2.5 sq. mm conductors exceed this value, higher conductor sizes shall be used.</p> <p>3.3 <u>INSTRUMENTATION CABLE</u></p> <p>3.3.1 Element identification : As per IEC-60189-2</p> <p>3.3.2 Core wrapping : By non-hygroscopic material by taping or by extrusion</p> <p>3.3.3 Element screening : By copper tape of minimum 0.04mm thickness or by copper laminated plastic tape</p> <p>3.3.4 Rip cord : Non-metallic rip cord under the core wrapping</p> <p>3.3.5 Drain wire : A tinned copper drain wire of minimum 0.05 mm² cross section in contact with each screen of cabling element.</p> <p>Cabling elements shall be any one of the following:</p> <p>A 'Pair' of two insulated conductors twisted together designated by alphabet 'p' printed on a binding tape at 200 mm intervals.</p> <p>A 'Triple' of three insulated conductors twisted together designated by alphabet 't', printed on a binding tape at 200 mm intervals.</p> <p>Maximum length of lay in the finished cable shall be 120 mm.</p> <p>3.3.6 <u>Units</u></p> <p>Cables shall be bunched together in units of twenty cabling elements or sub units of five or ten elements, stranded in concentric layers. The units or sub</p>		
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PART B	RRVUNL, 2 x 660 MW Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan CABLE & CABLE CARRIER SYSTEM	SHEET 6 OF 9
<p>units shall be designated by p1, p2, p3,. t1, t2, t3..,q1, q2, q3, .., or Q1, Q2, Q3 ..., etc. depending on the combination.</p> <p>3.3.7 <u>Overall screening and armouring</u></p> <p>Cables shall have an overall screen made up of copper/aluminium tape of 0.04 mm thickness or copper/aluminium of 0.008 mm thickness laminated with plastic tape with a minimum overlap of 15%.A drain wire of tinned copper with minimum 0.5 mm² cross section shall be provided in continuous contact with the screen.</p> <p>3.3.8 <u>Inner and Outer Sheath</u></p> <p>The inner and outer sheaths shall consist of black PVC compound.</p> <p>3.3.9 <u>Insulation Resistance</u></p> <p>Minimum insulation resistance per km shall be 500 mega Ohm.</p> <p>3.3.10 <u>Mutual Capacitance</u></p> <p>Mutual capacitance of any pair of conductors shall not exceed 120 nF/km.</p> <p>3.3.11 <u>Capacitance Unbalance</u></p> <p>The capacitance unbalance between any two pairs shall not exceed 400 pF for 500 metre length of cable.The construction, performance and testing of cables except as mentioned above shall generally comply with the following standards :</p> <p>IEC-60189 - Part-1 : Low frequency cables and wires with PVC insulation and sheath. General test and measuring methods</p> <p>IEC-60189 - Part-2: (-do- Cables in pairs and triples).</p> <p>4.0 <u>CABLE TERMINATIONS</u></p> <p>4.1 Cables shall be laid in trays /trenches/ conduits by the Bidder. Also joint markers shall be provided at each joint.</p> <p>4.2 All 1100V termination for XLPE/PVC power cables and control cables shall be by Double compression weather proof type cable glands. Heavy duty, tinned, long barrel copper lugs shall be used for termination.</p> <p>5.0 <u>CABLE JOINTS</u></p> <p>Cable joints shall be avoided to the extent possible. If joints are unavoidable due to circuit length, in excess of permissible maximum drum length, they shall be heat shrinkable types having a short circuit with stand capacity value as specified in clause 3.1.2 above. Lugs shall be heavy duty, tinned copper, long barrel type. All cable glands shall be double compression, weather proof.</p> <p>6.0 <u>POWER RECEPTACLES</u></p>		
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<p>3 phase, 5 pin, 63A power receptacles with switch shall be provided . The receptacle shall be industrial heavy duty type and shall have suitable interlock facility for safety. The receptacle shall conform to IS 1293 and the switch to IS 4064.</p> <p>7.0 <u>CABLE CARRIER SYSTEM</u></p> <p>7.1 The cable carrier system shall be designed considering the following :</p> <ul style="list-style-type: none"> (a) Facility for easy laying of cables. (b) Access to maintenance. (c) Neat and aesthetic appearance. (d) Safety of equipment & personnel. (e) Ground water seepage. (f) Drainage system for oil and water. <p>7.2 Cables shall be laid in prefabricated ladder (for power and control) / perforated (instrumentation) type trays and in conduits. Also joint markers shall be provided at each joint. The cable trays shall be laid vertical in boiler and ESP area, coal handling and ash handling area.</p> <p>7.3 Cable trays and supporting structures in chemically corrosive area like battery room and water treatment plant shall be mild steel painted trays finished with chlorinated rubber based paint/epoxy paint.</p> <p>7.4 Cable trenches will be avoided to the extent possible inside Fuel oil pump house, water treatment plan where possibility of oil and water collection exists and Boiler & ESP areas.</p> <p>7.5 No direct underground burial cables shall be laid except lighting tower, street lighting. For some exceptional case like isolated individual equipments it shall be allowed after approval by the owner /consultant.</p> <p>8.0 <u>CABLE INSTALLATION AND ACCESSORIES</u></p> <p>8.1 All material and accessories required for cable installation like cable trays, tray covers, support steel, etc., shall be hot dip galvanized. Conduits/pipes shall also be hot dip galvanized steel. The racks/trays, conduits/pipes, trenches required to route the cables to individual equipment shall be supplied and installed by the BIDDER.</p> <p>8.2 Separate trays shall be provided for LV Power (AC&DC)/Control & Instrumentation cables.</p> <p>8.3 After laying all the cables, BIDDER shall dress all cables by clamping at every metre, so that the cables are securely held and aesthetically good.</p> <p>8.4 Cable trays shall be avoided very close to the pipes carrying high temperature steam. When they are inevitable, it shall be laid after OWNER approval and</p>		
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PART B	RRVUNL, 2 x 660 MW Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan CABLE & CABLE CARRIER SYSTEM	SHEET 8 OF 9
<p>suitable insulation material shall be provided between the cable trays and pipes.</p> <p>8.5 1100 V cables up to 120-sq. mm. can be laid in two layers. Control and Instrumentation cables can be laid in three layers.</p> <p>8.6 One spare conduit shall be provided for cable of center / outer drive in clarifier.</p> <p>8.7 Power and control cables for critical / emergency drives / equipment like DC EOP / JOP shall be kept away and routed in separate cable trays</p> <p>8.8 All cable entries to the buildings to be sealed by fire proof & water proof cement after cable installation.</p> <p>8.9 One drum (500m) spare LT power/control of each size of cable shall be included.</p> <p>9.0 <u>CABLE TRAYS AND COVERS</u></p> <p>9.1 All outdoor cable trays are to be provided with covers. All vertical cable tray race ways are to be provided with covers all round. Cable trays shall be of ladder / perforated type complete with all necessary coupler plates, elbows, tees, bends, reducers, stiffeners and other accessories. Cable trays of ladder and perforated types and the associated accessories such as coupler plates, tees, elbows, etc., shall be fabricated from 12 gauge (2.5 mm thick) mild steel sheets. Cable tray covers shall be provided for all cable trays and raceways. The cable tray accessories like trays, elbows, bends, etc., shall be fabricated and galvanized before bringing to site. Cable tray covers shall be fabricated from 16 gauge (1.7 mm thick) MS sheets. All the sheet steel shall be hot dip galvanized.</p> <p>9.2 1100 V rated cables of sizes 120-sq. mm and above shall be laid in single layer. Single core cables used for 3-phase AC power circuits shall be laid in Trefoil form with suitable PVC aluminum clamps to hold the cables.</p> <p>9.3 The sizing of cable trays from TG building to other areas shall consider para 9.2 above an additionally to avoid crowding and criss crossing of cables, especially in boiler area where vertical risers are to be provided for various power, control and instrumentation cables to higher elevations of boiler.</p> <p>9.4 Slotted angles shall not be used for cabling. In all locations smaller size cable trays of 50 mm / 100 mm wide shall be used for one or two cables.</p> <p>10.0 <u>FIRE-PROOF SEALING OF CABLE PENETRATION</u></p> <p>Cables / cable tray openings in walls and floors or through pipe sleeves from one area to another or one elevation to another, between the units and within the same unit, shall be sealed by a fire-proof sealing system. The fireproof sealing system (FPSS) shall effectively prevent the spread of fire from the flaming to the non-flaming side, in the event of a fire. The FPSS shall conform to the following requirements:</p>		
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SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D16
PART B	RRVUNL, 2 x 660 MW Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan CABLE & CABLE CARRIER SYSTEM	SHEET 9 OF 9
<p>(a) FPSS shall have a fire rating of two hours.</p> <p>(b) The FPSS shall be subjected to fire endurance test, hose stream test, temperature measurement of non-flaming side as per ASTM-E119. 'Standard method of fire tests of building construction and materials'.</p> <p>(c) The FPSS will also conform to the in-combustibility test carried out in accordance with IS: 3144-1992.</p> <p>(d) Under fire condition, the FPSS material shall not emit excessive smoke or any corrosive or toxic fumes.</p> <p>(e) FPSS shall have minimum life of 25 years.</p> <p>11.0 FIRE BREAK</p> <p>11.1 Fire break shall be provided by applying a suitable fire-resistant coating on cables for the required length to meet the fire rating of 30 minutes.</p> <p>11.2 Fire break shall be provided at an interval of 15 metres in the straight portion of each of the cable tray above ground, at intervals of 30 metres in cable trenches and at 5M for all vertical trays. All cable inter section and tee offs shall be provided with firebreaks.</p> <p>11.3 When pipe sleeves are provided for cables from outdoor areas to indoor areas, the pipe opening at the outdoor side shall be sealed by fire proof sealing material, which is also continuously waterproof. The indoor side of the pipe opening shall also be sealed by continuous fire proof sealing materials. The duct banks in outdoor areas also need to be sealed by water poof seals. It is necessary to explore possibility of applying waterproof coating on fireproof sealing.</p> <p>12.0 TESTS</p> <p>All routine tests and FRLS tests as per relevant standard shall be performed on each size of cable. If same size is supplied in different lots, inspection shall be done for each lot. If same cable is supplied by different agencies, test shall be carried out on cables supplied by each agency. These tests shall be carried out as per relevant standards as applicable.</p> <p>Routine and acceptance test shall be carried out on FPSS.</p> <p>Type test certificates for type tests conducted on identical design and size of the Cables shall be submitted for review. If type tests have not been done or the certificates are found to be not in order by purchaser then these type tests shall be conducted on Cables to be supplied for this project at no extra cost to Purchaser.</p> <p>13.0 For technical particulars refer datasheet-A.</p>		
		ISSUE R1

SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D16
PART B	RRVUNL, 2 x 660 MW Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan DATA SHEET-A CABLE & CABLE CARRIER SYSTEM	SHEET 1 OF 2

Sr. No.	Description	unit	Client specification
1.0	Name of manufacturer		*
2.0	Make of cable		
3.0	Conductor No. core x Size Form- circular/segmented Effective cross sectional area sq. mm		*
4.0	Whether cores identification numbers for cables with 5 cores and above to be provided		Yes
5.0	Whether incremental running lengths are marked on cable		Yes
6.0	Finished cable a) Diameter under armour in mm b) Diameter over armour in mm c) Overall diameter in mm		*
7.0	Cable drums a) Whether cable drums confirm to IS : 10417 b) Length of cables in drum & tolerance c) Weight of cable drum without cables d) Weight of cable drum with cables e) Type of end sealing		*
8.0	FRLS cables a) Critical oxygen index value at 250 deg C when tested for temperature index test as per ASTM-		Ref. Clause 2.3

REV. NO.	R0	R1	JOB NO.	CLIENT : RRVUNL
PPD. BY :	UM	SK	TCE -	
CKD. BY :	MSVM	MSVM	5750A	
DATE	NOV'2009	JUN'2012		PROJECT : 2 x 660 MW Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan

SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D16
PART B	RRVUNL, 2 x 660 MW Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan DATA SHEET-A CABLE & CABLE CARRIER SYSTEM	SHEET 2 OF 2

Sr. No.	Description	unit	Client specification
	D-2863 b) Total acid gas generation by weight when tested as per IEC – 754-1 in % c) Percentage of light transmission under fire for assessment of smoke generation when tested as per ASTM – D – 2843-77 d) Will the cables offered against this specification pass the flammability tests as per 1) Class – F3 – Swedish standard S5-424- 1475 2) IEC 60332 – 1C 3) IEC 60331 – 1		
9.0	Maximum dielectric loss of cable per KM at normal voltage and frequency	Watt/km	*
10.0	Short circuit capability for 1 Sec (HT & LT Power Cable)	kA rms	Minimum 40kA and 50 kA for HT and LT respectively and shall be in line with requirements of the switchgear and protection.
11.0	Maximum dielectric stress at core screen	KV/cm	*
12.0	Max. overall diameter of cables	mm	*

“*” indicated above shall be filled by BIDDER.

REV. NO.	R0	R1	JOB NO. TCE - 5750A	CLIENT : RRVUNL
PPD. BY :	UM	SK		
CKD. BY :	MSVM	MSVM		
DATE	NOV'2009	JUN'2012		PROJECT : 2 x 660 MW Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan



**TITLE : TECHNICAL SPECIFICATION
FOR
CONDENSER ON LOAD TUBE CLEANING
SYSTEMS (COLTCS)**

SPEC. NO. PE-TS- 392-165-N002

VOLUME : IIB

SECTION : D

REV. NO. 0

**DATE :
27.11.2013**

SHEET 1 of 1


SECTION C3

CONDENSER ONLOAD TUBE CLEANING SYSTEMS

C&I DETAILS

C&I SCOPE MATRIX FOR COLTCS

2X660 MW SURATGARH PROJECT

S.NO.	PROJECT	SURATGARH
1.00	SYSTEM	COLTCS,
2.00	COMMON / PER UNIT	REFER NOTE -03
3.00	CONTROL SYSTEM	DCS (STN C&I)
3.10	PROCESSOR CONFIGURATION FOR PLC SYSTEM	NA
4.00	LOCATION OF CONTROL SYSTEM	CCR
4.10	CONTROL SYSTEM SCOPE (BIDDER/ BHEL/ CUSTOMER)	BHEL
5.00	HARDWIRED INTERFACE WITH DCS (Y/N)	NA
6.00	SOFTLINK TO DCS (Y/N)	NA
7.00	CONTROL FROM PB's ON LCP	NA
8.00	ACTUATOR WITH INTEGRAL STARTER (Y/N)	N
9.00	ANNUNCIATION ON LCP (Y/N) -- IF Y, MIN NO. OF HARDWIRED ALARMS / INDICATIONS	NA
9.10	MIMIC ON LCP (Y/N)	NA
10.00	CONTROL FROM DCS IN CCR (Y/N)	Y
11.00	TYPE OF SOFTLINK (TP/OFC)	NA
12.00	SIZE OF OWS/ CRT OR LCD	NA
13.00	NO. OF PRINTER	NA
14.00	POWER SUPPLY AVAILABLE FOR BALL MONITOR (24V DC / 110 V AC UPS / 230 V AC UPS)	240 V AC UPS
14.10	REDUNDANT FEEDERS (R) / NON-REDUNDANT (NR) FEEDERS FOR POWER SUPPLY	R
15.00	PG/ DPG/ PS/ DPS/ PT/ DPT per Balls Collecting Strainer 	DPT = 02no DPG= 1 no. (ACROSS EACH)

16.00 NOTES:

1. THE ABOVE SCOPE IS APPLICABLE FOR COLTCS (DCS CONTROLLED SYSTEMS).
2. BIDDER TO TERMINATE ALL INSTRUMENTATION AND CONTROL ELEMENTS IN JUNCTION BOXES FOR FURTHER CABLING TO DCS BY BHEL/CUSTOMER. BIDDER TO PROVIDE INPUT/OUTPUT LIST, DRIVES LIST, JUNCTION BOX SCHEDULE AND TERMINATION DETAILS, RECOMMENDED CONTROL LOGICS / WRITE-UP ETC. DURING DETAILED ENGINEERING
3. 2 SETS OF COLTCS SHALL HAVE ONE COMMON STARTER PANEL (SWITCH GEAR PANEL).
4. COLOUR OF STARTER PANEL SHALL BE AS PER IS-5 SHADE 631 OR EQUIVALENT. THIS SHALL BE DECIDED DURING DETAIL ENGINEERING
5. INSTRUMENT RACK AND JUNCTION BOXES SHALL BE IN BIDDER'S SCOPE OF SUPPLY.
6. BIDDER TO FURNISH ELECTRICAL LOAD DATA DURING DETAILED ENGINEERING.
7. BIDIRECTIONAL VALVES ARE NON-INTERGRAL STARTER TYPE.

LEGEND:

DCS- DISTRIBUTED CONTROL SYSTEM

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME V SECTION : D5.4
Package: EPC	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan INSTRUMENTATION AND CONTROL EQUIPMENT SPECIFICATION FOR INSTRUMENTATION & CONTROL EQUIPMENT	SHEET 1 OF 42
<p>1.0 SPECIFICATIONS FOR INSTRUMENTS TO BE SUPPLIED ARE AS FOLLOWS.</p> <p>1.1 Pressure Indicators/DP indicators</p> <p>Direct reading, pipe mounted Pressure gauges of die-cast aluminium body, with 6 inch(150mm) phenolic dial (white dial with black numerals), 316 SS/304 SS Bourdon tube for high pressure application and 316SS Diaphragm/bellow for low pressure applications, AISI 304 movements and micrometer type adjustable aluminium pointer an accuracy of +/-1.0% of span including accessories like siphons for steam services, snubbers for pump discharge applications and chemical diaphragm for corrosive and oil services and name plate, etc. Material of accessories shall be SS. IP65 or equivalent degree of protection for enclosure. Over range protection shall be 50% above maximum pressure. Armoured capillary of 10 M shall be provided as required. Process connection shall be ½"NPT (F).</p> <p>1.2 Pressure Switches/DP Switches</p> <p>Non indicating type, field mounted Pressure Switches of aluminium casing (epoxy coated), and 316 SS element and repeatability of +/-1% of span, including accessories like siphons for steam services, snubbers for pump discharge applications and chemical diaphragm for corrosive and oil services, name plate & mounting brackets. Material of accessories shall be SS. Auto reset micro switch with internal adjustment for set values with 2 SPDT contacts rated for 0.2 A at 220 V DC. IP 65 or equivalent degree of protection for enclosure. Over range protection 50% above maximum pressure. Scale for setting shall be provided. Piston actuated for high pressure applications and diaphragm/bellows for low pressure/vacuum. Process connection ½" NPT (F).</p> <p>1.3 Pressure Transmitters/DP Transmitters/Flow transmitters(DP type/Level transmitters/DP type (SMART))</p> <p>Micro-processor based 2 wire indicating type (LCD display), rack mounted with accuracy of +/-0.075% of span, external zero and span adjustment, self diagnostics, temperature sensor for compensation. Power supply 24 V DC; output signal of 4-20 mA DC. IP 65 or equivalent degree of protection. Aluminum housing with epoxy coating, Accessories like snubbers for pump discharge applications and chemical diaphragm. 10 m PVC covered SS armoured capillary for corrosive and oil services, three way manifold, nameplate etc. Material for accessories shall be SS. Turn down ration 30:1. Load impedance 700 ohm (min).Process connection-1/2"NPT (F). 2 valve manifold for absolute pressure, 3 valve manifold for gauge/vacuum and 5 valve manifold for DP/level/flow measurements. For HFO, LFO applications, SS capillary with ANSI RF flanged ends shall be provided.</p>		
		ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME V SECTION : D5.4
Package: EPC	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan INSTRUMENTATION AND CONTROL EQUIPMENT SPECIFICATION FOR INSTRUMENTATION & CONTROL EQUIPMENT	SHEET 7 OF 42
<p>coloured LCD or fluorescent tube with user selectable span; programmability (selection of input & scan/storage rate) shall be through Front panel keyboard; the recorder shall have the capability of being drawn out from the front side of the housing for maintenance and shall have electrical connection of plug-in type; material of casing shall be die-cast aluminium with epoxy coating and with a non-glare shatter proof Glass; enclosure shall be IP32 The quantity of Hybrid recorders shall be 4 nos.</p> <p>1.21 Pressure and Differential Pressure Transmitter Racks</p> <p>Open type transmitter racks to mount all pressure, differential pressure and flow transmitters with vibration dampener: air supply lines and header shall be provided with bulk head fittings to receive impulse lines; Also provided with blow down/drain header. The material of accessories shall be SS. Drains shall be connected upto suitable Owner / Project Manager's drain header. The quantity shall be as required for the specified Pressure and Diff. Pressure transmitter.</p> <p>1.22 Junction Boxes (JB)</p> <p>All JB's shall be Galvanised. Wall/column mounted junction boxes having 32 (2x16) terminals and cable entry only at the bottom and sealed with fireproof compound; Screwed terminal type; IP 65 or equivalent degree of protection for enclosure. Separate terminal blocks shall be used for analog and digital signal and also for signals with different voltages. Removable gland plate shall be supplied. JB shall have single lockable door with gasket, able to open side ways, with common keys. Painting inside shall be glossy white & outside - IS-5 shade 631. Shield bus for screw connection shall be provided. Terminal size shall be suitable for 0.5 sq.mm to 2.5 sq.mm wire. Terminal blocks shall be vertical. JB shall have provision to add 10% additional terminals. Accessories like metal tag (SS), clamps, fixtures, bolts (SS), nuts (SS), gaskets (neoprene), lock & key, fireproof compound for sealing, etc. shall be supplied. The grouping of instruments in JB's is subject to Owner / Project Manager's approval. All the field Junction boxes shall have single doors and provision for locking. The doors shall not have screwed type of locking, but turnable hinge based. The JB's are subject to approval prior to manufacturing All JB's shall be provided with individual canopies to avoid ingress of water. All the TB's used shall be 6.6polymide to withstand corrosion and the metallic portion shall be coated against rust / corrosion.</p> <p>1.23 Programmable Logic controller (PLC)-Refer Cl.no. 9.0 & Table-15</p> <p>1.24 Interposing Relays (IPR)</p> <p>Electro magnetic type IPRs with plug-in type connections, suitable for channel/rail mounting in cabinets; coil rating 24V D.C; 2 set of silver plated Change over contacts rated for 0.2A 220 V DC. Freewheeling diode across relay coil (copper) and self reset type status indicator flag (electronic) shall be provided. All relays</p>		
		ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME V SECTION : D5.3
Package: EPC	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan INSTRUMENTATION AND CONTROL EQUIPMENT DESIGN, PERFORMANCE AND FUNCTIONAL REQUIREMENTS	SHEET 12 OF 55
7.5	The Contractor shall submit a brief write up on CLCS function for all SG, TG and balance of plant controls along with the bid.	
8.0	OPEN LOOP CONTROL SYSTEM FOR SG & TG AND ITS AUXILIARIES	
8.1	The open loop controls shall be provided as per system requirement.	
8.2	The open loop control system shall be provided as per the guidelines given under clause 4.0 of this section.	
8.3	The Contractor shall submit a brief write up on OLCS function for all SG, TG and balance of plant controls along with the bid.	
9.0	REDUNDANCY AND AVAILABILITY REQUIREMENTS	
9.1	Measurement system (MS), Closed Loop Control System (CLCS) and Open Loop Control System (OLCS) shall all be configured with redundancy at processor modules, communication modules, data bus and power supply modules.	
9.2	Both CLCS & OLCS shall be configured with Redundant I/O channels for each sensor/signals. Where redundant sensors are provided redundant I/O channels shall be provided for each sensors/signals. (For eg. If two sensors are provided for a particular service, then totally 4 input channels are required.). All the outputs from the CLCS and OLCS shall be dual redundant.	
9.3	Boiler protection system & Turbine Protection system shall be with SIL3 certification for each unit.	
9.4	Redundant sensors shall be provided for all control applications.	
9.5	For all important and critical controls (CLCS) triple redundant sensors shall be provided. This will include sensors provided for compensation also. Similarly for critical protection logic requirements triple redundant sensors for 2 out of 3 logic shall be provided to avoid spurious tripping. For all other control application dual redundant sensors shall be provided. Critical closed loop controls are detailed in Clause 12.0 of this section.	
10.0	SENSOR REDUNDANCY- PHILOSOPHY	
10.1	Two out of three measurements philosophy shall be adopted for the control of all critical closed and open loop variables for reliability of operation. The control system shall select the median value for the normal control purpose.	
10.2	In case of deviation of one transmitter output from the other two, the same shall be automatically isolated and average output of the remaining transmitters shall be fed to the control and measurement system and the control loop in this case shall be	
		ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME V SECTION : D5.3
Package: EPC	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan INSTRUMENTATION AND CONTROL EQUIPMENT DESIGN, PERFORMANCE AND FUNCTIONAL REQUIREMENTS	SHEET 13 OF 55
<p>maintained on auto, with an alarm on the operator's monitor as well as maintenance engineer's monitor. In case of failure of the two remaining transmitters in circuit, deviation of one transmitter output is more than the preset limit compared to the other transmitter, there shall be automatic bump less transfer and changeovers shall have suitable alarms.</p> <p>10.3 For all other control parameters the number of sensors / transmitters shall be two. One out of two selection logic and selection of average value of the two signals shall be followed.</p> <p>10.4 In the event of excessive deviation between two signals control system shall trip to manual and it shall be annunciated to bring operators attention and operator has facility to select any of the transmitters through VDU operation.</p> <p>10.5 In the event of failure of one of the two transmitters, it shall automatically select a healthy transmitter but control system shall remain in auto mode.</p> <p>10.6 Separate transmitters shall be used for measurement avoiding signal tapping from control loop/ control transmitter.</p> <p>10.7 For signal compensations, separate signals from separate transmitters shall be used for measurement and control.</p> <p>10.8 Sensor Redundancy For OLCS</p> <p>10.8.1 All sensors for the following causes of trips shall be triple.</p> <p>(a) Unit trips,</p> <p>(b) Boiler trips,</p> <p>(c) Turbine trips</p> <p>(d) Trip of any auxiliary which will lead to substantial (50%) loss of unit availability.</p> <p>10.8.2 All sensors for the following causes of trips shall be dual (requirement specified at Clause 10.8.1 will have priority of application).</p> <p>(a) All HT equipment trips.</p> <p>(b) All LT equipment trips.</p> <p>10.8.3 Single sensors shall be provided for the following:</p> <p>(a) Alarm</p>		
		ISSUE R1

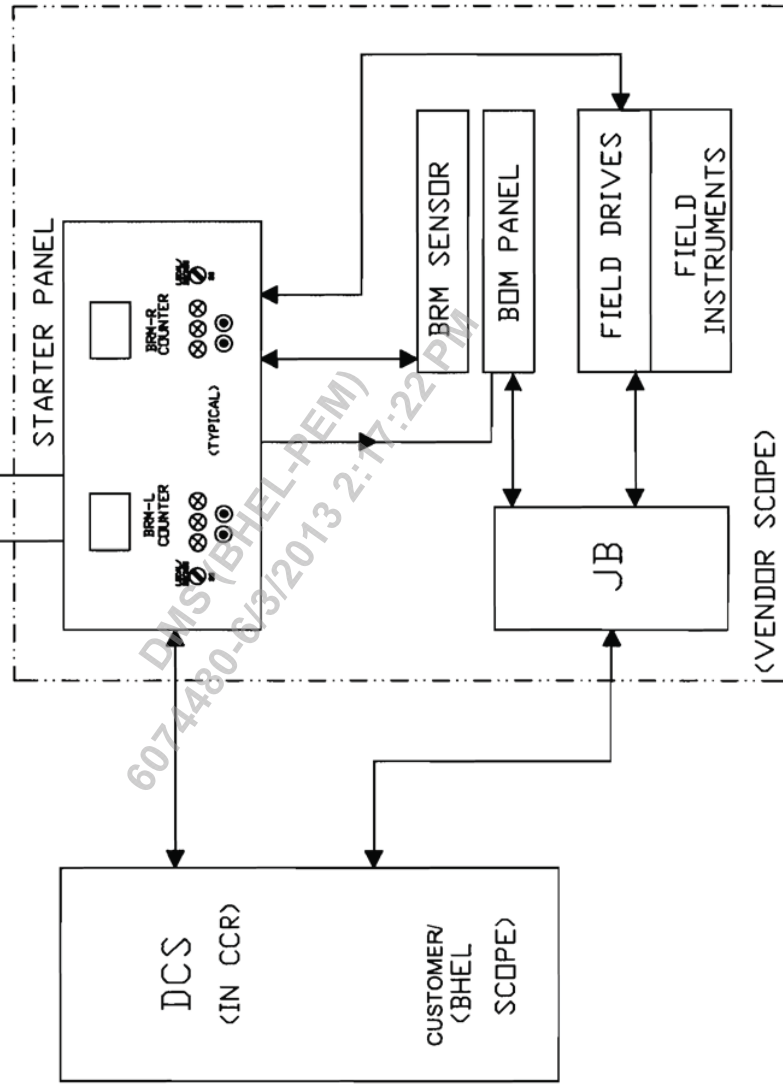
SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME V SECTION : D5.3
Package: EPC	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan INSTRUMENTATION AND CONTROL EQUIPMENT DESIGN, PERFORMANCE AND FUNCTIONAL REQUIREMENTS	SHEET 14 OF 55
<p>(b) Permissive</p> <p>(c) Measurement</p> <p>10.9 Sensor Redundancy For CLCS</p> <p>11.0 CONTROLS INCLUDED IN DCS</p> <p>11.1 Steam Generators (SG) soot blowing controls, Fans, blowers (if applicable) controls for boiler and auxiliaries. All SG closed loop controls like combustion control (fuel flow / air flow), temperature & pressure, air flow, SA/PA pressure, SH/ RH steam temperature, furnace draft, drum level (if applicable) etc..</p> <p>11.2 All turbine analog controls including EHTC for TD BFP(except turbine integral system analog controls)</p> <p>11.3 Co-ordinated Master Control</p> <p>11.4 Regenerative cycle controls like heater drain, deaerator level, deaerator pressure, hotwell level, CEP controls, BFP controls, Hotwell makeup, Vacuum Bkr.vlv gland seal water pressure control.</p> <p>11.5 Balance of plant controls like auxiliary steam, CW & Circulating cooling water system, Emergency cooling water system (if applicable), etc.</p> <p>12.0 CRITICAL CONTROL LOOPS</p> <p>Following CLCS loops are considered critical, for which triple redundant sensors shall be provided for all involved parameters involved in the loop. Parameters involved will also include parameters used for compensation. For the balance control loops, only dual redundant sensors shall be provided.</p> <p>(a) Furnace draft</p> <p>(b) PA Flow Control,</p> <p>(c) SA Pressure control</p> <p>(d) SA Flow control</p> <p>(e) O2 correction control</p> <p>(f) Steam Temperature Control</p> <p>(g) Turbine Governor control</p>		
		ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME V SECTION : D5.3
Package: EPC	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan INSTRUMENTATION AND CONTROL EQUIPMENT DESIGN, PERFORMANCE AND FUNCTIONAL REQUIREMENTS	SHEET 53 OF 55
31.9	For all HT drives alarm and trip signals for bearing and winding temperatures shall be considered through soft LVM from temperature element signal only. No temperature transmitters are required for these signals.	
31.10	All Critical control valves shall be provided with anti-cavitation trim. Control valves / dampers shall be supplied with all accessories including non-contact type position transmitters and E/P Positioners. Combination of I/P + Pneumatic positioner is not acceptable. All inching valves shall be supplied with position transmitters integral with the valve positioner.	
31.11	All transmitters shall be SMART type with integral local LCD indication and HART protocol.	
31.12	All Temperature sensors shall be Duplex type and field mounted temperature transmitter shall be provided for all temperature measurement applications. Direct wiring of RTD or T/C to DCS or PLC is not preferred. (Except for Winding and bearing temperature sensors).	
31.13	Switches (pressure, temperature, level & flow etc.) shall be provided only for critical equipment trip such as BFP/ CEP trip etc. Wherever possible, transmitters shall be provided with required redundancies for all other purposes.	
31.14	Similar make and model shall be provided for same type of I&C system equipment. This shall specifically apply for field transmitters, control valves etc.	
31.15	Smart positioners shall be provided for all control valves/ dampers.	
31.16	Where multiple functions like monitoring /control/alarm etc. are sought to be performed based on a parameter value, in minimum dual sensor shall type be provided.	
31.17	All outdoor field equipment shall be provided with epoxy painting.	
31.18	Individual continuous purging shall be provided for all Air and Flue gas transmitters. The tap points for these services shall be "Y" shaped. The purging line shall be connected near the root valve only and not at the Transmitter end.	
31.19	All local cabinets / utility plant control panels with bottom cable entry shall be provided with suitable pedestals for easy cabling. The panels shall be designed for ease of operation of operating hardware and monitoring the indicators.	
31.20	All local panel indicating lamp/indicating type Push button should be of cluster LED type only. All local panels shall be of double door type instead of double leaf type to avoid ingress of dust in dust prone areas.	
31.21	All motorised bypass valves shall be inching type and shall be provided with position transmitters of non-contact type.	
		ISSUE R1

STANDARD BLOCK DIAGRAM FOR COLTCS PACKAGE WITH DCS CONTROL

415V AC, 3P, 4WIRE
REDUNDANT FEEDER (BY CUSTOMER/BHEL)

CONFIGURATION A:
WITH STARTER PANEL IN VENDOR SCOPE



PE-DG-999-145-I274A(α)



TITLE : TECHNICAL SPECIFICATION
FOR
CONDENSER ON LOAD TUBE CLEANING
SYSTEMS (COLTCS)

SPEC. NO. PE-TS- 392-165-N002

VOLUME : IIB

SECTION : D

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SECTION – D

STANDARD TECHNICAL SPECIFICATION

SECTION D1 : CONDENSER ONLOAD TUBE CLEANING
SYSTEM

SECTION D2 : ELECTRICAL SYSTEMS

SECTION D3 : C&I SYSTEM



**TITLE : TECHNICAL SPECIFICATION
FOR MOU
CONDENSER ON LOAD TUBE CLEANING
SYSTEMS (COLTCS)**

SPEC. NO. PE-TS-XXX-165-N001

VOLUME : III

SECTION :


REV. NO. 0


DATE : 12.05.2012


SHEET 1 of 1


**SECTION D1
STANDARD TECHNICAL SPECIFICATION
FOR
CONDENSER ONLOAD TUBE CLEANING SYSTEMS**

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	TITLE : STANDARD TECHNICAL SPECIFICATION CONDENSER ON - LOAD TUBE CLEANING SYSTEM (Sponge Rubber Ball Type)	SPECIFICATION NO. PE-TS-999-165-N001	
		VOLUME : II B	
		SECTION : D	
		REV. NO. 00	DATE : 27.09.07
		SHEET 1	OF 14
1.00.00	<u>GENERAL</u>		
	<p>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.</p>		
2.00.00	<u>CODES AND STANDARDS</u>		
2.01.00	<p>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.</p>		
2.01.01	<p>IS/BS/DIN/US Standards regarding pressure vessels, pumps, piping, flanges and others as necessary.</p>		
2.01.02	<p>IS/BS/DIN/ASTM Standards for materials specification and testing procedures.</p>		
2.01.03	<p>IS/BS/DIN/AWWA Standards for valves and the testing.</p>		
2.02.00	<p>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.</p>		
3.00.00	<u>DESIGN AND CONSTRUCTION</u>		
3.01.00	General Requirements		
3.01.01	<p>Unless otherwise necessary, manufacturer's standard and proven models of the tube cleaning system shall be supplied.</p>		
3.01.02	<p>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.</p>		
3.01.03	<p>Suitable Corrosion allowance shall be provided whenever necessary. Adequate provision for future installation of cathodic protection shall be provided.</p>		
3.01.04	<p>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.</p>		

	TITLE : STANDARD TECHNICAL SPECIFICATION CONDENSER ON - LOAD TUBE CLEANING SYSTEM (Sponge Rubber Ball Type)	SPECIFICATION NO. PE-TS-999-165-N001	
		VOLUME : II B	
		SECTION : D	
		REV. NO. 00	DATE : 27.09.07
		SHEET 2 OF 14	
3.02.00	<u>Performance Requirements.</u>		
3.02.01	<p>The tube cleaning system with all accessories shall be designed and guaranteed to meet the following requirements :</p> <p>The tube cleaning system shall perform satisfactorily under the flow and pressure drop conditions (in the condenser) specified in Data Sheet - A and shall be capable of removing the various forms of fouling and scaling from condenser tubes.</p>		
3.02.02	<p>The ball separator at the condenser outlet, shall be designed such that the pressure drop across the ball separator under clean conditions shall not be more than that specified in Data Sheet - A. The performance of the ball separator shall be continuous with minimum number of backwashing operations.</p>		
3.02.03	<p>The power consumption by ball recirculation pump during various operations shall be minimum possible.</p> <p>The quantity of cleaning balls worn out and / or lost, shall be minimum possible.</p>		
3.03.00	<u>Operational Requirements.</u>		
	<p>The tube cleaning system and other accessories shall be designed for the following operation modes :</p>		
3.03.01	<p>Complete automatic start-up of tube cleaning system initiated by pressing the push button (manual command).</p>		
3.03.02	<p>Complete automatic shut-down of tube cleaning system with ball collection, effected by the following :</p> <ul style="list-style-type: none"> ◆ 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	<p>Complete automatic backwashing of ball separator with ball collection, effected by the following :</p> <ul style="list-style-type: none"> ◆ Differential pressure measuring system at a pre-determined differential across the ball separating strainer/ screen. ◆ Adjustable timer ◆ Push button 		
3.03.04	<p>Complete automatic emergency backwashing of ball separator with alarm indication, effected by differential pressure measuring system.</p>		
3.03.05	<p>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.</p>		

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3..04.00	<u>Ball Separator</u>		
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 separating 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 handwheels shall be provided to enable manual swivelling of strainers / screens.		
3.05.00	<u>Ball Recirculating Pump</u>		
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.		

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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.

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	<p>The ball collector shall be designed and manufactured as per the applicable codes for pressure vessels.</p> <p>3.06.02 Ball collector shall be provided with an inspection window/sight glass for visual inspection of the cleaning balls.</p> <p>3.06.03 Ball collector shall be provided with suitable ports with covers for ball feeding and removal.</p> <p>3.06.04 The ball collector shall be provided with vent and drain connections with isolating valves.</p> <p>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.</p> <p>3.06.06 If specified in Data Sheet -A, ball collector body shall be lined with suitable resilient material.</p> <p>3.06.07 The differential pressure measuring system shall be provided with D.P. transmitter ,DPS & DPGof remote seal arrangement.</p> <p>3.07.00 <u>Differential Pressure Measuring System.</u></p> <p>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.</p> <p>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.</p> <p>3.07.03 The differential pressure measuring system shall be with remote seal arrangement .</p> <p>3.08.00 <u>Ball Monitoring System</u></p> <p>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 :</p> <ol style="list-style-type: none"> 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. 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. Bidder's if not manufacturing ball oversized monitor, can supply automatic ball sorter in lieu of same for automatic sorting of the undersized balls. 	

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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°C. 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 ,

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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

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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.

3.15.00 **Materials of Construction**

Materials of various equipments in the tube cleaning system shall be corrosion resistant and consistent with the fluid handled. However, material specification for various components shall be equal to or superior to those specified in Data Sheet-A.

4.00.00 **PAINTING**

4.01.00 The surface preparation of the various equipments / components of the tube cleaning system shall be done as per the standard mentioned in Data Sheet - A and shall include the following :

a) Removal of oil, grease, dirt and swarf etc.

b) Removal of rust and scale etc.

c) Sand blasting / shot blasting.


4.02.00 All internal surfaces of the various equipments / components of the tube cleaning system, which are subjected to immersion or water spray and which are not made of stainless steel or other corrosion resistant materials after surface preparation, shall be coated with epoxy paint of approved make and quality over a coat of zinc chromite primer, unless otherwise specified in Data Sheet - A.

4.03.00 The external surfaces of the various equipments / components of the tube cleaning system after surface preparation, shall be coated with synthetic enamel paint of approved make and quality over two coats of red oxide primer, unless otherwise specified in Data Sheet -A.

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

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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

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	per ISO-1940		
5.04.00	<u>Ball Collector</u>		
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	<u>Piping, Valves, Distributors, and Injection Nozzles.</u>		
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	<u>Rubber Lining (as applicable)</u>		
	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	<u>Flanges</u>		
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.		

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5.08.00	<u>Dimensional Checks.</u>
	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	<u>Hydrostatic Test</u>
	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	<u>Leakage Test</u>
	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	<u>Performance Test on Recirculating Pump</u>
	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	<u>Functional Tests</u>
	Various assemblies / 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	<u>TESTING AT SITE</u>
	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.

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

The Tube Cleaning Systems shall be guaranteed to meet the performance requirements specified in Section-D , Data Sheet A and Guarantee schedule and also for trouble free operation after commissioning. Schedule of performance guarantees (enclosed in Volume III) duly filled and signed shall be furnished with the bid.

The Performance guarantees of equipments shall stand valid till the satisfactory completion of performance testing & its acceptance by BHEL/ Customer. If the guarantee period specified in the Commercial Specification is higher, same shall prevail.

7.01.00 Performance Parameters to be guaranteed by bidders shall be as under :

- i) Pressure drop in ball separator in clean condition viz. after back washing.
- ii) Percentage recovery of balls (min. 95% recovery)
- iii) Life of Sponge Rubber Ball (Min. 4 weeks)

7.02.00 Bidder to note that bids shall be evaluated on account of pressure drop across ball collecting strainer (in clean condition) and liquidated damages on account of not meeting the same during PG test shall be in accordance with following :

A) Bid Evaluation Criteria & Liquidated Damages:

The bids received shall be evaluated for Pressure drop across balls collecting strainers :


- The permissible limit of pressure drop across balls collecting strainers in clean condition shall be 0.15 MWC.
- If the pressure drops quoted are higher than above limit, the bids shall be technically loaded @ indicated in Data Sheet A .
- However no advantage shall be given for pressure drops quoted less than above permissible limit.
- The maximum acceptable limit for pressure drop across balls collecting strainer shall be (with technical loadings) 0.2 MWC.


The bids will be technically rejected for pressure drops quoted higher than above maximum limit.

- The guaranteed pressure drops shall be demonstrated at site by bidder and if found higher shall be subject to LD @ twice the bid evaluation factor as above.

7.03.00 OtherGuaranteed Parameters to be demonstrated at site

- i) Life of sponge rubber balls shall be minimum 4 weeks.
- ii) Percentage recovery of balls shall be minimum 95%.

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<p>Any deviation to above balls life and percentage recovery will not be accepted.</p>			
<p>Bidder to indicate the life of sponge rubber ball and nos. of balls lost during 1000 hours of plant operation in the Guarantee schedule and shall demonstrate same at site.</p>			
<p>In case the successful bidder fails to demonstrate any of these parameters he shall carry out modifications at his own cost, to purchasers approval.</p>			
<p>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.</p>			
<p>8.00.00</p>	<p><u>QUALITY ASSURANCE & QUALITY PLAN</u></p>		
<p>8.01.00</p>	<p>The tube cleaning system and other accessories to be supplied, shall have assured quality and workmanship.</p>		
<p>8.02.00</p>	<p>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.</p>		
<p>9.00.00</p>	<p><u>NAME PLATE AND TAG NUMBERS</u></p>		
<p>9.01.00</p>	<p>Ball separator, recirculating pump, ball collector shall be provided with a permanently attached brass or stainless steel plate indicating the following details :-</p> <ul style="list-style-type: none"> a) Design and maximum flow rates. b) Design and test pressures. c) Design temperature. d) Empty and operating weights. 		
<p>9.02.00</p>	<p>Each valve in the tube cleaning system shall be provided with a name plate indicating the following :-</p> <ul style="list-style-type: none"> a) Service. b) Design and test pressures. c) Maximum flow and flow direction. d) Size. e) Tag Number. <p>Tag Numbers will be indicated on the drawings submitted for approval during contract stage.</p>		
<p>9.03.00</p>	<p>Each motor shall be provided with a name plate indicating the following details :</p> <ul style="list-style-type: none"> a) Supply conditions. b) KW Rating. c) Make. 		


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10.00.00


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

The drawings, data and other documents as required in Data Sheet-C shall be furnished after the award of contract.


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1.00.00	<u>DRAWING, DATA & INFORMATION TO BE SUBMITTED AFTER THE AWARD OF CONTRACT.</u>
	After the award of contract, the following drawings, data and information is to be submitted for review / approval of BHEL as per the distribution schedule given in Section - C.
1.01.00	Within 2 (two) weeks of the date of LOI, the following shall be submitted,
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 :- <ul style="list-style-type: none">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.

	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. 05	DATE : 29.07.2007
		SHEET 2 OF 2	
<p>1.02.08 List of annunciations, protections and interlocks provided.</p> <p>1.02.09 Detailed drawings of flanges.</p> <p>1.02.10 Ball recirculating pump performance characteristic curves.</p> <p>1.02.11 Write-up and instruction manuals for erection, operation and maintenance.</p> <p>1.02.12 Storage instructions.</p> <p>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.</p> <p>G:\MSEVASHISTSCOTCS.RTF</p>			

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	TITLE : STANDARD TECHNICAL SPECIFICATION		SPEC. NO. PE-TS- 392-165-N002	
	DATA SHEET-A		VOLUME : II B	
	CONDENSER ON - LOAD TUBE CLEANING		SECTION-D	
	SYSTEM (Sponge Rubber Ball Type)		REV. NO. 0	DATE: 27.11.13
SL.NO	PROJECT	RRUVNL SURATGARH STPS (2X660MW)		

1	GENERAL		
1.1	Nos. of tube cleaning systems sets required for station	NOS.	Four (04) Nos. for 2 units viz. One independent set for each half of condenser
1.2	Liquid handled		Clarified Water as per Analysis Attached along with project information in section B.
1.3	Size of COLTCS	Nb	2500 NB
2.0	DESIGN		
2.1	Operating pressure at Condenser inlet flange	kg/cm2 (g)	Approx 1.8 to 2.2
2.2	Design Pressure for ball separator	kg/cm2 (g)	5.0 kg/cm ² (g) & vacuum 0.1 kg/cm ² (abs)
2.3	Design Mechanical Temperature	Deg. C	60
2.4	Condenser Details		
	a) Type of condenser		Single pass
	b) No. of Condenser sections	Nos.	2 (Two)
	c) No. of passes per condenser section (viz. condenser half)	Nos.	1 (One)
	d) No. of tubes per condenser	Nos.	35000
	• Top two rows		2450
	• Remaining		32550
	e) Tube Dia. OD x Thickness		
	• Top two rows	mm x mm	22.225 x 1.244
	• Remaining	mm x mm	22.225 x 0.7112
	f) Length of tubes between ends.	mm	17900
	g) Tube material		Welded SS: ASTM A 249 TP 304
	h) Pressure drop across condenser - At Normal flow (between Inlet and Outlet flanges of condenser)	MWC	3.26 MWC (However the actual value can vary +/-10% of the design value)
2.5	CW flow rate through each ball separator		
	- Normal	cu.m/hr	34390
	- Maximum	cu.m/hr	41268
2.6	Design differential pressure for ball separator strainer/screen	Kg/cm ² (g)	0.2

	TITLE : STANDARD TECHNICAL SPECIFICATION DATA SHEET-A CONDENSER ON - LOAD TUBE CLEANING SYSTEM (Sponge Rubber Ball Type)		SPEC. NO. PE-TS- 392-165-N002	
			VOLUME : II B	
			SECTION-D	
			REV. NO. 0	DATE: 27.11.13
SL.NO	PROJECT	RRUVNL SURATGARH STPS (2X660MW)		


2.7	Pressure drop across ball separator i.e. between inlet & outlet flanges in clean condition at normal flow.	MWC	0.15
2.8	Pressure drop across ball separator in choked condition when strainer backwashing starts	MWC	Not to exceed 0.30
2.9	No. of balls required for COLTCS per condenser section	Nos.	Minimum 10% of number of condenser tubes
3	<u>CONNECTING PIPE DETAILS</u>		
3.1	Condenser inlet pipe		
	a) Material		Carbon Steel to IS – 2062 Gr. B rolled & welded conforming to IS:3589
	b) O.D. X Thickness	mm x mm	2540 X 20
3.2	Condenser outlet pipe		
	a) Material	CS	Carbon Steel to IS – 2062 Gr. B rolled & welded conforming to IS:3589
	b) O.D. X Thickness	mm x mm	2540 X 20
3.3	Manhole		Yes, 600 NB size
4.0	<u>MATERIALS OF CONSTRUCTION</u>		
4.1	BALL SEPARATOR		
	a) Body / housing		Carbon Steel to IS -2062 Gr.B. with epoxy painted inside (with minimum housing thickness same as connecting pipe thickness)
	b) Screen / Strainer		SS-316
	c) Strainer shaft		SS-316
	e) Internal Hardware including nuts, bolts , etc.		SS-316
	f) Site Glass provision		Yes
4.2	BALL RECIRCULATING PUMP		Non Clog type
	a) Casing		CI to IS 210 FG 260
	b) Impeller		SS-316
	c) Shaft		SS-316
4.3	<u>BALL COLLECTOR</u>		
	a) Body / housing		Carbon steel-IS 2062 Gr. B with epoxy painted inside
	b) Screen / Strainer		SS-316
	c) Site Glass Provision		Yes

	TITLE : STANDARD TECHNICAL SPECIFICATION DATA SHEET-A CONDENSER ON - LOAD TUBE CLEANING SYSTEM (Sponge Rubber Ball Type)		SPEC. NO. PE-TS- 392-165-N002	
			VOLUME : II B	
			SECTION-D	
			REV. NO. 0	DATE: 27.11.13
SL.NO	PROJECT	RRUVNL SURATGARH STPS (2X660MW)		


4.4	Differential pressure measuring system		SS-316
4.5	Injection nozzle		SS-316
4.6	Valves		
4.6.1	Check Valves (65 NB & Above)		For sizes 65 NB and above-Swing check type or dual plate type.
	a) Body & Bonnet		CI, IS 210, Gr.FG 260, Flanged Ends
	b) Disc for Check Valve		CI, IS 210 Gr. FG 260
	c) Stem		ASTM B132 Gr-A/ IS 320 HT2
4.6.2	Check Valves (50 NB & Below)		For size 50 NB and below-Piston type
	a) Body & Bonnet		ASTM B 62/ IS 318 Gr 2
	b) Disc for Check Valve		ASTM B 62/ IS 318 Gr 2
	c) Stem		ASTM B132 Gr-A/ IS 320 HT2
4.6.3	Gate/ Globe Valves 50 Nb & Below		
	Body & Bonnet		Gun metal as per IS 318 Gr. 2, screwed ends
4.6.4	➤ BF/Gate Valves (65 NB & above)		
	➤ Body & Disc		CI IS 210, FG 260
	➤ Shaft		SS
	➤ Stem		ASTM B132 Gr-A/ IS 320 HT2
	➤ Sealing, Retaining segment & internals		18 – 8 SS
	➤ Bearings		Self lubricating
	➤ Companion Flange		IS 2062, Gr. B
	<u>C) Ball valves</u>		
	i) Body		SA 351 CF8M
	ii) Ball		SA 351 CF8M
	iii) Stem		SS 316

	TITLE : STANDARD TECHNICAL SPECIFICATION		SPEC. NO. PE-TS- 392-165-N002	
	DATA SHEET-A		VOLUME : II B	
	CONDENSER ON - LOAD TUBE CLEANING		SECTION-D	
	SYSTEM (Sponge Rubber Ball Type)		REV. NO. 0	DATE: 27.11.13
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4.7	Interconnecting Piping		By Bidder
	Material		a) Upto 150NB - Carbon steel ERW, IS:1239 (Heavy Grade) b) Greater than 150NB – CS to IS 2062 Gr. B, rolled & butt welded, conforming to IS 3589
5	COUNTER FLANGES for Ball Separator		
	a) Flanges		Carbon Steel to IS 2062 Gr. B or eq for thickness, drilling etc refer Annexure II in section C1
	b) Fasteners		A 193 & A 194 (In Bidder's scope).
	c) Gaskets		Min 4 mm thick rubber
6	OTHER COUNTER FLANGES (for interconnecting piping)		In Bidder's scope
6.1	MATERIALS		
	a) Flanges		Carbon Steel to IS 2062 Gr. B
	b) Fasteners		A 193 & A 194
	c) Gaskets		Min 4 mm thick rubber
7.0	Material of Other components not specified above		Suitable for intended duty and shall be subject to Purchasers approval during detailed engg. In the event of order.
8.0	PAINTING		
8.1	INTERNAL SURFACE		
	a) Surface preparation		SA - 2.5 of Swedish Specn. SIS-05-59-00-1967
	b) Primer		Two coat of Epoxy Resin based Zinc Phosphate epoxy primer
	c) Final paint		Adequate no. of coats of coal tar epoxy paint to achieve total dry film thickness of 200 to 250 microns
8.2	EXTERNAL SURFACE		
	a) Surface preparation		SA-2.5 of Swedish Specn. SIS-05-5900-1967
	b) Primer		Two coat of Epoxy resin based zinc phosphate epoxy primer
	a) Intermediate		Epoxy based TiO2 pigmented coat
	d) Final paint		Two coats of Chlorinated rubber paint to achieve total DFT of 175 to 200 microns.

	TITLE : STANDARD TECHNICAL SPECIFICATION		SPEC. NO. PE-TS- 392-165-N002	
	DATA SHEET-A		VOLUME : II B	
	CONDENSER ON - LOAD TUBE CLEANING		SECTION-D	
	SYSTEM (Sponge Rubber Ball Type)		REV. NO. 0	DATE: 27.11.13
SL.NO	PROJECT	RRUVNL SURATGARH STPS (2X660MW)		


9.0	Adequate provision for future installation of cathodic protection (Sacrificial type anodic protection by Purchaser)		YES
10.0	Flow straightner 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.
11.0	Performance Guarantee & Bid Evaluation		
11.1	Performance Parameters to be Guaranteed		
	❖ Pressure drop in ball separator in clean condition		As per Guarantee schedule of bidder
	❖ Percentage recovery of balls		Min. 90 % recovery
	❖ Life of sponge Rubber Balls		Min. 3 weeks
11.2	Bid evaluation Criteria & Liquidated damages		As per clause no 8.00.00 of Section C1
11.3	Bid evaluation rate		@ Rs. 25.0 Lacs per 0.05 MWC pr. drop across each balls collecting strainer
11.4	Liquidated damages		Twice the bid evaluation rate
12.0	The tube cleaning system shall be designed for following operation modes		
	a) Automatic start up initiated by push button		YES
	b) Automatic shut down with ball collection effected by : i. Push button ii. Adjustable timer iii. Ball monitoring system		YES
	c) Automatic backwashing of ball seperator with ball collection effected by : a. Push button b. Adjustable timer c. Diff. Pressure measuring system		YES
	d) Automatic emergency backwashing of ball seperator effected by diff. Pressure measuring system		YES
	e) Automatic ball sorting initiated by push button		YES
	f) Provision for manual operation of complete tube cleaning system in case of control system failure		YES
	g) Whether the contacts for DPG, DPS and DPT are independent		YES
	h) Timer for Backwashing		YES

	TITLE : STANDARD TECHNICAL SPECIFICATION		SPEC. NO. PE-TS- 392-165-N002	
	DATA SHEET-A		VOLUME : II B	
	CONDENSER ON - LOAD TUBE CLEANING		SECTION-D	
	SYSTEM (Sponge Rubber Ball Type)		REV. NO. 0	DATE: 27.11.13
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	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
	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
	k) Whether provision for self testing and self calibration are made		YES
13.0	Mandatory Spares to be supplied under this specification.		
13.1	Mandatory Spares (Mechanical)		Quantity for both units
1	Sponge balls		50 Charges viz. Total 87500 nos. balls
2	Abrasive balls		20 Charges viz. Total 35000 nos. balls
3	Worm gear assembly for Ball separator screen		1 Set
4	Ball separator screen		1Set
5	Ball recirculating pump for tube cleaning system		
5.1	Rotating assembly		1 Set (Rotating assembly consists of all the rotating parts except the bearings.)
5.2	Shaft with sleeves		1 Set
5.3	Wearing rings (if applicable)		2 Sets
5.4	Bearings		2 Sets
5.5	Impeller		1 No.
Note: One charge shall be equal to the total No. of balls required for each COLTCS per condenser section.			
13.2	Mandatory Spares (C&I Items)		

	TITLE : STANDARD TECHNICAL SPECIFICATION DATA SHEET-A CONDENSER ON - LOAD TUBE CLEANING SYSTEM (Sponge Rubber Ball Type)		SPEC. NO. PE-TS- 392-165-N002	
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			SECTION-D	
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SL.NO	PROJECT	RRUVNL SURATGARH STPS (2X660MW)		


S.no.	Field Instruments/ Elements /Equipment (Gauges, Switches, transmitters etc.)		Quantity for both units
1	Local gauges (including PG, DPG etc.)		10 %For each type, size and range or minimum 2 No. whichever is higher.
2	Field Switches (including PS, DPS etc)		10 %For each type, size and range or minimum 2 No. whichever is higher.
3	Transmitters (incl PT, DPT etc.)		10 %For each type, size and range or minimum 2 No. whichever is higher.
4	Junction Box		10 %For each type, size and range or minimum 2 No. whichever is higher.
5	Panels, local panels, System/Marshalling cabinets		
5.1	Fuses		100 Nos. of each type and rating
5.2	Miniature Ckt.Breaker(MCB)		20 Nos. of each type and rating
5.3	Male/Female parts of pre-fabricated cables		12 Nos. of each type
5.4	Space Heater		10 % For each type,size and range or minimum 2 No. whichever is higher.
5.5	Smoke detector		10 % For each type,size and range or minimum 2 No. whichever is higher.
5.6	Terminal Blocks		20 % of total quantity
5.7	Terminals in Terminal blocks		20 Nos. of each type
5.8	Cable clamps		10 Nos. of each type
5.9	Blowers		2 No
5.10	Cabinet Cooling Fans		8 Nos. of each type/rating
Note: Whoever % is indicated for mandatory spares, the quantity shall be calculated for % of supply for total quanity for 2 units of 2x660 MW Suratgarh, unless otherwise specified. The quantity to be reckoned for % indicated shall rounded off to the next higher whole number. For example if the % arrived is 0.2, the quantity to be supplied shall be 1 and if it is 5.1 then quantity supplied shall be 6.			
13.3	Mandatory Spares (Electrical Items)		
S.no.	LT Motors(AC/DC)		Quantity for both units
1	Motor		1 No of each type
2	Bearings		1 Set of each type
3	Cooling fan		3 Nos. of each type
14.0	Documents enclosed for bidder's reference		
	❖ Water Analysis		Indicated in project information in Section B.
	❖ GA of CW piping in TG hall		Attached as per Annexure-III

		Manufacturer's Name & Address		STANDARD QUALITY PLAN		BHEL Doc No.: PE- V1 -XXX- 185-N008	
				INDEX		PROJECT:	
				Vendor Q.P. NO.		CUSTOMER:	
				PACKAGE : COLTCS		PURCHASER:	
				Date :		CONSULTANT:	
				Page 01 of 15		P.O. No.	
				DESCRIPTION		PAGE NO.	
		SL. NO.					
		1		BALL SEPARATOR		2 TO 5	
				WORM GEAR		6	
				ACTUATORS		6	
		2		BALL RECIRCULATION SKID		7	
				BALL VESSEL		7,8	
				BALL INJECTION NOZZLE		8	
				BALL RECIRCULATING PUMP		9	
				BALL VALVE		10	
				RECIRCULATING PUMP MOTOR		11	
		3		V - PIECE		11	
		4		BALL OVERSIZE MONITOR		12	
		5		PRESSURE GAUGE DP GAUGE DP SWITCH & DP TRANSMITTER		13	
		6		CLEANING BALLS		13	
		7		ALL COMPONENT & EQUIPMENT		13	
		8		STARTER PANEL		14	
		9		FASTENERS		15	
				Note: Items not included in quality plan to be inspected as per approved data sheet/drawings			
				ANNEXURES			
				DRY RUN TEST PROCEDURE FOR BALL SEPARATOR			
				HYDRO STATIC TEST PROCEDURE			
				LEAK TIGHTNESS TEST PROCEDURE			
				PACKING PROCEDURE			
				LEGEND			
				* Records identified with "STAR" shall be essentially included by contractor in QA Documentation.			
				** M. Manufacturer / Manufacturer's Sub-contractor			
				C. Contractor			
				Indicate "P" - Perform, "W" - Witness and "V" - Verification			
				Manufacturer / Sub-Contractor Signature			
				Contractor			
				Reviewed By			
				Name & Sign. Of approving authority & Seal			

Manufacturer's Name & Address		STANDARD QUALITY PLAN										BHEL Doc No.: PE-V1-XXX-165-N008	
P.O. No.		Item : Ball Separator		Vendor Q.P. NO.		PACKAGE : COLTCS		PROJECT:		CUSTOMER:			
Component / Operation		Class		Type of Check		Quantum of Check		Reference Documents		Date :			
Sl. No.		Characteristics Checked		Type of Check		Quantum of Check		Reference Documents		Date :			
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130		4		5		6		7		8			
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132		4		5		6		7		8			
133		4		5		6		7		8			
134		4		5		6		7		8			
135		4		5		6		7		8			
136		4		5		6		7		8			
137		4		5		6		7		8			
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140		4		5		6		7		8			
141		4		5		6		7		8			
142		4		5		6		7		8			
143		4		5		6		7		8			
144		4		5		6		7		8			
145		4		5		6		7		8			
146		4		5		6		7		8			
147		4		5		6		7		8			
148		4		5		6		7		8			
149		4		5		6		7		8			
150		4		5		6		7		8			
151		4		5		6		7		8			
152		4		5		6		7		8			
153		4		5		6		7		8			
154		4		5		6		7		8			
155		4		5		6		7		8			
156		4		5		6		7		8			
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158		4		5		6		7		8			
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163		4		5		6		7		8			
164		4		5		6		7		8			
165		4		5		6		7		8			
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171		4		5		6		7		8			
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176		4		5		6		7		8			
177													

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Manufacturer's Name & Address			STANDARD QUALITY PLAN					BHEL Doc No.: PE-V1-XXX-16S-N008	
P.O. No.			Vendor O.P. NO.					PROJECT:	
Item: Ball Vessel & Ball Injection Pipe			PACKAGE: COLTCS					CUSTOMER:	
Date:			Date:					PURCHASER:	
Page 08 of 15			Page 08 of 15					CONSULTANT:	
Sl. No.	Component/Operation	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	Agency	Remarks
1	2	3	4	5	6	7	8	9	10
2.2.5	Fit-up of butt weld dimensions	Major	Measurement	100%	Manufacturing Drawing	ASME Sec VIII Div.1	Log book	P	WV
2.2.6	Fit-up of shell flange and nozzle assembly to shell	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	Major	Penetrant test / Visual	100%	ASME Sec VIII Div.1 Appendix 8	ASME Sec VIII Div.1 Appendix 8	Operation Process Sheet	P	V
2.2.8	(a) Completed butt welds	Major	Penetrant test	100%	ASME Sec VIII Div.1 Appendix 8	ASME Sec VIII Div.1 Appendix 8	Inspection report	P	V
	(b) Completed fillet welds	Critical	10% of total weld length & 100% of joints	100%	ASME Sec VIII Div.1 Appendix 8	ASME Sec VIII Div.1 Appendix 8	RT films will be reviewed by BHEL	P	V
2.2.9	Fabricated Shell	Major	Measurement	100%	Manufacturing Drawing	ASME Sec VIII Div.1 Appendix 8	Inspection report	P	V
	2. Hydro test for Ball Vessel	Critical	Hydrostatic test (1.5 times design pr. (positive) (Duration 30 minutes)	100%	ASME Sec VIII Div.1	ASME Sec VIII Div.1	Inspection report	P	W
2.2.10	Pickling and Passivation	Major	Visual	100%	IS : 10117	IS : 10117	Log Book	P	-
2.2.11	Ball Injection Pipe	Major	Chemical & Physical properties	One sample/heat	Approved dig/Data sheet	dig/Data Approved sheet	Mill Test Certificate / lab test report / raw material flow sheet	P	V
	Surface defects	Minor	Visual	100%	Approved dig/ Data sheet	dig/ Data Approved sheet	MTC / Inspection report	P	V
	Leak Tightness	Major	Hydrostatic test	100%	Approved dig/Data sheet	dig/Data Approved sheet	Test Certificate	P	V
<p>LEGEND</p> <p>* Records identified with "STAR" shall be essentially included by contractor in QA Documentation</p> <p>** M: Manufacturer / Manufacturer's Sub-contractor</p> <p>C: Contractor</p> <p>O: Owner</p> <p>Indicate "P" - Perform, "W" - Witness and "V" - Verification</p>									
Manufacturer / Sub-Contractor Signature								Name & Sign. Of approving authority & Seal	


		Manufacturer's Name & Address		STANDARD QUALITY PLAN				BHEL Doc No.: PE-VI-XXX-16S-N008	
		P.O. No.		Vendor Q.P. No.		PROJECT:		CUSTOMER:	
Component / Operation		Item : RECIRCULATING PUMP		PACKAGE : COLTOS		PURCHASER:		CONSULTANT:	
Sl. No.		Class		Type of Check		Quantum of Check		Reference Documents	
1		3		4		5		6	
2.3.0 Raw material control		4		5		6		7	
2.3.1 Casing		Major		Chemical & Physical analysis		One Sample/Cast /Heat		Approved dtp/ Data sheet	
2.3.2 Impeller, Sleeve		Minor		Visual		100%		Approved dtp/ Data sheet	
2.3.3 Shaft		Major		Physical and Chemical analysis		One Sample/Cast /Heat		Approved dtp/ Data sheet	
2.3.4 In-process control		Major		Ultrasound Test		100%		ASME SA 745	
2.3.5 Casing		Critical		Hydro test @ 1.5 times design pressure (Duration 30 minutes)		100%		Manufacturing Standard	
2.3.6 Shaft		Critical		Penetrant test		100%		ASME Sec.VIII Div.1 Appendix 6	
2.3.7 Impeller		Major		Static/dynamic balancing		100%		ISO 1940, Gr 6.3	
2.3.8 All components		Major		Measurement, visual examination		100%		Manufacturing drawing	
2.3.9 Assembly, control, final inspection		Major		Test		100%		Log book / job card	
Performance Test		Critical		Performance test		100%		Approved curve data sheet	
2.3.10 Complete pump		Major		Visual examination		100%		Approved data sheet / Mfg. Dwg.	
LEGEND									
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** M. Manufacturer / Manufacturer's Sub-contractor									
C. Contractor									
Indicate "P" - Perform, "W" - Witness and "V" - Verification									
Manufacturer / Sub-Contractor Signature									
Contractor Signature									
Reviewed By									
Name & Sign. Of approving authority & Seal									

Manufacturer's Name & Address		STANDARD QUALITY PLAN				BHEL Doc No.: PE-V1-XXX-165-N008	
P.O. No.		Vendor Q.P. NO.		PACKAGE: COLTCS		PROJECT:	
Item: BALL VALVES		Date: 10/01/15		CUSTOMER:		PURCHASER:	
Reference Documents		Acceptance Norms		CONSULTANT:		Remarks	
Quantum of Check		Format of Record		Agency			
6		8		M C O		11	
3		7		D			
4		5					
Sl. No.	Component / Operation	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record
1	2	4	5	6	7	8	9
2.4.0	Ball valves						
2.4.1	Materials						
	Body and Tail end pieces	Major	Chemical & Physical analysis	One Sample/Case /heat	Approved dtp/ Data sheet	Approved dtp/ Data sheet	Manufacturer's T.C.
2.4.2	Ball	Major	Chemical & Physical analysis	One Sample/Case /heat	Approved dtp/ Data sheet	Approved dtp/ Data sheet	Manufacturer's T.C.
2.4.3	Stem	Major	Chemical & Physical analysis	One Sample/Case /heat	Approved dtp/ Data sheet	Approved dtp/ Data sheet	Manufacturer's T.C.
2.4.4	In-process inspection						
2.4.5	Machining of body, end, pieces, ball	Major	Measurement	100%	Approved dtp/ Data sheet	Approved dtp/ Data sheet	Log book
2.4.6	a) Surface defects	Critical	Penetrant test	100%	ASME Sec.VIII Div.3	ASME Sec.VIII Div.3	Inspection report
	b) Hardness	Major	Hardness testing	Random	Approved dtp/ Data sheet	Approved dtp/ Data sheet	Inspection report
2.4.7	Assembly	Major	Measurement	100%	EN ISO 17292	EN ISO 17292	Manufacturer's T.C.
	a) Dimensions	Major	Measurement	100%	EN ISO 17292	EN ISO 17292	Manufacturer's T.C.
	b) Opening / Closing	Major	Operation	100%	As per approved data sheet	As per approved data sheet	Test at works for opening / closing time of actuator operated valves
2.4.8	Testing						
	(a) Body	Critical	Hydraulic test	100%	EN 12266-1&2/API 598	EN 12266-1&2/API 598	Manufacturer's T.C.
	(b) Seat test	Critical	Hydraulic test	100%	EN 12266-1&2/API 598	EN 12266-1&2/API 598	Manufacturer's T.C.
	(c) Seat	Critical	Air test	100%	EN 12266-1&2/API 598	EN 12266-1&2/API 598	Manufacturer's T.C.
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Manufacturer / Sub-Contractor Signature				Reviewed By			
				Name & Sign. Of approving authority & Seal			

Manufacturer's Name & Address		STANDARD QUALITY PLAN				BHEL Doc No.: PE-V1-XXX-165-N008								
P.O. No.		Vendor Q.P. NO:				PROJECT:								
Item : RECIRCULATING PUMP MOTOR		PACKAGE : COLTCS				CUSTOMER:								
V PIECE		Date :				PURCHASER:								
Page 11 of 15		CONSULTANT:				Remarks								
Sl. No.	Component / Operation	Characteristics	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	Agency	M	C	O		
1	2	3	4	5	6	7	8	9	10	11	12	13		
25.0	Motor	Routine test, No Load test & IR	Major	Electrical test	100% test	IS 325	IS 325	Manufacturer test certificate	*	P	V	V		
		Make, Rating	Major	Verification	100%	Appd dig/Data sheet	Appd dig/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		
31.0	V - Piece													
	Raw material inspection	Chemical & Physical properties	Major	Chemical & mechanical tests	& One sample heat	Approved dig/Data sheet	Approved dig/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 dig/ Data sheet	Approved dig/ 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 Appendix 4	ASME Sec.VIII Div.1 Appendix 4	Radiographs and inspection report	*	P	V	V		
		d) Hydro Static Test	Critical	Hydrostatic Pt. @ 1.5 times design pressure (Duration 30 minutes)	100%	ASME Sec.VIII Div.1	No leakage	Inspection report	*	P	V	V		
<p>LEGEND</p> <p>* Records identified with "STAR" shall be essentially included by contractor in QA Documentation.</p> <p>** M - Manufacturer / Manufacturer's Sub-contractor</p> <p>C - Contractor</p> <p>O - Owner</p> <p>Indicate "P" - Perform, "V" - Verify and "V" - Verification</p>														
Manufacturer / Sub-Contractor Signature										Reviewed By			Name & Sign. Of approving authority & Seal	

Manufacturer's Name & Address		STANDARD QUALITY PLAN		Vendor Q.P. NO.		BHEL Doc No.:		PROJECT:		
P.O. No.		Item : Ball Monitoring System (Ball Oversize Monitor)		PACKAGE : COLTCS		CUSTOMER:		PURCHASER:		
Class		Reference Documents		Date : Page 12 of 15		CONSULTANT:		Remarks		
Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Approved sheet	Format of Record	Agency		
1	2	3	4	5	6	7	8	9	10	
4.1.0	Raw Material Housing shell, Flanges	Chemical properties	Major	Chemical Analysis	One sample/heat	Approved sheet	dg/Data	Mill test Certificate / Lab test report/raw material flow sheet	P	V
		Physical properties	Major	Physical test	One sample/heathead/batch	Approved sheet	dg/Data	Mill test Certificate / Lab test report/raw material flow sheet	P	V
		Surface defects	Minor	Visual	100%	Approved sheet	dg/Data	Mill Test Certificate/Inspection report	P	V
		Sub-surface defects	Major	Ultrasonic test	100%	ASME SA 435	ASME SA 435	Mill Test Certificate	P	V
4.2.0	In-process Quality Control									
4.2.1	Welding procedure specification	Correctness	Critical	Sensory	100%	ASME Sec IX	ASME Sec IX	QW 482 of ASME Sec IX	P	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
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
4.2.4	Fabricated Shell	1. Surface defects (fillet welds)	Major	Pendulant test	100%	ASME Sec. VIII Div. 1	ASME Sec. VIII Div. 1	Inspection report	P	V
		2. Dimensions, Orientation	Major	Measurement by visual	100%	Approved doc / Data sheet	Approved documents / Data sheets	Inspection report	P	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
		4. Functional Test	Major	Functional	100%	Approved procedure	Approved procedure	-	P	V
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Manufacturer / Sub-Contractor Signature									Reviewed By	
Contractor Signature									Name & Sign. Of approving authority & Seal	

Manufacturer's Name & Address		STANDARD QUALITY PLAN		BHEL Doc No.:						
Item : Starter Panel		Vendor Q.P. NO.		PROJECT:						
P.O. No.		Date		CUSTOMER:						
Page 14 of 15		Page 14 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
1	2	3	4	5	6	7	8	9	10	11
8.0.0	Starter panel									
8.0.1.0	Incoming Material									
8.0.1.1	Fabricated & Painted Panel	Panel G.A.	Major	Measurement	100%	Approved Drgs.	Approved Drgs.	Inspection report	P	
		Paint colour	Major	Visual	100%	Approved Drgs.	Approved Drgs.	Inspection report	P	
		Paint thickness	Major	Measurement	100%	Approved Drgs.	Approved Drgs.	Inspection report	P	
		Paint Shade, Adhesion	Major	Visual	Sample	Approved Drgs.	Approved Drgs.	Inspection report	P	
8.0.1.2	Wire	Size / Colour / Rating / Surface Defects	Major	Visual / Dimension	Sample	IS 694	Specification drawings	Inspection report	P	(S) Marked wire
8.0.1.3	Panel Mounting	Make, Functional, Type & Rating	Major	Visual / Electrical	100%	Approved BOM	Approved BOM	---	P	V V
8.0.2.0	In Process Inspection									
8.0.2.1	Name Plate, Component Mounting, Etc.	Workmanship, Finish, Correctness	Major	Visual	100%	Approved Drgs.	Approved drawings	Inspection report	P	
8.0.2.2	Electrical Wiring of Panels	Continuity, Colour of wires, Bundling and Grouping	Major	Visual	100%	Mounting Drawing	Approved drawings	Inspection report	P	
8.0.2.3	Ferruling of Cables	Start & End	Major	Visual	100%	Manufacturer's drawing	Manufacturer's drawing	Inspection report	P	
8.0.3.0	Final Inspection									
8.0.3.1	Workmanship, Finish & Paint shade / Thickness	Visual	Major	Visual	100%	G.A Drawing	Approved drgs.	Inspection report	P	W V
8.0.3.2	Overall Dimension, G.A. of starter panel	Measurement	Major	Visual	100%	G.A Drawing	Approved drgs.	Test Certificate	P	W V
8.0.3.3	Component Identification	Visual	Major	Visual	100%	G.A Drawing	Approved drgs.	Inspection report	P	W V
8.0.3.4	Degree of Protection	Ingress Protection IP55	Critical	Environmental	Verification	Approved drgs.	IS 2147	Inspection Report	P	V V for enclosure
8.0.3.5	IR - HV - IR	Electrical	Critical	Electrical	100%	Approved Procedure	Approved Procedure	Inspection report	P	V V
8.0.3.6	Functional & Continuity	Functional	Major	Functional	100%	Appd Drawing	Appd Drawing	Inspection report	P	W W
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Manufacturer / Sub-Contractor Signature Contractor Name & Sign. Of approving authority & Seal										

		Manufacturer's Name & Address		STANDARD QUALITY PLAN				BHEL Doc No.: PE-VI-XXX-165-N008		
		P.O. No.		Vendor O.P. NO.	PACKAGES: COLTCS			PROJECT:		
Component / Operation 2		Characteristics Checked		Item : FASTENERS		Date : 15 of 15		PURCHASER:		
		Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	CONSULTANT:		
1	3	4	5	6	7	8	9	10	11	
9.1.0	Internal Fasteners (Duplex Steel)	Chemical & Physical properties	Major	Chemical & Mechanical analysis	& 1 Per head/MT Batch	Approved sheet	digData	Approved sheet	Mfr TC / Lab report	* P V V
	Visual workmanship finish	Major	Visual	Visual	Sample	Approved sheet	digData	Approved sheet		- P V V
	Dimensions	Major	Measurement	Measurement	Sample	Approved sheet	digData	Approved sheet		- P V V
9.2.0	Main Fasteners	Visual	Major	Visual	Sample	Approved sheet	digData	Approved sheet	Inspection report / Mfr TC	* P V V
	Dimensions	Major	Measurement	Measurement	Sample	Approved sheet	digData	Approved sheet	Inspection report / Mfr TC	* P V V
	Chemical & Physical properties	-	Chemical & Physical test	Chemical & Physical test	1 sample per heat	Approved sheet	digData	Approved sheet	Mfr TC / Lab report	* P V V
				a) Tensile						
				b) Yield						
				c) Elongation						
				d) Proof load						
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TITLE : TECHNICAL SPECIFICATION
FOR
CONDENSER ON LOAD TUBE CLEANING
SYSTEMS (COLTCS)

SPEC. NO. PE-TS- 392-165-N002

VOLUME : IIB

SECTION : D

REV. NO. 0

DATE :
27.11.2013

SHEET 1 of 1

SECTION D2
STANDARD TECHNICAL SPECIFICATION
FOR
ELECTRICAL SYSTEMS



TITLE :
GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS


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

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

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

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

1.0

INTENT OF SPECIFIATION

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

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

2.0

CODES AND STANDARDS

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

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

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

3.0

DESIGN REQUIREMENTS

3.1

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

3.2

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

3.3

Starting Requirements

3.3.1

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

3.3.2

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



TITLE :
GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.
PE-SS-999-506-E101
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SHEET : 2 OF 4

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

3.3.3 The following frequency of starts shall apply

- i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.
- ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)
- iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for minimum 20,000 starts during the life time of the motor

3.4 **Running Requirements**

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

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

3.5 **Stress During bus Transfer**

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

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

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

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


4.0 **CONSTRUCTIONAL FEATURES**


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

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

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

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

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 3 OF 4
4.4.	Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.	
4.5	Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.	
4.6	In case Class ‘F’ insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class ‘B’ insulation. In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.	
4.7	Terminals and Terminal Boxes	
4.7.1	Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A. Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet “A”.	
4.7.2	unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.	
4.7.3	Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively.	
4.7.4	Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.	
4.7.5	Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.	
4.7.6	Degree of protection for terminal boxes shall be IP 55 as per IS 4691.	
4.7.7	Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.	
4.7.8.	Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.	
4.7.9	Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.	
4.8	Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.	
4.9	General	

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

4.9.1 Motors provided for similar drives shall be interchangeable.

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

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

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

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

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

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

5.0 **INSPECTION AND TESTING**

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

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

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

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

6.0 **DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT**

a) OGA drawing showing the position of terminal boxes, earthing connections etc.

b) Arrangement drawing of terminal boxes.

c) Characteristic curves:
(To be given for motor above 55 kW unless otherwise specified in Data Sheet).

i) Current vs. time at rated voltage and minimum starting voltage.

ii) Speed vs. time at rated voltage and minimum starting voltage.

iii) Torque vs. speed at rated voltage and minimum voltage.
For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.

iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.

CLAUSE NO.	LT SWITCHGEAR (Starters Panel)
1.00.00	<p>CODES AND STANDARDS</p> <p>IEC 947, IS 13947</p>
2.00.00	<p>TYPE</p> <p>Circuit Breakers Shall be air break, three pole, spring charged, horizontal drawout type, suitable for electrical operation.</p> <p>Switchgear Fully drawout type single front</p> <p>MCC Fully drawout type single front/Double front.</p> <p>ACDB/DCDB Fixed type single front</p>
3.00.00	<p>SYSTEM PARAMETERS</p> <p>415VAC $\pm 10\%$ (SOLIDLY GROUNDED)</p> <p>50 Hz $\pm 3\%$-5%</p> <p>45KA RMS / 1 SEC (FAULT LEVEL)</p> <p>220V DC NOMINAL (190V DC-240V DC) ISOLATED TYPE</p>
4.00.00	<p>TEMPERATURE RISE</p> <p>The temperature rise of the horizontal and vertical busbars and main bus link including all power drawout contacts when carrying 90% of the rated current along the full run shall in no case exceed 55 deg. C with silver plated joints and 40 deg. C with all other types of joints over an ambient of 50 deg C.</p>
5.00.00	OPERATIONAL REQUIREMENTS
5.01.00	Breakers
5.01.01	Breakers shall have anti-pumping feature.
5.01.02	The incomer and bus coupler breakers for switchgear shall be electrically operated with over current releases or relays.
5.01.03	Breakers shall have inherent fault making and breaking capacities. They shall have shunt trip coils. In case releases are offered, the same shall have contact for energisation of lockout relay. All breakers shall have built in interlocks for equipment and personnel safety.
5.01.04	Paralleling of two supplies shall be avoided by interlocking except for switchgear where auto-changerover is provided. Breaker contact multiplication, if required, shall be through latch relay.

CLAUSE NO.	LT SWITCHGEAR
01.05	Mechanical tripping shall be through red 'Trip' push button outside the panels for breakers, and through control switches for other circuits.
01.06	Provision of mechanical closing of breaker only in 'Test' and 'Withdrawn' position shall be made. Alternatively, mechanical closing facility should be normally inaccessible, accessibility rendered only after deliberate removal of shrouds. It shall be possible to close the door with breaker in test position.
01.07	Clear status indication for each circuit shall be provided through lamps, switch positions or other mechanical means.
01.08	Supervision relay shall be provided for trip coil monitoring.
03.00	Switches, Contactors and Fuses
02.01	Incomers for MCCs and DBs rated upto 630A could be load break isolators.
02.02	Motor starter contactors shall be of air break, electromagnetic type suitable for DOL starting of motor, and shall be of utilisation category AC-3 for ordinary and AC-4 for reversing starters. DC contactor shall be of DC-3 utilisation category.
02.03	Fuses shall be HRC type with operation indicator. Isolating switches shall be of AC 23A category when used in motor circuit, and AC 22A category for other applications. Fuse switch combination shall be provided wherever possible.
02.04	Isolating switches and MCCBs shall have door interlocks and padlocking facility.
	Panels
	All switchgears, MCCs, DBs, panels, modules, local starters and push buttons shall have prominent engraved identification plates.
02.02	Local push button stations shall have metal enclosure of die cast aluminium or rolled sheet steel of 1.6mm thickness & shall have DOP of IP-55. Push buttons shall be of latch type with mushroom knobs.
02.03	Where breaker/starter module front serves as compartment cover, suitable blanking covers, one for each size of modules per switchboard shall be supplied for use when carriage is withdrawn.
02.04	All non-current carrying metal work of boards/panels shall be effectively bonded to earth bus of galvanised steel, extending throughout the switchboard/MCC/DB. Positive earthing shall be maintained for all positions of chassis and breaker frame.
02.05	Suitable trolley arrangement shall be provided for breaker/starter modules. Two trolleys per switchgear room shall be provided so that top most breaker module of all types, sizes and rating can be withdrawn on trolley and lowered for maintenance purpose.
	The incoming connection to transformer of more than 1000KVA and inter-connecting sections between switchboards shall preferably be of busducts. The busduct enclosure

CLAUSE NO.	LT SWITCHGEAR
	<p>shall be made of minimum 3mm thick aluminium alloy. The section of the busduct should have adequate strength to withstand internal and external forces resulting from the various operating conditions. Aluminium sheet hood shall be provided for outdoor busduct enclosure joints to provide additional protection against water ingress. The busduct top shall be sloped to prevent retention of water. The busduct shall have DOP of IP55.</p>
5.03.07	<p>It should be possible to carryout maintenance on a feeder with adjacent feeders alive.</p>
5.04.00	<p>Control, Protection & Metering Requirements</p>
5.04.01	<p>Control circuits shall operate at suitable voltage of 110V AC or 220V DC. Necessary control supply transformers having primary and secondary fuses shall be provided for each MCC, 2 x 100% per section. However the breakers shall operate on 220V DC. The auxiliary bus bars for control supply shall be segregated from main bus bars. The control supplies shall be monitored.</p>
5.04.02	<p>Contractor shall fully co-ordinate overload and short circuit tripping of breaker with up-stream and down stream breakers/fuses/MCCBs motor starters. Various equipments shall meet requirement of Type-II class of coordination as per IEC.</p>
5.04.03	<p>All relays and timers shall operate on available DC supply and not have any inbuilt batteries. They shall be provided with hand-reset operation indicator (flags) or LEDs with pushbuttons for resetting.</p>
5.04.04	<p>All equipments shall have necessary protections. However, following minimum protections shall be provided:</p>
	<ol style="list-style-type: none"> 1) Contactor controlled motor feeders (Motors up to 160 kW) <ol style="list-style-type: none"> a) Instantaneous short circuit protection on all phases through HRC cartridge type fuses rated to: 80 kA rms (prospective breaking capacity at 415V). b) Thermal overload protection. c) Single phasing protection for motors protected by fuses. 2) Breaker controlled motors feeders (motors rated above 160kW) <ol style="list-style-type: none"> a) Instantaneous short circuit protection on all phases b) Overload protection on two phases c) Over load alarm on third phase d) Earth fault protection e) Under voltage protection

CLAUSE NO.	LT SWITCHGEAR
	<p>h) hand reset lockout relay with a blue lamp for monitoring.</p> <p>3) incomers/bus coupler/outgoing breaker feeders other than motor feeders</p> <p>a) Definite time delay short circuit protection</p> <p>b) Hand reset lockout relay with a blue lamp</p> <p>4) Incomer From DG Set.</p> <p>a) Differential Protection (87) - Three Pole</p> <p>b) Reverse Power Protection.</p> <p>c) Overload Alarm on one phase</p> <p>d) Earth Fault Detection Relay (64)</p> <p>e) Voltage controlled overcurrent relay</p> <p>e) Generator under/over voltage Protection</p> <p>f) Hand Reset/Lockout Relay with a blue lamp.</p> <p>g) 3 Phase Energy Meter having accuracy of 1.0 class.</p>
5.04.05	<p>Meters / instruments</p>
	<p>All meters/ instrument shall be flush mounted on front panel, at least 96 sq.mm. size with 90 degree linear scales and accuracy class of 2.0.</p>
5.04.06	<p>All motors of 30kW and above shall have an Ammeter. Bus-section shall have bus VT, voltmeter with selector switch, and other relay and timers required for protection. Adequate control and selector switches, push buttons and indicating lamps shall be provided. Thermostatically controlled space heaters with switches shall be provided to prevent condensation.</p>
5.04.07	<p>In case of remote controlled breaker panels, following shall be ensured.</p> <p>Each feeder shall have local/remote selector switch. Closing from local shall be possible only in test position whereas closing from remote shall be possible in either service or test position. Tripping from local shall be possible only when local/remote selector switch is in local position. Tripping from remote shall be either breaker in service position or selector switch being in remote position.</p>
05.00	<p>Control from Remote</p> <p>Necessary hardware shall be provided in the switchgear panel like coupling relays (24V DC, with max burden 2.5VA), auxiliary relays, current & voltage transducers (4-20 mA, dual output) etc. to effect interlocks, exchange information / status and exercise control from remote.</p>

CLAUSE NO.	LT SWITCHGEAR
6.00.00	DESIGN AND CONSTRUCTIONAL FEATURES
6.01.00	All 415V switch gear motor control centers (MCCs), AC & DC distribution boards (DBs), etc shall have following features :
	<ol style="list-style-type: none"> 1) Shall be of metal enclosed, indoor, floor mounted and free standing type. 2) All frames and load bearing members shall be fabricated using mild steel structural sections or pressed and shaped cold rolled sheet steel of thickness not less than 2mm. 3) Frame shall be enclosed in cold rolled sheet steel of thickness not less than 1.6mm. Doors and covers shall also be of cold rolled sheet steel of thickness not less than 1.6 mm. Stiffeners shall be provided wherever necessary. Removable gland plates of thickness 3mm (hot/cold rolled sheet steel) or 4 mm (non-magnetic material) shall be provided for all panels. 4) All switchboards/panels shall be of dust and vermin proof. All cutouts shall have synthetic rubber gaskets. 5) For motors above 160kW, remote controlled electrical circuit breakers, and for smaller motors, switch-fuse contactor feeders shall be provided. The other outgoing feeders would be switch-fuse units or moulded case circuit breakers. 6) All switchboards, MCCs and DB's shall have following distinct vertical sections. <ol style="list-style-type: none"> a) Completely enclosed bus bar compartment for horizontal and vertical bus bars. b) Completely enclosed switchgear compartments (one for each circuit housing circuit breakers, motor starter or switch-fuse feeder). c) Compartment for cable alley or cable box for power and control cables In case of cable box, they shall be segregated with complete shrouding for individual feeders at the rear for direct termination of cables. d) For cable connection to circuit breaker, a separately enclosed cable compartment shall also be acceptable. e) Compartment for relays and other control devices associated with a circuit breaker, wherever necessary. f) The switchboards/MCC/DBs of 1600A & above rating shall be of DOP IP42 & of IP52 for less than 1600A rating g) All 415V switchgears, MCC's, AC & DC distribution boards etc. shall be painted by powder coating process. Paint shade shall be as follows

CLAUSE NO.	LT SWITCHGEAR												
	(i) Front & Back : RAL 9002												
	(ii) Extreme end covers : RAL 5012												
7)	Busbars shall be of high conductivity aluminium alloy or copper.												
8)	Minimum air clearance in air between phases and phase-earth shall be 25 mm for busbars and cable terminations. For all other components, the Clearances shall be at least 10mm. Wherever above is not possible except for horizontal and vertical busbars, insulation shall be provided by anti tracking sleeving or barriers. However for horizontal and vertical busbars, clearances specified above shall be maintained even when busbars are insulated/sleeved. In case of DC DBs/ fuse boards, the busbar system shall be insulated or physically segregated with barriers to prevent interpole short circuit.												
9)	Busbar insulators shall be of track-resistant high strength non-hygroscopic, non-combustible type and suitable to withstand stresses due to over-voltages and short circuit current. Insulators and barrier of inflammable material such as Hylam shall not be accepted.												
10)	All types of relays and timer shall be subject to Employer's approval. They shall be flush mounted with connections from inside, and shall have transparent & dust tight cover, removable from front, drawout construction for easy replacement and testing facility. The auxiliary relays and timer may be provided in fixed cases.												
11)	Maxi terminal /cage clamp type terminal blocks shall be provided for signals to be interfaced with DDCMIS/PLC.												
12)	The switchgears/MCC shall be designed to offer adequate level of safety to operating/maintenance personnel. Means shall be provided to prevent access to the live part to avoid accidents during service as well as maintenance period. Bidder shall bring out the safety means provided to achieve above. A detailed instruction plate suitable for wall mounting shall be provided for each switchgear/MCC room describing various safe operating procedure/safety precautions for safe operation and maintenance of switchgear/MCC.												
13)	All current and voltage transformers as required for metering & protection specified shall be completely encapsulated, cast resin insulated type. Incomers from transformers shall have CTs for transformer REF protection. All current and voltage transformers as required for metering and protection specified shall be completely encapsulated, cast resin insulated type. Incomers from transformers shall have CTs for transformer restricted earth fault protection. The accuracy shall be as follows:												
	<table><tr><td></td><td>CTs</td><td>PTs</td></tr><tr><td>Protection</td><td>5P20</td><td>3P</td></tr><tr><td>Metering</td><td>10</td><td>10</td></tr><tr><td>REF</td><td>PS</td><td></td></tr></table>		CTs	PTs	Protection	5P20	3P	Metering	10	10	REF	PS	
	CTs	PTs											
Protection	5P20	3P											
Metering	10	10											
REF	PS												

CLAUSE NO.	LT SWITCHGEAR
6.02.00	Indicating lamps shall be cluster LED type.
6.03.00	20% spare feeders of each type & rating used in the MCC with a minimum one (1) number on each bus section shall be provided.
7.00.00	<p>TYPE TESTS</p> <p>(a) All equipments to be supplied shall be of type tested quality. The Contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last five years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.</p> <p>(b) In case the Contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract free of cost to the Owner and submit the reports for approval.</p> <p>(c) All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.</p>
8.01.00	<p>L. T. SWITCHGEAR</p> <p>The following type test certificates on each type & rating of L.T. Switchgear, MCC panel and distribution boards shall be submitted.</p> <p>(a) Short time withstand test with circuit breaker mounted inside the switchgear panel.</p> <p>(b) Temperature rise test.</p> <p>(c) Type II - Short circuit co-ordination test for any three ratings of MCC module as selected by the Employer.</p> <p>(d) Test sequence -1 & combined test sequence shall be carried out on each rating of circuit breaker mounted inside the panel.</p> <p>(e) Degree of protection tests</p>

CABLES SPECIFICATIONS


POWER CABLES:


1.1 kV grade, power cables with stranded compacted Aluminium conductor, XLPE insulated, PVC type ST2 extruded inner sheathed (no inner sheath for single core cables), Galvanised steel single layer round wire/ formed wire (non magnetic hard drawn aluminium single layer round wire H4 grade for single core cables) as per IS : 3975 (where applicable) and extruded PVC Type ST2 outer sheath with FRLS properties, generally conforming to IS:7098 (Part-1).


CONTROL CABLES:


1.1 kV control cables with stranded plain annealed copper conductor, PVC Type-A insulation, core identification by colour coding (upto five cores)/ number marking (more than five cores), distinct extruded inner sheath of PVC type ST1 material, GS formed/round wire armour as per IS: 3975 (where applicable), and extruded PVC Type ST1 outer sheath with FRLS properties, generally conforming to IS: 1554 (Part-1).

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		QUALITY PLAN SHEET 2 OF 9		CUSTOMER :		PROJECT		SPECIFICATION :			
				BIDDER/ :		TITLE		NUMBER :			
				VENDOR		QUALITY PLAN		SPECIFICATION :			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	REMARKS	
									P W V		
1	2	3	4	5	6	7	8	9	10	11	
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND. 2. CHEM. & PHYSICAL PROPERTIES 3. DIMENSIONS 4. INTERNAL FLAWS	MA MA MA CR	VISUAL CHEM. & PHYSICAL TESTS MEASUREMENT UT	100% 1/HEAT NO. OR HEAT TREATMENT BATCH NO 100% -DO-	- MFG. DRG. SPEC. -DO- ASTM-A388	FREE FROM VISUAL DEFECTS RELEVANT IS MANUF'R'S DRG. MANUF'R'S SPEC. BHEL SPEC.	-DO- SUPPLIER'S TC LOG BOOK -DO-	3 3 3 3 3	- 2 2 2 1 2	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED FOR DIA OF 55 MM & ABOVE
1.6	SPACE HEATERS, CONNECTORS, TERMINAL BLOCKS, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING 2. PHYSICAL COND. 3. DIMENSIONS (WHEREVER APPLICABLE) 4. PERFORMANCE/ CALIBRATION	MA MA MA	-DO- MEASUREMENT TEST	-DO- SAMPLE 100%	- MANUF'R'S DRG. / SPEC. -DO-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY MANUF'R'S DRG. / SPEC. -DO-	-DO- -DO- INSP. REPORT	3 3 3	- 2 2 2	
BHEL		PARTICULARS		BIDDER/VENDOR							
		NAME									
		SIGNATURE									
		DATE									
				BIDDER'S/VENDORS COMPANY SEAL							


<div></div>		QUALITY PLAN			CUSTOMER :		PROJECT TITLE		SPECIFICATION : NUMBER :		
SHEET 3 OF 9		BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007_REV-03		SPECIFICATION : TITLE				
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	SYSTEM CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION VOLUME III REMARKS		
									P	W	V
1	2	3	4	5	6	7	8	9	1011		
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	NO VISUAL DEFECTS	INSPT. REPORT	3	-	2
		2. OTHER CHARACTERISTICS	MA	TEST	SAMPLE	MANUF'S SPEC.	MANUF'S SPEC.	LOG BOOK AND OR SUPPLIER'S TC	3	-	2
		1. SURFACE COND.	MA	VISUAL	100%	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK	3	-	-
1.8	SHEET STAMPING (PUNCHED)	2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	MANUF'S DRG. .	MANUF'S DRG.	-DO-	3	-	2
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	-DO-	MANUF'S SPEC./ RELEVANT IS	RELEVANT IS	SUPPLIER'S TC	3	-	2
		1. SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	LOG BOOK	3*	-	2*
1.9	CONDUCTORS	2.ELECT. PROP. & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	RELEVANT IS/ BS OR OTHER STANDARDS	RELEVANT IS/ BS OR OTHER STANDARDS	SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3	-	2
BHEL		PARTICULARS			BIDDER/VENDOR						
		NAME									
		SIGNATURE									
		DATE									
									BIDDER/SVENDORS COMPANY SEAL		


<div></div>		QUALITY PLAN		CUSTOMER :		PROJECT		SPECIFICATION :					
				BIDDER/ VENDOR :		TITLE		NUMBER :		TITLE			
SHEET 4 OF 9		SYSTEM		QUALITY PLAN		NUMBER PED-506-00-Q-007, REV-03		VOLUME III		REMARKS			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION	AGENCY	P	W	V
1	2	3	4	5	6	7	8	9	10		11		
1.10	BEARINGS	3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2		
		1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG./ APPROVED DATASHEET	MANFR'S DRG./ APPROVED DATASHEET	-DO-	3	-	2		
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	2		
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2		
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-		
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-		
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC./BHEL SPEC.	MANUF'S SPEC./BHEL SPEC.	-DO-	3	-	2		
		4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	2		
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	3	-	-		
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-		
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-		
		BHEL											
		PARTICULARS		BIDDER/VENDOR									
		NAME											
		SIGNATURE											
		DATE											
				BIDDER'S/VENDORS COMPANY SEAL									


		QUALITY PLAN		CUSTOMER :		PROJECT		SPECIFICATION :					
				BIDDER/ VENDOR :		TITLE		NUMBER :					
				SYSTEM		QUALITY PLAN		TITLE					
SHEET 5 OF 9		CHARACTERISTIC CHECK		EXTENT OF CHECK		REFERENCE DOCUMENT		ACCEPTANCE NORM		FORMAT OF RECORD			
SL. NO.	COMPONENT/OPERATION	CAT.	TYPE/METHOD OF CHECK	6	7	8	9	10	11	P	W	V	
1	2	3	4	5	6	7	8	9	10	11	P	W	V
2.0	IN PROCESS	1.WORKMANSHIP & CLEANNES	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	-			
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-			
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	2	-			
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-			
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVANT SPEC./ASTM-E165	MANUF'S SPEC./BHEL SPEC./	-DO-	2	-	1		
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC./BHEL SPEC./RELEVANT STAND	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-			
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	2	-			
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-			
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	2	-			
BHEL													
PARTICULARS				BIDDER/VENDOR									
NAME													
SIGNATURE													
DATE													
BIDDER'S/VENDORS COMPANY SEAL													


<div><div></div><div>भारत भारती</div><div>BHEL</div></div>		QUALITY PLAN		CUSTOMER :		PROJECT TITLE		SPECIFICATION : NUMBER :		SPECIFICATION : TITLE	
SHEET 6 OF 9		BIDDER/ VENDOR :		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE		SPECIFICATION : TITLE		SPECIFICATION : TITLE	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	SYSTEM	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION AGENCY	VOLUME III REMARKS
1	2	3	4	5	6	7	8	9	10	11	
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUF'R'S SPEC.	MANUF'R'S SPEC.	Log Book	2	-	-
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1 (FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUF'R'S SPEC./BHEL SPEC.	MANUF'R'S SPEC./BHEL SPEC.	Log Book	2	-	-
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-
		3.IR-HV/IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-
		6.SURGE WITH STAND AND TAN.DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1 FOR MV MOTOR
2.6	IMPREGNATION	1.VISCOSITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1 THREE DIPS TO BE GIVEN
BHEL		PARTICULARS		BIDDER/VENDOR							
		NAME									
		SIGNATURE									
		DATE									

<div></div>		CUSTOMER :		PROJECT		SPECIFICATION :							
		BIDDER/ : VENDOR		TITLE		NUMBER :							
				QUALITY PLAN		SPECIFICATION :							
SHEET 7 OF 9		QUALITY PLAN		NUMBER PED-506-00-Q-007, REV-03		TITLE		SECTION		VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10		11		
2.7	COMPLETE STATOR ASSEMBLY	4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1		
		1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-		
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-		
		2.SOUNDNESS	CR	MALLET TEST & UT	-DO-	-DO-	-DO-	Log Book	2		1		
2.9	COMPLETE ROTOR ASSEMBLY	3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2		1		
		1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2		1		VERIFICATION FOR MV MOTOR ONLY
2.10	ASSEMBLY	2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2		1		
		1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-		
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-		
		3.AXIAL PLAY	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	1		
		4.DIMENSIONS	MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	2	-	-		
		5.CORRECTNESS, COMPLETENESS/ TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	-		
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2		1		
BHEL		PARTICULARS			BIDDER/VENDOR								
		NAME											
		SIGNATURE											
		DATE											
													BIDDER'S/VENDORS COMPANY SEAL

<div></div>		QUALITY PLAN		CUSTOMER :		PROJECT TITLE		SPECIFICATION : NUMBER :					
SHEET 8 OF 9		BIDDER/ VENDOR :		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE		SECTION VOLUME III					
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	SYSTEM	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
										P	W	V	
1	2	3	4	5	6	7	8	9	10	11			
3.0	TESTS	1. TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC. 2. ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC. 3. VIBRATION & NOISE LEVEL 4. OVERALL DIMENSIONS AND ORIENTATION 5. DEGREE OF PROTECTION 6. MEASUREMENT OF RESISTANCE OF RTD & BTD 7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER 8. NAMEPLATE DETAILS 9. EXPLOSION FLAME PROOF NESS (IF SPECIFIED) 10. PAINT SHADE, THICKNESS & FINISH	MA	ELECT. TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	2	1*	1	* NOTE - 1	
			MA	-DO-	100%	-DO-	-DO-	-DO-	2	1\$	1	\$ NOTE - 2	
			MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1\$	1	\$ NOTE - 2	
			MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-		
			MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3	
			MA	-DO-	100%	-DO-	-DO-	-DO-	2	1\$	1	\$ NOTE - 2	
			MA	-DO-	100%	-DO-	-DO-	-DO-	2	1\$	1	\$ NOTE - 2	
			MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1\$	1	\$ NOTE - 2	
			MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3	
			MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1\$	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY \$ NOTE - 2	
BHEL			PARTICULARS		BIDDER/VENDOR								
			NAME										
			SIGNATURE										
			DATE										
							BIDDER'S/VENDORS COMPANY SEAL						

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE		SPECIFICATION : NUMBER :	
				BIDDER/ VENDOR :		QUALITY PLAN		SPECIFICATION :	
				SYSTEM		NUMBER PED-506-00-Q-007, REV-03		TITLE	
SHEET 9 OF 9						ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION	
COMPONENT/OPERATION		CHARACTERISTIC CHECK		TYPE/ METHOD OF CHECK		REFERENCE		AGENCY	
						NORM		P W V	
		3		4		5		6	
		2		3		7		8	
		1		9		10		11	
<p>NOTES:</p> <p>1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.</p> <p>2 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.</p> <p>3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED.</p> <p>4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.</p> <p><u>Legends for Inspection agency</u></p> <p>1. BHEL/CUSTOMER</p> <p>2. VENDOR (MOTOR MANUFACTURER)</p> <p>3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)</p> <p>P. PERFORM</p> <p>W. WITNESS</p> <p>V. VERIFY</p>									
BHEL									
PARTICULARS									
NAME									
SIGNATURE									
DATE									
BIDDER'S/VENDORS COMPANY SEAL									

		QUALITY PLAN SHEET 1 OF 2		CUSTOMER :		PROJECT		SPECIFICATION :					
				BIDDER/ VENDOR		TITLE		NUMBER :		SPECIFICATION			
				SYSTEM		QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01		TITLE		SECTION			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10				11
1.0	ASSEMBLY	1.WORKMANSHIP 2.DIMENSIONS 3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-	-	
			MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	2	-	-	-	
			MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUF'R'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. 2.OVERALL DIMENSIONS & ORIENTATION	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1			NOTE -1 & NOTE-3
			MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	-	NOTE -1 & NOTE-3
BHEL		PARTICULARS		BIDDER/VENDOR									
		NAME											
		SIGNATURE											

	QUALITY PLAN		CUSTOMER :		PROJECT TITLE		SPECIFICATION : NUMBER :			
	SHEET 2 OF 2		BIDDER/ : VENDOR		QUALITY PLAN		SPECIFICATION : TITLE :			
	COMPONENT/OPERATION	CHARACTERISTICS CHECK	SYSTEM CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD		
	SL. NO.	2	3	4	5	6	7	8	9	
1		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	10	11
<p>NOTES:</p> <p>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</p> <p>2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.</p> <p>3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW . ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.</p>										
<p><u>Legends for Inspection agency</u></p> <p>1. BHEL/CUSTOMER</p> <p>2. VENDOR (MOTOR MANUFACTURER)</p> <p>3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)</p> <p>P. PERFORM</p> <p>W. WITNESS</p> <p>V. VERIFY</p>										
BHEL		PARTICULARS		BIDDER/VENDOR						
		NAME								
		SIGNATURE								
		DATE								
BIDDER'S/VENDORS COMPANY SEAL										



TITLE : TECHNICAL SPECIFICATION
FOR
CONDENSER ON LOAD TUBE CLEANING
SYSTEMS (COLTCS)

SPEC. NO. PE-TS- 392-165-N002

VOLUME : IIB


SECTION : D

REV. NO. 0

DATE :
27.11.2013

SHEET 1 of 1

SECTION D3
STANDARD TECHNICAL SPECIFICATION
FOR
C&I SYSTEMS

	DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE		SPECIFICATION NO.:	
			VOLUME	
			SECTION	
			REV. NO.	DATE:
			SHEET 1	OF 2
Data Sheet No.: PE-DC-999-145-1026-A				
TECHNICAL REQUIREMENTS FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE (TO BE FILLED BY PURCHASER) TO BE FILLED-UP /CONFIRMED BY BIDDER				
=GENERAL	MANUFACTURER			
	MODEL NUMBER			
TECHNICAL	SENSING ELEMENT	<input type="checkbox"/> BOURDON <input type="checkbox"/> DIAPHRAGM (BOURDON FOR HIGH PRESS AND DIAPHRAGM FOR LOW PRESS APPLICATION)		
	MATERIAL	SENSING ELEMENT – AISI 316 SS MOVEMENT – AISI 304 SS CASING – <input type="checkbox"/> DIE CAST AL <input checked="" type="checkbox"/> SS		
	ENCLOSURE	CLASS: <input type="checkbox"/> IP-55 <input checked="" type="checkbox"/> IP-65 <input type="checkbox"/> EXPL PROOF PAINT: <input type="checkbox"/> ENAMEL <input type="checkbox"/> EPOXY		
	DIAL	SIZE: 150 MM COLOR: WHITE NUMERALS: BLACK SCALE: LINEAR, 270° ARC GRADUATED IN METRIC UNITS		
	CASE	COLOUR : BLACK		
	SPAN/ ZERO ADJUSTMENT	INT. MICRO SCREW		
	RANGE SELECTION	SHOULD COVER 125% OF OPERATING PARAMETER		
	OVER RANGE PROTECTION	1.5 TIMES OF FSD		
	BLOW OUT DISC	REQUIRED		
	SWITCHING FACILITY (IF APPLICABLE)	NOT REQUIRED		
	TYPE	<input type="checkbox"/> MICRO SWITCH <input type="checkbox"/> OTHER		
	NO. / TYPE OF CONTACTS	2 NOS. SPDT		
	CONTACT RATING	5A 230V AC, 0.25A 220V DC		
	SETTING RANGE	FIELD ADJUSTABLE OVER FULL RANGE		
	REPEATABILITY	± 1% OF FSR		
POWER SUPPLY	<input type="checkbox"/> 230V AC <input type="checkbox"/> 110V AC			
PERFORMANCE	ACCURACY	± 1% OR BETTER OF FULL SCALE DEFLECTION		
CONNECTION	PROCESS	<input type="checkbox"/> M20 x 1.5 (M) <input type="checkbox"/> ½" NPT (M) <input checked="" type="checkbox"/> ½" NPT (F) <input type="checkbox"/> OTHER		
	LOCATION	BOTTOM		
ACCESSORIES	NAME PLATE / METAL TAG	SS		
	OTHER	SIPHON FOR STEAM, SNUBBER FOR PUMP DISCHARGE, CHEMICAL SEAL DIAPHRAGM FOR CORROSSIVE, OIL SERVICES and SLURRY APPLICATION TO BE PROVIDED		
OTHER REQUIREMENT	INSTRUMENT LIST	INSTRUMENT LIST COMPRISING OF TAG NO., SERVICE, DESIGN/OPERATING PRESSURE & TEMPERATURE TO BE ATTACHED		
QUALITY REQUIREMENT	CHECK LIST FOR PG/DPG	REFER CHECK LIST NO PE-CL-999-145-I 026-0		



TITLE

TYPICAL INSTALLATION DIAGRAM FOR PRESSURE GAUGE

SPECIFICATION NO. PES-145-26A

VOLUME IIB

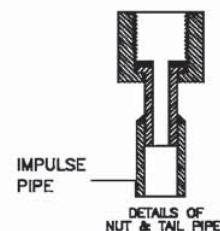
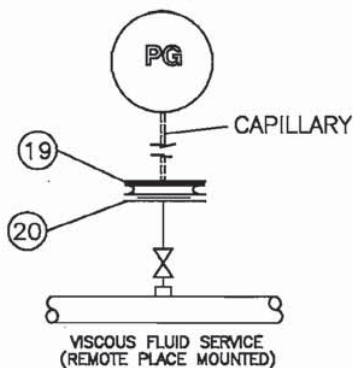
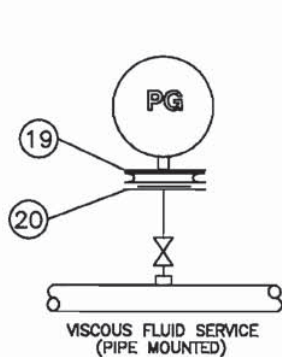
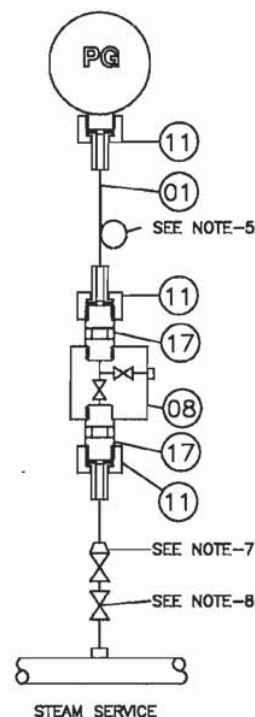
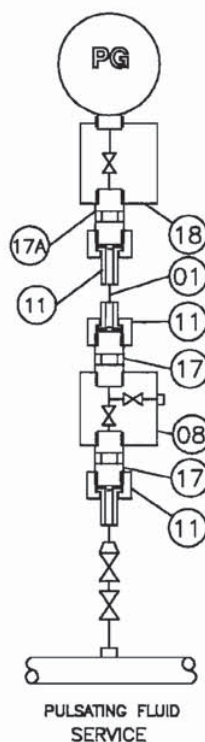
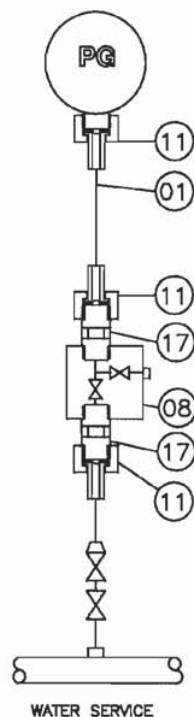
SECTION D

REV. NO. 02

DATE 20.08.97

SHEET 3

OF 4



ITEM NO	ITEM/DESCRIPTION	MATERIAL	SIZE	QTY			
				WATER	PULSATING	STEAM	VISCIOUS
01	SEAMLESS STEEL IMPULSE PIPE	ASTM A106/A335	1/2" / 15NB	1.5M	1.5M	1.5M	
08	TWO VALVE 3-WAY MANIFOLD	STAINLESS STEEL SS316	1/2" NPT(F) ENDS	01	01	01	
17	MALE CONNECTOR	STAINLESS STEEL SS316	1/2" NPT(M) x M20x1.5(M) ENDS	02	02	02	
17A	MALE CONNECTOR	STAINLESS STEEL SS316	M20x1.5(M) ENDS		01		
18	SNUBBER	STAINLESS STEEL SS316	M20x1.5(F) ENDS		01		
19	CHEMICAL SEAL	STAINLESS STEEL SS316	2" ANSI 300				01
20	MATING FLANGE	ASTM A105	2" ANSI 300				02
11	M20x1.5 SS NUT WITH ANNEALED COPPER WASHER & 100mm LONG TAIL PIPE TO SUIT 1/2" NB PIPE	STAINLESS STEEL SS316	M20x1.5x 1/2" NB	03	03	03	



TITLE

TYPICAL INSTALLATION DIAGRAM FOR PRESSURE GAUGE

SPECIFICATION NO. PES-145-26A

VOLUME IIB

SECTION D

REV. NO. 02

DATE 20.08.97

SHEET 4

OF 4

NOTES :-

- IMPULSE PIPES SHALL BE OF SEAMLESS AND ANNEALED CARBON STEEL OR ALLOY STEEL (CONFORMING TO ANSI B36.10) IN LINE WITH THE MAIN PIPE MATERIAL. STAINLESS STEEL TUBES SHALL BE USED FOR ANALYTICAL MEASUREMENTS.
- ALL IMPULSE PIPES AND FITTINGS SHALL BE OF RATING TO SUIT THE ASSOCIATED PROCESS PARAMETERS IN THIS REGARD THE GENERAL GUIDELINES ARE GIVEN BELOW

SERVICE

IMPULSE PIPE


PIPE FITTINGS

	MATERIAL	SCHEDULE	MATERIAL	CLASS
i) MAINSTM/HP BYPASS UPSTREAM/ UPSTREAM OF AUX PRDS FROM MS	SA335 Gr P22	SCH.160	ASTM A182 Gr F22	6000
ii) FEED & SPRAY WATER	SA106 Gr C	SCH.160	ASTM A105	6000
iii) HRH/ LP BYPASS STEAM	SA335 Gr P22	SCH.80	ASTM A182 Gr F22	6000
iv) CRH TILL HPBP/HPBP DOWN STREAM/ EXTRN TO HPH5	SA106 Gr B	SCH.40	ASTM A105	3000
v) CRH LINE AFTER HPBP/EXTRN/ HEATER DRAINS/CONDENSATE AND OTHER LOW PRESS LINES	SA106 Gr B	SCH.40	ASTM A105	3000

- PIPE FITTINGS SHALL BE OF FORGED MATERIAL CONFORMING TO ANSI B16.11-1991.
- SNUBBER SHALL BE PROVIDED FOR PUMP DISCHARGE PRESS MEASUREMENTS AND CHEMICAL SEAL DIAPHRAGM FOR HEAVY FUEL OIL SERVICES.
- IN CASE OF STEAM SERVICE SYPHON SHALL BE MADE BY BENDING THE TUBE OR PIPE.
- VALVE MANIFOLDS & SNUBBER SHALL BE OF FORGED SS-316.
- 25NB x 15NB WELDED REDUCER SHALL BE USED FOR ROOT VALVE OF 25NB SIZE.
- ROOT VALVES AND REDUCERS (IF APPLICABLE) SHALL BE IN THE SCOPE OF AGENCY SUPPLYING THE MAIN PIPE/EQUIPMENT. THE SELECTION CRITERIA FOR ROOT VALVES SHALL BE AS FOLLOWS :-

OPERATING PRESS Kg/Cm2	OPERATING TEMP DEG. C	SIZE NB	BODY MATERIAL	QUANTITY NOs.
< 40	< 425	15	FCS	01
40-60	< 425	15	FCS	02
> 60	< 425	25	FCS	02
--	> 425	25	FAS	02

- INSTALLATION FOR DIFF. PRESS GAUGE SHALL BE SIMILAR TO PRESS GAUGE EXCEPT THE FOLLOWING
 - IT SHALL HAVE TWO LIMBS FOR PROCESS CONNECTIONS AND EACH CONNECTION SHALL BE SIMILAR TO THAT SHOWN FOR PRESS GAUGE
 - IT SHALL HAVE FIVE VALVE MANIFOLD IN PLACE OF THREE WAY MANIFOLD

	CHECK LIST FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE (Mechanical Auxiliary Packages)	SPECIFICATION NO.:	
		VOLUME	
		SECTION	
		REV. NO.	DATE:
		SHEET 2 OF 2	
Data Sheet No.: PE-CL-999-145-I026-0			


SL NO	TESTS/CHECKS	QUANTM OF CHECK	REFERENCE DOC. ACCEPTANCE NORMS	AGEN CY			REMARKS
				P	W	V	
1.0	CHECK FOR		APPROVED TECHNICAL REQUIREMENT/ DATA SHEET				MFR TO CARRY OUT ROUTINE TEST ON 100%. WHEN MATL CORELATION ARE NOT AVAILABLE MFR'S COMPLIANCE TO BE PROVIDED
	1.1 DIAL SIZE	100%		M	C	C	
	1.2 MODEL NO/TAG NO	100%		M	C	C	
	1.3 RANGE/SCALE	100%		M	C	C	
	1.4 END CONNECTION	100%		M	C	C	
	1.5 SWITCH CONTACT RATING & NOS	100%		M	C	C	
2.0	CALIBRATION						
	2.1 ACCURACY	100%		M	C	B	
	2.2 REPEATABILITY (FOR SWITCH)	100%		M	C	B	
	2.3 SET POINT ADJUSTMENT FOR SWITCH	100%		M	C	C	
3.0	OVER PRESSURE & LEAK TEST	100%		M	C	C	
4.0	OPERATION OF PR. RELEIF DEVICE	ONE PER TYPE		M	C	C	
5.0	REVIEW OF T.C. FOR MATERIAL OF--						
	5.1 SENSOR	FOR LOT		-	-	B	
	5.2 MOVEMENT			-	-	B	
	5.3 PROCESS CONNECTION			-	-	B	
	5.4 HOUSING			-	-	B	
6.0	REVIEW OF T.C. FOR DEGREE OF PROTECTION	TYPE TEST		-	-	B	
7.0	REVIEW OF T.C. FOR CONTACT RATING OF SWITCH	ONE PER TYPE		-	-	B	
8.0	ACCESSORIES AS APPLICABLE	100%		M	C	C	


LEGEND:


M: MANUFACTURER/ SUB CONTRACTOR, C: CONTRACTOR/ NOMINATED INSP AGENCY, B: BHEL. P: PERFORM, W: WITNESS, V: VERIFICATION.

NOTE:

CONTRACTOR TO PROVIDE COMPLIANCE CERTIFICATE FOR TESTS/CHECKS VERIFIED BY CONTRACTOR AND SUBMIT THE SAME ALONGWITH TEST CERTIFICATES TO BE VERIFIED BY BHEL.

	DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER		SPECIFICATION NO.:	
			VOLUME	
			SECTION	
			REV. NO.	DATE:
			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)	
GENERAL	MANUFACTURER			
	MODEL NUMBER			
TECHNICAL	TYPE (SMART TRANSMITTER)	<input type="checkbox"/> INDUCTANCE <input type="checkbox"/> CAPACITANCE <input type="checkbox"/> STRAIN GAUGE		
	POWER SUPPLY	24V DC		
	TRANSMITTER MEASUREMENT	<input type="checkbox"/> PRESSURE <input checked="" type="checkbox"/> DIFF. PRESSURE		
	OUTPUT SIGNAL	4-20 mA		
	NO. OF WIRE	TWO		
	ACCURACY	± 0.075% OF SPAN		
	LINEARITY, HYSTERESIS AND DEAD BAND	± 0.1% OF SPAN		
	REPEATABILITY	± 0.05% OF SPAN		
	STABILITY	± 0.25 % OF SPAN OR BETTER FOR 6 MONTHS		
	SENSITIVITY	± 0.05% OF SPAN		
	<u>MATERIAL</u>			
	A) BODY	ALUMINIUM HOUSING (Epoxy Coated)		
	B) ELEMENT	316 SS		
	C) SEAL	TEFLON		
	CONTINUOUSLY ADJUSTABLE SPAN AND ZERO ADJUSTMENT PROVIDED	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
	MOUNTING	<input type="checkbox"/> WALL/PIPE STAND <input checked="" type="checkbox"/> TRANSMITTER RACK		
	ENCLOSURE	IP-65		
	TURN DOWN RATIO	30:1		
	INSULATION RESISTANCE	TO BE SPECIFIED BY BIDDER		
	ZERO SUPPRESSION RANGE	TO BE SPECIFIED BY BIDDER		
ZERO ELEVATION RANGE	TO BE SPECIFIED BY BIDDER			

	DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER			SPECIFICATION NO.:	
				VOLUME	
				SECTION	
				REV. NO.	DATE:
				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)	
	INTEGRAL INDICATOR(LCD TYPE)		<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
	TRANSMITTER SHALL BE ABLE TO DRIVE OUTPUT IMPEDANCE OF 700 OHMS.		YES		
	ZERO DRIFT		< 0.1%		
	SPAN DRIFT		< 0.1%		
	<u>MANIFOLD</u>				
	DIFFERENTIAL PRESSURE MEASUREMENT		5 WAY		
	CABLE ENTRY DETAIL		SUITABLE FOR DIA OF 17.5 mm		
NAME SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL NAME SIGNATURE DATE	

	CHECK LIST FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER (Mechanical Auxiliary Packages)		SPECIFICATION NO.:	
			VOLUME	
			SECTION	
			REV. NO.	DATE:
			SHEET 1	OF 1
Data Sheet No.: PE-CL-999-145-1026-0				

SL NO	TESTS/CHECKS	QUANTM OF CHECK	REFERENCE DOC. ACCEPTANCE NORMS	AGENCY			REMARKS
				M	C	B	
1.0	CHECKS FOR VISULA, MODEL TAG NO.	SEE NOTE-1 BELOW	APPROVED TECHINCAL REQUIREMENT/ DATA SHEET	P	W	V	MFR TO CARRY OUT ROUTINE TEST ON 100%. WHEN MATERIAL CORELATION ARE NOT AVAILABLE MFR'S COMPLIANCE TO BE PROVIDED
2.0	PROCESS CONNECTION	-do-		P	W	V	
3.0	ACCURACY	-do-		P	W	V	
4.0	REPEATEABILITY	-do-		P	W	V	
5.0	HYSTERISIS	-do-		P	W	V	
6.0	EFFECT OF TEMP VARIATION ON ACCURACY	-do-		P	W	V	
7.0	SPAN /ZERO ADJUSTMENT	ONE/TYPE		P	W	V	
8.0	EFFECT OF SUPPLY VOLTAGE VARIATION	ONE/TYPE		P	W	V	
9.0	HIGH PRESSURE TEST	SEE NOTE-1 BELOW		P	W	V	
10.0	BURN IN TEST	ONE/TYPE		P	W	V	
11.0	DEGREE OF PROTECTION	ONE/TYPE		P	W	V	

LEGEND:

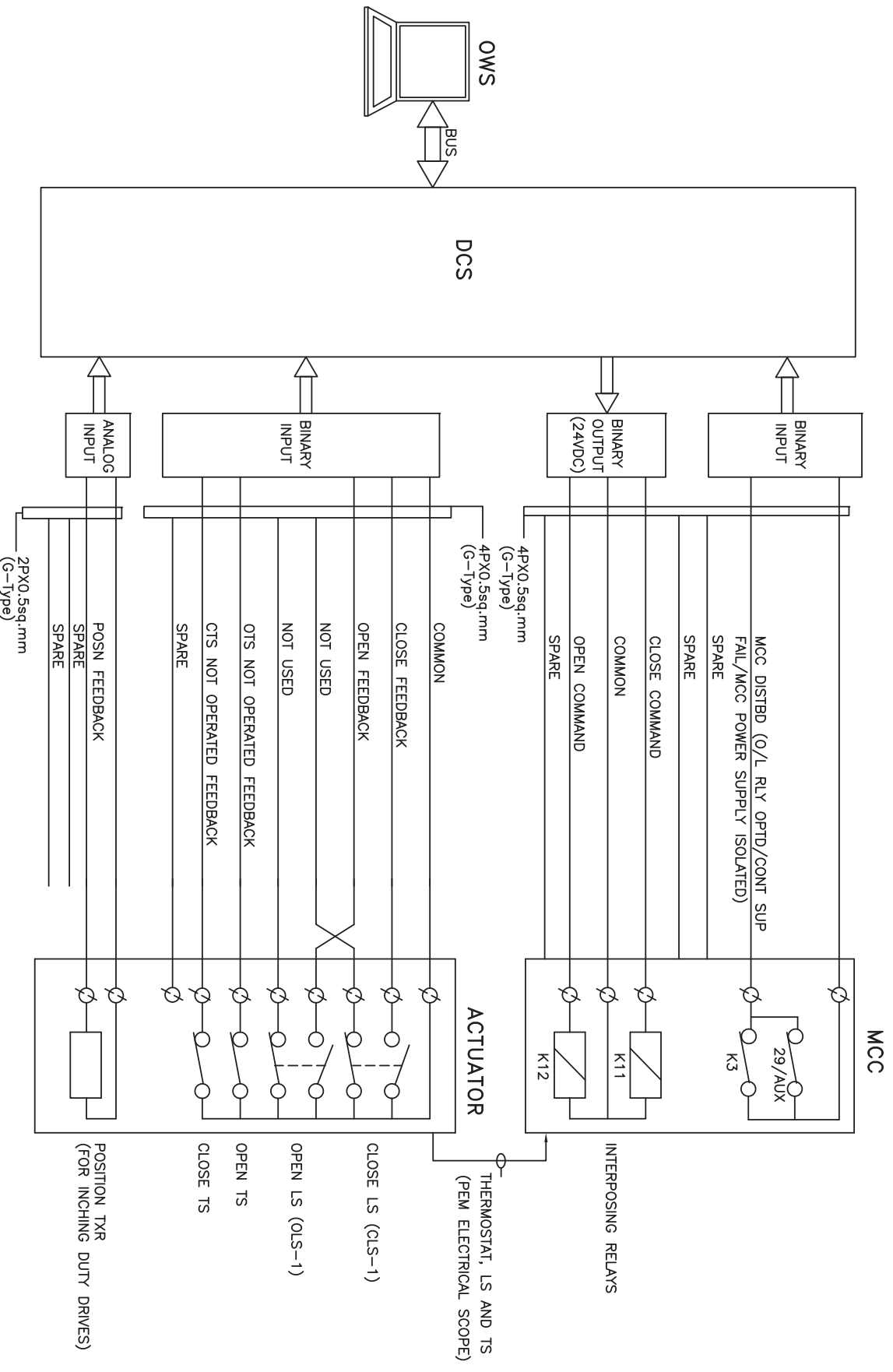
M: MANUFACTURER/ SUB CONTRACTOR, C: CONTRACTOR/ NOMINATED INSP AGENCY, B: BHEL. P: PERFORM, W: WITNESS, V: VERIFICATION.


NOTE:

1. QUANTUM OF CHECK SHALL BE AS BELOW
100 % - BY MANUFACTURER
RANDOM FOR EACH TYPE – BY BHEL & CUSTOMER
2. MANUFACTURER TO MAINTAIN CALIBRATED INSTRUMENT HAVING BETTER ACCURACY THAN THE ITEM UNDER TEST. INSPECTING ENGINEER SHALL CHECK THE SAME.
3. IN CASE OF IMPORTED ITEMS CONTRACTORS SHALL REVIEW TC's AND NOT INSPECT.

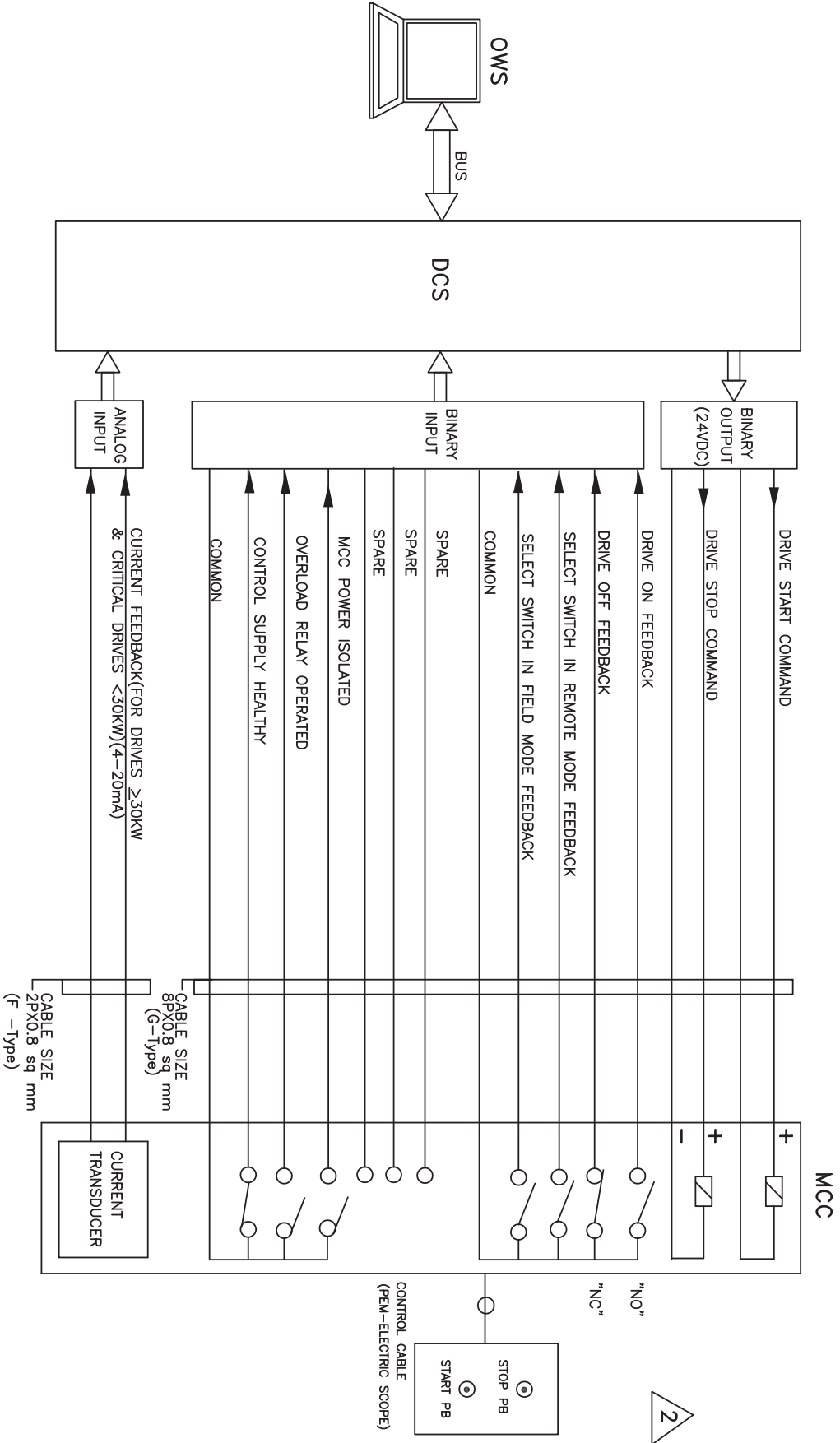
CONTRACTOR TO PROVIDE COMPLIANCE CERTIFICATE FOR TESTS/CHECKS VERIFIED BY CONTRACTOR AND SUBMIT THE SAME ALONGWITH TEST CERTIFICATES TO BE VERIFIED BY BHEL.

DCS INTERFACE FOR BIDIRECTIONAL DRIVE(WITH MCC)



	
PROJECT: 2 X 660 SURATGARH STPS, STAGE-V	
TITLE	DDCMS INTERFACE FOR BIDIRECTIONAL DRIVE
DRG. NO.	PE-DW-392-145-1002
DATE	09.04.2013
REV. NO.	00
SHT	7 OF 12

DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE



		PROJECT: 2X660 MW SURATGARH STPS, STAGE-V	
TITLE		DDCMIS INTERFACE FOR UNIDIRECTIONAL LT DRIVE	
DRG.NO.	PE-DM-392-145-1002	REV.NO.	02
DATE	03.10.2013	SHT	8 OF 11



TITLE : TECHNICAL SPECIFICATION
FOR
CONDENSER ON LOAD TUBE CLEANING
SYSTEMS (COLTCS)

SPEC. NO. PE-TS- 392-165-N002

VOLUME : IIB

SECTION : D

REV. NO. 0

DATE :
27.11.2013

SHEET 1 of 1

LIST OF SUBVENDORS

LIST OF SUB-VENDORS (AS ON DATE)

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME V SECTION:TABLE17
Package: EPC	RRVUNL, 2 x 660 MW,Super-Critical TPS,Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan INSTRUMENTATION AND CONTROL EQUIPMENT LIST OF SUB VENDORS	SHEET 1 OF 16
<p><u>The list of acceptable makes for I&C equipment / system are as listed below: -</u></p> <p>AIR FILTER REGULATORS</p> <p>PLACKA Shavo – Norgan (India) Pvt Ltd. ABB Ltd. BELLS CONTROLS LTD. Schrader – Schorill Duncan Ltd., Mumbai. Vel jan Hydrair Pvt Ltd., Hyderabad.</p> <p>GAS ANALYSERS</p> <p>Emerson Process Management ABB Ltd. Teledyne Novatel Codel Land Combustion Fuji. Yokogawa Bluestar Ltd. Chemtrols. Siemens.</p> <p>NITRIC OXIDE (NOX) ANALYSER</p> <p>Land Combustion Ltd. Emerson Process Management Horiba Chemtrols Siemens ABB Ltd.</p> <p>OXYGEN MEASUREMENT (ZIRCONIUM PROBE)</p> <p>ABB Ltd. H & B (HARTMANN & BRAUN) Emerson Process Management Seco Controls Land Combustion.</p>		
		ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME V SECTION:TABLE17
Package: EPC	RRVUNL, 2 x 660 MW,Super-Critical TPS,Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan INSTRUMENTATION AND CONTROL EQUIPMENT LIST OF SUB VENDORS	SHEET 2 OF 16
<p>PARTICULATE EMISSION</p> <p>Land Combustion Ltd. Emerson Process Management Siemens Durag. Fireye. Sintrol – oy – Finland. Erwin – Sick (Germany) Oldham (France)</p> <p>SMOKE DENSITY</p> <p>Skil Teledyne / Honeywell Codel Land Combustion EMERSON PROCESS MANAGEMENT Durag</p> <p>SULPHUR-DI-OXIDE (SO2)</p> <p>ABB Land Combustion Ltd. Emerson Process Management Horiba, Fuji.</p> <p>COMPENSATING CABLE</p> <p>Industrial Instrumentation Consortium General Instruments Toshiniwal Industries Pvt. Ltd. Polycab. Udey Pyro Cables. REL</p> <p>INSTRUMENT CABLES</p> <p>Incab Delton Fort Globster Industries</p>		
		ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME V SECTION:TABLE17
Package: EPC	RRVUNL, 2 x 660 MW,Super-Critical TPS,Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan INSTRUMENTATION AND CONTROL EQUIPMENT LIST OF SUB VENDORS	SHEET 3 OF 16
<p>Universal Cables Ltd Reliance Cables</p> <p>Gems Cab</p> <p>CONTROL CABLES Delton Incab Universal Cables ltd Reliance Cables Gems Cab.</p> <p>CONDUCTIVITY MEASUREMENT</p> <p>Emerson Process Management Honeywell ABB Ltd. Polymetron. Yokogawa Bluestar Ltd</p> <p>DISSOLVED OXYGEN MEASUREMENT</p> <p>Honeywell Polymetron Emerson Process Management ABB Yogokawa Bluestar Ltd.</p> <p>HYDRAZINE ANALYSER</p> <p>Hach ABB Polymetron Emerson Process Management</p> <p>PH</p> <p>Hach Polymetron Forbes Marshall Honeywell Emerson Process Management ABB Ltd</p>		
		ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME V SECTION:TABLE17
Package: EPC	RRVUNL, 2 x 660 MW,Super-Critical TPS,Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan INSTRUMENTATION AND CONTROL EQUIPMENT LIST OF SUB VENDORS	SHEET 4 OF 16
<p>SILICA</p> <p>Hach Polymetron Braun & Leube ABB Emerson Process Management</p> <p>CONTROL VALVES</p> <p>Dresser Masoneilan - France, Fisher Yamatake CCI ABB Welland & Tuxhorn Gulde Regal Armaturen. Pneucor</p> <p>ELECTRICAL ACTUATORS</p> <p>Vaas Bernard Auma India Ltd. Limitorque Rotork Controls Ltd. Antrieb</p> <p>DIFFERENTIAL PRESSURE INDICATORS</p> <p>Indfoss AN Instruments Switzer Instruments Ltd. Waaree Instruments Ltd. General Instruments (GIC) H.Guru A N Instruments</p> <p>DIFFERENTIAL PRESSURE SWITCHES</p> <p>Indfoss Switzer Instruments Ltd. Varma Trafag Waaree Instruments Ltd</p>		
		ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME V SECTION:TABLE17
Package: EPC	RRVUNL, 2 x 660 MW,Super-Critical TPS,Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan INSTRUMENTATION AND CONTROL EQUIPMENT LIST OF SUB VENDORS	SHEET 5 OF 16
<p>General Instruments (GIC)</p> <p>PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER</p> <p>Honeywell Emerson Process Management ABB Yokogawa Fuji Yamatake Endress & Hauser SIEMENS</p> <p>DIGITAL DISPLAY UNIT</p> <p>Laxsons Yogokawa Bluestar Ltd. Tata Honeywell Ltd. Gossien Metrawatt</p> <p>DISPLACEMENT TYPE LEVEL TRANSMITTERS</p> <p>Dresser Masoneilan Emerson Process Management Magnetrol Yamatake Endress & Hauser</p> <p>ELECTRIC METERS</p> <p>AE MECO Gossien ABB</p> <p>E/P CONVERTERS</p> <p>Bells Controls Ltd. ABB Emerson Process Management Sical Yamatake</p>		
		ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME V SECTION:TABLE17
Package: EPC	RRVUNL, 2 x 660 MW,Super-Critical TPS,Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan INSTRUMENTATION AND CONTROL EQUIPMENT LIST OF SUB VENDORS	SHEET 6 OF 16
<p>FLOW ELEMENT</p> <p>Starmech Micro precision products Engineering Specialities Pvt Ltd. Mech Engg General Instruments (GIC) Teleflow Emerson Dag Process Instruments Hydropneumatic</p> <p>FLOW GLASSES</p> <p>Eureka General Instruments Levcon V.Automat & Instrument (p) Ltd. Bliss Anand</p> <p>FLOW INTEGRATORS</p> <p>Lectrotek Nishko ABB Ltd. Rockwin</p> <p>ILLUMINATED PUSH BUTTONS</p> <p>EAO H & B L & T Ronan Honeywell Siemens</p> <p>STANDALONE SER</p> <p>Hathaway (Imported) Ronan (Imported)</p>		
		ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME V SECTION:TABLE17
Package: EPC	RRVUNL, 2 x 660 MW,Super-Critical TPS,Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan INSTRUMENTATION AND CONTROL EQUIPMENT LIST OF SUB VENDORS	SHEET 7 OF 16
<p>MICROPROCESSOR BASED ANNUNCIATION SYSTEM</p> <p>Hathaway (Imported) Ronan (Imported)</p> <p>LEVEL GAUGES</p> <p>Chemtrols Engg. Levcon Sigma Instruments co. Technomatic (India) pvt. ltd. Teleflo Instruments co. ltd. Pune Techtrol B K Equipment V Automat SBEM Bliss Anand</p> <p>LEVEL SWITCHES</p> <p>Bells Control Ltd. Levcon Magnetrol Placka Pune Techtrol B K Equipment V Automat SBEM Bliss Anand</p> <p>POSITION TRANSMITTER</p> <p>Endress & Hauser Yamatake Siemens Gulde</p> <p>PRESSURE INDICATORS</p> <p>H.Guru Bells Controls ltd. General Instruments</p>		
		ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME V SECTION:TABLE17
Package: EPC	RRVUNL, 2 x 660 MW,Super-Critical TPS,Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan INSTRUMENTATION AND CONTROL EQUIPMENT LIST OF SUB VENDORS	SHEET 8 OF 16
<p>A.N. Instruments Gauges Bourdon Industrial Eqpt. co. Waaree Instruments Ltd. Odion Druck India Wika Instruments</p> <p>PRESSURE SWITCHES</p> <p>Indfoss (India) Ltd. Switzer Instruments Ltd. Varma Trafag A.N. Instruments Waaree Instruments Ltd Dag Process Instruments Chemtrols</p> <p>PUSH BUTTONS</p> <p>Honeywell Larsen & Toubro ltd. Siemens ltd. Tele Mechanic</p> <p>RECEIVER INDICATOR (BAR GRAPH)</p> <p>Laxons Masibus Industrial Instrumentation Yokogawa Teletherm Instruments co.</p> <p>RECEIVER RECORDER / MULTIPOINT RECORDER</p> <p>Laxons Engg. & Electronic Pvt. Ltd. Yokogawa. Tata Honeywell ABB Digital Electronics. Penny & Guile</p>		
		ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME V SECTION:TABLE17
Package: EPC	RRVUNL, 2 x 660 MW,Super-Critical TPS,Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan INSTRUMENTATION AND CONTROL EQUIPMENT LIST OF SUB VENDORS	SHEET 9 OF 16
<p>RELAYS</p> <p>Jyothi ABB Paramount Omron SIEMENS</p> <p>SAMPLE COOLER</p> <p>Polymetron Emerson Process Management Sentry Lowe</p> <p>SAMPLING RACK</p> <p>Emerson Process Management Polymetron</p> <p>SOLENOID VALVES</p> <p>Asco Avcon Rotex Schrader Herion-Norgren Schovill Duncan Ltd.</p> <p>TEMPERATURE INDICATORS</p> <p>G.I.Consortium Bells Controls Waaree instruments ltd Dresser-USA</p> <p>TEMPERATURE SWITCH</p> <p>Ashcroft Switzer Instruments Ltd. Waaree Instruments Ltd Dresser-USA</p>		
		ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME V SECTION:TABLE17
Package: EPC	RRVUNL, 2 x 660 MW,Super-Critical TPS,Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan INSTRUMENTATION AND CONTROL EQUIPMENT LIST OF SUB VENDORS	SHEET 10 OF 16
<p>TEMPERATURE TRANSMITTERS</p> <p>ABB Ltd. Emerson Process Management Camille-Baur P & F.</p> <p>THERMO COUPLE ASSEMBLY</p> <p>Industrial Instrumentation General Instruments Nagman Sensors (p) Ltd Pyro Electric instruments Toshniwal Industries Pvt. Ltd. Altop Temsens Waaree</p> <p>THERMOWELL</p> <p>General Instruments Nagman Sensors (p) Ltd. Pyro Electric Instruments Detriev Instrumentation Toshniwal Industries Ltd. Altop Temsens Waaree</p> <p>RTD</p> <p>Industrial Instrumentation Nagman Sensors (p) Ltd. Toshniwal Industries Pvt. Ltd Pyro Electric Instruments Altop Temsens Waaree</p> <p>UNIT CONTROL PANELS</p> <p>Industrial Controls & Appliances (P) Ltd. J & H</p>		
		ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME V SECTION:TABLE17
Package: EPC	RRVUNL, 2 x 660 MW,Super-Critical TPS,Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan INSTRUMENTATION AND CONTROL EQUIPMENT LIST OF SUB VENDORS	SHEET 11 OF 16
<p>Chemin Rittal</p> <p>LOCAL CONTROL PANELS</p> <p>Industrial Controls & Appliances (P) Ltd. J & H Pyrotech Rittal Chemin</p> <p>VARIABLE AREA FLOWMETERS</p> <p>Eureka Krone – Marshall Scientific Devices Chemtrols Trac Instrument Engineers</p> <p>CONDITION MONITORING SYSTEM</p> <p>Bently Nevada Schenk Avery SPM Instruments Ltd. Rockwell Automation. Shinkawa.</p> <p>ANNUBAR</p> <p>Dietrich Emerson Process Management</p> <p>ASSIGNABLE TREND RECORDER</p> <p>Honeywell Yokogawa Penny & Guile</p> <p>DESUPERHEATER</p> <p>Fisher Dresser Masoneilan</p>		
		ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME V SECTION:TABLE17
Package: EPC	RRVUNL, 2 x 660 MW,Super-Critical TPS,Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan INSTRUMENTATION AND CONTROL EQUIPMENT LIST OF SUB VENDORS	SHEET 12 OF 16
<p>CCI</p> <p>FLOAT & CHORD TYPE LEVEL INDICATOR</p> <p>Jayati Pune Techtrol B K Equipment V Automat SBEM Bliss Anand</p> <p>LEVEL SWITCH (PROBE TYPE)</p> <p>Level Stat Solatron Keystone Yarway.</p> <p>LAB INSTRUMENTS</p> <p>Dead Weight Tester (Pneumatic)</p> <p>Pressurements Waaree Instruments Ltd</p> <p>PRESSURE AND VACCUM GENERATORS WITH FINE REGULATOR</p> <p>Superb Instruments</p> <p>HIGH PRECISION REGULATORS FOR PRESSURE & VACUUM</p> <p>Fairchild</p> <p>HIGH TEMPERATURE FURNACE</p> <p>Nagman Waaree Instruments Ltd</p> <p>DIGITAL STORAGE OSCILLOSCOPE</p> <p>Phillips</p>		
		ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME V SECTION:TABLE17
Package: EPC	RRVUNL, 2 x 660 MW,Super-Critical TPS,Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan INSTRUMENTATION AND CONTROL EQUIPMENT LIST OF SUB VENDORS	SHEET 13 OF 16
<p>AC CLAMP ON METER</p> <p>Extech</p> <p>DIGITAL STROBOSCOPE</p> <p>Lutron</p> <p>SLING SYNCHROMETER</p> <p>Extech</p> <p>PORTABLE FLUE GAS ANALYSER</p> <p>Emerson Process Management</p> <p>BAROMETER</p> <p>Standard make subject to purchaser's approval</p> <p>SMD REWORK STATION</p> <p>Soldron Hakko OKS</p> <p>LAB & Control room FURNITURE</p> <p>Godrej</p> <p>PNEUMATIC POSITIONER / ELECTRO PNEUMATIC POSITIONER</p> <p>Masoneilan (India) Ltd. ABB</p> <p>ULTRASONIC TYPE LEVEL SWITCHES</p> <p>Nivo Controls Pvt Ltd. SB Electro Mechanics Ltd. E & H. Emerson Process Management</p>		
		ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME V SECTION:TABLE17
Package: EPC	RRVUNL, 2 x 660 MW,Super-Critical TPS,Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan INSTRUMENTATION AND CONTROL EQUIPMENT LIST OF SUB VENDORS	SHEET 14 OF 16
<p>RF Level Switch.</p> <p>EIP Bulk Controls Pvt Ltd. EIP Enviro Controls.</p> <p>TERMINAL BLOCKS</p> <p>Phoenix Weidmueller Wago</p> <p>MINIATURE CIRCUIT BREAKERS</p> <p>Siemens ABB L & T.</p> <p>LARGE VIDEO SCREENS / PLASMA VIDEO WALLS</p> <p>Barco Synelec SONY SAMSUNG LG</p> <p>DCS</p> <p>ABB BHEL Tatahoneywell Emerson Process Management Invensys Siemens Yokogawa Bluestar Ltd</p> <p>PLC</p> <p>AllenBradley ABB Honeywell</p>		
		ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME V SECTION:TABLE17
Package: EPC	RRVUNL, 2 x 660 MW,Super-Critical TPS,Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan INSTRUMENTATION AND CONTROL EQUIPMENT LIST OF SUB VENDORS	SHEET 15 OF 16
<p>BUNKER LEVEL INDICATORS</p> <p>Pepper &Flucs E&H Emerson Process Management EIP Enviro Controls</p> <p>PLASMA MONITORS</p> <p>Sony Samsung LG</p> <p>WORK STATIONS / MIS STATIONS/SERVERS</p> <p>IBM HP DELL</p> <p>MASS FLOW METER</p> <p>Emerson Process Management E&H</p> <p>SCREW PUMPS & DEAD WEIGHT TESTER(Hydraulic) Manometer India Budenberg Nagman Druck</p> <p>VIBRATION ANALYSIS SYSTEM</p> <p>Bentley Nevada Bruelenzar Rockwell SKF</p> <p>FURNACE FLAME ANALYSIS SYSTEM</p> <p>Durag, Hitech(BFI) EU tech scientific engg., GMBH</p>		
		ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME V SECTION:TABLE17
Package: EPC	RRVUNL, 2 x 660 MW,Super-Critical TPS,Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan INSTRUMENTATION AND CONTROL EQUIPMENT LIST OF SUB VENDORS	SHEET 16 OF 16
<p>PADO</p> <p>STEAG encotec (India) Pvt. Ltd. (Evonics) Honeywell Invensys Emerson</p> <p>CMMS</p> <p>Honeywell InvensysABB TCS</p> <p>AAQMS & MMS</p> <p>Chemtrols Campbell scientific canda corp Honeywell (Teledyne) Techmark engineers and cosultants (Horiba) Nevco engg pvt. Ltd. (LSI lastern)</p> <p><u>NOTES</u></p> <ol style="list-style-type: none"> 1. The final make selected out of the recommended makes listed above shall be subject to purchaser / consultant's approval during detailed Engineering. 2. Wherever the make is not specified for any item, the Bidder shall indicate 2 or 3 reputed makes, out of which Purchaser / Consultant shall select any one which is acceptable suggest an acceptable make. This shall have no price implication. 		
		ISSUE R1