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)

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 : 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).

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.

INDEX

SECTION	TITLE
A	**SCOPE OF ENQUIRY**
B	**PROJECT INFORMATION**
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

BHEL	TITLE : TECHNICAL SPECIFICATION FOR CONDENSER ON LOAD TUBE CLEANING SYSTEMS (COLTCS).	SPEC. NO. PE-TS-392-165-N002
		VOLUME : II B
		SECTION : A
		REV. NO. 0 / DATE : 29.05.2013
		SHEET 1 of 1

SECTION - A
SCOPE OF ENQUIRY

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.**

2.00.00 **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.

2.0.2.00 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.

SECTION – B

PROJECT INFORMATION

SECTION: B

PROJECT INFORMATION

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	

	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

		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 ± 10% Frequency variation ± 5% Combined voltage & frequency variation 10%
DC supply	Voltage variation +10% ,-15%

j) For instrument and control system of steam generator and steam turbine generator. — 230 V ± 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.

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 CaCO3	mg/l	74
9.	Magnesium hardness as CaCO3	mg/l	52
10.	Sodium as Na	mg/l	61
11.	Potassium	mg/l	-
12.	Chloride as cl	mg/l	39
13.	Sulphate as So4	mg/l	48
14.	Sulphide	mg/l	-
15.	M- Alkalinity as CaCO3	mg/l	140
16.	P-Alkalinity as CaCO3	mg/l	Nil
17.	Nitrates as No3	mg/l	17
18.	Nitrite	mg/l	Nil
19.	Silica as SiO2 – Dissolved	mg/l	15
20.	Silica as SiO2 – 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 O2	mg/l	5.0
26.	Carbon dioxide free	mg/l	5

SECTION – C

SPECIFIC REQUIREMENTS

SECTION C1 : CONDENSER ONLOAD TUBE CLEANING

SECTION C2 : ELECTRICAL SYSTEMS

SECTION C3 : C&I SYSTEMS

SECTION C1

CONDENSER ONLOAD TUBE CLEANING SYSTEMS

(MECHANICAL DETAILS)

	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 : 29.05.2013
		SHEET 1 OF 10	

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.

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 over size 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.

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 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.

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".

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.

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 out rightly.

8.1.2 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 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.

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.

- 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.

ANNEXURE- I

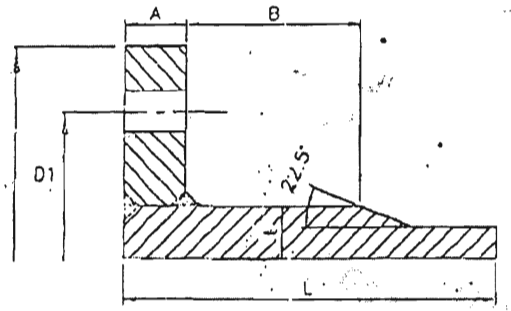
COLTCS

SL.NO.	Projects	Size (NB)	Length of Ball Seperator (Including 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

FIRST ANGLE PROJECTION ALL DIMENSIONS ARE IN MM

DRAWING NO PE-DG-999-141-M017

ANNEXURE II



NOTES:-

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

PIPE SIZE	PIPE THK.	FLANGE OD 'D'	Bolt PCD 'D1'	WELD NECK FLANGE				SLIP-ON FLANGE THICKNESS
				FLANGE THK. 'A'	NECK THK. 't'	NECK Length 'B'	Appx. Total Length 'L'	
1200	10-12	1405	1380	40	24	70	200	90
1400	14	1675	1590	50	24	70	200	100
1600	14	1915	1920	60	32	80	220	110
1800	14-16	2115	2020	70	32	90	250	120
2200	18	2550	2420	80	36	100	300	140
2300	20			90	38	110	325	150
2500	20			90	38	110	325	150
2700	20			90	38	110	325	150

— TENTATIVE

DRAWING FOR BAI.' SEPARATOR COUNTER FLANGE

REV.	DATE	ALTD	CHD	APPD

JOB NO. 999

STATUS: -

DISTRIBUTION

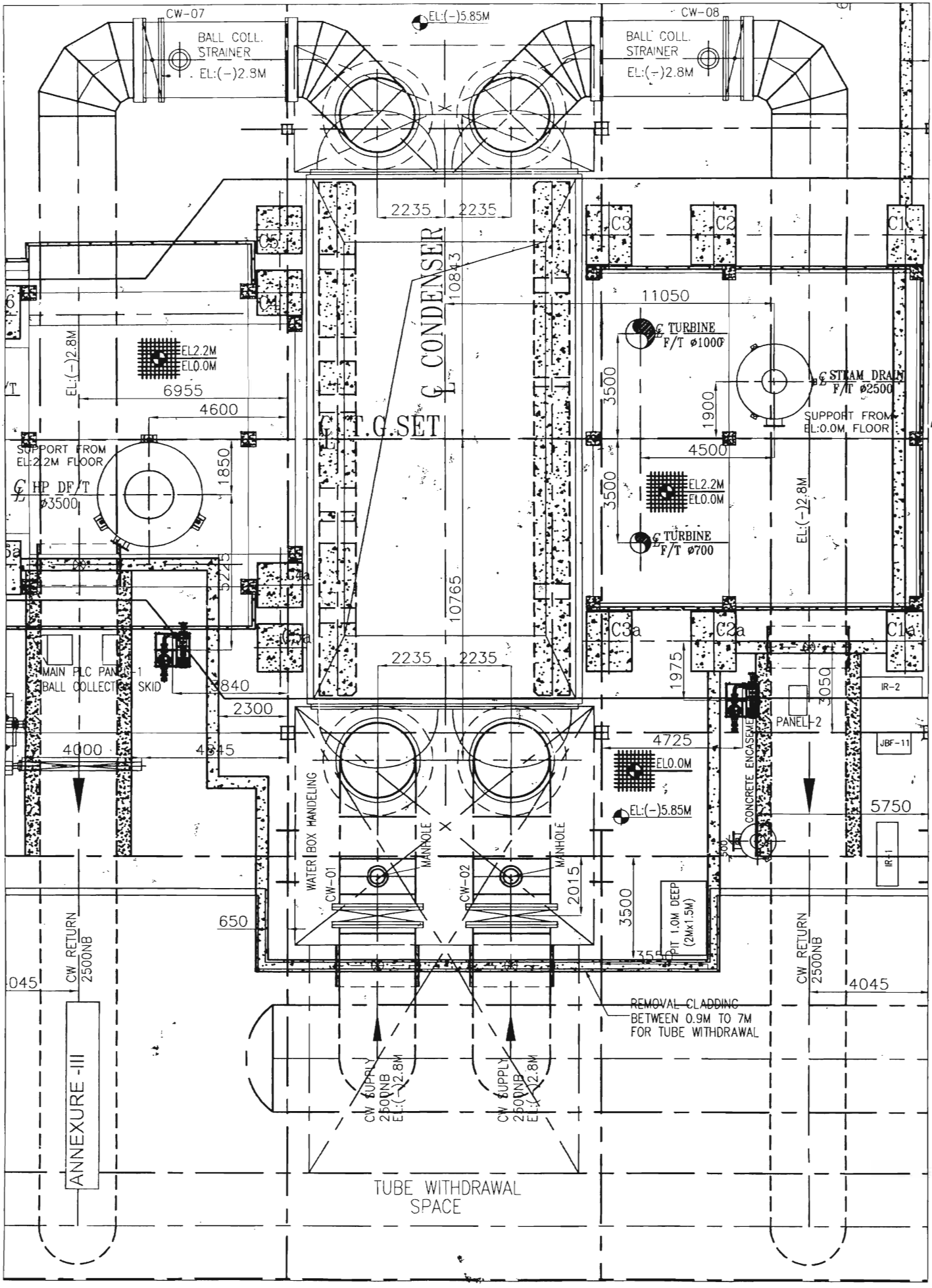
BHARAT HEAVY ELECTRICALS LTD
POWER GROUP
PROJECTS ENGINEERING MANAGEMENT
PPEI, NOIDA

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

TITLE: COUNTER FLANGE DETAILS

DRAWING NO PE-DG-999-141-M017

SHEET 01 OF 01 REV 00


CW-07
BALL COLL. STRAINER
EL:(-)2.8M
EL:(-)5.85M
CW-08
BALL COLL. STRAINER
EL:(-)2.8M
2235
2235
C5
C4
C3
C2
C1
10843
℄ CONDENSER
℄ T.G.SET
11050
℄ TURBINE F/T ø1000
℄ STEAM DRAIN F/T ø2500
SUPPORT FROM EL:0.0M FLOOR
1900
3500
4500
EL2.2M
EL0.0M
EL:(-)2.8M
6955
4600
EL2.2M
EL0.0M
SUPPORT FROM EL:2.2M FLOOR
℄ HP DF/T ø3500
1850
℄ TURBINE F/T ø700
10765
C3a
C2a
C1a
2235
2235
1975
3050
IR-2
PANEL-2
JBF-11
MAIN PLC PANEL-1
BALL COLLECTOR SKID
3840
2300
4000
4045
4725
EL0.0M
EL:(-)5.85M
CONCRETE ENCASEMENT
5750
IR-1
WATER BOX HANDELING
CW-01
MANHOLE
CW-02
MANHOLE
2015
650
3500
PIT 1.0M DEEP (2Mx1.5M)
CW RETURN 2500NB
CW RETURN 2500NB
4045
4045
REMOVAL CLADDING BETWEEN 0.9M TO 7M FOR TUBE WITHDRAWAL
CW SUPPLY 2500NB EL:(-)2.8M
CW SUPPLY 2500NB EL:(-)2.8M
ANNEXURE -III
TUBE WITHDRAWAL SPACE

SECTION C2

CONDENSER ONLOAD TUBE CLEANING SYSTEMS

ELECTRICAL DETAILS

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).

REV : 1 DATE : 06.06.2013

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.

SECTION C3

CONDENSER ONLOAD TUBE CLEANING SYSTEMS

C&I DETAILS

INDEX

S. No.	DESCRIPTION
1	TITLE SHEET
2	C&I SCOPE MATRIX FOR COLTCS
3	INDEX SHEET
4	C&I SPECIFIC TECHINCAL REQUIREMENT
5	DATA SHEETS FOR PRESSURE GAUGE/ DP GAUGE
6	CHECK LIST FOR PRESSURE GAUGE/ DP GAUGE
7	DATA SHEETS FOR PRESSURE SWITCH/ DP SWITCH
8	CHECK LIST FOR PRESSURE SWITCH / DP SWITCH
9	DATA SHEETS FOR PRESSURE TRANSMITTER/ DP TRANSMITTER
10	CHECK LIST FOR PRESSURE TRANSMITTER / DP TRANSMITTER
11	DRIVE CONTROL PHILOSOPHY
12	APPROVED VENDOR LIST FOR C&I ITEMS (AS ON DATE 20.05.2013)

C&I SCOPE MATRIX FOR COLTCS & SCS - 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. FOR COLTCS. 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

C&I SPECIFIC TECHINCAL REQUIREMENT

1.0 SPECIFICATIONS FOR INSTRUMENTS TO BE SUPPLIED ARE AS FOLLOWS.

1.1 Pressure Indicators/DP indicators

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).

1.2 Pressure Switches/DP Switches

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).

1.3 Pressure Transmitters/DP Transmitters/Flow transmitters(DP type/Level transmitters/DP type (SMART)

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.

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.

1.21 Pressure and Differential Pressure Transmitter Racks

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.

1.22 Junction Boxes (JB)

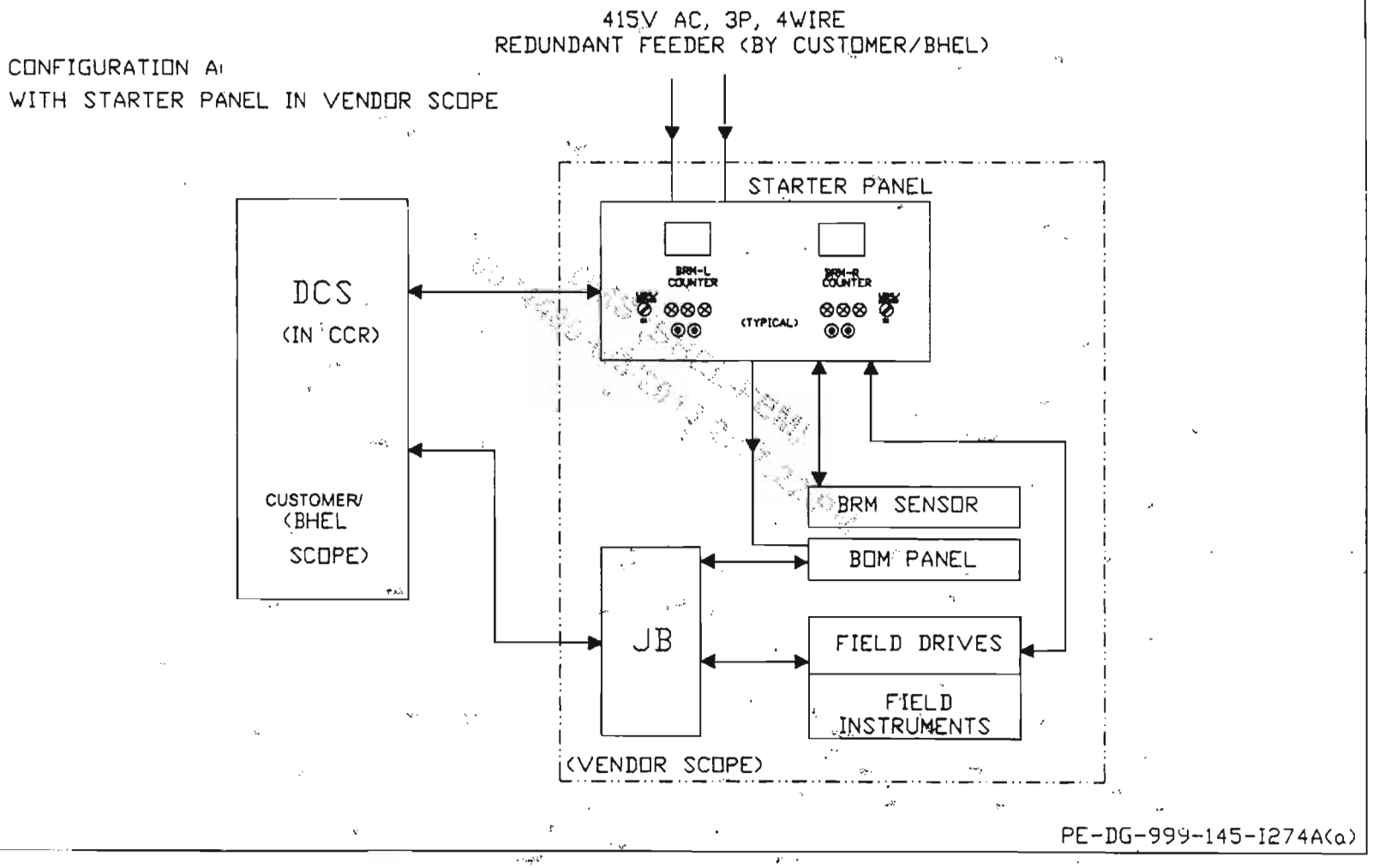
All JBs shall be Galvanised. Wall/column mounted junction boxes having 32 (2x16) terminals and cable entry only at the bottom and sealed with fireproof compound; Screwed terminal type; IP 65 or equivalent degree of protection for enclosure. Separate terminal blocks shall be used for analog and digital 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 JBs 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 JBs are subject to approval prior to manufacturing All JBs shall be provided with individual canopies to avoid ingress of water.
All the TBs used shall be 6.6polymide to withstand corrosion and the metallic portion shall be coated against rust / corrosion.

1.23 Programmable Logic controller (PLC)-Refer Cl.no. 9.0 & Table-15

1.24 Interposing Relays (IPR)

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

STANDARD BLOCK DIAGRAM FOR COLTCS PACKAGE WITH DCS CONTROL



SECTION D1

STANDARD TECHNICAL SPECIFICATION FOR CONDENSER ONLOAD TUBE CLEANING SYSTEMS

1.00.00 **GENERAL**

This specification covers the design, performance and operational requirements, configuration and constructional features, manufacture, assembly, inspection and testing at the manufacturer's and/or his sub-contractor's works and painting for delivery of condenser on-load tube cleaning system (sponge rubber balls type) complete with all accessories as specified hereinafter. Each half of the condenser shall be provided with an independent tube cleaning system.

2.00.00 **CODES AND STANDARDS**

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

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

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

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

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

3.00.00 **DESIGN AND CONSTRUCTION**

3.01.00 General Requirements

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

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

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

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

3.02.00 **Performance Requirements.**

3.02.01 The tube cleaning system with all accessories shall be designed and guaranteed to meet the following requirements :

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.

3.02.02 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.

3.02.03 The power consumption by ball recirculation pump during various operations shall be minimum possible.

The quantity of cleaning balls worn out and / or lost, shall be minimum possible.

3.03.00 **Operational Requirements.**

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

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

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

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

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

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

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

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

3..04.00 **Ball Separator**

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

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

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

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

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

3.05.00 **Ball Recirculating Pump**

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

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

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

3.05.04 Pumps shall be provided with mechanical seals to the extent feasible. If Gland packing is provided it should be of good quality to be provided to prevent leakage of water from pump glands.

3.05.05 Shaft size selected shall take into Consideration the critical speed which shall be away from the operating speed as recommended in applicable codes / standards. Renewable type fine finished shaft sleeves shall be integral with water thrower plates at the end and the length must extend beyond the outer faces of gland packing so as to distinguish between the leakage between shaft and the shaft sleeve and that past the seals / glands.

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

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

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

3.05.09 All rotating components shall be statically and dynamically balanced.

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

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

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

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

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

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

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

3.06.00 **Ball Collector**

3.06.01 The body of the ball collector shall be designed to withstand 2.0 times the operating pressure or 1.5 times the recirculating pump shut-off pressure, whichever is higher.

The ball collector shall be designed and manufactured as per the applicable codes for pressure vessels.

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

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

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

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

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

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

3.07.00 **Differential Pressure Measuring System.**

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

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

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

3.08.00 **Ball Monitoring System**

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

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

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

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

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

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

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

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

c) Recorder for ball consumption.

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

3.09.00 **Cleaning Balls**

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

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

3.09.03 The composition of the cleaning balls shall be based on natural rubber and shall be suitable for temperature upto 100°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 ,

gate / globe /B.F. valves shall be provided. All instrument valves shall be needle valves.

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

3.10.05 Distributors (if applicable) with sight glass shall be provided wherever ball transport piping branching out or joining together for proper guidance of cleaning balls.

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

3.11.00 **Actuators**

3.11.00 Tube cleaning system shall be provided with actuators wherever necessary for various automatic operations. The actuators shall be electric motor operated and shall meet the requirements of the enclosed specification. The actuator shall be provided with auxiliary handwheel for manual operation in the event of control system failure.

3.12.00 **Electric Motors**

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

3.13.00 **Instrumentation and Control System.**

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

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

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

3.14.00 **Other Accessories.**

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

Data Sheet-A / Section -C.

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

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

3.15.00 **Materials of Construction**

Materials of various equipments in the tube cleaning system shall be corrosion resistant and consistant 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

quality plan to ensure that the various equipments and other accessories of the tube cleaning system shall conform to the requirements of this specification and of the applicable codes / standards.

5.01.02 All materials used for manufacture /fabrication of the various equipments of the tube cleaning system shall be of tested quality. Relevant test certificates for chemical analysis, mechanical tests and heat treatment shall be made available before the final shop inspection. In case the relevant test certificates are not available, the manufacturer shall arrange to carry out the necessary tests as per the approved quality plan and applicable codes at his cost for which samples shall be identified by BHEL's representative.

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

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

5.2.00 **Ball Separator**

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

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

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

5.03.00 **Ball Recirculating Pump**

5.03.01 Chemical analysis, mechanical tests shall be carried out on materials used for casing, impeller, shaft, sleeves, wear rings etc., as per the applicable material specification standards.

5.03.02 The casting used for pump casing and impeller shall be sound, clean and free from porosity, blow holes, hard spots, cold shuts, distortion and other harmful defects. All accessible surfaces of the impeller shall be subjected to penetrant test as per ASTM-E165 for surface defects with acceptance norms as per ASME B&PV code, Section VIII, Division 1. No welding or repairs shall be carried out without prior permission of BHEL.

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

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

5.03.05 Pump impellers and rotor assembly shall be statically and dynamically balanced as

per ISO-1940

5.04.00 **Ball Collector**

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

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

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

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

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

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

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

5.06.00 **Rubber Lining (as applicable)**

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

5.07.00 **Flanges**

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

5.07.02 In case of fabricated flanges, all the welds shall be subjected to 100% radiography as per ASME B&PV code, Section VIII, Division 1.

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

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

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

5.08.00 **Dimensional Checks.**

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

5.09.00 **Hydrostatic Test**

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

5.10.00 **Leakage Test**

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

5.11.00 **Performance Test on Recirculating Pump**

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

5.12.00 **Functional Tests**

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

5.12.01 Smooth and free operation of all movable parts.

5.12.02 Interlock and sequential operation.

5.12.03 Satisfactory operations of ball monitoring system.

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

6.00.00 **TESTING AT SITE**

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

7.0.0 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%.

Any deviation to above balls life and percentage recovery will not be accepted.

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.

In case the successful bidder fails to demonstrate any of these parameters he shall carry out modifications at his own cost, to purchasers approval.

In case bidder fails to demonstrate above parameters to purchaser's satisfaction even after modification carried by him at site, the purchaser has the right to reject the equipment out rightly.

8.00.00 **QUALITY ASSURANCE & QUALITY PLAN**

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

8.02.00 Typical quality plans are enclosed herewith this specification for bidder's guidance. The bidder shall furnish his own quality plan based on materials, equipments and components of the tube cleaning system being offered.

9.00.00 **NAME PLATE AND TAG NUMBERS**

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

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

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

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

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

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

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

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.

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

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

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

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

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

1.01.03 Bar chart and inspection schedule.

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

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

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

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

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

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

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

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

1.02.08 List of annunciations, protections and interlocks provided.

1.02.09 Detailed drawings of flanges.

1.02.10 Ball recirculating pump performance characteristic curves.

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

1.02.12 Storage instructions.

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

G:\MSE\ASH\STSCOTCS.RTF

	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: 14.06.2013
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/cm² (g) & vacuum 0.1 kg/cm² (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

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	**CONNECTING PIPE DETAILS**		
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	**MATERIALS OF CONSTRUCTION**		
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	**BALL COLLECTOR**		
	a) Body / housing		Carbon steel-IS 2062 Gr. B with epoxy painted inside
	b) Screen / Strainer		SS-316
	c) Site Glass Provision		Yes

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
	C) Ball valves		
	i) Body		SA 351 CF8M
	ii) Ball		SA 351 CF8M
	iii) Stem		SS 316

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 (In Bidder's scope)
	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.

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

	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 caliberation are made		YES
13.0	Mandatory Spares to be supplied under this specification.		Nil
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 Appendix A.

Manufacturer's Name & Address	STANDARD QUALITY PLAN	BHEL Doc No.:	PE- V1 -XXX- 165-N008
	Vendor Q.P. NO.	PROJECT:	
	INDEX PACKAGE : COLTCS	CUSTOMER:	
	Date :	PURCHASER:	
	Page 01 of 15	CONSULTANT:	
		P.O. No.	

SL. NO.	DESCRIPTION	PAGE 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

DAY RUN TEST PROCEDURE FOR BALL SEPERATOR

, HYDRO STATIC TEST PROCEDURE

LEAK TIGHTNESS TEST PROCEDURE

PACKING PROCEDURE

LEGEND

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

** M Manufacturer / Manufacturer's Sub-contractor

C Contractor O Owner

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

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

	BHEL	Manufacturer's Name & Address			STANDARD QUALITY PLAN				BHEL Doc No.:	PE V1 356 165 N 008				
							Vendor Q.P. NO:		PROJECT:					
		P.O. No.			Item : Ball Separator		PACKAGE : COLTCS		CUSTOMER					
									PURCHASER:					
							Date :		CONSULTANT:					
							Page 02 of 15							
Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	Agency				Remarks	
									O*	M **	C	O		
1	2	3	4	5	6	7	8	9	10				11	
1.0.0	Ball Separator													
1.1.0	Raw Material													
[a]	Housing Shell, Nozzle flanges	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample/cast / heat / batch	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / Lab test report/Raw material flow sheet	★	P	V	V		
		Surface defects	Minor	Visual	100%	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report/ Raw material Flow sheet	–	P	V	V		
		Sub Surface Defects	Major	Ultrasonic test	100%	ASME SA 435	ASME SA 435	Inspection report	★	P	V	V	Plates > 20mm Thk only (UT - Full Volume)	
[b]	Nozzle Pipes	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample/heat	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / Lab test report/Raw material flow sheet	★	P	V	V		
		Surface defects	Minor	Visual	100%	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report/ Raw material Flow sheet	–	P	V	V		
		Leak Tightness	Major	Hydrostatic test	100%	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate	★	P	V	V		
[c]	Main Flange	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample/cast / heat / batch	Approved drg/Data sheet	Approved drg/Data sheet	Manufacturer's Test Certificate	★	P	V	V		
		Heat treatment (Normalising)	Major	Verification	HT Chart	Approved drg/Data sheet	Approved drg/Data sheet	Manufacturer's Test Certificate	★	P	V	V	If casting	
		Surface defects	Critical	Magnetic particle test	100%	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report	★	P	V	V	If casting	
		Sub-surface defects	Critical	Ultrasonic test	100%	ASME SA609 / SA 435	ASME SA609 Level II / SA 435 / SA 388	Inspection report	★	P	V	V		
[d]	Screen Shell	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample/heat	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / Lab test report/Raw material flow sheet	★	P	V	V		
				LEGEND										
				* Records indentified with "STAR" shall be essentially included by contractor in QA Documentation.										
				** M. Manufacturer / Manufacturer's Sub-contractor										
				C. Contractor	Q. Owner									
Manufacturer / Sub-Contractor		Contractor		Indicate : "P" - Perform, "W" - Witness and "V" - Verification										
Signature								Reviewed By					Name & Sign. Of approving authority & Seal	

		Manufacturer's Name & Address			STANDARD QUALITY PLAN				BHEL Doc No.:	PE- V1 -XXX- 165-N008				
							Vendor Q.P. NO:		PROJECT:					
		P.O. No.			Item : Ball Separator		PACKAGE : COLTCS		CUSTOMER:					
							Date :		PURCHASER:					
							Page 03 of 15		CONSULTANT:					
Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	Agency				Remarks	
									*	M	C	O		
1	2	3	4	5	6	7	8	9	10				11	
		Surface defects on machined area	Critical	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	★	P	V	V		
		Sub-surface defects	Critical	Ultrasonic test	100%	ASME SA745	ASME SA745	Inspection report	★	P	V	V		
(e)	Screen ribs	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample / heat	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / Lab test report/Raw material flow sheet	★	P	V	V		
		Corrosion Resistance	Major	IGC	One/Heat	ASTM A 923	ASTM A 923	Test Report/Lab test report	★	P	V	V		
		Surface Defects	Minor	Visual	100%	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report/ Raw material Flow sheet	-	P	V	V		
(f)	Ball Extraction Nozzle Pipe (Duplex Stainless Steel)	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample / cast/heat/ batch	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / Lab test report/Raw material flow sheet	★	P	V	V		
		Surface Defects	Minor	Visual	100%	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report/ Raw material Flow sheet	-	P	V	V		
		Leak Tightness	Major	Hydrostatic Test	100%	Approved drg/Data sheet.	Approved drg/Data sheet	Manufacturer's Test Certificate	★	P	V	V		
1.2.0	Inprocess Quality Control													
1.2.1	Welding procedure specification	Correctness	Critical	Scrutiny	100%	ASME Sec.IX	ASME Sec.IX	QW 482 of ASME Sec.IX	★	P	V	V		
1.2.2	Welding procedure qualification	Weld soundness	Critical	Physical test	100%	ASME Sec.IX	ASME Sec.IX	QW 483 of ASME Sec.IX	★	P	V	V	Welding procedure already approved by BHEL/LRQA/GL/DNV/TUV shall be employed for this job	
1.2.3	Welder performance qualification	Weld soundness	Critical	Radiography	100%	ASME Sec.IX	ASME Sec.IX	QW 484 of ASME Sec.IX	★	P	V	V	Welders already qualified by BHEL/LRQA/GL/DNV/TUV shall be employed for this job	
1.2.4	Fit-up of butt weld	Alignment and dimensions	Major	Template, visual	100%	Manufacturing Drawing	ASME Sec VIII Div.1	Log book		P	W/V	W	BHEL to witness > 20mm thick butt joint	
1.2.5	Fit-up of shell flange and nozzle assembly to shell	Orientation, alignment and dimensions	Major	Template, visual	100%	Manufacturing Drawing	ASME Sec VIII Div.1	Log book		P	-	-		

LEGEND

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

** M : Manufacturer / Manufacturer's Sub-contractor

C : Contractor O : Owner

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

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

		Manufacturer's Name & Address			STANDARD QUALITY PLAN				BHEL Doc No.:	PE- V1 -XXX- 185-N008			
							Vendor Q.P. NO.		PROJECT:				
		P.O. No.			Item : Ball Separator		PACKAGE : COLTCS		CUSTOMER:				
							Date :		PURCHASER:				
							Page 04 of 15		CONSULTANT:				
Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record		Agency			Remarks
										M	C	O	
1	2	3	4	5	6	7	8	9	10*	**			11
1.2.6	Weld quality for Pressure Parts												
	(a) Root run	Surface defects	Major	Penetrant test / Visual	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Operation Process Sheet	–	P	V	V	
1.2.7	(a) Completed butt welds	1.Surface defects	Major	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	★	P	V	V	
		2.Sub-surface defects	Critical	Radiography test	10% of total weld length & 100% T Joints	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 4 / UW 52	Radiographs & inspection report	★	P	V	V	RT films will be reviewed by BHEL
	(b) Completed fillet welds	Surface defects	Major	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	★	P	V	V	
1.2.8	Fabricated Shell (Prior to sand blasting)	1.Dimensions, Orientation	Major	Measurement by visual	100%	Manufacturing Drawing	Manufacturing Drawing	Inspection report	★	P	V	V	
		2. Hydro test	Critical	Hydrostatic Pr. @ 1.5 times design pr. (positive) Duration 30 minutes	100%	ASME Sec.VIII Div.1	No Leakage	Inspection report	★	P	W	V	
1.2.9	Pickling and Passivation	Protection Layer	Major	Visual	100%	IS : 10117	IS : 10117	Log Book	–	P	–	–	
1.2.10	Final tests (completed equipments) - After assembly	1.Dimensions, orientation, workmanship & finish	Major	Measurement by visual	100%	G.A.drawing	G.A.drawing	Inspection report	★	P	W	W	
		2.Leak tightness for assembly	Critical	Leak Tightness @ design pr. (positive) Duration 30 minutes	100%	ASME Sec.VIII Div.1	No Leakage	Inspection report	★	P	W	W	
		3.Dry function test for Ball Separator	Critical	Operational test	100%	Approved procedure	Approved procedure	Inspection report	★	P	W	W	
			LEGEND										
			* Records indentified with "STAR" shall be essentially included by contractor in QA Documentation.										
			** M :Manufacturer / Manufacturer's Sub-contractor C :Contractor O : Owner										
Manufacturer / Sub-Contractor		Contractor	Indicate : "P" - Perform, "W" - Witness and "V" - Verification										
Signature								Reviewed By					Name & Sign. Of approving authority & Seal

		Manufacturer's Name & Address			STANDARD QUALITY PLAN				BHEL Doc No.:				PE- V1 -XXX- 165-N008
		P.O. No.			Item : Ball Separator		Vendor Q.P. NO:		PROJECT:				
							PACKAGE : COLTCS		CUSTOMER:				
							Date :		PURCHASER:				
							Page 06 of 15		CONSULTANT				
Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	Agency				Remarks
										M	C	O	
1	2	3	4	5	6	7	8	9	0*	**	10		
1.3 0	Rubber Lining for ball Seperator Shell, V-Piece & skid IC Pipe.												
1.3 1	Rubber formulation	Tensile elongation and hardness	Major	Physical test	One per lot	Manufacturer's procedure	BS 6374/Equivalent	Manufacturer's test certificate		P	V	V	
		Polymer identification	Major	Flame test	One per lot	For Semi Ebonite	For Semi Ebonite	Inspection report	*	P	V	V	
						Ebonite Polymer catches fire; catches fire and On removal from fire it continues to burn	Ebonite Polymer catches fire; catches fire and On removal from fire it continues to burn						
		% Change in weight after 24 hrs immersion in sea water at 70 degrees	Major	Immersion test (bleeding test)	One per lot	ASTM D 471	+/- 1 %	Inspection report	*	P	V	V	
1.3.2	Surface preparation of dams to be lined	Free from rust scale, dust and grease	Major	Visual	100%	SA 2.5	SA 2.5	Manufacturer's Internal inspection		P	-		
1.3.3	Vulcanising	Temperature, Pressure and time	Major	Process monitoring	100%	Manufacturer's procedure	Manufacturer's procedure	Process Procedure		P	-	-	
1.3.4	Vulcanised rubber lined dams	a) Chip test	Major	Chip test	One per lot	Approved drawing and BS 6374/Equivalent	BS 6374/Equivalent	Inspection report	*	P	V	V	
		b)Adhesion, Visual defects, thickness and hardness	Major	Measurement,visual inspection	100% visual, Thickness&hardness at random	Approved drawing and BS 6374/Equivalent	BS 6374/Equivalent	Inspection report	*	P	V	V	
		c)Spark test for Pin holes at 5 kv/mm	Major	Spark test for Pin holes	100%	Approved drawing and BS 6374/Equivalent	BS 6374/Equivalent	Inspection report	*	P	V	V	

LEGEND

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

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

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

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

		Manufacturer's Name & Address			STANDARD QUALITY PLAN				BHEL Doc No.:	PE- V1 -XXX- 165-N008			
		P.O. No.			Item : WORM GEAR & ACTUATORS		Vendor Q.P. NO:		PROJECT:				
							PACKAGE : COLTCS		CUSTOMER:				
							Date :		PURCHASER:				
							Page 06 of 15		CONSULTANT:				
Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record		Agency			Remarks
										M	C	O	
1	2	3	4	5	6	7	8	9	10*	10			11
14.0	Complete Unit of Worm gear	Reduction Ratio	Critical	Functional Test	100%	Approved Data Sheet	Approved Data Sheet	Manufacturer test certificate	*	P	V	V	
		Angle of Rotation											
		Input Torque											
		Output Torque											
		Degree of protection	Critical	Water & Dust ingress tests	Type test	Approved Data Sheet	Approved Data Sheet	Type test certificate	*	V	V	V	
15.0	Actuators	Routine Test	Major	Electrical test	100%	Supplier catalogue	Supplier catalogue / ADS	Manufacturer TC	*	V	V	V	Review of TCs
		Make, Range, Model	Major	Visual	100%								
		Assembly check alongwith ball valves	Major	Visual	100%	Supplier catalogue	Supplier catalogue / ADS	Inspection Report	-	P	-	-	
		Functional check alongwith settings/auxiliary contacts	Major	Visual	100%								
		Note ADS - APPROVED DATA SHEET											
			LEGEND										
			* Records indentified with "STAR" shall be essentially included by contractor in QA Documentation.										
			** M :Manufacturer / Manufacturer's Sub-contractor C :Contractor O : Owner										
Manufacturer / Sub-Contractor Signature		Contractor	Indicate "P"- Perform, "W" - Witness and "V" - Verification					Reviewed By					Name & Sign. Of approving authority & Seal

		Manufacturer's Name & Address			STANDARD QUALITY PLAN				BHEL Doc No.:				PE- V1 -XXX- 165-N008	
							Vendor Q.P. NO:		PROJECT:					
		P.O. No.			Item : Ball Recirculation Skid & Ball Vessel		PACKAGE : COLTCS		CUSTOMER.					
							Date :		PURCHASER:					
							Page 07 of 15		CONSULTANT:					
Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record		Agency			Remarks
										M	C	O	
1	2	3	4	5	6	7	8	9	6*	**	10		11	
2.0.0	Complete Skid													
	Recirculating Skid with ball vessel and ball overage monitor	Completeness, Correctness, Orientation, Dimensions	Major	Visual & Measurement	100%	Approved Drawing	Approved Drawing	Inspection report	*	P	V	V		
	Ball Vessel													
2.1.0	Raw Material													
[a]	Housing Shell, Nozzle flanges and dished end	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample/heat	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / lab test report / raw material flow sheet	*	P	V	V		
		Surface defects	Minor	Visual	100%	Approved drg/Data sheet	Approved drg/Data sheet	Mill TC/Inspection report	*	P	V	V		
		Sub-surface defects	Major	Ultrasonic test	100%	ASME SA 435	ASME SA 435	Inspection report	-	P	V	V	Plates > 20mm Thk only (UT - Full Volume)	
2.2.0	Inprocess Quality Control													
2.2.1	Welding procedure specification	Correctness	Critical	Scrutiny	100%	ASME Sec.IX	ASME Sec.IX	QW 482 of ASME Sec.IX	*	P	V	V		
2.2.2	Welding procedure qualification	Weld soundness	Critical	Physical test	100%	ASME Sec.IX	ASME Sec.IX	QW 483 of ASME Sec.IX	*	P	V	V	Welding procedure already approved by BHEL/LRQA/GL/DNV/TUV shall be employed for the job.	
2.2.3	Welder performance qualification	Weld soundness	Critical	Radiography	100%	ASME Sec.IX	ASME Sec.IX	QW 484 of ASME Sec.IX	*	P	V	V	Welders already qualified by BHEL/LRQA/GL/DNV/TUV shall be employed for the job.	
2.2.4	Dished end for ball vessel	Dimensions	Major	Template	100%	Manufacturing Drawing	ASME Sec VIII Div.1	Inspection report	-	P	V	V		
		Surface defects	Critical	Penetrant test	100%	ASME Sec VIII Div.1	ASME Sec VIII Div 1 Appendix 8	Inspection report	-	P	V	V		
				LEGEND										
				* Records indentified with "STAR" shall be essentially included by contractor in QA Documentation.										
				** M : Manufacturer / Manufacturer's Sub-contractor C : Contractor O : Owner										
Manufacturer / Sub-Contractor Signature		Contractor		Indicate "P" - Perform, "W" - Witness and "V" - Verification				Reviewed By					Name & Sign. Of approving authority & Seal	

		Manufacturer's Name & Address			STANDARD QUALITY PLAN				BHEL Doc No.:	PE- V1 -XXX- 165-N008			
							Vendor Q.P. NO:		PROJECT:				
		P.O. No.			Item : Ball Vessel & Ball Injection Pipe		PACKAGE : COLTCS		CUSTOMER:				
							Date :		PURCHASER:				
							Page 08 of 15		CONSULTANT:				
Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	Agency				Remarks
										M	C	O	
1	2	3	4	5	6	7	8	9	D*	**	10		11
2.2.5	Fit-up of butt weld	Alignment and dimensions	Major	Measurement	100%	Manufacturing Drawing	ASME Sec VIII Div.1	Log book	–	P	W/V	–	BHEL to witness >20mm thick butt joint
2.2.6	Fit-up of shell flange and nozzle assembly to shell	Orientation alignment and dimensions	Major	Template, visual	100%	Manufacturing Drawing	ASME Sec VIII Div.1	Log book	–	P	–	–	
2.2.7	Weld quality for Pressure Parts												
	(a) Root run	Surface defects	Major	Penetrant test / Visual	100%	ASME Sec VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Operation Process Sheet	★	P	V	V	
2.2.8	(a) Completed butt welds	1.Surface defects	Major	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	★	P	V	V	
		2.Sub-surface defects	Critical	Radiography test	10% of total weld length & 100% T Joints	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 4 / UW 52	Radiographs and inspection report	★	P	V	V	RT films will be reviewed by BHEL
	(b) Completed fillet welds	Surface defects	Major	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	★	P	V	V	
2.2.9	Fabricated Shell	1.Dimensions, Orientation	Major	Measurement	100%	Manufacturing Drawing	Manufacturing Drawing	Inspection report	★	P	V	V	
		2. Hydro test for Ball Vessel	Critical	Hydrostatic Pr. @ 1.5 times design pr. (positive) [Duration 30 minutes]	100%	ASME Sec.VIII Div.1	No leakage	Inspection report	★	P	W	V	Hydrostatic test shall be conducted along with Recirculating skid Assly for Ball Vessel.
2.2.10	Pickling and Passivation	Protection Layer	Major	Visual	100%	IS : 10117	IS : 10117	Log Book		P	–	–	
2.2.11	Ball Injection Pipe	Chemical & Physical properties	Major	Chemical & mechanical tests	One sample/heat	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / lab test report / raw material flow sheet	★	P	V	V	
		Surface defects	Minor	Visual	100%	Approved drg/ Data sheet	Approved drg/ Data sheet	MTC / Inspection report	–	P	V	V	
		Leak Tightness	Major	Hydrostatic test	100%	Approved drg/Data sheet	Approved drg/Data sheet	Manufacturer's Test Certificate	★	P	V	V	

LEGEND

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

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

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

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

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

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

LEGEND

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

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

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

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

	Manufacturer's Name & Address			STANDARD QUALITY PLAN				BHEL Doc No.:	PE- V1 -XXX- 165-N008			
						Vendor Q.P. NO:		PROJECT:				
	P.O. No.			Item : RECIRCULATING PUMP MOTOR		PACKAGE : COLTCS		CUSTOMER:				
				V PIECE		Date :		PURCHASER:				
						Page 11 of 15		CONSULTANT:				

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

LEGEND:

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

** M Manufacturer / Manufacturer's Sub-contractor

C Contractor O Owner

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

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

		Manufacturer's Name & Address			STANDARD QUALITY PLAN				BHEL Doc No.:				PE- V1 -XXX- 185-N008	
							Vendor Q.P. NO:		PROJECT:					
		P.O. No.			Item : Ball Monitoring System (Ball Oversize Monitor)		PACKAGE : COLTCS		CUSTOMER:					
							Date :		PURCHASER:					
							Page 12 of 15		CONSULTANT:					
Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record		Agency				Remarks
										M	C	O		
1	2	3	4	5	6	7	8	9	D*	**	10			11
4.1.0	Raw Material Housing shell, Flanges	Chemical properties	Major	Chemical Analysis	One sample/heat	Approved drg/Data sheet	Approved drg/Data sheet	Mill test Certificate / lab test report/raw material flow sheet	★	P	V	V	If fabricated type	
		Physical properties	Major	Physical test	One sample / cast/heat/ batch	Approved drg/Data sheet	Approved drg/Data sheet	Mill test Certificate / lab test report/raw material flow sheet	★	P	V	V		
		Surface defects	Minor	Visual	100%	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate/Inspection report	★	P	V	V		
		Sub-surface defects	Major	Ultrasonic test	100%	ASME SA 435	ASME SA 435	Mill Test Certificate	★	P	V	V	Plates > 20mm Thk only (UT - Full Volume)	
4.2.0	Inprocess Quality Control													
4.2.1	Welding procedure specification	Correctness	Critical	Scrutiny	100%	ASME Sec.IX	ASME Sec.IX	QW 482 of ASME Sec.IX	★	P	V	V		
4.2.2	Welding procedure qualification	Weld soundness	Critical	Physical test	100%	ASME Sec.IX	ASME Sec.IX	QW 483 of ASME Sec.IX	★	P	V	V	Welding procedure already approved by BHEL/LROA/GL/DNV/TUV shall be employed for the job	
4.2.3	Welder performance qualification	Weld soundness	Critical	Radiography	100%	ASME Sec.IX	ASME Sec.IX	QW 484 of ASME Sec.IX	★	P	V	V	Welders already qualified by BHEL/LROA/GL/DNV/TUV shall be employed for the job	
4.2.4	Fabricated Shell	1.Surface defects (fillet welds)	Major	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	★	P	V	V		
		2.Dimensions, Orientation	Major	Measurement by visual	100%	Approved doc./ Data sheet	Approved documents / Data sheets	Inspection report	★	P	V	V		
		3. Hydro test	Critical	Hydrostatic Pr. @ 1.5 times design pr. (positive) (Duration 30 minutes)	100%	ASME Sec.VIII Div.1	No leakage	Inspection report	★	P	W	V	Hydrostatic test shall be conducted alongwith Recirculating skid assembly	
		4. Functional Test	Major	Functional	100%	Approved procedure	Approved procedure	–	–	P	V	V	Functional test to be done at site	
				LEGEND										
				* Records identified with "STAR" shall be essentially included by contractor in QA Documentation.										
				** M- Manufacturer / Manufacturer's Sub-contractor C- Contractor O- Owner										
Manufacturer / Sub-Contractor Signature		Contractor		Indicate "P" - Perform, "W" - Witness and "V" - Verification				Reviewed By					Name & Sign. Of approving authority & Seal	

		Manufacturer's Name & Address			STANDARD QUALITY PLAN				BHEL Doc No.:	PE- V1 -XXX- 165-N008			
							Vendor Q.P. NO:		PROJECT:				
		P.O. No.			Item : Pressure Gauge, DP Gauge, DP Switch, DP Transmitter		PACKAGE : COLTCS		CUSTOMER:				
							Date :		PURCHASER: CONSULTANT:				
					Cleaning Balls								
					All components & Equipments		Page 13 of 15		PACKAGE : COLTCS				
Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record		Agency			Remarks
										M	C	O	
1	2	3	4	5	6	7	8	9	10*	**			11
5.0.0	In process quality control	Make, Range and Model	Critical	Visual	100%	Approved Data Sheet	Approved Data Sheet	Manufacturer test certificate	*	P	V	V	
		Calibration	Critical	Calibrasion test	100%	Approved Data Sheet	Approved Data Sheet	Manufacturer test certificate	*	V	V	V	
		Degree of Protection	Critical	-	Type Test Certificate	Approved Data Sheet	Approved Data Sheet	Manufacturer test certificate	*	V	V	V	For Pressure guage, DP Guage, DP Switch
6.0.0	Cleaning Balls												
	- Normal balls - Abrasive balls	Dimensions Type Size	Critical	Measurement	Random	Approved Data Sheet	Approved Data Sheet	Manufacturer's test certificate	*	P	V	V	Quantity and type of balls to be checked with datasheets
7.0.0	All Components / Equipments	Painting Dry film thickness and visual	Major	Measurement	Random	Painting schedule	Painting schedule	Inspection report	*	P	V	V	
		Packing	Major	Measurement	100%	MFG. Procedure	MFG. Procedure	Inspection report	*	P	V	-	

LEGEND

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

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

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

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

	Manufacturer's Name & Address	STANDARD QUALITY PLAN	Vendor Q.P. NO:	BHEL Doc No.:	PE- V1 -XXX- 165-N008
		Item : Starter Panel		PROJECT:	
			PACKAGE : COLTCS	CUSTOMER:	
	P.O. No.		Date :	PURCHASER:	
			Page 14 of 15	CONSULTANT:	

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

LEGEND

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

** M : Manufacturer/ Sub-contractor C : BHEL O Owner

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

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

		Manufacturer's Name & Address			STANDARD QUALITY PLAN				BHEL Doc No.:				PE- V1 -XXX- 165-N008
							Vendor Q.P. NO:		PROJECT:				
		P.O. No.			Item : FASTENERS		PACKAGE : COLTCS		CUSTOMER:				
							Date :		PURCHASER:				
							Page 15 of 15		CONSULTANT:				
Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	Agency				Remarks
										M	C	O	
1	2	3	4	5	6	7	8	9	0*	4*	10		11
9.1.0	Internal Fasteners (Duplex Steel)	Chemical & Physical properties	Major	Chemical & Mechanical analyses	1 Per heat/HT Batch	Approved drg/Data sheet	Approved drg/Data sheet	Mfr TC / Lab report	*	P	V	V	
		Visual & workmanship finish	Major	Visual	Sample	Approved drg/Data sheet	Approved drg/Data sheet		-	P	V	V	
		Dimensions	Major	Measurement	Sample	Approved drg/Data sheet	Approved drg/Data sheet		-	P	V	V	
9.2.0	Main Fasteners	Visual	Major	Visual	Sample	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report / Mfr TC	*	P	V	V	
		Dimensions	Major	Measurement	Sample	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report / Mfr TC	*	P	V	V	
		Chemical & Physical properties	-	Chemical & Physical test a) Tensile b) Yield c) Elongation d) Proof load	1 sample per heat	Approved drg/Data sheet	Approved drg/Data sheet	Mfr TC/Lab report	*	P	V	V	

LEGEND

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

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

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

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

SECTION D2

STANDARD TECHNICAL SPECIFICATION FOR ELECTRICAL SYSTEMS

CLAUSE NO.	LT SWITCHGEAR (Starter Panel)	
1.00.00	CODES AND STANDARDS	
	IEC 947, IS 13947	
2.00.00	TYPE	
	Circuit Breakers	Shall be air break, three pole, spring charged, horizontal drawout type, suitable for electrical operation
	Switchgear	Fully drawout type single front
	MCC	Fully drawout type single front/Double front.
	ACDB/DCDB	Fixed type single front
3.00.00	SYSTEM PARAMETERS	
	415VAC +/- 10 % (SOLIDLY GROUNDED)	
	50 Hz +3%/-5%	
	45KA RMS / 1 SEC (FAULT LEVEL)	
	220V DC NOMINAL (190V DC-240V DC) ISOLATED TYPE	
4.00.00	TEMPERATURE RISE	
	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.	
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.
02.00	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.
03.00	Panels
03.01	All switchgears, MCCs, DBs, panels, modules, local starters and push buttons shall have prominent engraved indentification plates.
03.02	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.
03.03	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.
03.04	All non-current carrying metal work of boards/panels shall be effectively bonded to earth bus of galavanised steel, extending throughout the switchboard/MCC/DB. Positive earthing shall be maintained for all positions of chassis and breaker frame.
03.05	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.
03.06	The incoming connection to transformer of more than 1000KVA and inter-connecting sections between switchboards shall preferably be of busducts.The busduct enclosure

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.

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

5.04.00 Control, Protection & Metering Requirements

5.04.01 Control circuits shall operate at suitable voltage of 410V 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.

5.04.02 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.

5.04.03 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.

5.04.04 All equipments shall have necessary protections. However, following minimum protections shall be provided:

1) Contactor controlled motor feeders (Motors up to 160 kW)

   a) Instantaneous short circuit protection on all phases through HRC cartridge type fuses rated for 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)

   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
	f) hand reset lockout relay with a blue lamp for monitoring
	3) Incomers/bus coupler/outgoing breaker feeders other than motor feeders
	a) Definite time delay short circuit protection
	b) Hand reset lockout relay with a blue lamp
	4) Incomer From DG Set.
	a) Differential Protection (87) - Three Pole
	b) Reverse Power Protection.
	c) Overload Alarm on one phase
	d) Earth Fault Detection Relay (64)
	e) Voltage controlled overcurrent relay
	e) Generator under/over voltage Protection
	f) Hand Reset/Lockout Relay with a blue lamp.
	g) 3 Phase Energy Meter having accuracy of 1.0 class.
5.04.05	Meters / instruments
	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.
5.04.06	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.
5.04.07	In case of remote controlled breaker panels,following shall be ensured.
	Each feeder shall have local/remote selector switch. Closing from local shall be possible only in test possition 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.
05.00	Control from Remote
	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.

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 : 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 whereever 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 outouts 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. 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 separatelly 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 8002 (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-hygro-scopic, non-combustible type and suitable to withstand stresses due to over-voltages and short circuit current. Insulators and barrier of inflammable material such as Hylam shall not be accepted.
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 discribing 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:

	CTs	PTs
Protection	5P20	3P
Metering	1.0	1.0
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	TYPE TESTS (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. (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. (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.
8.01.00	L. T. SWITCHGEAR The following type test certificates on each type & rating of L.T. Switchgear, MCC panel and distribution boards shall be submitted. (a) Short time withstand test with circuit breaker mounted inside the switchgear panel. (b) Temperature rise test. (c) Type II :- Short circuit co-ordination test for any three ratings of MCC module as selected by the Employer. (d) Test sequence -1 & combined test sequence shall be carried out on each rating of circuit breaker mounted inside the panel. (e) Degree of protection tests

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).

SECTION D13

MOTOR AND ACTUATOR

1.0 AC & DC MOTORS

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.

1.2. All LT motors shall be energy efficient class – I in line with IS: 12615. However, the starting current shall be limited to 600% (inclusive of 20% tolerance) of full load current.

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.

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.

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.

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.

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.

These motors shall be designed to withstand at least 5% harmonics in the supply voltage.

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.

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

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.

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.

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.

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.

1.14. The maximum double amplitude vibrations for motors shall be as per IS 12075.

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).

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.

1.17. The star connection side terminal box should have sufficient capacity to accommodate CT's for differential protection for motor above 1000kW.

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.

1.19. Motor bearing shall be insulated wherever required.

1.20. All HT motors shall be with VPI insulation or better

1.21. All HT motors / LT motors 15 kW and above shall be provided with external greasing arrangement

1.22. CACW motor shall be provided with water leakage detector with remote alarms and tripping.

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.

1.24. All motors below 15 kW shall be provided with sealed ZZ bearings

1.25. Each motor shall have two earthing terminals.

1.26. All motors for outdoor duty shall have detachable metal canopy.

1.27. HT motors shall be designed for operation as follows:

a) Upto 1000kW – Vacuum circuit breakers/SF6.

b) Above 1000kW-Vacuum circuit breakers/SF6.

c) All motors shall be suitable for DOL starting.

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.

1.29. Provision shall be made at DCS to monitor, integrate running hours, nos. of starts and stop recording for all motors.

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.

2.0 ACTUATOR

2.1. GENERAL TECHNICAL REQUIREMENT

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.

2.1.2. The actuator shall be suitable for installation in any position without lubrication leakage or other operational difficulty.

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.

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

output drive. The hand wheel shall be clearly marked with an arrow and the word CLOSE.

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.

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.

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).

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.

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.

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.

2.2. LIMIT AND TORQUE SWITCHES

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.

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.

2.2.3. Two additional limit switches with 2NO + 2NC contacts, each adjustable at any intermediate position, shall be provided in the actuator.

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

2.2.5. Torque and limit switches shall have only stainless steel flaps for better protection against environmental condition.

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.

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 loosing any lubricant regardless of mounting position.

2.3.10. Finsh 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

Degrees of protection provided by enclosures at low:IS 2147
voltage switch gear and control gear

Flame Proof enclosure at electrical apparatus:IS 2148
Specification for three phase induction motors:IS 325

AC contactor for voltages not exceeding 1000 V:IS 2959

Degree of protection provided by enclosures for :IS 4691
Rotating electrical machinery

Specification for rotating electrical machines:IS 4722
For other code refer Section D28.

2.5. OTHER REQUIREMENTS OF ACTUATOR.

2.5.1. Common potential free contact shall be available to annunciate the fault condition to the remote control station or DCS.

2.5.2. The following individual relay / potential free contacts shall be provided for the remote indication:-

- Actuator OPEN.
- Actuator CLOSE
- Actuator fault feed-back
- Thermal overload relay shall be provided to trip the actuator in case of overload

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.

3.0 TESTS

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.

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.

3.3. Efficiency and loss measurements shall be done for all LT motors as per relevant standard (Being energy efficient motors.) as routine test.

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).

3.5. Noise level measurement test shall be conducted on one motor of each type.

3.6. Vibration measurement shall be taken for each motor of 45kW & above.

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.

4.0 For technical particulars refer datasheet-A.

ISSUE R1

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	%	± 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

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

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/NO	*
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	

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		*

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.

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		*

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-B MOTORS & ACTUATORS	SHEET 1 OF 6

ENQUIRY/SPECIFICATION NO.:	BIDDER:

SL. NO.	DESCRIPTION	UNITS	BIDDERS DATA
1.0	Application		
2.0	Manufacturer		
3.0	Country of Origin		
4.0	Applicable Standards		
5.0	Efficiency Category(For Energy Efficient Motors only)		
6.0	Rated a) Output b) Speed c) Frame size	 kW RPM	
7.0	Type of Duty (IS 325 or equivalent)		
8.0	Supply Conditions		
	(a) Allowable variation in		
	(i) Voltage AC/DC		
	(ii) Frequency		
	(iii) Combined		
	(b) Permissible unbalance in supply voltage		

NOTES TO BIDDER	SIGNATURE OF BIDDER & DATE
1. ITEMS WHICH DEVIATE FROM THE SPECIFICATION SHOULD BE MARKED WITHIN ASTERISK (*) AND DETAILS TO BE GIVEN IN SCHEDULE OF DEVIATIONS. 2. THIS DATA SHEET SHALL BE FILLED UP COMPLETELY AND A COPY SHALL BE ENCLOSED WITH EACH COPY OF THE BID.	ISSUE R1

ENQUIRY/SPECIFICATION NO.:	BIDDER:

9.0	Guaranteed Efficiency of motor a) At full load b) At duty point At no load		
10.	Guaranteed Power factor of motor a) At full load b) At duty point At no load		
11.0	Current at a) Starting b) Full load c) Duty point Full load & 70 % of rated supply voltage.		
12.0	Rated voltage a)HT motors b)LT motors c)UPS supplied d)Single phase e)DC motors		
13.0	Number of phase		
14.0	Rated frequency for AC motor	Hz	
15.0	Normal winding connection	Star / Delta	

NOTES TO BIDDER

1. ITEMS WHICH DEVIATE FROM THE SPECIFICATION SHOULD BE MARKED WITHIN ASTERISK (*) AND DETAILS TO BE GIVEN IN SCHEDULE OF DEVIATIONS.
2. THIS DATA SHEET SHALL BE FILLED UP COMPLETELY AND A COPY SHALL BE ENCLOSED WITH EACH COPY OF THE BID.

SIGNATURE OF BIDDER & DATE

ISSUE R1

ENQUIRY/SPECIFICATION NO.:	BIDDER:

16.0	Method of starting a)AC motors b) DC motors		
17.0	Temperature rise above ambient of 50 deg. by Resistance method		
18.0	Type of duty		
19.0	Duty designation		
20.0	Synchronous speed a) Constant speed b) Variable speed (for VFD)		
21.0	Starting time at specified minimum starting voltage	Sec	
22.0	Starting torque (as % of FLT)		
23.0	Pull out torque (as % of FLT)		
24.0	Location considered – Hazardous area division		
25.0	Atmosphere considered- Chemical/Dusty/Salt laden		
26.0	Weather motor is suitable for VFD drive		
27.0	Details of bearing		
28.0	VOID		

NOTES TO BIDDER	SIGNATURE OF BIDDER & DATE
1. ITEMS WHICH DEVIATE FROM THE SPECIFICATION SHOULD BE MARKED WITHIN ASTERISK (*) AND DETAILS TO BE GIVEN IN SCHEDULE OF DEVIATIONS. 2. THIS DATA SHEET SHALL BE FILLED UP COMPLETELY AND A COPY SHALL BE ENCLOSED WITH EACH COPY OF THE BID.	ISSUE R1

ENQUIRY/SPECIFICATION NO.:	BIDDER:

29.0	Whether CT for differential protection required		
30.0	Whether vibration detectors required		
31.0	Details of winding / space heaters		
32.0	Details of accessories a) Fans b) Temperature gauge c) Bearing d) Cooling motors e) Cooling water parameters f) Heaters g) Lube oil system details		
33.0	Maximum size & number of cables that can be accommodated in motor terminal box.		
34.0	Thermal capability curve to be attached		
35.0	Relay co-ordination guide to be attached		
36.0	Min. voltage required under starting conditions to accelerate driven equipment to rated speed.	Volts	
37.0	Locked rotor current withstand time (safe stall time) at 110 % rated voltage a) At rated temp. (hot) b) When cold	 sec sec	
38.0	Stator thermal time constant	Sec	

NOTES TO BIDDER

1. ITEMS WHICH DEVIATE FROM THE SPECIFICATION SHOULD BE MARKED WITHIN ASTERISK (*) AND DETAILS TO BE GIVEN IN SCHEDULE OF DEVIATIONS.
2. THIS DATA SHEET SHALL BE FILLED UP COMPLETELY AND A COPY SHALL BE ENCLOSED WITH EACH COPY OF THE BID.

SIGNATURE OF BIDDER & DATE

ISSUE R1

ENQUIRY/SPECIFICATION NO.: | BIDDER:

39.0	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		
40.0	Method of Starting and maximum starting current inclusive of tolerances		
	AC HT Motors a) DOL	450 % above 1500 kW & 600 % all other.	
	b) Soft starters	200 %	
	AC LT Motors c) DOL d) Star Delta e) Star Delta with series resistance f) Star Delta with rotor resistance g) Soft Starters	.600 % 200 % 200% 200% 200%	
	DC Motors a) Soft starters b) Any other	200% 200%	

NOTES TO BIDDER

1. ITEMS WHICH DEVIATE FROM THE SPECIFICATION SHOULD BE MARKED WITHIN ASTERISK (*) AND DETAILS TO BE GIVEN IN SCHEDULE OF DEVIATIONS.
2. THIS DATA SHEET SHALL BE FILLED UP COMPLETELY AND A COPY SHALL BE ENCLOSED WITH EACH COPY OF THE BID.

SIGNATURE OF BIDDER & DATE

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-B MOTORS & ACTUATORS	SHEET 6 OF 6

ENQUIRY/SPECIFICATION NO.:	BIDDER:

NOTES TO BIDDER	SIGNATURE OF BIDDER & DATE
1. ITEMS WHICH DEVIATE FROM THE SPECIFICATION SHOULD BE MARKED WITHIN ASTERISK (*) AND DETAILS TO BE GIVEN IN SCHEDULE OF DEVIATIONS. 2. THIS DATA SHEET SHALL BE FILLED UP COMPLETELY AND A COPY SHALL BE ENCLOSED WITH EACH COPY OF THE BID.	ISSUE R1

DATA TO BE FURNISHED BY THE CONTRACTOR DURING DETAIL ENGINEERING

- Motor outline dimension drawing
- Type test certificates
- Speed torque curve at rated & minimum starting voltage superimposed with the speed-Torque
- characteristic of the load.
- Current - speed curve.
- Current - time curve.

- Efficiency, power factor, slip, current against output curve
- Thermal withstand characteristic for motors of 100 kW & above - Hot & Cold
- Negative sequence current Vs time curve for motor of 100 kW & above.
- Motor Data sheet
- GA of all Terminal Boxes

SECTION D15

CONTROL PANEL/STARTER PANEL/JB/PB

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**

Sl. 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