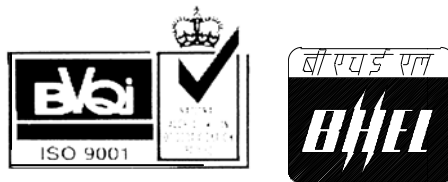


**IB THERMAL POWER STATION, BANHARPALI  
2x660MW UNIT 3&4**


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

**Specification No. : PE-TS- 391-165-N002 (REV. 0)**

**VOLUME -IIB**



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

	<b>TITLE : TECHNICAL SPECIFICATION FOR CONDENSER ON LOAD TUBE CLEANING SYSTEMS (COLTCS). PREAMBLE</b>	<b>SPEC. NO. PE-TS- 391-165-N002</b>	
		<b>VOLUME : II B</b>	
		<b>REV. NO. 0</b>	<b>DATE :04.06.2014</b>
		<b>SHEET 1 OF 2</b>	

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).



TITLE : TECHNICAL SPECIFICATION  
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PREAMBLE

SPEC. NO. PE-TS- 391-165-N002

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1.2.2 **Volume - III TECHNICAL SCHEDULES**

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



**TITLE : TECHNICAL SPECIFICATION  
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## INDEX

<b>SECTION</b>	<b>TITLE</b>
<b>A</b>	<b>SCOPE OF ENQUIRY</b>
<b>B</b>	<b>PROJECT INFORMATION</b>
<b>C</b>	<b>SPECIFIC REQUIREMENTS</b>
C1	SPECIFIC TECHNICAL REQUIREMENTS FOR CONDENSER ONLOAD TUBE CLEANING SYSTEMS .
C2	SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)
C3	SPECIFIC TECHNICAL REQUIREMENTS (C&I)
<b>D</b>	<b>STANDARD TECH. SPECIFICATIONS</b>
D1	CONDENSER ON LOAD TUBE CLEANING SYSTEMS <ul style="list-style-type: none"><li>◆ STANDARD TECHNICAL SPEC.NO. PE-TS-999-165-N001</li><li>◆ DATA SHEET-A</li><li>◆ DATA SHEET-C</li><li>◆ QUALITY PLAN</li></ul>
D2	ELECTRICAL SYSTEMS
D3	CONTROL & INSTRUMENTATION SYSTEMS



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

**SPEC. NO. PE-TS-391-165-N002**

**VOLUME : II B**

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**SECTION - A  
SCOPE OF ENQUIRY**



TITLE : TECHNICAL SPECIFICATION  
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#### 1.00.0 SCOPE

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

#### 1.01.0 Condenser On Load Tube Cleaning Systems :

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

- **IB THERMAL POWER STATION, BANHARPALI  
2x660MW UNIT 3&4**

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.

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

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

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

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

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



**TITLE : TECHNICAL SPECIFICATION  
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SYSTEMS (COLTCS)**

**SPEC. NO. PE-TS- 391-165-N002**

**VOLUME : II B**

**SECTION : C**

**REV. NO. 0**

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SECTION - B

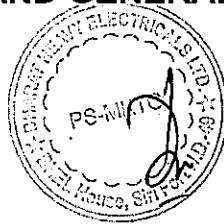
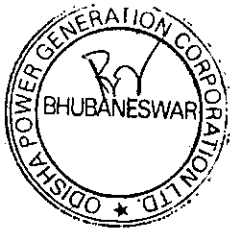
PROJECT INFORMATION

	Odisha Power Generation Corporation Ltd.	Technical Specification for Main Plant Package	IB TPS – 2 X 660 MW Units 3 &4, Jharsuguda, Odisha
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**VOLUME: IIA**

**SECTION-III**

**PROJECT SYNOPSIS AND GENERAL INFORMATION**



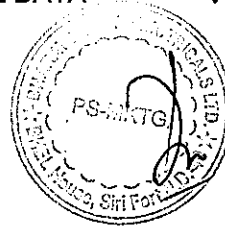
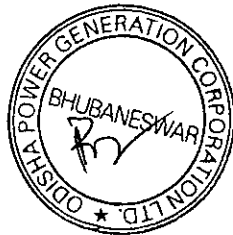
Doc. No. : K8B09-MP-SPC-G-001		Development Consultants Pvt. Ltd.
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## CONTENT

CLAUSE NO.	DESCRIPTION	PAGE NO.
1.00.00	INTRODUCTION	V.IIA/S-III : 1
2.00.00	APPROACH TO SITE	V.IIA/S-III : 1
3.00.00	LAND	V.IIA/S-III : 1
4.00.00	SOURCE OF COAL	V.IIA/S-III : 2
5.00.00	SOURCE OF WATER	V.IIA/S-III : 2
6.00.00	ASH DISPOSAL AREA	V.IIA/S-III : 2
7.00.00	METEOROLOGICAL DATA	V.IIA/S-III : 2



	Odisha Power Generation Corporation Ltd.	Technical Specification for Main Plant Package	IB TPS – 2 X 660 MW Units 3 & 4, Jharsuguda, Odisha
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## VOLUME : IIA

### SECTION-III

#### PROJECT SYNOPSIS AND GENERAL INFORMATION

#### 1.00.00 INTRODUCTION

The proposed Thermal Power Station comprising of 2 x 660 MW base unit size, Super-Critical Units would be set up by Odisha Power Generation Corporation Limited (OPGCL) in the Jharsuguda district of Odisha, India. OPGCL had already installed two units of 210 MW each adjacent to the proposed units under Phase-I of the project at IB Thermal Power Station and the units have been working for the last fifteen years.

Seller has acquainted himself by visiting to the site, with the conditions prevailing at site. The information given here in under is for general guidance and shall not be contractually binding on the Buyer. All relevant site data /information as may be necessary shall have to be obtained/ collected by the Seller.

#### 2.00.00 APPROACH TO SITE

The project site is located at Banaharpalli in the Jharsuguda district of Odisha on the bank of Hirakud Reservoir and about 20 km south of Belpahar railway station and 40 km south west of Jharsuguda. The main Howrah-Mumbai railway line passes 20 km north of the plant (at Belpahar). NH-200 (Chandikhole to Raipur) and SH-10 (Sambalpur to Sundergarh) pass through Jharsuguda town.

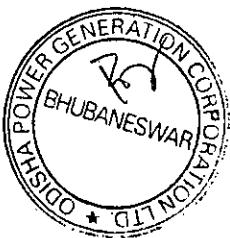
OPGCL has a private railway siding connecting the plant to the Indian Railways network at Lajkura Railway station.

Nearest Airport – Bhubaneswar.

Nearest Seaport – Paradeep/ Haldia.

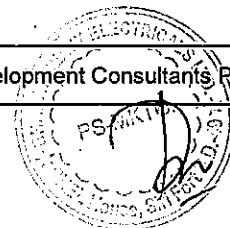
#### 3.00.00 LAND


The total land proposed to be required (around 40 Ha) taking into account the locations of various facilities and plant auxiliaries for units 3 & 4 under IB Thermal Power Station 2 x 660 MW units 3 & 4 and also future 2 x 660 MW will be as per the Plot Plan enclosed in Volume II-L. Land for the proposed units have already been acquired and Power block area is fairly flat land sloping towards South to South -West with contour variation from RL 204.00 M to RL 199.00 M. The Seller shall accommodate equipment offered under this specification generally within the spaces allocated for such equipment in the Plot Plan. Specific approval from Consultant shall be taken by the Seller prior to any revision or relocation.



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(2. K8B09-MP-V-II-A-LEA1\_OPGC\_CONTRACT-BHEL.docx)



	<b>Odisha Power Generation Corporation Ltd.</b>	<b>Technical Specification for Main Plant Package</b>	<b>IB TPS – 2 X 660 MW Units 3 &amp; 4, Jharsuguda, Odisha</b>
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**4.00.0 SOURCE OF COAL**

Coal will be the primary fuel for the proposed project. OPGC has been allotted with two coal blocks (Manoharpur and Dip-side of Manoharpur) in IB valley area with an estimated total reserve of 531.68 Million Metric Tons for captive use of the projects. Manoharpur coal block has been explored fully and has net geological reserves of 181.68 Million Metric Tons and Dip side of Manoharpur (Regionally explored) has geological reserves of 350 Million Metric Tons approximately.

Manoharpur Coal Block is about 45 Km away from Sundargarh Town along Sundargarh – Hemgiri road which passes near the block. It is also connected by black top road with two important towns of Odisha viz. Rourkela (145 Km) and Jharshuguda (75 Km). The nearest Railway station is Hemgiri, lying on the Mumbai – Howrah main line and is about 20 Km away from Manoharpur Block. Coal from the mine to the power plant will be transported by dedicated merry-go-round rail system.

**5.00.00 SOURCE OF WATER**

Water is drawn from the Hirakud reservoir through a 5.45 Km intake channel. The reservoir has a catchment area of 83.395 sq.km. with a current gross storage capacity of 7189 lakhs m<sup>3</sup>. The project too will meet its water requirements from the Hirakud reservoir through the existing intake structure, which is sufficient to cater to the proposed project. The project had taken approval from the Water Resources Department of Odisha to draw 5400 m<sup>3</sup>/hr of water from the reservoir, which will cater the requirement of Phase-I (existing 2 x 210 MW) and the proposed units of 2x660 MW.

The Power station will operate on semi open recirculating condenser cooling system using cooling towers. In addition all water conservation and recycling measures will be adopted to minimize requirement of make up water. The proposed project will adopt zero effluent discharge philosophy.

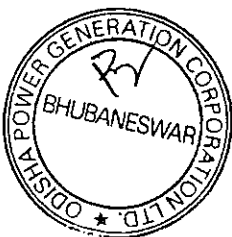
**6.00.00 ASH DISPOSAL AREA**

Not Used.


**7.00.00 METEOROLOGICAL DATA**

7.01.00 For the purpose of equipment design, the following Ambient Conditions / Meteorological data of site (Jharsuguda) shall be taken into consideration:-

Site elevation above MSL	:	199.5 M
Highest temp recorded	:	48.0 °C.
Lowest temp recorded	:	4.0 °C.
Monthly max. dry bulb temp	:	38.9 °C/28.0 °C/33.4 °C (Summer/winter/monsoon)



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	Odisha Power Generation Corporation Ltd.	Technical Specification for Main Plant Package	IB TPS – 2 X 660 MW Units 3 &4, Jharsuguda, Odisha
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Monthly min. dry bulb temp : 25.4 °C/16.7 °C/26.8 °C  
(Summer/winter/monsoon)

Monthly max. wet bulb temp : 23.9 °C/17.8 °C/25.5 °C  
(Summer/winter/monsoon)

Monthly min. wet bulb temp : 17.6 °C/13.4 °C/25.0 °C  
(Summer/winter/monsoon)

Maximum Relative Humidity : 46% / 67% / 87%  
(Summer/winter/monsoon)

Minimum Relative Humidity : 21% / 33% / 87%  
(Summer/winter/monsoon)

Average relative Humidity : 65%

Average Annual Rainfall : 1460 mm.

Normal period of rain fall : June – September.

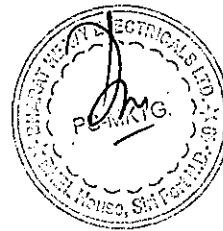
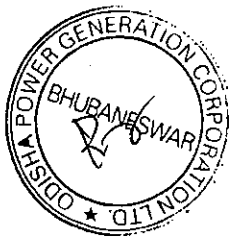
Heaviest rainfall in 24 hours : 257.8 mm

Wind direction : South West – North East.

Basic Wind Speed at 10 m Height : 44 m/sec as per IS:875 Part-3 (1987).

Seismic Zone : Zone III as per IS:1893 Part-1 (2002).

Geographical location : At  
Latitude 21° 48' North and Longitude 83° 52' East.

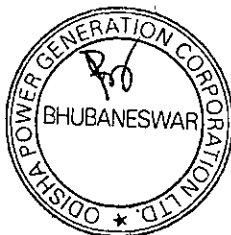


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**TABLE VI**  
**DESIGN CLARIFIED WATER ANALYSIS**

CONSTITUENTS	As	CONTENT
Calcium Hardness	CaCO <sub>3</sub>	90 ppm
Magnesium Hardness	CaCO <sub>3</sub>	40 ppm
Sodium and Potassium	CaCO <sub>3</sub>	42 ppm
Iron in Solution.	Fe	0.2 ppm
Hydrogen (FMA)	CaCO <sub>3</sub>	ppm
TOTAL CATIONS (Except iron in solution)	CaCO <sub>3</sub>	172 ppm
Bicarbonate	CaCO <sub>3</sub>	97 ppm
Carbonate	CaCO <sub>3</sub>	- ppm
Hydroxide	CaCO <sub>3</sub>	- ppm
Sulphate	CaCO <sub>3</sub>	60 ppm
Chloride	CaCO <sub>3</sub>	15 ppm
Nitrate	CaCO <sub>3</sub>	- ppm
Fluoride	CaCO <sub>3</sub>	- ppm
TOTAL ANIONS	CaCO <sub>3</sub>	172 ppm
M-Alkalinity	CaCO <sub>3</sub>	97 ppm
P-Alkalinity	CaCO <sub>3</sub>	ppm
Reactive Silica (Dissolved)	SiO <sub>2</sub>	6.0 ppm
Colloidal Silica	SiO <sub>2</sub>	9.0 ppm
Total Iron	Fe	0.2 ppm
Conductivity at 25° C	-	200 Micro siemens/ cm (maximum)
Carbon-di-oxide	CO <sub>2</sub>	
pH value at 25° C	-	7.5-8.5
Total Dissolved solids	-	200 ppm
Total Suspended solids	-	ppm (maximum)
Turbidity		10 NTU (maximum)
Oxygen absorbed at 27° C for 4 hours		Traces ppm





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## **SECTION – C**

### **SPECIFIC REQUIREMENTS**

**SECTION C1 : CONDENSER ONLOAD TUBE CLEANING**

**SECTION C2 : ELECTRICAL SYSTEMS**

**SECTION C3 : C&I SYSTEMS**



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**SECTION C1  
CONDENSER ONLOAD TUBE CLEANING SYSTEMS  
(MECHANICAL DETAILS)**



**TITLE : TECHNICAL SPECIFICATION  
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SYSTEMS (COLTCS)**

**SPEC. NO: PE-TS-391-165-N002**

**VOLUME : II B**

**SECTION:C1**

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## 1.0 GENERAL

The Condenser On load Tube Cleaning Systems (COLTCS) complete with all accessories shall conform to the standard technical specifications (Section-D) and Data Sheet-A enclosed herewith. In addition the requirements of this section C shall also be complied with. However, wherever the details given in Section-D and Data Sheet-A are different, the requirements of Data Sheet-A shall prevail. Similarly in the event of contradictions between Section-C & Section-D/ Data Sheet-A, Section-C shall prevail.

Section C consists of 3 parts viz. Sec. C1, C2 and C3 for Mechanical, Electrical and C&I respectively, the requirements of all 3 sections shall be complied with.

## 2.0 DESCRIPTION OF EQUIPMENTS :

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

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

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

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

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

SL.NO.	PROJECT	COLTCS
1.	IB THERMAL POWER STATION, BANHARPALI 2x660MW UNIT 3&4	2 SETS PER UNIT viz. TOTAL 4 SETS FOR BOTH UNIT.



TITLE : TECHNICAL SPECIFICATION  
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### 3.2 SCOPE OF SUPPLY IN THE BIDDER'S SCOPE FOR COLTCS:

3.2.1 Each set of COLTCS for each projects shall comprise of following :

- a) One No. Ball Separator at Condenser CW outlet pipe.
- b) One No. Ball recirculation pump with drive motor.
- c) One No. Ball collector.
- d) One No. Manual ball sorter (Bucket type sorter with sieves to manually sort out the undersized balls by shaking the sieved bucket manually) for each set of COLTCS.
- e) Differential pressure measuring system for ball separator. DP measuring system shall comprise of 2 nos. DPT +1 no. DPG for each COLTCS. Instrument shall be with *Remote seal* arrangement. Stubs for DPT and DPG shall be independent.
- f) Ball monitoring system comprising of an independent balls recirculation monitor and an independent balls oversize monitor. If bidder is not manufacturing Ball 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 (SS-316), 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 PLC/LCP and various drives in bidder's scope of supply.
- k) PLC/LCP shall be as follows:
  - a) 2 Sets of COLTCS shall have one Common PLC control system cum starter panel. However, separate LCP/RIO panel shall be provided for each set of COLTCS. (refer note no. 5 of C&I requirement, section C3)



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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 PLC control panel.
- m) All the field instruments stipulated in this specification shall be in Bidder's scope.
- n) Commissioning balls and other commissioning spares on "As required basis".
- o) Set of mandatory spares as indicated in Data Sheet A.
- p) Supporting arrangement complete with saddle support, foundation plates, anchor bolts, nuts, sleeves, inserts, all installation materials, fixing bolts, clamps and other accessories etc. for complete equipment supplied under this package.
- q) Finish paints for touch up painting of equipment after erection at site, in sealed containers.
- r) Set of special tools and tackles if required for maintenance and erection of the equipment supplied.
- s) Various drawings, data test reports/ certificates instruction manuals for erection operation and maintenance etc. as specified in Data Sheet-C. and cables schedule indicating BOQ for power & control cables.
- t) Panels & Instruments: Scope and Type as specified in C&I section wherever required.

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

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

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

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



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

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

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

- **For drawings/documents approval**

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

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

- **Site Visits :**

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

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

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



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## 5.0 EXCLUSIONS :

The following are excluded from the bidder's scope .

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

## 6.0 DESIGN CONSTRUCTION :

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

- 6.1 For COLTCS - Layout Piping Arrangement Drg. is enclosed in the specifications at Annexure-III.
- 6.2 Thickness of body flange and counter flange of COLTCS shall be as per Drg no PE-DG-999-141-MO17 enclosed at enclosures at Annexure-II.
- 6.3 The materials of construction specified in Data Sheet-A are minimum requirements and materials of construction for other components not specified shall be similarly selected by the bidder for the intended duty which shall be subject to purchaser's approval during detailed engineering in the event of order.
- 6.4 Housing/ body of COLTCS shall be designed and manufactured as per the applicable codes for pressure vessels and to take care of force and moments as enclosed in the specification. However in no case thickness of housing/ body shall be less than connecting pipe thickness as specified in Data Sheet-A of COLTCS.
- 6.5 Adequate provision for future installation of Cathodic Protection for COLTCS (Sacrificial type) shall be kept by the bidder in the equipment.
- 6.6 Flow straightner for streamlining the CW flow in balls collecting strainer if required shall be supplied by the bidder along with mounting arrangement and the fixing details.
- 6.7 Velocity in the pipe work shall be less than 1.5 m/ sec for pump suction and less than 2.5 m/ sec. in other pipe work. All valves upto 150 NB shall be ball valves. For higher sizes, gate/ globe/ B.F. valves shall be provided. All instrument valves shall be needle valves.



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## **7.0 Performance Guarantee and Testing :**

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

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

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

### **8.1 Condenser On Load Tube Cleaning Systems.**

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

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

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

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

- ii) Percentage recovery of balls (min. 90% recovery for 3 weeks with 8 hrs operation of COLTCS per day)
- iii) Life of Sponge Rubber Ball (Min. 6 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.



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

**9.0 SPARES :**

**9.1 Recommended Spares :**

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

**9.2 Mandatory Spares**

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

**10.0 Quality Plan**

Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL/ Customer approval and customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. Charges for 3<sup>rd</sup> party inspection (TUV/ equivalent) for imported components wherever required shall be included by bidder in the base price itself. Witness for all the test identified under agency "C" & "N" in Quality plan shall be by third party.



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If BHEL or BHEL customer decides to witness the tests along with third party, the cost of travel of BHEL or BHEL customer shall be borne by BHEL or BHEL customer themselves.

#### 10.0 DELIVERY & DRAWINGS/ DOCUMENTS DISTRIBUTION SCHEDULE :

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

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

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

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

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



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

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

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

#### 14.0 Important Note:-

1. Bidder to note that C&I, Electrical, Fragile materials, cleaning balls shall be sent in separate proper packing (segregating from heavy items).
2. Bidder to include handling instructions in engineering drg/doc and packing to be done in such a way to avoid damage of items mention above in transit and long storage at site and same shall be approved in contract stage by BHEL/Customer.
3. For detail despatch instruction, please refer Special Conditions of Contract (SCC) for the project.



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**ANNEXURE- I**

**COLTCS**

SL.NO.	Projects	Size (NB)	Length of Ball Separator (Excluding Counter Flange)	Scope of Counter Flange	Scope of nuts and bolts.
1	IB THERMAL POWER STATION, BANHARPALI 2x660MW UNIT 3&4	2500 NB	4000 mm	In Purchaser's Scope.	In Bidder's Scope

**Notes:**

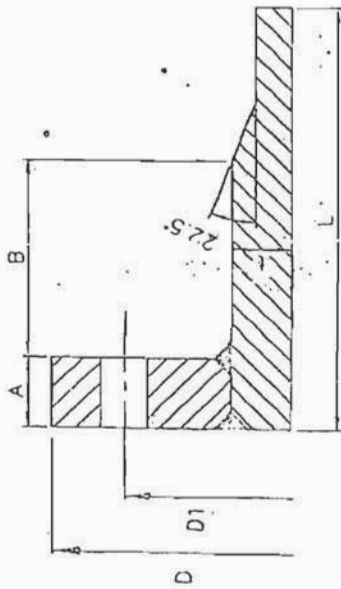
1. Ball separator shall be mounted directly on the existing Butterfly valve.
2. Flap of butterfly valve shall be extended to 1250 mm inside the Ball separator (GA of Butterfly valve has been enclosed).

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

ANNEXURE-II

L10M-141-666-DG-3d ON DRAWING



NOTES:-

Flange thicknesses listed are for Design pressure=5Kg/cm<sup>2</sup>(g) and Flange dimensions as given in the table. Final thickness of the flange is to be checked for actual OD/Bolting PCD/Neck dimensions.

PIPE SIZE	PIPE THIK.	FLANGE OD 'D'	Bore PCD 'D1'	WELD NECK FLANGE		SLIP-ON FLANGE THICKNESS
				FLANGE THIK. 'A'	NECK Length 'L'	
1200	10-12	1465	1380	40	24	200
1400	14	1675	1590	50	24	200
1600	14	1915	1920	60	32	220
1800	14-16	2115	2020	70	32	250
2200	18	2550	2420	80	36	300
2300	20			90	38	325
2500	20			90	38	325
2700	20			90	38	325

DRAWING FOR BAL SEPARATOR COUNTER FLANGE

REV. CODE	DATE	BY	CHK	APPD	SIGN
	25.06.07				
	25.06.07				
	25.06.07				

GHARAT HEAVY ELECTRICALS LTD  
POWER GROUP  
PROJECTS ENGINEERING MANAGEMENT  
PPEI, NOLDA

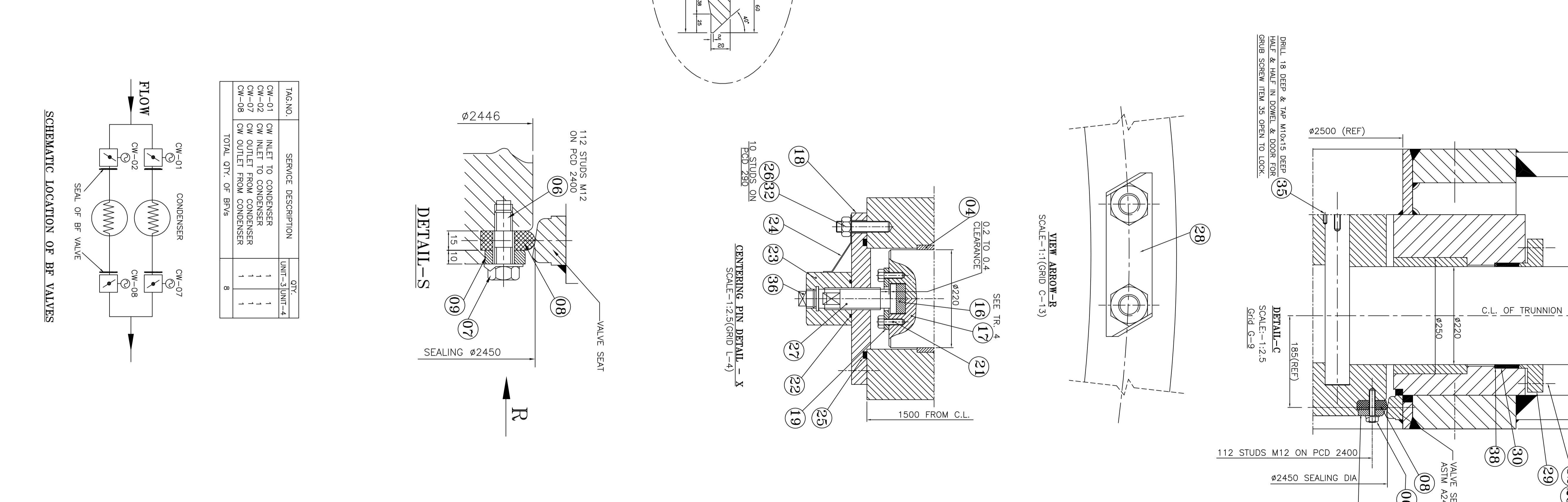
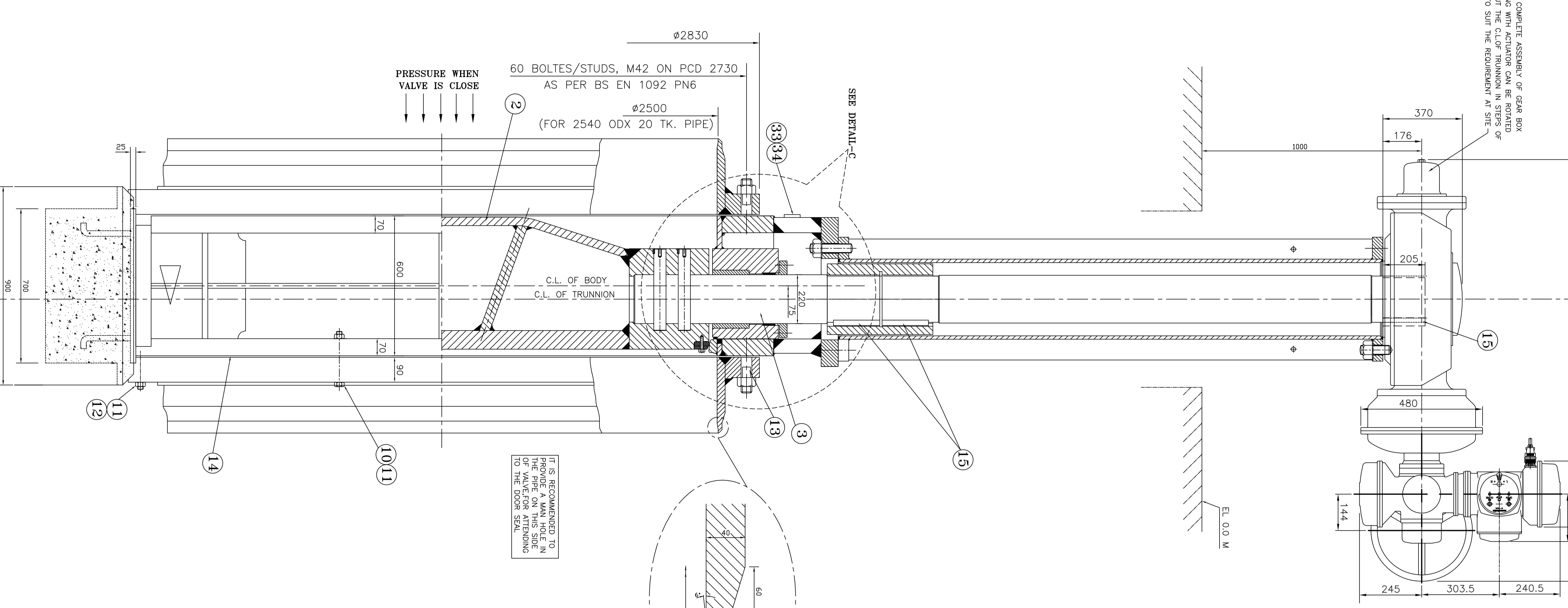
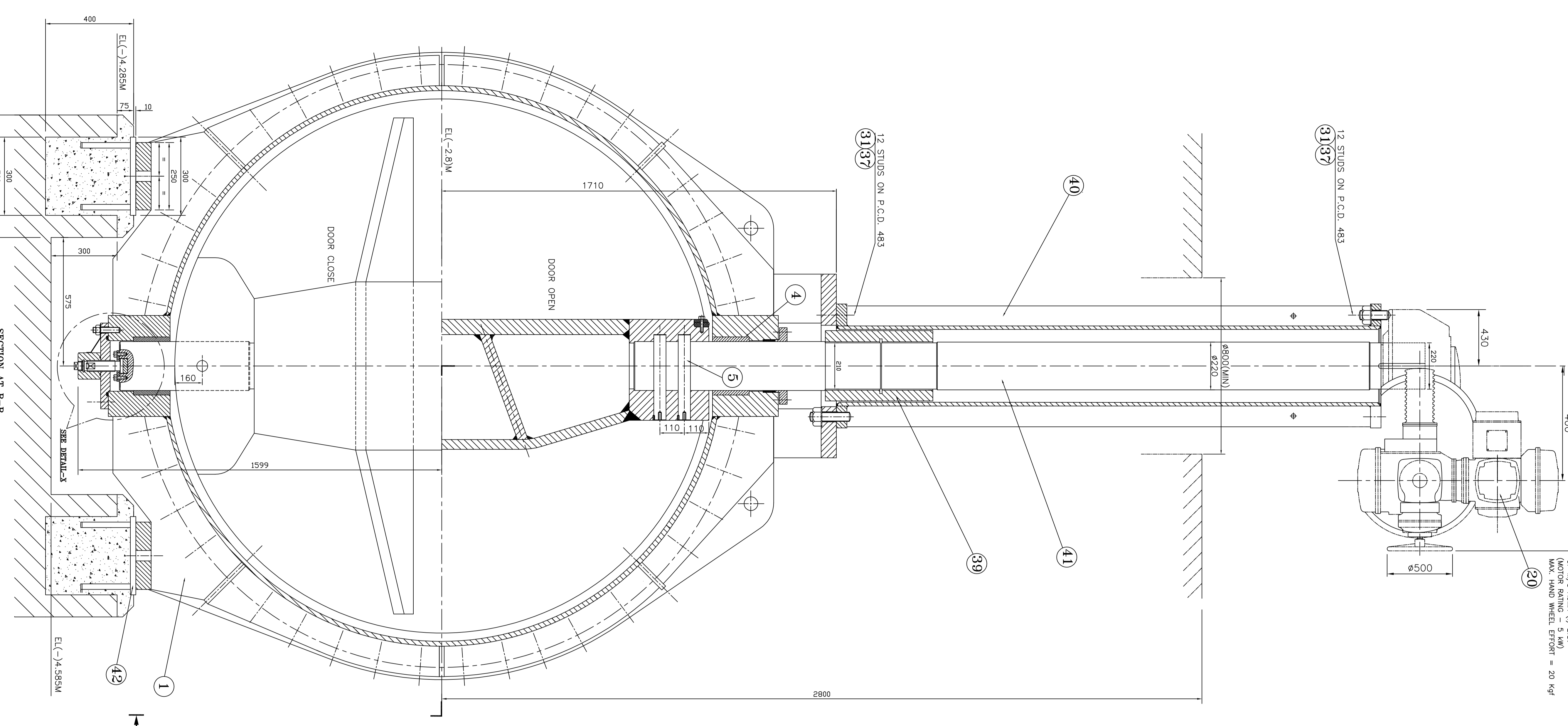


COUNTER FLANGE DETAILS

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					999		

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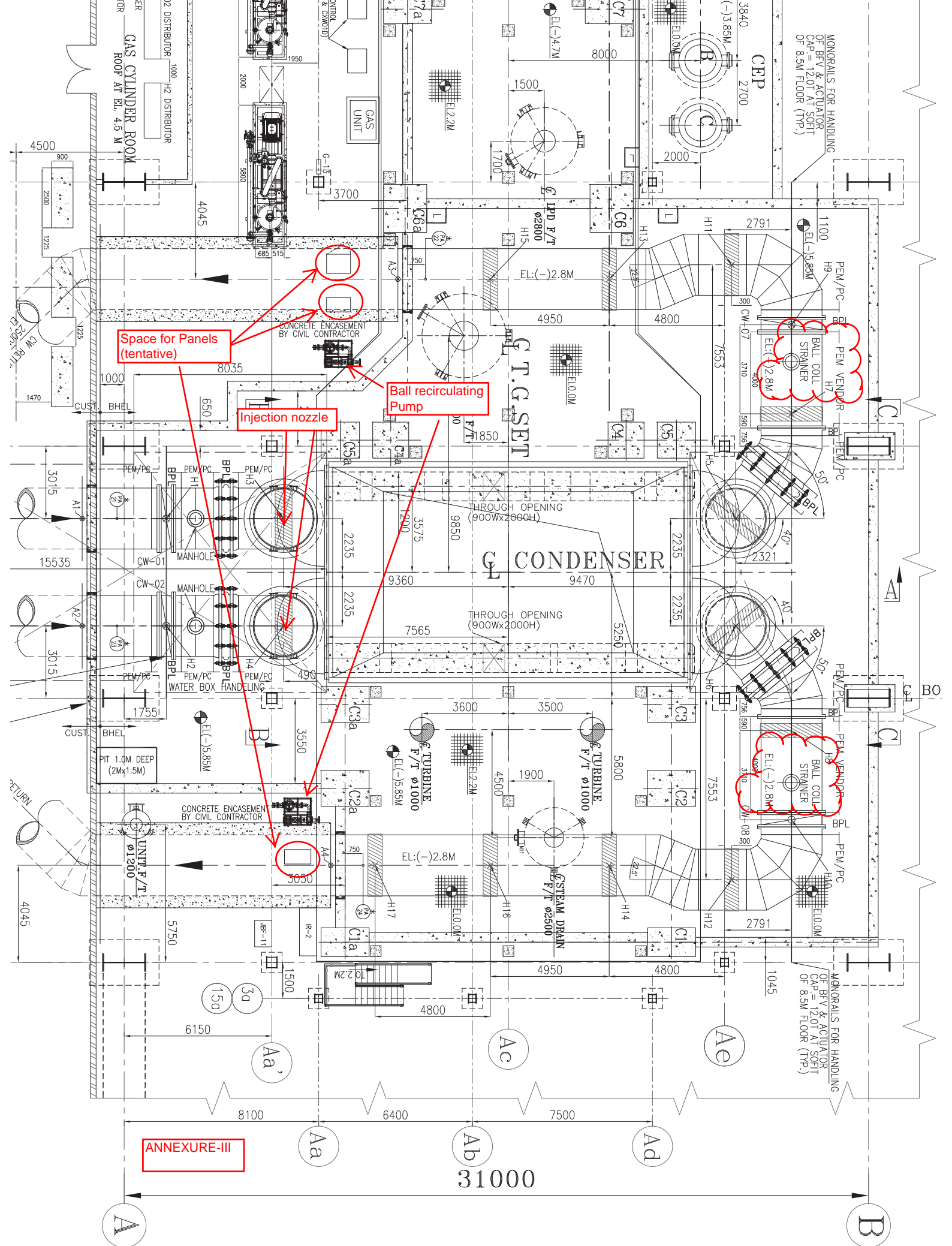
**LINCOLN MOTOR**  
 THE VALVE & ACTUATOR ARE DESIGNED TO SITE AFTER WELDING THE VALVE BODY. THE SEALING SURFACES OF THE VALVE SHALL BE PAINTED ON THE INSIDE OF THE VALVE BODY. THE SEALING SURFACES OF THE VALVE SHALL BE PAINTED ON THE INSIDE OF THE VALVE BODY. THE SEALING SURFACES OF THE VALVE SHALL BE PAINTED ON THE INSIDE OF THE VALVE BODY.



NO.	QTY.	DESCRIPTION	UNIT	QTY.
001	1	VALVE BODY	NO.	1
002	1	ACTUATOR	NO.	1
003	1	TRUNNION (DRAWING SIDE)	NO.	1
004	1	BUSH	NO.	1
005	1	PARALLEL DOG	NO.	1
006	1	STUD M12 X 37	NO.	1
007	1	HEX NUT M12	NO.	1
008	1	B.F. VALVE DOOR SEAL	NO.	1
009	1	DOOR SEAL CLAMPING RING	NO.	1
010	1	BOLT M42 X 205 LG	NO.	1
011	1	NUT M42	NO.	1
012	1	STUD M42 X 135 LG	NO.	1
013	1	COMPANION FLANGE	NO.	1
014	1	KEY	NO.	1
015	1	DISC	NO.	1
016	1	END COVER	NO.	1
017	1	REINFORCING PLATE	NO.	1
018	1	LOCKING STRIP	NO.	1
019	1	LOCKING STRIP	NO.	1
020	1	TRUNNION SEALING RING	NO.	1
021	1	SCREW HEX HD M12 X 25	NO.	1
022	1	SCREW HEX HD M12 X 25	NO.	1
023	1	SCREW HEX HD M12 X 25	NO.	1
024	1	SCREW HEX HD M12 X 25	NO.	1
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099	1	SCREW HEX HD M12 X 25	NO.	1
100	1	SCREW HEX HD M12 X 25	NO.	1

TECHNICAL REQUIREMENTS

- CARE TO BE TAKEN TO AVOID DAMAGE WHEN PRESSING SELF LUBRICATING BRUSHES IN THE BODY.
- CLEAN THE SELF LUBRICATING BRUSHES THOROUGHLY BEFORE INSERTING TRUNNIONS. DURING ASSY, BRUSH TIGHT AT THE SEAL TEST PRESSURE.
- THE REQUIRED CLEARANCE AS SHOWN IN DETAIL - X
- DESIGN PRESSURE = 5.0 kg/cm<sup>2</sup>
- VALVE SEAL - 10.0 kg/cm<sup>2</sup> FOR 5 MIN. DURATION
- VALVE SEAL - 5.0 kg/cm<sup>2</sup> FOR 5 MIN. DURATION
- ALL HARDWARES (EXCEPT S.S. HARDWARES) ARE TO BE ZINC PLATED AS PER BS 6828/93 HAVING 8 PAINT & PROTECT TO HT 000000 WORKS.
- INTERNAL SURFACES (2 COATS OF EPOXY PRIMER & COATING PRIMER PAINT) : CAT-C
- EXTERNAL SURFACES (BLACK TEMP. RUST PREVENTIVE COAT) : CAT-G
- MACHINED SURFACES (BLACK TEMP. RUST PREVENTIVE COAT) : CAT-G
- DOEWELING ON DRAWING SIDE TRUNNION WITH DOOR TO BE DONE AFTER ASSEMBLING THE VALVE WITH GEAR BOX & KEEPING BOTH DOOR & GEAR BOX IN FULLY CLOSED POSITION.
- SPECIFICATION: 480 sq. m<sup>2</sup>/hr
- DESIGN WATER TEMP = 60°C
- VALVE DESIGN CODE = GENERALLY AS PER AWWA C-504 CLASS 75
- MAX. TORQUE (REQUIRED FOR VALVE OPERATION) = 11186 kg-m
- OPER/CLOSE TIME = 40-60 SECONDS
- AFTER MANUALLY OPERATING THE VALVE AT WORKS THE TOPPER OF GEAR BOX TO BE KEPT OPEN FOR 300 SECONDS AS PER AGREED QUALITY PLAN.
- TESTING TO BE ACCORDING TO BE DONE AS PER AGREED QUALITY PLAN.
- COMPANION FLANGES ITEM 013 ARE TO BE PROOF ASSEMBLED WITH VALVE IN THE SHIP.



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

**SPEC. NO. PE-TS- 391-165-N002**

**VOLUME : IIB**

**SECTION : D**

**REV. NO. 0**

**DATE : 04.06.2014**

**SHEET 1 of 1**

**SECTION C2  
CONDENSER ONLOAD TUBE CLEANING SYSTEMS  
ELECTRICAL DETAILS**



TECHNICAL SPECIFICATION FOR  
COLTCS  
(ELECTRICAL PORTION)

SPECIFICATION NO.  
VOLUME II B  
SECTION-C  
REV                      DATE 05.06.2014  
PAGE 1 OF 1

**SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL**

**1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER/ PURCHASER**

- 1.1 Scope for supply, and erection & commissioning of various equipment forming part of electrical system for this package shall be as per Annexure-I to Section – C [Scope of Work (Electrical)].
- 1.2 Make of various equipment/ items in the scope of bidder shall be to approval of owner during detailed engineering stage without any commercial implications.
- 1.3 Bidder shall furnish all AC as well as DC loads required for the system at different voltage levels (e.g. 415V AC, 240 V AC, 220 V DC etc.) of all types, such as motor feeders, supply feeders in PEM format along with the offer.
- 1.4 All electrical equipment shall be suitable for the power supplies, fault levels and climatic conditions indicated in project information enclosed with the specification.
- 1.5 All drawings, data sheets, Quality Plan, calculations, test reports, test certificates, etc. shall be submitted during detailed engineering stage as per formats enclosed. The same shall be subject to approval without any commercial implications.
- 1.6 Technical requirements shall be as per specifications listed in Clause 4.1 to 4.5. In case of any discrepancy between Basic technical Feature for HT or LT motors and BHEL standard specification, basic technical feature for HT or LT motors shall prevail.

**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 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.
- 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 Basic Technical Feature of HT/LT motors.
- 4.5 Load data format (Annexure-II).

## ANNEXURE – I TO SECTION – C: STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGE: COLTCS

PROJECT: 2X660 MW OPGCL IB Valley TPS

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL <sup>\$</sup>	BHEL <sup>\$</sup>	1. 415 V AC/240 V AC supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract including power supply equipment (battery charger etc) required for the PLC/control panel (as applicable) for the system supplied by vendor. 2. Interposing relays (RE 302 of Jyoti make or equivalent), if required for PLC and microprocessor based systems, shall be provided by BHEL in MCCs. Requirement of these relays shall be furnished by vendor during detailed engineering stage.
2	Local Push Button Station (for motors)	BHEL <sup>\$</sup>	BHEL <sup>\$</sup>	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 <sup>\$</sup> Vendor BHEL <sup>\$</sup>	BHEL <sup>\$</sup> Vendor BHEL <sup>\$</sup>	1. Sizes and quantity of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL). Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Laying of cables by BHEL except for cabling in vendor scope. 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 <sup>\$</sup>	BHEL <sup>\$</sup>	
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 <sup>\$</sup>	BHEL <sup>\$</sup>	
9	Equipment grounding & lightning protection	BHEL <sup>\$</sup>	BHEL <sup>\$</sup>	
10	Below grade grounding	BHEL <sup>\$</sup>	BHEL <sup>\$</sup>	
11	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
12	Mandatory spares	Vendor	-	Vendor to quote as per specification.
13	Recommended O & M spares, E & C spares, erection &	Vendor	-	As per specification

## ANNEXURE – I TO SECTION – C: STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGE: COLTCS

PROJECT: 2X660 MW OPGCL IB Valley TPS

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
	maintenance tools & tackle.			
14	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	
15	a) Input cable schedules (C & I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for C & I systems for vendor supplied equipment shall be furnished during detail engineering by vendor in soft copies in the BHEL cable schedule format.
16	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.
17	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, 4 wire AC shall be provided by BHEL/Customer. Complete skid including changeover between feeder/starters/LCP/inter-locks/protection devices / any other supply etc. shall be in bidder's scope only.
4. \$: Shall be in customer scope where equipment are supplied by customer.

<b>SPECIFIC ELECTRICAL REQUIREMENT FOR COLTCS</b>			
<b>SL.NO.</b>	<b>PARAMETERS</b>	<b>UNIT</b>	<b>OPGCL</b>
	<b>MOTOR</b>		
1	DESIGN AMBIENT TEMP	DEG. C	50
2	VOLTAGE SUPPLY AND VARIATION	VOLT	415V, $\pm$ 10%
3	FREQUENCY WITH VARIATION	Hz	50 (+) 3% to (-) 5%
4	COMBINED VOLTAGE & FREQUENCY VARIATION		10%
5	MAX ACCEPTABLE RATING OF MOTOR AT 415 V	KW	Above 200W and upto 200 kW
6	SYSTEM FAULT LEVEL AND ITS DURATION	KA	50 KA, 1 Sec
7	SUTABILITY OF TERMINAL BOX FOR FAULT LEVEL AND DURATION		50 KA, 0.25 sec
8	CLASS OF INSULATION & TEMP RISE LIMITED TO		Class-F and temp rise limited to Class-B
9	MIN. STARTING VOLTAGE		80%
10	MOTOR RATING FOR SINGLE PHASE SUPPLY		Upto 200W
11	MAXIMUM LOCKED ROTOR CURRENT	% OF FLC	As per IS 12615/IS 325
12	ACCEPTABLE NOISE LEVEL	DB	85dB at 1.0m in line with IS 12065
13	TYPE OF STARTER PROVIDED IN MCC		DOL
14	DOP OF ENCLOSURE		IP:54 for Indoor Motor, IP:55 for Outdoor. Motor for outdoor or semi outdoor service shall be of weather proof construction.  DOP for terminal boxes shall be IP 55 as per IS 4691.
15	SPACE HEATER REQUIREMENT		30KW & ABOVE
16	PAINT SHADE		Shall be confirmed during detailed engineering.
17	SPECIAL REQUIREMENT		Type test to be conducted on the identical motor in the last 5 years or after the last design change, which ever is earlier. Otherwise, the equipment shall have to be type tested, free of charge, to prove the design.  All motors shall be subjected to routine tests as per IS: 325.  The motors shall generally conform to IS 325/IEC-60034. LT motors of continuous duty (S1) shall be energy efficient IE2 conforming to IS-12615.

# **2x660 MW IB TPS (UNIT-3 & 4), BANHARPALLI**

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

**BHEL DOC. NO. PE-DC-391-565-E003**

**REVISION 02**



**BHARAT HEAVY ELECTRICALS LIMITED  
POWER SECTOR  
PROJECT ENGINEERING MANAGEMENT  
NOIDA, INDIA**



## **2x660 MW IB TPS (UNIT-3 & 4)**

### **BANHARPALLI**

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

Doc. No. PE-DC-391-565-E003

Rev. No. 02

Dated 24-12-2013

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1.0 This document covers the basic technical features of high tension (HT) and low tension (LT) squirrel cage induction AC motors employed for driving auxiliaries of BHEL-PEM scope packages in 2x660 MW IB TPS (UNIT-3 & 4) BANHARPALLI

#### 2.0 CODES AND STANDARDS

**The motors shall generally conform to IS 325/IEC-60034. LT motors of continuous duty (S1) shall be energy efficient IE2 conforming to IS-12615.** For HT motors, efficiency (except for Mill motors and BCP) shall exceed 94% for all motors less than 2500HP (1865kW).

#### 3.0 DESIGN REQUIREMENTS

##### 3.1 General Requirements

The design ambient temperature shall be 50 deg C.

##### 3.2 Supply system and rated voltage of motors

KW rating	Supply system	Rated voltage of motor
Above 1500 kW	11 KV	11 KV
Above 200 kW & upto 1500 kW	3.3 KV	3.3 KV
Above 200W and upto 200 kW	415 V	415 V
Upto 200W	240V	240V

##### 3.2.1 Supply voltage & variations shall be as follows:-

Voltage variation (AC Supply) (+/-) 10%  
Voltage variation (DC Supply) (+) 10% to (-) 15%  
Frequency variation (+) 3% to (-) 5%  
Combined V & F variation 10% (sum of absolute values)

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

##### 3.3 Motor Rating

Motor ratings shall be adequate to meet the requirements of the drive equipment. Motors shall be continuously rated at the design ambient temperature of 50 deg C. Motor ratings shall have at least a 10% margin over the continuous maximum demand of the driven equipment at duty point or 10% margin over the continuous maximum demand of the driven equipment under entire operating range, whichever is higher.

##### 3.4 Starting Requirements

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

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

The limiting value of voltage at rated frequency under which a motor (except Mill Motors) will successfully start and accelerate to rated speed with load shall be taken to be a constant value of 80 (eighty) percent rated voltage.

**2x660 MW IB TPS (UNIT-3 & 4)****BANHARPALLI****BASIC TECHNICAL FEATURES  
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3.4.3 The locked rotor current of the HT motors (except MDBFP motors & mill motors) shall not exceed six times full load current inclusive of tolerance as per IS:325. For LT motors of continuous duty (S1) type motors, starting current shall be as per IS: 12615.

3.4.4 The following frequency of starts shall apply

- i) Three cold starts in succession with the motor being initially at a temperature not exceeding the ambient temperature.
- ii) The motor shall be capable of two starts in succession with coasting to rest between starts and the motor initially at rated operating temperature.
- iii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature.(not to be repeated in the second successive hour)

3.4.5 Locked motor withstand time of hot motors at 110% rated voltage shall be as follows:

- a) For motors with starting time upto 20 sec.  
- at least 2.5 sec. more than starting time.
- b) For motor with starting time above 20 secs  
- at least 5.0 sec. more than starting time.

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

### 3.5 Running Requirements

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

3.5.2 Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.

### 3.6 Stress During bus Transfer

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

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

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



## **2x660 MW IB TPS (UNIT-3 & 4)**

### **BANHARPALLI**

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

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

#### 3.7 Noise level

Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed 85 db(A) in line with IS 12065.

#### 3.8 Vibration

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

### 4.0 CONSTRUCTIONAL FEATURES

#### 4.1 Degree of Protection

4.1.1 Indoor motors shall conform to degree of protection IP:54 as per IS:4691. Outdoor or semi-indoor motors shall conform to degree of protection IP:55 as per IS:4691 and shall be of weather-proof construction. The degree of protection for terminal boxes shall be IP 55 as per IS 4691.

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

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

#### 4.2 Enclosure and Cooling

4.2.1 Motors shall generally have totally enclosed fan cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362. Alternatively, motors may have Closed Air circuit Air (CACA) method of cooling conforming to IC-0161 of IS: 6362 or shall be totally enclosed tube ventilated (TETV) .

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

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

#### 4.3 Class of Insulation

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

#### 4.4 Bearings

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

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- 4.4.2 The vertical motors shall have a combined thrust and guide bearing on top and guide bearing at bottom. If the ball or roller bearings can take vertical thrust, thrust and guide bearing need not be provided.
- 4.4.3 After taking all motor driven eqpt. loads and thrust(if any) into account , the bearings shall be suitable for min. 20,000 working hours. Re-greasable bearings shall be provided with grease nipples and relief holes for on-line re-greasing and shall be suitable for 8000 working hours without changing of the grease.
- 4.4.4 The bearings of solidly coupled motors shall be of the same type as those of the driven equipment.
- 4.4.5 For motors upto 2 kW, double sealed type bearings shall be provided.
- 4.4.6 HT motors shall be provided with insulated end shield on non-driving end to prevent flow of shaft current.
- 4.5 Terminals and Terminal Boxes
- 4.5.1 Motors of rating 100 kW and above will be controlled by circuit breaker. For all motors below 50 kW by MCCB and for motors between 50 KW to 100 KW MCCB with E/F protection shall be used. The terminal box of motors shall be designed for the fault current of 44 kA, 0.25 secs and 50 kA, 0.25 secs for HT & LT motors respectively.
- 4.5.2 Unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.
- 4.5.3 For MV motors, the main terminal box shall be of phase-segregated type with clamping arrangement for the terminals.
- 4.5.4 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A,C,B or V, W & U respectively.
- 4.5.5 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.
- 4.5.6 Motor terminals and terminal leads shall be fully insulated with no bar live parts.
- 4.5.7 Separate terminal boxes shall be provided for space heaters and temp. Indicators. If this is not possible in case of LT motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression tinned brass glands shall be provided in terminal boxes.
- 4.5.8 Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 180.
- 4.5.9 Cable glands and cable lugs as per selected cable sizes shall be provided in line with cable erection philosophy. For single core cable termination, gland plates shall be of non-magnetic material.
- 4.6 Grounding



## **2x660 MW IB TPS (UNIT-3 & 4)**

### **BANHARPALLI**

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

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

#### 4.7 General

4.7.1 Motors provided for similar drives shall be interchangeable.

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

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

#### 5.0 ACCESSORIES

##### 5.1 SPACE HEATERS

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

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

##### 5.2 RESISTANCE TEMPERATURE DETECTORS (RTDs)

5.2.1 HT motors stator windings shall be provided with 12 nos. ( 4 per phase) Simplex 3 wire Platinum RTDs with 100 ohms resistance at 0 deg C for remote monitoring of winding temperature. The leads from RTDs of each motor shall be brought out to a separate terminal Box.

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

##### 5.3 DIAL TYPE TEMP. INDICATORS

5.3.1 For HT motors, each bearing shall be provided with 1 no. Mercury-in-steel Dial type temperature indicator for local indication of bearing temperature. The indicators shall have 2 nos. NO contacts rated for 5A, 240 V AC and 0.5 A, 220 V DC for alarm/trip purpose.

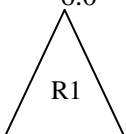
##### 5.4 Vibration monitoring pads

5.4.1 Provision shall be made in all HT motors for mounting vibration detectors.

#### 6.0 NAME PLATE

Motors shall have stainless steel name plate with all particulars as per IS: 325. In addition, the following information shall be shown on motor rating plates:

i) Temperature rise in deg.C under rated condition and method of measurement



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- ii) Degree of protection (IP No.)
- iii) Bearing identification number and recommended lubricant.
- iv) Location of insulated bearings.

**7.0 PAINTING**

The paint shall be epoxy based. The colour of finish shall be light grey to Shade No. 631 as per IS: 5 for motors.

**8.0 TESTING****8.1 Type Tests**

For HT motors, type test as per IS: 325 shall be conducted on one motor of each type and rating.

For LT Motors, type test certificates for tests carried out earlier on similar ratings, frame size and make shall be submitted for type tests as per IS:325. However, if such reports are not available, one motor of each type and rating shall be subjected to type tests as per IS: 325.

For DOP test, test certificates for tests carried out earlier on similar equipment shall be submitted.

**8.2 Routine Tests**

All motors shall be subjected to routine tests as per IS: 325.



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

**SPEC. NO. PE-TS- 391-165-N002**

**VOLUME : IIB**

**SECTION : D**

**REV. NO. 0**

**DATE : 04.06.2014**

**SHEET 1 of 1**

**SECTION C3  
CONDENSER ONLOAD TUBE CLEANING SYSTEMS  
C&I DETAILS**


**CONDENSER ON LOAD TUBE CLEANING SYSTEM - C&I REQUIREMENTS (scope matrix)**

<b>S.NO.</b>	<b>PROJECT</b>	<b>BANHARPALLI IB VALLEY</b>
1.00	SYSTEM	COLTCS
2.00	COMMON / PER UNIT	REFER NOTE -5
3.00	CONTROL SYSTEM	PLC
3.10	PROCESSOR CONFIGURATION FOR PLC SYSTEM	REDUNDANT WITH HOT STAND BY
4.00	LOCATION OF CONTROL SYSTEM	LOCAL TO COLTCS (NON AC ENVIRONMENT)
4.10	CONTROL SYSTEM SCOPE (BIDDER/ BHEL/ CUSTOMER)	BIDDER
5.00	HARDWIRED INTERFACE WITH DCS (Y/N)	N
5.10	PURPOSE OF HARDWIRED INTERFACE WITH DCS	NA
5.11	a) COMMAND FROM DCS (Y/N)	N
5.12	b) STATUS FEEDBACK TO DCS (Y/N)	N
5.13	c) GROUP FAULT ALARM TO DCS (Y/N)	Y
6.00	SOFTLINK TO DCS (Y/N)	Y
6.10	PURPOSE OF SOFTLINK TO DCS	MONITORING
6.11	a) COMMAND INTERFACE WITH DCS (Y/N)	N
6.12	b) STATUS MONITORING IN DCS (Y/N)	Y
7.00	PROTECTION CLASS FOR PLC / RIO PANEL	IP65
8.00	CONTROL FROM PB's ON LCP/OWS	PB's ON LCP & OWS
9.00	ANNUNCIATION ON LCP (Y/N) -- IF Y, MIN NO. OF HARDWIRED ALARMS / INDICATIONS	YES- BIDDER TO PROPOSE MIN NO OF ALARMS/INDICATIONS. PLEASE REFER NOTE-8.
9.10	MIMIC ON LCP (Y/N)	N
10.00	CONTROL FROM DCS IN CCR (Y/N)	N
11.00	TYPE OF SOFTLINK (TP/OFC)	OFC
11.10	COMMUNICATION CABLE SCOPE (BIDDER/ BHEL)	BHEL
11.20	REDUNDANT CABLE (Y/N)	Y
11.30	PROTOCOL	OPC on TCP/IP
12.00	RIO / RPU (Y/N)	N
13.00	NO. OF OWS / LAPTOP	2 NO. 22" COLOR LCD TFT BASED MONITOR FOR CONTROL & MONITORING AND PROGRAMMING FUNCTION
13.10	SIZE OF OWS/ CRT OR LCD	22" COLOR LCD TFT BASED MONITOR
14.00	NO. OF PRINTER	2 NOS.
14.10	PRINTER SIZE AND TYPE	ONE NO. A4 SIZE COLOR LASER & ONE NO. A4 SIZE DOT MATRIX PRINTER
15.00	\$\$ POWER SUPPLY AVAILABLE FOR BALL MONITOR (24V DC / 110 V AC UPS / 230 V AC UPS)	NA AS THE COLTCS SYSTEM IS PLC BASED

**CONDENSER ON LOAD TUBE CLEANING SYSTEM - C&I REQUIREMENTS (scope matrix)**

S.NO.	PROJECT	BANHARPALLI IB VALLEY
15.10	<b>&amp;&amp; POWER SUPPLY AVAILABLE FOR PLC PANEL (3PHASE, 415 V AC/ 1PHASE, 110 V UPS/ 1PHASE, 230 V UPS)</b>	BHEL SHALL PROVIDE UPS (SINGLE PHASE 230VAC) REDUNDANT FEEDER. REFER POINT-2.
15.20	<b>REDUNDANT FEEDERS (R) / NON-REDUNDANT (NR) FEEDERS FOR POWER SUPPLY</b>	R
15.30	<b>UPS BATTERY CONFIGURATION (1X100% / 2X100%)</b>	NA
15.40	<b>BATTERY TYPE (LEAD ACID/ Ni-Cd)</b>	NA
15.50	<b>BATTERY BACK-UP TIME (in minutes)</b>	NA
16.00	<b>ACTUATOR WITH INTEGRAL STARTER (Y/N)</b>	Y
17.00	<b>PG/ DPG/ PS/ DPS/ PT/ DPT per Balls Collecting Strainer/DF/SCS</b>	DPT = 2 nos. . DPI = 1 no.(ACROSS EACH BALL SEPARATOR APPLICABLE FOR ALL INSTRUMENTS )
19.00	<b>PROJECT SPECIFIC INFO</b>	Complete C&I is in bidder scope. PLC related document like IO list, control scheme, PLC configuration, power supply distribution scheme etc. shall be furnished by the bidder for BHEL approval during detailed engineering.
20.00	<b>REMARKS</b>	
21.00	<b>NOTES:</b>	
	1. <b>\$\$ THIS IS APPLICABLE FOR DCS CONTROLLED SYSTEMS ONLY.</b>	
	2. <b>&amp;&amp; THIS IS APPLICABLE FOR PLC CONTROLLED SYSTEMS. ALL POWER SUPPLY REQUIREMENTS FOR INDIVIDUAL SUB-SYSTEMS/ COMPONENTS EG. BALL MONITOR, SOL VALVES ETC SHALL BE DERIVED BY THE VENDOR FROM THIS POWER SUPPLY.</b>	
	3. <b>IN CASE OF PLC CONTROLLED SYSTEMS, CABLE ENGINEERING SHALL BE IN BIDDER'S SCOPE. CABLE SCOPE OF SUPPLY SHALL BE AS PER ELECTRICAL SCOPE SHEET.</b>	
	4. <b>## FOR PLC BASED CONTROL SYSTEM WHERE OWS IS PROVIDED, THE OWS SHALL HAVE PROGRAMMING &amp; CONFIGURATION FACILITY.</b>	
	5. <b>FOR THE PROJECTS IN WHICH CONTROL ARE ENVISAGED WITH PLC BASED CONTROL SYSTEM FOR COLTCS - 2 SETS OF COLTCS SHALL HAVE ONE COMMON PLC SYSTEM CUM STARTER PANEL.HOWEVER,SEPARATE LCP/RIO PANEL SHALL BE PROVIDED FOR EACH SET OF COLTCS.</b>	
	6. <b>COLOUR OF STARTER PANEL SHALL BE AS PER IS-5 SHADE 631 OR EQUIVALENT.THIS SHALL BE DECIDED DURING DETAIL ENGINEERING</b>	
	7. <b>BIDDER TO FURNISH ELECTRICAL LOAD DATA DURING DETAILED ENGINEERING.</b>	
	8. <b>ALARM FACIA SHALL BE UNDER BIDDER'S SCOPE. NO. OF FACIA SHALL BE DECIDED DURING DETAILED ENGINEERING.</b>	
	<b>LEGEND:</b>	
	DCS- DISTRIBUTED CONTROL SYSTEM	
	PLC- PROGRAMMABLE LOGIC CONTROLLER	
	RPU - REMOTE PROCESSING UNIT	

# C & I SPECIFICATIONS FOR COLTCS (PLC BASED)

				
	2 X 660 MW SUPER CRITICAL TPS ( BANAHARPALLI, ORISSA POWER GENERATION CO. LTD )		DESG	PS
			CHK	SSB
	REV. 00	DATE: 06.07.2014	APPD	MAM

**1.0.0 SECTION-C  
SPECIFIC TECHNICAL REQUIREMENT**



- 3) Provision for instructor to predefine a scenario for training, then injecting faults or transients in real time.
- 4) Analyse plant behavior under varying dynamic conditions such as plant start up or shut down transients, normal load change transients, as well as abnormal transients such as turbine trip or boiler feed pump trip.
- 5) Control system analysis capability to determine optimum controller tuning parameters such as gains, time constants etc.
- 6) Provision for simulation shall be made to carry out the local operations essential to meet the permissive required for start-up of any equipment.
- 7) Seller shall provide all required hardware & software to establish a functional training simulator. Hardware, configuration for the system shall not be limited to the following:
  - a) Work Stations
  - b) Instructor Station
  - c) Printers
  - d) Software
  - e) Cable and accessories

#### 6.00.00 PLC BASED MISCELLANEOUS CONTROL SYSTEMS

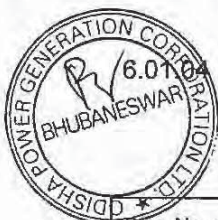
##### 6.01.00 GENERAL REQUIREMENTS

6.01.01 Seller shall provide complete and independent PLC based Control and Instrumentation system, preferably of same manufacturer with all accessories, auxiliaries and associated equipments and cables for the safe, efficient and reliable operation of the plant auxiliary systems as indicated in section-I of this volume.

6.01.02 Seller shall **provide** all instruments and devices, which are needed for the completeness of the system. Same shall be subject to approval of the Consultant during detailed engineering.

6.01.03 All instruments and control equipments like primary and secondary instruments etc. shall meet the requirements specified in Ci.1.00.00 of this section on Field Instruments. In addition, all electrical instrument devices like switches / transmitters / controllers / analyzers / solenoid valves which are located in the field / hazardous locations shall be provided with explosion proof enclosure suitable for hazardous areas described in National Electric Code (USA), Article 500, Class-I, Division-I. All field wiring should be through conduits. All fittings, cable glands etc. shall be strictly as per NEC recommendation article, 500 to 503.

ON/OFF control, indication, annunciation of incomers and bus-coupler are also to be performed from Seller's control system for each of the above system as applicable.





6.01.05 The control system shall be able to operate in non-air conditioned area and shall meet the minimum requirements as specified below.

6.02.00 **PROGRAMMABLE LOGIC BASED CONTROL SYSTEM**

6.02.01 **PLC Processor**

The processor unit shall be capable of executing the following functions:-

- a) Receiving binary and analog signals from the field and operator initiated commands from OWS / control panel.
- b) Implementing all logic functions for control, protection and annunciation of the equipment and systems.
- c) Implementing modulating control function for certain application as specified elsewhere in the specification.
- d) Issuing control commands.
- e) Providing supervisory information for alarm, various types of displays, status information, trending, historical storage of data etc.
- f) Performing self-monitoring and diagnostic functions.

6.02.02 The controller shall provide all basic functions for binary gating operations, modulating controls, storage, counting, timing, logging, transfer operations and comparison functions. The Seller shall submit full details regarding various functions along with expansion capability.

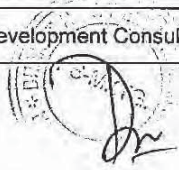
6.02.03 The programmable system shall be delivered completely programmed for the complete and reliable operation of the plant.

6.02.04 Each PLC unit shall be provided with two processors (Main processing unit, communication units and memories) one for normal operation and one as hot standby. In case of failure of working processor, there shall be an appropriate alarm and simultaneously the hot standby processor shall take over the complete plant operation automatically. The transfer from main processor to standby processor shall be totally bumpless and shall not cause any plant disturbance whatsoever. In the event of both processors failing, the system shall revert to fail safe mode. It shall be possible to keep any of the processors as master and other as standby. The standby processor shall be updated in line with the changes made in working processor.

6.02.05 The memory shall be field expandable. The memory capacity shall be sufficient for the complete system operation and have a capability for at least 20% expansion in future. Programmed operating sequences and criteria shall be stored in non volatile semi conductor memories like EEPROM/EPROM. All dynamic memories shall be provided with buffer battery back up which shall be for at least 360 hours. The batteries shall be lithium or Ni-Cd type.

6.02.06 The PLC system shall be provided with necessary interface hardware and software for dual fibre optic connectivity & interconnection with station wide LAN for two - way transfer of signals for the purpose of information sharing. The plant information shall be made available through an OPC compliant Ethernet link following TCP/IP standard. The exact data structure shall be as decided during

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detailed engineering. All required plant data shall be transferred to / from through this ensuring complete security. The exact number of points to be transferred through the above communication link and the format of the data shall be finalized during detailed engineering.

6.02.07 Two (2) nos latest version of PC based Operator Work Stations (OWS) each with 22" color LCD (TFT based) monitor and key boards shall be provided for control & monitoring and programming function. One heavy duty A4 size color laser printer and one dot matrix printer shall be provided along with operator work station. For the specification of PC and Printer Seller shall refer to the respective specification under DDCMIS. Refer PLC configuration diagram.

6.02.08 PC based OWS shall perform control, monitoring and operation of all auxiliaries/drives interacting with PLC based control system. It shall be possible to use the same as programming station of the PLC. It shall basically perform the following functions. In case the PC based OWS can not be used as programming station of the PLC, then a separate PC based programming station shall be provided.

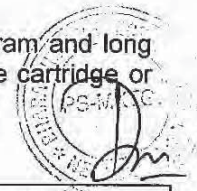
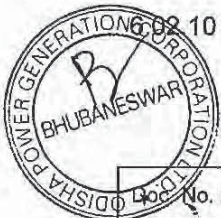
- a) Operator functions such as local/ remote selection, A/M selection, open / close operation, sequence auto, start / stop selection, ON / OFF, bypassing criteria etc.
- b) Supervisory functions like:-
  - i) Mimic displays, which shall depict the process in graphical form and shall cover all the process areas being monitored.
  - ii) Alarm monitoring/reporting, generation of logs, calculations, printing of logs & reports etc.

6.02.09 Programming station shall have access to the processor of the PLC system for programming. Programming shall not require special computer skills. On the programming console, it shall be possible to do the programming, self-diagnostics, testing of sequence, simulation and any sequence modification.

Programming shall be possible in any of the following formats :

- a) Flow-chart or block logic representing the instructions graphically.
- b) Ladder diagrams.
- c) A forcing facility shall be provided for changing the states of inputs and outputs, timers and flags to facilitate fault finding and other testing requirements. It shall be possible to display the signal flow during operation of the program. Programming shall be possible ON & OFF line.
- d) A NORMAL / TEST / PROGRAM / OFF lockable selector switch shall be provided in the PLC. In case of test mode of operation, all outputs should be blocked.

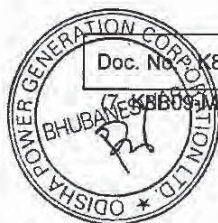
6.02.10 Provision shall be made for erasing and duplicating the user program and long term storage facilities shall be provided with the help of mag. Tape cartridge or DVD.



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- 6.02.11 Manual intervention shall be possible at any stage of operation. Protection commands shall have priority over manual commands and manual commands shall prevail over auto commands.
- 6.02.12 In PLC controller, memory should exist as to where the sequence was aborted due to power supply failure so that further operation from that point can restart after power supply restoration. This restart after recovery of the power supply shall be through operator intervention so as to enable verification of readiness of other related equipments.
- 6.02.13 All necessary software required for implementation of control logic, operator station displays / logs, storage & retrieval and other functional requirement shall be provided. The programs shall include high level languages as far as possible. The Seller shall provide sufficient documentation and program listing so that it is possible for the Buyer to carry out modification at a later date.
- 6.02.14 The Seller shall provide all software required by the system for meeting the intent and functional/parametric requirements of the specification.
- Industry standard operating system like UNIX/WINDOWS NT etc. to ensure openness and connectivity with other system in industry standard protocols (TCP-IP/ OPC etc.) shall be provided. The system shall have user oriented programming language & graphic user interface.
  - All system related software including Real Time Operating System, File management software, screen editor, database software. On line diagnostics/debug software, peripheral drivers software and latest versions of standard PC-based software and latest WINDOWS based packages etc. and any other standard language offered shall be furnished as a minimum.
  - All application software for PLC system functioning like input scanning, acquisition, conditioning, processing, control and communication and software for operator interface of monitors, displays, trends, curves, bar charts etc. Historical storage and retrieval utility, and alarm functions shall be provided.
  - The Seller shall provide software locks and passwords to Buyer's authorized engineers at site for all operating & application software so that Buyer's engineers can take backup of these software and are able to do modifications at site.
- 6.03.00 **INPUT / OUTPUT MODULES**
- 6.03.01 The PLC system should be designed according to the location of the input/output cabinets as specified.
- 6.03.02 Input Output modules, as required in the Control System for all type of field input signals (4-20 mA, RTD, Thermocouple, non change over/change over type of contact inputs etc.) and outputs from the control system (non change over/change over type of contact, 24 / 48 VDC output signals for energizing interface relays, 4-20 mA output etc.) are to be provided by the Seller.



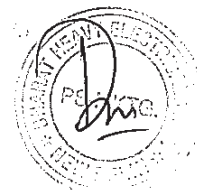
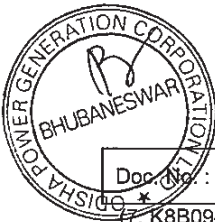
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- 6.03.03 Electrical isolation of 1.5kV with optical couplers between the plant input/output and controller shall be provided on the I/O cards. The isolation shall ensure that any inadvertent voltage or voltage spikes (as may be encountered in a plant of this nature) shall not damage or mal-operate the internal processing equipment
- 6.03.04 The Input/output system shall facilitate modular expansion in fixed stages. The individual input/output cards shall incorporate indications on the module front panels for displaying individual signal status, power healthy status, fault etc.
- 6.03.05 Individually fused output circuits with the blower fuse indicator shall be provided. All input/output points shall be provided with status indicator. Input circuits shall be provided with fuses preferably for each input, alternatively suitable combination of inputs shall be done and provided with fuses such that for any fault, fuse failure shall affect the particular drive system only without affecting other systems.
- 6.03.06 All input / output cards shall have quick disconnect terminations allowing for card replacement without disconnection of external wiring and without switching of power supply.
- 6.03.07 In case of power supply failure or hardware fault, the critical outputs shall be automatically switched to the fail-safe mode.
- 6.03.08 Further, keying-in of individual wire connectors shall be provided to ensure that only the correct card is plugged on the I/O module. It shall be possible to remove I/O module without disconnecting wiring from field inputs or outputs.
- 6.03.09 Binary Output modules shall be rated to switch ON/OFF coupling relays. Analog output modules shall be able to drive a load impedance of 600 Ohms minimum.
- 6.03.10 Output module shall be capable of switching ON/OFF inductive loads like solenoid valves, auxiliary relays etc. without any extra hardware.
- 6.03.11 Two output relays shall be provided for control of motor operated drives, whereas a single relay shall be provided for solenoid operated pneumatic drive.
- 6.03.12 All field input interrogation voltage shall be 24V DC.
- 6.03.13 In case of complete loss of I/O communication with the main processing unit, the I/O status shall go to predetermined fail safe mode (to be decided during detailed engineering) with proper annunciation.
- 6.03.14 The maximum number of inputs/outputs to be connected to each type of module shall be as follows :

01. Analog Input Module	:	16
02. Analog Output Module	:	16
03. Binary Input Module	:	32
04. Binary Output Module	:	32
05. Analog Input & Output (combined)	:	16



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06. Binary Input & Output (combined) : 32

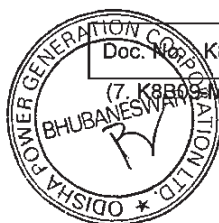
**6.04.00 SYSTEM SPARE CAPACITY**

Over and above the equipment and accessories required to meet the fully implemented system as per specification requirements, PLC shall have spare capacity and necessary hardware / equipment / accessories to meet following requirement for future expansion at site:

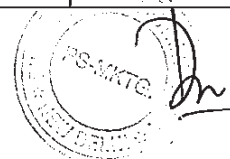
- a) 10% spare channels in input output modules fully wired upto cabinets TB.
- b) Wired-in "usable" space for 20% modules in each of the system cabinets for mounting electronic modules wired up to corresponding spare terminals in cabinets such that implementation of any additional control loop/logic can be achieved only by insertion of necessary electronic modules(s). Empty slots between individual modules /group of modules, kept for ease of maintenance or for heat dissipation requirement as per standard practice of Seller shall not be considered as wired-in usable space for IO modules. Terminal assemblies (if any in the offered system), corresponding to the IO modules shall be provided for above mentioned 20% blank space.
- c) Each processor shall have 30% spare functional capacity to implement additional function blocks, over and above implemented logics/ loops. Further, each processor shall have spare capacity to handle minimum 20% additional inputs/ outputs of each type (including (a) & (b) above), over and above implemented capacity. Each of the corresponding communication processor shall also have same spare capacity as that of processor.
- d) The data communication system shall have the capacity to handle the additions mentioned in clause nos. (a) to (c) above.
- e) Twenty (20) percent spare relays of each type and rating, mounted and wired in relays cabinets. All contacts of relays shall be terminated in terminal blocks of relay cabinets.
- f) The spare capacity as specified above shall be uniformly distributed throughout all cubicles. The system design shall ensure that above mentioned additions shall not require any additional controller/ processor/ peripheral drivers in the system delivered at site. Further, these additions shall not deteriorate the system response time/ duty cycle, etc. from those stipulated under this specification.


**6.05.00 PRINTER**

One A4 size color laser printer and one dot matrix printer, as a minimum, per PLC shall be provided as a part of the supervisory system. It shall print out all alarm / trip conditions and event changes in plant status along with date and time of occurrence. The time least count for event recording shall not be more than 100 milliseconds.



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**6.06.00 DATA COMMUNICATION SYSTEM (DCS)**

6.06.01 The PLC shall include a redundant System Bus with hot back-up and other applicable bus systems like cubicle bus, local bus, I/O bus etc.

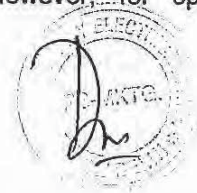
6.06.02 The PLC communication shall have the following minimum features :

- a) Redundant communication controllers & redundant communication link shall be provided to handle the communication between I/O Modules (including remote I/O) and PLCs and between PLCs and operator work station.
- b) The design shall be such as to minimize interruption of signals. It shall ensure that a single failure anywhere in the media shall cause no more than a single message to be disrupted and that message shall automatically be retransmitted. Any failure or physical removal of any station/module connected to the system bus shall not result in loss of any communication function to and from any other station / module.
- c) Built-in diagnostics shall be provided for easy fault detection. Communication error detection and correction facility shall be provided at all levels of communication. Failure of one bus and changeover to the standby system bus shall be automatic and completely bump less and the same shall be suitably alarmed / logged.
- d) The design and installation of the system bus shall take care of the environmental conditions as applicable.
- e) Data transmitting speed shall be sufficient to meet the responses of the system in terms of displays, control etc. plus the spare capacity mentioned above shall be available for future expansion.
- f) Passive coaxial cables or fibre optic cables shall be employed. The communication link in between remote located IO units and central processing unit shall be redundant and fiber optic based to make the communication reliable and free from any external noise prevailing in the plant.

The Seller shall furnish details regarding the communication system like communication protocol, bus utilization calculations etc.

**6.07.00 SYSTEM REACTION TIME**

The reaction time of the programmable control system from input signals at the input cards to output of the associated signals or commands of the output card inclusive of programmed logic processing, comprising a mixture of logic gates, arithmetic operations and other internal operations shall be less than 250 milli seconds under the worst data loading condition. However, for specific applications, it shall be less than 100 milli seconds.



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#### 6.08.00 SYSTEM PARAMETRIC REQUIREMENTS

PLC system shall be designed such that under worst case loading conditions the response time shall not be worst than the following:-

On/Off command	Response time for the screen update after execution of the control command from the time the command is issued shall be two second
Adjustment command	0.5 to 1 sec.
Screen update rate	1 sec.
Control related display	1 sec.
Bar chart display	2 to 3 sec
Plant mimic display	2 to 3 sec
Group review display	2 to 3 sec
X-T plot display	1 to 2 sec
Plant summary display	1 to 2 sec

#### 6.09.00 OPERATOR INTERFACE DISPLAYS / LOGS

Suitable displays and reports for control operation & monitoring shall be provided. The details shall be finalized during detailed engineering stage.

#### 6.10.00 CONTROL & POWER SUPPLY SCHEME Refer C&I scope matrix

- a) For PLC system, redundant 240 V AC Uninterruptible Power Supply (UPS) system shall be provided by the Seller. 415 V, 3-phase incomers to the UPS system shall be redundant. The Seller shall furnish all required hardware / equipment / cubicles for conversion and / or stabilization of the power source to all other levels which may be necessary for meeting the individual requirements of equipments/ systems furnished by him.
- b) For separately mounted I/O racks, separate redundant UPS systems shall be provided. Power supply module shall be redundant and of ample capacity to supply all modules. In addition 20% spare capacity for future shall be provided. The exact power supply scheme shall be as approved by the Consultant during detailed Engineering stage.
- c) Seller shall refer to the UPS specification mentioned in this volume.
- d) All the drives shall be switched ON/OFF through 24V DC coupling relays to be provided in HT/LT SWGR panels.

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**6.11.00 CONTROL CABINETS / PANELS / DESKS**

- 6.11.01 The cabinets shall be IP-22 protection class. The Seller shall ensure that the packaging density of equipment in these cabinets is not excessive and abnormal temperature rise, above the cabinet temperature during normal operation or air-conditioning failure, is prevented by careful design. This shall be demonstrated to the Buyer during the factory testing of the system. The Seller shall ensure that the temperature rise is limited to 10 deg. C above ambient and is well within the safe limits for system components even under the worst condition as specified in Sub-section-basic Design criteria and specification requirements for remote I/O cabinets.
- 6.11.02 Ventilation blowers shall be furnished as required by the equipment design and shall be sound proof to the maximum feasible extent. If blowers are required for satisfactory system operation, dual blowers with blower failure alarm shall be provided in each cabinet with proper enclosure and details shall be furnished. Suitable louvers with wire mesh shall be provided on the cabinet.
- 6.11.03 The cabinets shall be designed for front access to system modules and rear access to wiring and shall be designed for bottom entry of the cables.
- 6.11.04 Cabinets shall be designed for a grounded installation on the building structure. Any isolation from the building ground which is required by equipment design shall be provided internal to the cabinet.
- 6.11.05 The mimic shall be configured on the OWS/ LCD monitor and it shall be possible to control, monitor and operate the plant from the same.
- 6.11.06 Motor current shall be displayed on the OWS/Panel for all motors rated 30kW and above. Further, HT/LT switchgear voltage shall also be displayed on the OWS / Panel. Panel mounted Ammeters and voltmeters shall be suitable for 4-20 mA DC signals derived from Analog Output cards of PLC.
- 6.11.07 Mosaic based control desk type for mounting push buttons/meters etc. with door at the rear shall be provided by the Seller. The mosaic grid tiles shall be of 24mm x 48mm (or 25mm x 50mm) size, made of heat and flame retardant, self extinguishing and non hygroscopic material with flat-matt finish without glare and non reflecting type. PC based OWS (operator Work Station) of PLC shall be mounted on table type control desk to house PC / keyboards / mouse etc. The profile and dimension shall be decided during detailed engineering and shall be subject to Consultant's approval.
- 6.11.08 The technical specification covering panel fabrication details, wiring and termination details etc. are described in section-I and section-VI of this volume.

**6.12.00 ANNUNCIATION SYSTEM**

Seller shall provide annunciation system as integral part of PLC system. Field contacts shall be acquired through PLC only. The annunciation sequence logics shall be implemented as a part of PLC controllers. The annunciation window lamps mounted on control panel shall be driven through contact output modules of PLC. The lamp box shall have removable impact polystyrene window shall be 50 mm x 50 mm or 48mm x 48mm with 5 mm size inscription in black lettering on



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white background. Each annunciation window shall be back lighted with two long life LED lamps. The changing of lamps shall be conveniently done from the front by single removal of window. Redundant audible devices for alarms shall be cone type or metallic horn type and shall be driven by electronic tone generator of adjustable width and sound level. The trip alarm audible & ring back audible shall be differentiated from other alarms.

6.12.02 The annunciator sequence shall conform to ISA sequence ISA-2A. The number of annunciation facia windows and the provision for original input shall be on as required basis. However, the minimum number of facia windows, signal input to the annunciation system shall be 25 nos.

6.13.00 SOFTWARE DOCUMENTATION AND SOFTWARE LISTINGS

6.13.01 All technical manuals, reference manuals, user's guide etc., in English required for modification / editing / addition / deletion of features in the software of the PLC System shall be furnished. The Seller shall furnish a comprehensive list of all system / application software documentation after system finalization for Consultant's review and approval.

6.13.02 All The software listings including Source code for application software, All special-to-project data files etc. shall be submitted by the Seller:

6.13.03 SOFTWARE LICENCES

The Seller shall provide software license for all software being used in PLC. The software licenses shall be provided for the project (e.g. organization or site license) and shall not be hardware / machine-specific. That is, if any hardware / machine is upgraded or changed, the same license shall hold good and it shall not be necessary for Buyer to seek a new license / renew license due to up gradation / change of hardware / machine in PLC at site. All licenses shall be valid for the continuous service life of the plant.

6.13.04 SOFTWARE UPGRADES

As a customer support, the Seller shall periodically inform the designated engineer of the Buyer about the software upgrades / new releases that would be taking place after the system is commissioned so that if required, same can be procured & implemented at site.

6.14.00 FURNITURE

Seller shall provide complete set of industrial grade furniture of ergonomic design from reputed manufacturer especially designed for installing computer peripherals. The set of furniture shall include but not be limited to control desk, chair, printer table, computer tables etc, cabinets for storage of manuals / booklets / recorder charts, storage racks for special tools / diskettes etc.

6.15.00 SPECIAL TOOLS & TACKLE AND CONSUMABLES

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



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- 6.15.02 The tools & tackle and Test Equipment shall be shipped in separate container, clearly marked with names of the equipment for which they are intended.
- 6.15.03 Seller shall furnish list of tools & tackle and test equipment proposed to be supplied.
- 6.15.04 Seller shall provide maintenance and trouble shooting tools viz. test instruments, extender cards, cassettes / floppies / CDs etc. containing all type programs which are required for commissioning and maintenance.
- 6.15.05 Seller shall provide all the printer paper for the period upto hading over of the plant to Buyer.
- 6.15.06 Seller shall provide minimum one number of laptop computer with latest hardware configuration and loaded with the operating and application program as a backup portable programming and configuration station.

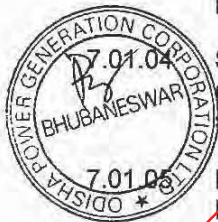
**7.00.00 ON LINE VIBRATION MONITORING AND ANALYSIS SYSTEM (VMS)**

**7.01.00 VIBRATION MONITORING SYSTEM**

7.01.01 Microprocessor based vibration monitoring system shall be provided for all HT motor & their driven equipment (pumps / fans) rated 200 kW and above like Motor driven Boiler Feed pump & motor, Condensate Extraction Pumps & motors, Auxiliary cooling water Pumps & motors, ID fans & motors, FD fans & motors, PA fans & motors, SA fans & motors, Coal Mills motors, ~~Boiler circulation water pumps & motors etc.~~ during all regime of operation. System shall be proven and from latest product range of the manufacturer. The System shall be supplied for each unit.

7.01.02 Vibration sensors shall be provided on the DE and NDE bearings of motors and fans / pumps. On each bearing there shall be two vibration sensors, one in X direction and other in Y direction. For vertical pumps there shall be three bearing locations i.e. DE motor, NDE motor and pump thrust / DE bearing. Proximity type key phasor sensor/s shall be provided for the shaft speed signal for analysis of the vibration.

7.01.03 The vibration monitoring system shall be furnished on a system basis including vibration transducers with low noise flexible cables in flexible conduit, terminated in local terminal boxes, necessary pre-amplifier / electronics mounted in local weather proof boxes, vibration monitors, mounting racks and cabinets. The vibration monitoring system shall include all power supplies, interconnecting cabling, calibration equipment, indicators, signal conditioning & measuring devices and all other accessories required for monitoring of vibration at each point.



Seller shall supply 2/4 channel vibration monitors for each measurement location catering for horizontal and vertical measurements. Offered vibration monitors shall be modular in construction, plug in type and suitable for 19" rack mounting.

Piezo electric transducer / Eddy current type proximity transducers shall be used. However, the finally selected sensor type shall also depend on recommendation of the equipment manufacturer & suitable for application requirement.



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Core to core- 1.5 kV for 1 min.

Core to screen- 1.0 kV for 1 min.

- f) Insulation Resistance 100 M Ohm / Km Min
- g) Rodent & Termite repulsion test (Presence of lead shall be confirmed)

22. Conductor material & sheath color for thermocouple cable as per ANSI MC 96.1

CABLETYPE	OVERALL SHEATH COLOR	WIRE	SHEATH COLOR	CONDUCTOR MATERIAL
Kx	Yellow	Positive	Yellow	Nickel / Chromium
		Negative	Red	Nickel / Aluminum
Rx	Green	Positive	Black	Copper
		Negative	Red	Copper Nickel Alloy

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

9.02.00 INSTRUMENTATION MULTI PAIRED SIGNAL CABLE

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





- i) Cable Twist Test
- j) Cable Cyclic Flexing Test
- k) Environmental Characteristics Test
- l) Temperature Cycling Test
- m) Color Permanence Test Cable Aging Test
- n) Water Penetration Test
- o) Lightning Test
- p) Routine Test / Sample Test

#### 10.00.00 ERECTION HARDWARE

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

#### 10.01.00 ELECTRICAL ACCESSORIES

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

##### a) Rigid Steel Conduit

- i) Conduits up to and including 25 mm shall be of 16 SWG and conduits above 25 mm shall be of 14 SWG. Minimum size of conduits shall be 19 mm.
- ii) Each piece of conduit shall be straight, free from blister and other defects and covered with capped bushing at both ends.
- iii) All rigid conduit couplings and elbows shall be hot dip galvanized rigid mild steel in accordance with ANSI C 80.1 and UL6. The conduit interior and exterior surfaces shall have a continuous zinc coating with an over coat of transparent enamel or zinc chromate. Conduits shall be furnished in standard length of 3 meters, threaded at both ends.
- iv) All conduit fittings shall conform to the requirements of ANSI C 80.4 and UL-514 where these standards apply.

##### b) Flexible Conduit

- i) Flexible conduit shall be of three layer construction of very high quality of lead coated steel. Outside and inside layer shall be reinforced with heat resistant material.
- ii) Lead coating outside and inside of the conduit steel surface shall provide a non-corrosive characteristic particularly in acidic atmosphere. Besides flexibility, this shall be strong enough to stay at the desired profile without support and shall be durable and strong so as to offer sufficient mechanical protection. It shall also be fully liquid





dust and air tight and shall withstand a continuous hydraulic pressure up to 2 Kg/Sq. cm and temperature up to 200 °C.

c) **Special Fittings**

- i) Conduit sealing and fittings shall be provided as required and shall be consistent with the area and equipment with which they are installed.
- ii) Double locknuts shall be provided on all conduit terminations not provided with threaded lugs and couplings. Locknuts shall be designed to securely bond the conduit to the enclosure when tightened. Locknuts shall not loosen due to vibration.

10.01.02 **Electrical Junction Box**

- 01. Type of enclosure : Dust tight & weatherproof conforming to IP 65
- 02. No. of ways : As required plus 20% spare terminals
- 03. Material : 4 mm thick fiberglass reinforced polyester. UV stabilized.
- 04. Type of cover : Screwed at all four corners for door.
- 05. Gasket : Neoprene
- 06. Mounting : Surface
- 07. Cable entry : Cable glands
- 08. Grounding : Brass earth lug with green screw head.
- 09. Number of Drain Holes : At bottom capped.
- 10. Identification : Label for JB and Tags for cable
- 11. Colour : Outer Colour= RAL 7032, Siemens Grey  
Inner Colour= Brilliant White
- 12. Accessories :
  - a) Rail mounted cage clamp type screw less terminals suitable for conductor size up to 2.5sq.mm with markers.
  - b) Aluminum back panel
  - c) Cable gland
  - d) Ferrules & lugs
  - e) Mounting brackets, bolts and nuts made of brass.





**10.01.03 Cable Gland**

- 01. Type : Double compression
- 02. Entry Thread : NPT
- 03. Material : Brass
- 04. Finish : Cadmium Plated.
- 05. Protection : IP 54 or better
- 06. Accessories : Neoprene gasket, locknuts, reducers etc.

**10.01.04 Cable Tray**

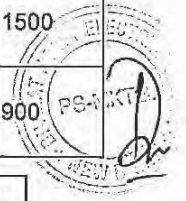
- 01. Material : Mild steel
- 02. Thickness : not less than 2.0 mm
- 03. Finish : Hot dip galvanized
- 04. Perforation : As per MFR standard.
- 05. Cover : Suitable for tray

**10.02.00 PROCESS HOOK UP ACCESSORIES & SPECIFICATION**

Material and rating of the hook up items shall suit the piping and fluid condition. Hook up materials shall be IBR certified for applicable cases. Seller shall furnish hook up drawings and the drawings for open racks & closed racks for Consultant's approval. For the design guide line Seller shall refer to section-I of this volume.

**10.02.01 Specification for Process Hook Up Materials**

Sr. No.	System	Piping class	Impulse Pipe Material	Schedule	Materials for Valve / Fittings	Stem Material	Rating of Fitting	Pr. Class of valve
1.	Main Steam, upstream of HP Bypass and Auxiliary Steam pressure reducing valve	A	ASTM-A335 Gr. P-91/22 (Note-2)	XXS (½ inch)	Note-3	Note-3	9000 lb	3000 SPL
2	BFP discharge / superheater attemperator / spary to PRDS	B	ASTM-A106 Gr. C	160 (½ inch)	ASTM-A 105	ASTM-A182 Gr. F-6a	6000 lb	2500
3.	Reheater	C	ASTM-A106 Gr. C	160 (½ inch)	ASTM-A 105	ASTM-A182 Gr. F-6a	6000 lb	1500
4.	Hot reheat / downstream of aux. steam	D	ASTM-A335 Gr. P-	160 (½ inch)	ASTM-A182 Gr. F-22	Note-3	3000 lb	900





Sr. No.	System	Piping class	Impulse Pipe Material	Schedule	Materials for Valve / Fittings	Stem Material	Rating of Fitting	Pr. Class of valve
	pressure reducing valve upto desuperheater /flash tank drain manifold		91/22 (Note-2)					
5.	CRH turbine upto tee off for HP bypass / Extraction steam to HPH	E	ASTM-A335 Gr. P-22	80 (½ inch)	ASTM-A 182 Gr. F-22	ASTM-A182 Gr. F-6a	3000 lb	800
6.	CRH downstream of tee off for HP bypass	F	ASTM-A106 Gr. C	80 (½ inch)	ASTM-A 105	ASTM-A182 Gr. F-6a	3000 lb	800
7.	BFP suction / condensate system / extraction to LPH / extraction to BFPT, Deaerator / aux. steam	G	ASTM-A106 Gr. B	80 (½ inch)	ASTM-A 105	ASTM-A182 Gr. F-6a	3000 lb	800
8.	Air / Flue Gas Outside Furnace	K	ASTM-A106 Gr. B/C	80 (¾ inch)	ASTM-A 105	ASTM-A182 Gr. F-6a	3000 lb	800
9.	Air / Flue Gas Inside Furnace	L	ASTM-A335 Gr. P-22	80 (¾ inch)	ASTM-A 182 Gr. F-22	ASTM-A182 Gr. F-6a	3000 lb	800
10.	DM Cooling Water	M	ASTM A312 TP 316	40 (1/2 inch)	ASTM A182 F316	SS or better	3000 lb	800
11.	CW & ACW	N	ASTM-A106Gr. C	80 (½ inch)	ASTM-A 105	SS or better	3000 lb	800

**10.02.02 Seamless Stainless Steel Pipe**

01. Reference : ASTM A-312 TP 316  
02. Material Grade : TP 316  
03. Type : Seamless /Plain end  
04. Size : ½" NB  
05. Schedule : 40  
06. Standard Length : 5 meter

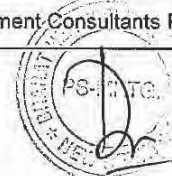


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**10.02.03 Stainless Steel Pipe Fittings**

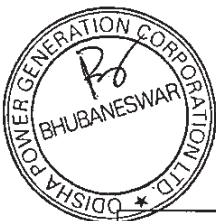
- 01. Reference : ASTM A-182 F 316 / ANSI B16.11
- 02. Type : Forged
- 03. Rating : 3000 lbs / 6000 lbs / 9000 lbs
- 04. Size : ½" NB
- 05. End connection : Generally socket weld
- 06. Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

**10.02.04 Seamless Stainless Steel Tube**

- 01. Reference : ASTM A-213 TP 316
- 02. Material Grade : TP 316
- 03. Size : ½" OD X 2.1 MM Thick
- 04. Type : Cold drawn annealed, pickled, passivated, de-scaled, hydraulically cleaned seamless tube.
- 05. Properties : The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80.
- 06. Test Pressure : 400 Kg/Sq. cm (minimum)
- 07. Tolerance : ± 0.13 mm for outside diameter  
± 15 % for wall thickness
- 08. Standard Length : 5 meter
- 09. Test : Flare, Hardness, Ball and Bubble Test

**10.02.05 Stainless Steel Tube Fittings**

- 01. Reference : ASTM-A-182
- 02. Type : Double ferrule double compression
- 03. Material : 316 Stainless steel forged
- 04. Ferrule : 316 Stainless Steel
- 05. Type of Fittings : Male / female connector, elbow, cross / equal tee, straight connector, bulkhead union, ferrule etc. as required to suit installation.





06. Size : To suit SS tubing and NPT end connection

**10.02.06 C.S. Pipe**

- 01. Reference : ASTM-A 106 Gr. C
- 02. Material : Cold drawn seamless black C.S.
- 03. Type : Seamless / Plain ends
- 04. Size : ½" NB
- 05. Schedule : 80, 160, XXS as required
- 06. Standard Length : 5 meter

**10.02.07 C.S. Pipe Fittings**

- 01. Reference : ASTM-A 105 / ANSI B16.11
- 02. Type : Forged
- 03. Rating : 3000 lbs / 6000 lbs / 9000 lbs
- 04. Size : ½" NB
- 05. End connection : Generally socket weld
- 06. Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

**10.02.08 A.S. Pipe**

- 01. Reference : ASTM-A 335 P22 AS PER ANSI B 36.10
- 02. Material : Cold drawn seamless A.S.
- 03. Type : Seamless / Plain ends
- 04. Size : ½" NB
- 05. Schedule : XXS
- 06. Standard Length : 5 meter

**10.02.09 A.S. Pipe Fittings**

- 01. Reference : ASTM-A 182 F22 AS PER ANSI B 16.11
- 02. Type : Forged
- 03. Rating : 9000 lbs



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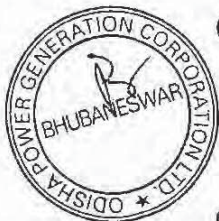
- 04. Size : ½” NB
- 05. End connection : Generally socket weld
- 06. Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

**10.02.10 Carbon Steel Globe Valve**

- 01. Reference : ASTM A-105
- 02. Type : Globe
- 03. Construction : Forged Body Cadmium Plated
- 04. End Connection : ½” Socket Weld
- 05. Rating : Cl. 800 / CL. 2500
- 06. Material : Body - Carbon steel  
Stem - Hardened Steel  
Plug - AISI 316 SS  
Seat- Stainless steel stellited
- 07. Packing : Teflon / Grafoil as required
- 08. Yoke : ASTM A105
- 09. Handwheel : Carbon steel
- 10. Design standard : As per ANSI B 16.34

**10.02.11 Stainless Steel Globe Valve**

- 01. Reference : ASTM A-182 F316
- 02. Type : Globe
- 03. Construction : Forged Body
- 04. End Connection : Socket Weld
- 05. Proof Pressure : 400 Kg/cm<sup>2</sup>
- 06. Material : Body - Stainless steel  
Stem - Hardened Steel  
Plug - AISI 316 SS  
Seat- Stainless steel stellited
- 07. Packing : Teflon as required



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- 08. Yoke : ASTM A182 F316
- 09. Handwheel : Carbon steel
- 10. Design standard : As per ANSI B 16.34

**10.02.12 Alloy Steel Globe Valve**

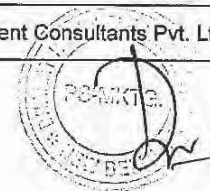
- 01. Reference : ASTM A-182 F22
- 02. Type : Globe
- 03. Construction : Forged Body
- 04. End Connection : ½" Socket Weld
- 05. Rating : CL. 2500
- 06. Material : Body - Alloy steel  
Stem - Hardened Steel  
Plug - AISI 316 SS  
Seat- Stainless steel stellited
- 07. Packing : Grafoil as required
- 08. Yoke : ASTM A182 F22
- 09. Handwheel : Carbon steel
- 10. Design standard : As per ANSI B 16.34

**10.02.13 Condensate Pot**

- 01. Reference : ASTM A182 F22 / ASTM A105
- 02. Material : Alloy steel / carbon steel as per application
- 03. Construction : Drilled from barstock
- 04. End connection : 3 nos. ½" socket weld end
- 05. Accessories : Vent valves

**10.02.14 Instrument Valve Manifold**

- 01. Type : a) Two valve manifold  
b) Five valve manifold  
c) Three valve manifold
- 02. Mounting : Remote 2" Pipe Mounting





03. Construction	:	Single block (bar stock)
04. Material	:	Forged body and bonnet AISI 316 stainless steel
05. Ports	:	1/2 " NPT (F)
06. Rating	:	420 Kg/Sq. cm at ambient
07. Operating Temperature	:	(-)30 to (+)170 Deg C
08. Packing	:	PTFE Wafer
09. Seat & Stem	:	AISI 316 SS
10. Plug	:	AISI 316 SS free to turn on stem / 17-4 PH
11. Handle Bar	:	AISI 316 SS
12. Connection	:	Straight
13. Accessories	:	a) Plugs for all ports b) Mounting Bracket, bolts, nuts

**10.02.15 Air Header**


		<b>For Panel</b>	<b>For Field</b>
01. Material of Construction	:	Stainless steel	Stainless steel
02. Inlet Connection	:	2" NPT (M)	1" NPT (M)
03. Header Take-off	:	Stainless Steel	Stainless Steel
04. Take off connection	:	1 / 2" NPT (M)	1/ 2" NPT (M)
05. Take-off Valves	:	Stainless Steel	Stainless Steel
06. Tube Take-off	:	Tube adapter on valve	Tube adapter on valve
07. Drain	:	SS drain valve at lowest point	SS drain valves at lowest point



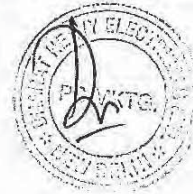
**10.02.16 Seamless Stainless Steel Tube**

01. Reference	:	ASTM A-269 TP 316
02. Material Grade	:	TP 316



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- 03. Size : ¼” OD x 0.049” wall thickness
- 04. Type : Cold drawn annealed, pickled, passivated, de-scaled, hydraulically cleaned seamless tube.
- 05. Properties : The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80.
- 06. Test Pressure : 400 Kg/Sq. cm
- 07. Tolerance : ± 0.13 mm for outside diameter  
± 15 % for wall thickness
- 08. Standard Length : 5 meter
- 09. Test : Flare, Hardness, Ball and Bubble Test



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

**SPEC. NO. PE-TS- 391-165-N002**

**VOLUME : IIB**

**SECTION : D**

**REV. NO. 0**

**DATE : 04.06.2014**

**SHEET 1 of 1**

## **SECTION – D**

### **STANDARD TECHNICAL SPECIFICATION**

**SECTION D1 : CONDENSER ONLOAD TUBE CLEANING  
SYSTEM**

**SECTION D2 : ELECTRICAL SYSTEMS**

**SECTION D3 : C&I SYSTEM**



**TITLE : TECHNICAL SPECIFICATION  
FOR  
CONDENSER ON LOAD TUBE CLEANING  
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**SPEC. NO. PE-TS- 391-165-N002**

**VOLUME : IIB**

**SECTION : D**


**REV. NO. 0**

**DATE : 04.06.2014**

**SHEET 1 of 1**

**SECTION D1**

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

	<b>TITLE :</b>	<b>SPECIFICATION NO. PE-TS-999-165-N001</b>	
	<b>STANDARD TECHNICAL SPECIFICATION</b>	<b>VOLUME : II B</b>	
	<b>CONDENSER ON - LOAD TUBE CLEANING</b>	<b>SECTION : D</b>	
	<b>SYSTEM ( Sponge Rubber Ball Type )</b>	<b>REV. NO. 00</b>	<b>DATE :27.09.07</b>
		<b>SHEET I</b>	<b>OF 14</b>

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.

	<b>TITLE :</b>	<b>SPECIFICATION NO. PE-TS-999-165-N001</b>	
	<b>STANDARD TECHNICAL SPECIFICATION</b>	<b>VOLUME : II B</b>	
	<b>CONDENSER ON - LOAD TUBE CLEANING</b>	<b>SECTION : D</b>	
	<b>SYSTEM ( Sponge Rubber Ball Type )</b>	<b>REV. NO. 00</b>	<b>DATE :27.09.07</b>
		<b>SHEET 2</b>	<b>OF 14</b>

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.

	<b>TITLE :</b>	<b>SPECIFICATION NO. PE-TS-999-165-N001</b>	
	<b>STANDARD TECHNICAL SPECIFICATION</b>	<b>VOLUME : II B</b>	
	<b>CONDENSER ON - LOAD TUBE CLEANING</b>	<b>SECTION : D</b>	
	<b>SYSTEM ( Sponge Rubber Ball Type )</b>	<b>REV. NO. 00</b>	<b>DATE :27.09.07</b>
		<b>SHEET 3</b>	<b>OF 14</b>

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

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

3.05.00 **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.

	TITLE :	SPECIFICATION NO. PE-TS-999-165-N001	
	STANDARD TECHNICAL SPECIFICATION	VOLUME : II B	
	CONDENSER ON - LOAD TUBE CLEANING	SECTION : D	
	SYSTEM ( Sponge Rubber Ball Type )	REV. NO. 00	DATE :27.09.07
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- 3.05.06 Bearings of adequate design shall be provided for taking the entire pump load arising from all probable conditions of continuous operation through its range of operation. The bearings shall be designed on the basis of 20,000 working hours minimum for the load corresponding to the duty point. Proper lubricating element does not contaminate the liquid being pumped. Bearings shall be easily accessible without disturbing the pump assembly
- 3.05.07 Stuffing box of suitable design to permit replacement of packing without removing any part other than the gland shall be provided. The stuffing boxes shall be sealed / cooled by the fluid being pumped.
- 3.05.08 Pumps shall be of self-lubricated, self - sealed and self-cooled type. All pipework, fitters etc., for sealing, cooling and lubricating purpose shall be supplied and no external cooling/lubricating/sealing water will be supplied. Pump capacity shall take into account the cooling/lubricating/sealing water requirement.
- 3.05.09 All rotating components shall be statically and dynamically balanced.
- 3.05.10 The pump shall be designed such that pump impellers and other accessories of the pump, are not damaged due to flow reversal.
- 3.05.11 The pump shall be capable of developing the required total head at rated capacity for continuous operation. Also the pumps shall be capable of being operated to give satisfactory performance at any point on the head Vs. flow characteristic curve over a range or 40% of rated flow to 120 -130 % of rated flow.
- 3.05.12 The pump shall preferably be non-overloading type. The total head Vs. capacity curve shall be continuously rising from the maximum flow point towards shut-off without any zone of instability.
- 3.05.13 The pump shall run smoothly without undue noise and vibration. Peak to peak vibration limits and noise level shall be within the acceptable values of applicable codes/standards.
- 3.05.14 The pump and motor shafts shall be connected through a pin and rubber bush flexible type of couplings. Suitable coupling guards shall be provided for the couplings.
- 3.05.15 The pump shall be capable of being started with discharge valve fully opened. Motor rating shall be adequate for this condition. The output KW rating of the pump drive motor shall not be less than the larger of the following :
- Maximum power input to the pump over the entire range for maximum flow to shut-off condition.
  - 125% of power input to the pump at duty point corresponding to 103% of the rated speed.
- 3.06.00 **Ball Collector**
- 3.06.01 The body of the ball collector shall be designed to withstand 2.0 times the operating pressure or 1.5 times the recirculating pump shut-off pressure, whichever is higher.



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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 gauge 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 gauge 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.

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- 3.08.02 The monitoring system shall be of proven and reliable design and shall be complete with necessary transducers, amplifiers, transmission lines, power cables and electronic processor etc.
- 3.08.03 The electronic processor of the ball monitoring system shall be housed in the control panel and shall consist the following : -
- a) Indicators for
    - ◆ required basic ball charge.
    - ◆ recirculating ball quantity.
    - ◆ oversized ball quantity.
  - b) Time counters for
    - ◆ total cleaning system operating hours.
    - ◆ cleaning system operating hours with sufficient number of oversized balls.
  - c) Recorder for ball consumption.
- 3.08.04 The ball monitoring system shall have provisions for self-testing and self-calibration.
- 3.09.00 **Cleaning Balls**
- 3.09.01 The sponge rubber cleaning balls shall be slightly oversized to the internal diameter of condenser tubes and should be able to remove all fouling and scaling deposits in the condenser tubes.
- 3.09.02 The specific gravity of the cleaning balls shall be such that good distribution of balls across the tube sheet and cleaning of all tubes are ensured.
- 3.09.03 The composition of the cleaning balls shall be based on natural rubber and shall be suitable for temperature upto 100°C. Hardness of the cleaning balls shall be compatible to tube material and corrosion/fouling behaviour. If cleaning balls consist of abrasive coated balls, the abrasive material shall also be compatible for use with the tube material.
- 3.09.04 Calculations and basis for selection of cleaning balls circulation quantity, type, size, hardness, cleaning frequency etc., shall be furnished during contract stage.
- 3.10.00 **Piping, Valves, Distributors and Injection Nozzles.**
- 3.10.01 Interconnecting piping, valves, injection nozzles and other fittings shall be designed to withstand 2.0 times the operating pressure or 1.5 times the pump shut-off pressure whichever is higher.
- 3.10.02 Interconnecting piping shall be sized and routed optimally. Velocity in the pipe work shall be less than 1.5 m/s for pump suction and less than 2.2 m/s in other pipe work.
- 3.10.03 Necessary isolation valves, vent and drain valves for various equipments shall be provided. Valves shall conform to appropriate standards. Valves provided in ball transport piping shall be ball type. Gland packing of all valve shall be of superior quality to avoid leakage. All valves upto 150 Nb shall be ball valves. For higher sizes ,



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- gate / globe /B.F. valves shall be provided. All instrument valves shall be needle valves.
- 3.10.04 Adequate number of ball injection nozzles shall be provided for proper distribution of cleaning balls in condenser inlet. Ball injection nozzles shall be flanged type and shall have two sets of flanges, one for connecting to ball transport pipe and other for connecting to the stub on condenser inlet pipe for ease of removal during repairs or checking.
- 3.10.05 Distributors ( if applicable) with sight glass shall be provided wherever ball transport piping branching out or joining together for proper guidance of cleaning balls.
- 3.10.6 Type of valves shall be ball valves, no diaphragm type valve shall be used.
- 3.11.00 **Actuators**
- 3.11.00 Tube cleaning system shall be provided with actuators wherever necessary for various automatic operations. The actuators shall be electric motor operated and shall meet the requirements of the enclosed specification. The actuator shall be provided with auxiliary handwheel for manual operation in the event of control system failure.
- 3.12.00 **Electric Motors**
- The drive motors for recirculating pump and differential pressure measuring system flushing pump shall conform to the requirements of the enclosed specification.
- 3.13.00 **Instrumentation and Control System.**
- 3.13.01 Complete instrumentation and control system for automatic operation of tube cleaning system, protection, interlocking, indication / annunciation of differential pressure and other malfunctions etc., shall be provided. This shall consist of adequate operational hardware, local control panel ( As applicable ) and interconnecting control and power cabling between the control panel and various equipments in the tube cleaning system.
- 3.13.02 The control panel shall house all necessary instruments, indicating / annunciation lamps, alarms, differential pressure indicator, timer, function selection switches, ball monitoring system processor, relays, protection and interlocking systems, start / stop push button etc., and shall be complete with internal wiring. The control panel shall meet the requirements of the enclosed specification.
- 3.13.03 Pressure guages shall be provided at recirculating pump suction and discharge. All instrumentation shall be of reputed make and shall meet the requirements of the enclosed specifications.
- 3.14.00 **Other Accessories.**
- 3.14.01 Counter flanges, complete with gaskets, bolts and nuts etc., shall be supplied for ball separator inlet, outlet connections and all other terminal points Fabrication, dimensions and drilling of the flanges shall conform to the codes/standards specified in



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

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

3.15.00 **Materials of Construction**

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

4.00.00 **PAINTING**

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

- a) Removal of oil, grease, dirt and swarf etc.
- b) Removal of rust and scale etc.
- c) Sand blasting / shot blasting.


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

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

5.00.00 **SHOP INSPECTION AND TESTS**

5.01.01 **General**

5.01.01 Manufacturer shall conduct all tests and stage inspections as per the approved

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

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

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

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

5.2.00 **Ball Separator**

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

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

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

5.03.00 **Ball Recirculating Pump**


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

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

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

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

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

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per ISO-1940

5.04.00 **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.



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

5.12.01 Smooth and free operation of all movable parts.

5.12.02 Interlock and sequential operation.

5.12.03 Satisfactory operations of ball monitoring system.

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

**6.00.00 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.



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

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

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

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

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

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

**A) Bid Evaluation Criteria & Liquidated Damages:**

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


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

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

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

7.03.00 **Other Guaranteed Parameters to be demonstrated at site**

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

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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.



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

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

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	<b>TITLE :</b> <b>DATA SHEET - C</b> <b>CONDENSER ON - LOAD TUBE CLEANING</b> <b>SYSTEM ( Sponge Rubber Ball Type )</b>	<b>SPECIFICATION NO. PE-TS-999-165-N001</b>	
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**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.

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

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

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

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

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



**TITLE :**  
DATA SHEET - C  
CONDENSER ON - LOAD TUBE CLEANING  
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- 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.

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TITLE : STANDARD TECHNICAL SPECIFICATION

DATA SHEET-A

CONDENSER ON - LOAD TUBE CLEANING  
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SECTION-D

REV. NO. 0

DATE: 04.06.2014

SL.NO PROJECT

IB THERMAL POWER STATION, BANHARPALI 2x660MW UNIT 3&4

1	<b>GENERAL</b>		
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	<b>DESIGN</b>		
2.1	Operating pressure at Condenser inlet flange	kg/cm <sup>2</sup> (g)	Approx 1.8 to 2.2
2.2	Design Pressure for ball separator	kg/cm <sup>2</sup> (g)	5.0 kg/cm <sup>2</sup> (g) & vacuum 0.1 kg/cm <sup>2</sup> (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	280	
	• Remaining	34720	
	e) Tube Dia. OD x Thickness		
	• Top two rows	mm x mm	22.225 x 0.889
	• Remaining	mm x mm	22.225 x 0.7112
	f) Length of tubes between ends.	mm	14730
	g) Tube material		SS: ASTM A 249 TP 304
	h) Pressure drop across condenser - At Normal flow (between Inlet and Outlet flanges of condenser)	MWC	3.15 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	37207
	- Maximum	cu.m/hr	44649
2.6	Design differential pressure for ball separator strainer/screen	Kg/cm <sup>2</sup> (g) 0.2	



TITLE : STANDARD TECHNICAL SPECIFICATION

DATA SHEET-A

CONDENSER ON - LOAD TUBE CLEANING  
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PROJECT

IB THERMAL POWER STATION, BANHARPALI 2x660MW UNIT 3&4

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	<b><u>CONNECTING PIPE DETAILS</u></b>		
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	<b><u>MATERIALS OF CONSTRUCTION</u></b>		
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		
a)	Casing		SA351CF8M
b)	Impeller		SS-316
c)	Shaft		SS-316
4.3	<b><u>BALL COLLECTOR</u></b>		
a)	Body / housing		SS
b)	Internals		SS-317L/ or equivalent/superior
c)	Site Glass Provision		Yes



TITLE : STANDARD TECHNICAL SPECIFICATION

DATA SHEET-A

CONDENSER ON - LOAD TUBE CLEANING  
SYSTEM ( Sponge Rubber Ball Type )

SPEC. NO. PE-TS- 391-165-N002

VOLUME : II B

SECTION-D

REV. NO. 0

DATE: 04.06.2014

SL.NO PROJECT

IB THERMAL POWER STATION, BANHARPALI 2x660MW UNIT 3&4

4.4	Differential pressure measuring system		SS-316
4.5	Injection nozzle		SS-316
4.6	Valves		
4.6.1	Gate/Globe/Check Valves (65 NB & Above)		For sizes 65 NB and above-Swing check type or dual plate type.
	a) Body & Bonnet/cover		IS 210, Gr. FG 260 or ASTM A126 class B.
	b) Trim/Disc		IS 210, Gr. FG 260 or ASTM A126 class B.
	c) Seating surface		13% Cr steel as per IS 1570.
4.6.2	Gate/Globe/Check Valves (50 NB & Below)		For size 50 NB and below-Piston type
	a) Body & Bonnet/cover		ASTM A 216 Gr. WCB for cast body & ASTM A-106 for forged body.
	b) Trim/Disc		13% Cr Steel as per ASTM A-182 Gr. F6 heat treated and hardened (min. 250HB) for cast body and ASTM A-105 Hard faced with Stellite (min. 350HB) for above 800 class and 250 HB for 800 class) for forged body.
	d) Seating surface		13% Cr steel as per A-182 Gr. F6.
4.6.3	<b>A) Ball valves</b>		
	i) Body		SA 351 CF8M
	ii) Ball		SA 351 CF8M
	iii) Stem		SS 316
4.7	Interconnecting Piping		By Bidder
	Material		a) SS-316
5	<b>COUNTER FLANGES for Ball Separator</b>		
a)	Flanges		Carbon Steel to IS 2062 Gr. B or eq for thickness, drilling etc refer Annexure II in section C1
	b) Fasteners		A 193 & A 194 (In Bidder's scope).
	c) Gaskets		Min 4 mm thick rubber
6	<b><u>OTHER COUNTER FLANGES (for interconnecting piping)</u></b>		In Bidder's scope



TITLE : STANDARD TECHNICAL SPECIFICATION

DATA SHEET-A

CONDENSER ON - LOAD TUBE CLEANING  
SYSTEM ( Sponge Rubber Ball Type )

SPEC. NO. PE-TS- 391-165-N002

VOLUME : II B

SECTION-D

REV. NO. 0

DATE: 04.06.2014

SL.NO

PROJECT

IB THERMAL POWER STATION, BANHARPALI 2x660MW UNIT 3&4

6.1	<b>MATERIALS</b>		
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	<b><u>PAINTING</u></b>		
8.1	<b>INTERNAL SURFACE</b>		
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	<b>EXTERNAL SURFACE</b>		
a)	Surface preparation		SA-2.5 of Swedish Specn.
b)	Primer		Two coat of Epoxy resin based zinc phosphate epoxy primer
a)	Intermediate		One coat of HB M10 epoxy
d)	Final paint		Two coats of synthetic enamel long oil alkyd to IS:2932 to achieve total DFT of 240 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



TITLE : STANDARD TECHNICAL SPECIFICATION

DATA SHEET-A

CONDENSER ON - LOAD TUBE CLEANING  
SYSTEM ( Sponge Rubber Ball Type )

SPEC. NO. PE-TS- 391-165-N002

VOLUME : II B

SECTION-D

REV. NO. 0

DATE: 04.06.2014

SL.NO

PROJECT

IB THERMAL POWER STATION, BANHARPALI 2x660MW UNIT 3&4

11.3	Bid evaluation rate		@ Rs. 6.0 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 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



TITLE : STANDARD TECHNICAL SPECIFICATION

DATA SHEET-A

CONDENSER ON - LOAD TUBE CLEANING

SYSTEM ( Sponge Rubber Ball Type )

SPEC. NO. PE-TS- 391-165-N002

VOLUME : II B

SECTION-D

REV. NO. 0

DATE: 04.06.2014

SL.NO

PROJECT

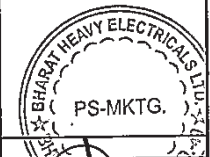
IB THERMAL POWER STATION, BANHARPALI 2x660MW UNIT 3&amp;4

	j) Whether the electronic processor of the ball monitoring system is provided with the following : i. Indicators for required basic ball charge ii. Indicators for recirculating ball quantity iii. Indicators for oversized ball quantity iv. Time counters for total cleaning system operating hours v. Time counters for cleaning system operating hours with sufficient no. of oversized balls vi. Recorders for ball consumption		YES
	k) Whether provision for self testing and self calibration are made		YES
13.0	Mandatory spares		
(i)	Mechanical	Complete set of Pump without motor- 1 set	
		Valve complete assembly- 10% of each type and size of total population or minimum 1 (one) no.)	
		Normal Sponge rubber balls & abrasive balls- for one year operation	
(ii)	C&I field instruments & PLC as applicable as per C&I list in Annexure-I		
(iii)	Electrical spares as applicable as per electrical list in Annexure-II		

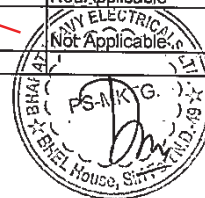
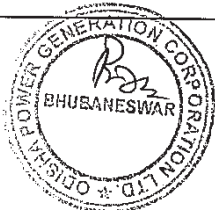
MANDATORY SPARES

ANNEXURE-I

Sl. No.	Equipment/Package Name	Quantity Required per unit*	Remarks (BHEL)
1.31	Toner for colour Laser Printer (for each type)	10 (ten) nos. each colour other than black & 20nos. black	
1.32	Memory Module/ EEPROM Chip	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.	Not applicable
1.33	Battery for RAM Backup	4 (four) nos.	Not applicable
1.34	Fuse: Card mounted type, PCB mounted type, Rack Power supply etc.	Each type of fuse, 25% of total nos. used in the system or minimum 25 nos. whichever is more.	
1.35	Terminal Block	10% of total nos. used in the system for each type and rating.	
<b>2 Large Video Screen</b>			
2.1	Lamp for Large Video Screen Display (DLP type)	15 (fifteen) nos.	
2.2	Video Input Card	1No. each type and model	
2.3	Video output Card	1No. each type and model	
2.4	Interfacing Module/components with DDCMIS	1No. each type and model	
<b>3 PLC System (for each system)</b>			
3.1	CPU Card	1No.	
3.2	Communication Processor Module	1No. for each type	
3.3	Binary Input Card	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.	
3.4	Pulse Input Card (if applicable)	10% of total nos. used in the system or minimum 2(two) nos. whichever is more.	
3.5	Analog Input Card (4 to 20 mA type)	10% of total nos. used in the system or minimum 2(two) nos. whichever is more.	
3.6	Analog Input Card (TC input type)	10% of total nos. used in the system or minimum 2(two) nos. whichever is more.	
3.7	Analog Input Card (RTD input type)	10% of total nos. used in the system or minimum 2(two) nos. whichever is more.	
3.8	Binary Output Card	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.	
3.9	Pulse output Card	1No.	
3.10	Analog Output Card (4 to 20 mA type)	10% of total nos. used in the system or minimum 2(two) nos. whichever is more.	
3.11	Interposing Realy	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.	
3.12	Output Relay modules/ Relay Board & Auxiliary Relay	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.	
3.13	I/O Communication Modules	1No. for each type	
3.14	Prefab-cable with connector for CPU, Communication Card and I/O modules	1No. for each type	
3.15	Networking Modules/Components/Switch	1No. for each type	
3.16	Power Supply Unit for CPU, Communication Card and I/O racks	10% of total nos. used in the system or minimum 2(two) nos. whichever is more for each type and rating.	
3.17	RAM Backup Battery	2 (two) nos.	
3.18	MCB	1No. for each type and rating	
3.19	Special Fuse for the Cards	Each type/rating of fuse, 25% of total nos. used in the system or minimum 25 nos. whichever is more.	
<b>3.20 MMI Unit</b>			
3.20.1	22" Monitor	1No.	
3.20.2	Key Board	1No.	
3.20.3	Mouse/ Trackball	1No.	
3.21	UPS for PLC system (Applicable for 1.5KVA rating or below. For high capacity UPS, refer Electrical List)	One Complete Set	
3.22	Micro PLC system (i.e. integrated CPU & I/O system, where above mentioned components are not applicable)	One Complete Set	



	UNIT	(QTY)
4 Field Instrument		To be supplied wherever applicable
4.1 Electronic Transmitters (Pressure, Differential Pressure, Level, Speed etc.) all types	1(One) no. complete set for each type and model/range used in the system	Pressure transmitters-1No
4.2 Switch (Pressure, Differential Pressure, Level, Flow, Temperature etc.)	1(One) no. of each type & model/range used in the system	Pressure Switch(0-10KG/SQCM)-1No-for APH Flow indicating switch(7-25LPM)-1No- for APH ON-OFF Switch-1No-for APH Go-Switch-1No for APH
4.3 Thermocouple	10% of each type and length of the total nos. used in the system or minimum 2(two) nos. whichever is more.	5No's-for APH
4.4 RTD	10% of each type and length of the total nos. used in the system or minimum 2(two) nos. whichever is more.	2No's-for APH 2No's-for Fans
4.5 Thermo-well for both TC and RTD	One no. for each type and rating/length used in the system	1No's-for APH
4.6 Solenoid Valve		
4.6.1 Complete Solenoid Valve Assembly	2Nos. for each type and rating used in the system	240V-1" AC type-2No's for APH application
4.6.2 Coil (single or double coil type)	10% of total nos. used in the system or minimum 5(five) Nos. whichever is more for each type and rating.	
4.7 Gauge (Pressure, Differential Pressure, Temperature, Level)	10% of total nos. used in the system or minimum 1(one) no. whichever is more for each type and range.	Pressure gauge with needle valve-1No
4.8 Air Filter Regulator complete set with pressure gauges	10Nos.	Filter Regulator lubricator-10No's
4.9 Rotameter	10% of total nos. used in the system or minimum 2(Two) nos. whichever is more for each type, rating, model and size used in the system.	
4.10. Gauge Glass	1No. for each type and size	Not Applicable
4.11 Erection Hardware		Not Applicable



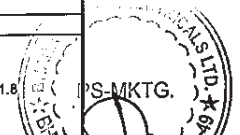
ANNEXURE-II

Sl. No.	Equipment/Package Name	Quantity for Two units	Remarks (BHEL)
6.11	Electrical		
6.11.1	Other Spares as applicable as per the Electrical List	Item & Quantity same as indicated in Electrical list 'B'	
6.11.2	UPS Spares as applicable as per the Electrical List	Item & Quantity same as indicated in Electrical list 'B'	
6.12	C&I Items		
6.12.1	Microprocessor control complete with MMI System	1 Set	
6.12.2	Field Instruments & Others as applicable as per the C&I List	Item & Quantity same as indicated in C&I list 'C'	
6.12.3	PLC system, if any	Item & Quantity same as indicated in C&I list 'C'	
6.13	Air Drying Unit (HOC Type)		
6.13.1	Ejector	1Set for each category of Compressor Dryer	
6.13.2	Steel drum	1Set for each category of Compressor Dryer	
6.13.3	Rotor	1Set for each category of Compressor Dryer	
6.13.4	Desiccant material	1lot	
6.13.5	Bearing	1Set for each category of Compressor Dryer	
6.13.6	Cooler Tube Bunch Assembly	1Set for each category of Compressor Dryer	
6.13.7	Regeneration line control valve	1Set for each category of Compressor Dryer	
6.13.8	Safety Valve	1Set for each category of Compressor Dryer	
6.13.9	Water Separator	1Set for each category of Compressor Dryer	
6.13.10	Electrical Spares as applicable as per the Electrical List	1Set for each category of Compressor Dryer	
6.13.11	Field Instruments & Others as applicable as per the C&I List	1Set for each category of Compressor Dryer	
7.0	Sump Pump		
7.1	Complete set with Level Switch & Motor	10% of the total quantity used in the system for each type and rating or	CONSIDERED IN CL. NO. III(1,2)
7.2	Annunciation System	Item & Quantity same as indicated in C&I list 'C'	

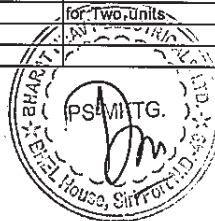
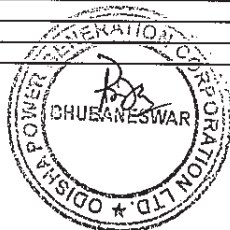
**B. Electrical Packages**

Sl. No.	Equipment/Package Name	Quantity Required per unit*	Remarks	Remarks (BHEL)
I	Electrical Items			
1.0	Generator Transformer (1f)			
1.1	Bushing			
1.1.1	HV	1No.		
1.1.2	HV Neutral	1No.		
1.1.3	LV	2Nos.		
1.2	Winding Temperature Indicator	2Nos.		
1.3	Oil Temperature Indicator	2Nos.		
1.4	Pressure Relief Device or Diaphragm for explosion Relief Vent	2Nos.		
1.5	Magnetic Oil Level Gauge	2Nos.		
1.6	Buchholz Relay	2Nos.		
1.7	Silica Gel Breather	2Nos.		
1.8	CT			
1.8.1	HV Neutral CT for Restricted Earth Fault	1No.		
1.8.2	HV Neutral CT for Standby Earth Fault	1No.		
1.8.3	HV Line CT for Restricted Earth Fault	1No.		
1.8.4	HV Line CT for Differential protection	1No.		
		2Nos		

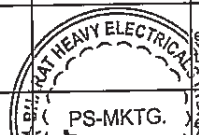
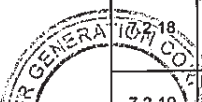
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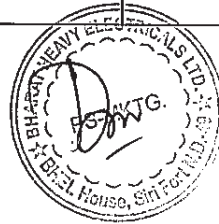
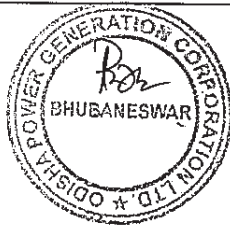
2.1.1	HV	2Nos.		
2.1.2	LV	2Nos.		
2.1.3	LV Neutral	2Nos.		
2.2	Winding Temperature Indicator	2Nos.		
2.3	Oil Temperature Indicator	2Nos.		
2.4	Pressure Relief Device or Diaphragm for explosion Relief Vent	2Nos.		
2.5	Magnetic Oil Level Gauge	2Nos.		
2.6	Buchholz Relay	2Nos.		
2.7	Silica Gel Breather	2Nos.		
2.8	Oil Surge Relay for OLTC	2Nos.		
2.9	LV CT			
2.9.1	LV Neutral CT for Restricted Earth Fault	1No.		
2.9.2	LV Neutral CT for Standby Earth Fault	1No.		
2.9.3	LV Line CT for Restricted Earth Fault	1No.		
3.0	<b>Reserve Auxilliary Transformer</b>			
3.1	Bushing			
3.1.1	HV	1No.		Since only 1 no RAT is offered, spares are offered for one unit only.
3.1.2	LV	1No.		
3.1.3	HV Neutral	1No.		
3.1.4	LV Neutral	1No.		
3.2	Winding Temperature Indicator	1No.		
3.3	Oil Temperature Indicator	1No.		
3.4	Pressure Relief Device or Diaphragm for explosion Relief Vent	1No.		
3.5	Magnetic Oil Level Gauge	1No.		
3.6	Buchholz Relay	1No.		
3.7	Silica Gel Breather	1No.		
3.8	Oil Surge Relay for OLTC	1No.		
4.0	<b>Auxiliary Power Transformers</b>			
4.1	<b>Bushing</b>			
4.1.1	<b>HV</b>	<b>2Nos.</b>		
4.1.2	<b>LV</b>	<b>2Nos.</b>		
4.1.3	<b>LV Neutral</b>	<b>2Nos.</b>		
4.2	<b>Winding Temperature Indicator</b>	<b>2Nos.</b>		
4.3	<b>Oil Temperature Indicator</b>	<b>2Nos.</b>		
4.4	<b>Pressure Relief Device or Diaphragm for explosion Relief Vent</b>	<b>2Nos.</b>		
4.5	<b>Magnetic Oil Level Gauge</b>	<b>2Nos.</b>		
4.6	<b>Buchholz Relay</b>	<b>2Nos.</b>		
4.7	<b>Silica Gel Breather</b>	<b>2Nos.</b>		
5.0	<b>LT Transformers</b>			
5.1	<b>Bushing</b>			
5.1.1	<b>HV</b>	<b>2Nos.</b>		
5.1.2	<b>LV</b>	<b>2Nos.</b>		
5.1.3	<b>LV Neutral</b>	<b>2Nos.</b>		
5.2	<b>Winding Temperature Indicator</b>	<b>2Nos.</b>		
5.4	<b>Pressure Relief Device or Diaphragm for explosion Relief Vent(for Oil type Transformers)</b>	<b>2Nos.</b>		
5.5	<b>Magnetic Oil Level Gauge(for Oil type Transformers)</b>	<b>2Nos.</b>		
5.6	<b>Buchholz Relay(for Oil type Transformers)</b>	<b>2Nos.</b>		
5.7	<b>Silica Gel Breather(for Oil type Transformers)</b>	<b>2Nos.</b>		
5.8	<b>Cooler fan (AN/AF)</b>	<b>2Nos.</b>		
6.0	<b>Bus Duct</b>			
6.1	<b>Generator Bus Duct</b>			
6.1.1	<b>Bus Bar Support Insulator</b>	<b>3Nos.</b>		
6.1.2	<b>Bolt Disconnet Link (single Phase) Rigid Type Complete with hardware rated for :</b>			
6.1.2.1	<b>Main Run &amp; Delta Run</b>	<b>2Nos.</b>		
6.1.2.2	<b>Tap-off</b>	<b>2Nos.</b>		
6.1.3	<b>Flexible Terminal Connetor (Single Phase) complete with hardware rated for:</b>			
6.1.3.1	<b>Generator end</b>	<b>2Nos.</b>		
6.1.3.2	<b>Generator Transformer</b>	<b>2Nos.</b>		
6.1.3.3	<b>Unit Transformer</b>	<b>2Nos.</b>		
6.1.4	<b>Main Run CTs (Line side)</b>			
6.1.4.1	<b>Generator Differential</b>	<b>1No.</b>	for Two units	
6.1.4.2	<b>Digital AVR System</b>	<b>1No.</b>	for Two units	
6.1.4.3	<b>Generator Metering</b>	<b>1No.</b>	for Two units	
6.1.4.4	<b>Backup Impedence Protection</b>	<b>1No.</b>	for Two units	
6.1.5	<b>Tap-off CTs</b>			
6.1.4.1	<b>Unit Transformer Differential</b>	<b>1No.</b>	for Two units	
6.1.4.2	<b>Backup Impedence Protection</b>	<b>1No.</b>	for Two units	
6.1.4.3	<b>Overall Differential</b>	<b>1No.</b>	for Two units	
6.1.6	<b>Voltage Transformer</b>	<b>2Nos.</b>	for Two units	
6.1.7	<b>Surge Capacitor</b>	<b>1No.</b>	for Two units	
6.1.8	<b>Lightning Arrestor</b>	<b>1No.</b>	for Two units	



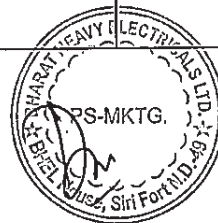
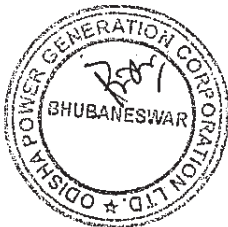
Sl. No.	Equipment/Package Name	Quantity Required per unit*	Remarks	Remarks (BHEL)
6.1.9	Seal-off Bushings for the rating			
6.1.9.1	Main Run & Delta Run	1No.		
6.1.9.2	Tap-off	1No.		
6.1.10	Expansion Bellows for the rating			
6.1.10.1	Main Run & Delta Run	1No.	for Two units	
6.1.10.2	Tap-off	1No.	for Two units	
6.2	11 KV & 3.3 KV Bus Duct			
6.2.1	Bus Support Insulator	15Nos.		
6.2.2	Flexible Terminal Connector (Single Phase) complete with hardware rated for:	3Nos each type and ratings	for Two units	
6.2.3	Wall Seal-off Bushing	1No each type and ratings	for Two units	
6.2.4	Expansion Bellows	1No each type and ratings	for Two units	
6.3	415 V Bus Duct			
6.3.1	Bus Support Insulator	10Nos.		
6.3.2	Aluminum Flexible	1 set for each type and Rating		
6.3.3	Copper Flexible	1 set for each type and		
6.3.4	Rubber (Neoprene Bellow)	1 set for each type and		
7.0	11 KV & 3.3 KV System			
7.2	11 KV & 3.3 KV Switch Gear			
7.2.1	Trip Coil	10% of the total number.		
7.2.2	Closing Coil	10% of the total number.		
7.2.3	Spring Charging Motor	5Nos.		
7.2.4	Spring Charging Motor with complete Mechanism	10% of total number of breakers		
7.2.7	Spring Charging Limit Switch	10Nos.		
7.2.6	Thermal Overload for Spring Charging Motor	3Nos.		
7.2.7	Breaker Complete Pole Assembly (Bottle)	3Sets (1set consists of 3nos.)		(set comprising 3 nos. each of C1 & Eaton VI)
7.2.8	Breaker Auxiliary (A & B) Contact Assembly	5Nos		
7.2.9	Breaker Auxiliary (C & D) Contact Assembly	5Nos		
7.2.10	Plug Socket with Prefab cable	5Nos		
7.2.11	Position Limit Switch	10Sets		
7.2.12	Surge Arrester	6Nos.		
7.2.13	Indicating Lamps complete assembly			
7.2.13.1	Red	10% of the total number.		
7.2.13.2	Amber	10% of the total number.		
7.2.13.3	Green	10% of the total number.		
7.2.13.4	Blue	10% of the total number.		
7.2.14	CT	1No. for each type and Rating	for Two units	Set comprising 1 no. each of assumed 15 types)
7.2.15	Transducer	5 Nos. for each type and Rating		
7.2.16	Breaker Control Switch			
7.2.16.1	Trip / Neutral / close Switch	5Nos. for each type and Rating		
7.2.16.2	Swgr / Trial / Normal Switch	5Nos. for each type and Rating		
7.2.16.3	AC Supply On / Off Switch	5Nos. for each type and Rating		
7.2.16.4	DC Supply On / Off Switch	5Nos. for each type and Rating		
7.2.16.7	Motor Heater On /Off Switch	1No. for each type and Rating		
7.2.16.8	DC Supply Source Selector Switch (3-position)	3Nos. for each type and Rating		
7.2.16.7	Ammeter Selector Switch	1 No. for each type and Rating		
7.2.16.8	Voltmeter Selector Switch	1 No. for each type and Rating		
7.2.17	Voltmeter	1 No. for each type and Rating		
	Ammeter	1 No. for each type and Rating		(Set comprising 1 no. each of assumed 15 types)
7.2.10	Breaker Jaw Contact ( Bus-end & Breaker- end) assembly	5Sets. for each type and Rating		(Set comprising 1 no. each of 3 types)



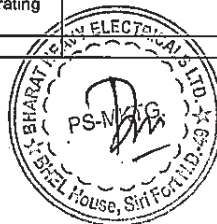
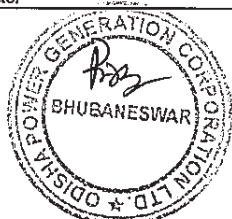
7.3	Energy Meter	1No. For each type & rating	for Two units	(Set comprising 1 no. each of assumed 15 types)
8.0	415V System			
8.1	Air Circuit Breaker			
8.1.1	Trip Coil	<u>10% of the total number.</u>		
8.1.2	Closing Coil	<u>10% of the total number.</u>		
8.1.3	Spring Charging Motor	3Nos.		
8.1.4	Spring Charging Motor with complete Mechanism	<u>10% of total number of breakers</u>		
8.1.5	Spring Charged Limit Switch	5Nos.		
8.1.6	Thermal Overload for Spring Charging Motor	3Nos.		
8.1.7	Breaker Contact			
8.1.7.1	Main Contact (Fixed and moving) assembly	5Sets for each type and rating		
8.1.7.2	Arcing Contact (Fixed and moving) assembly	5Sets for each type and rating		
8.1.7.3	Breaker Jaw Contact ( Bus-end & Breaker- end) assembly	5Sets. for each type and Rating		
8.1.7.4	Sliding Contact (Fixed & Moving)	3Sets.		
8.1.7.5	Breaker Auxiliary Contact Block	5Nos.		
8.1.8	Arcing Chute	3Sets for each type and rating		
8.1.9	Plug Socket with Prefab cable	5Nos		
8.1.10	Position Limit Switch	10Sets		
8.1.11	Indicating Lamps complete assembly			
8.1.11.1	Red	<u>10% of the total number.</u>		RED-15No's
8.1.11.2	Amber	<u>10% of the total number.</u>		AMBER-15No's,
8.1.11.3	Green	<u>10% of the total number.</u>		GREEN-15No's
8.1.11.4	Blue	<u>10% of the total number.</u>		BLUE-15No's
8.1.12	CT	1No. for each type and Rating	for Two units	
8.1.13	Transducer	5 Nos. for each type and Rating		
8.1.14	Breaker Control Switch			
8.1.14.1	Trip / Neutral / close Switch	5Nos. for each type and Rating		
8.1.14.2	Swgr / Trial / Normal Switch (Local/Remote)	5Nos. for each type and Rating		
8.1.14.3	AC Supply On / Off Switch	5Nos. for each type and Rating		
8.1.14.4	DC Supply On / Off Switch	5Nos. for each type and Rating		
8.1.14.5	Motor Heater On /Off Switch	1No. for each type and Rating		
8.1.14.6	DC Supply Source Selector Switch (3-position)	3Nos. for each type and Rating		
8.1.14.7	Ammeter Selector Switch	1 No. for each type and Rating		
8.1.14.8	Voltmeter Selector Switch	1 No. for each type and Rating		
8.1.15	Voltmeter	1 No. for each type and Rating		
8.1.16	Ammeter	1 No. for each type and Rating		
8.1.17	Auxiliary Control Contactor			
8.1.17.1	Auxiliary Control Contactor DC complete	5Nos.		
8.1.17.2	Auxiliary Control Contactor DC spare kits	10Nos.		
8.1.17.3	Auxiliary Control Contactor DC Coils	10Nos.		



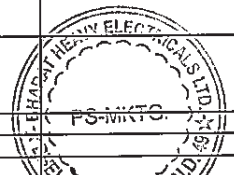
SI. No.	Equipment/Package Name	Quantity Required per unit*	Remarks	Remarks (BHEL)
9.2	PMCC/MCC/ACDB			AS APPLICABLE, CONSIDERED UNDER MRHS SPARES UNDER CL. I (28) OF Mechanical portion  Only applicable items under cl no 9.2 only will be offered. Applicable items are those which are installed in the system.
9.2.1	Contactor			
9.2.1.1	Power Contactor (AC)			
9.2.1.1.1	Power Contactor Complete Assembly	2Nos.for each type and rating		2 sets  (Each set comprises of 8A, 16A, 32A, 63A, 80A, 100A, 125A Contactors-3No's)
9.2.1.1.2	Power Contactor spare kits	5Sets for each type and rating		
9.2.1.1.3	Power Contactor AC Coils	5Nos. Coils for each type and rating		
9.2.1.2	Auxiliary Control Contactor (AC)			
9.2.1.2.1	Auxiliary Control Contactor Complete Assembly	20Nos.for each type and rating		20Set  (Each set comprises of 8A, 16A, 32A, 63A, 80A, 100A, 125A Contactors-3No's)
9.2.1.2.2	Auxiliary Control Contactor spare kits	25Setsfor each type and rating		
9.2.1.2.3	Auxiliary Control Contactor AC Coils	25Nos.for each type and rating		
9.2.2	MCCB (Power Circuit)	2Nos. for each type and rating		2Sets  (Each set comprises of 16A, 32A, 63A, 125 A, 315A, 320A, 400A-1No)
9.2.3	MCB (Control Circuit)	15Nos.for each type and rating		Not applicable
9.2.4	Switch			
9.2.4.1	Local / Remote Selector Switch	10Nos.		
9.2.4.2	MCCB Status (On/off) Monitoring Switch/Contact	5Nos.		
9.2.4.3	Trial / Normal /MCC Selector Switch	10Nos.		
9.2.4.4	MCC module Service Position Limit Switch	5Nos.		



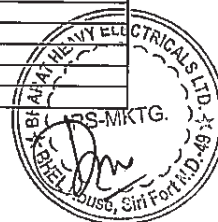
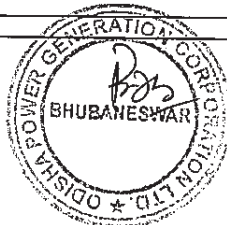
				2Sets
9.2.5	Thermal Overload Relay	2Nos. for each type and rating		1 Set Numerical relay for ACB. (1 Set comprises of 1.Over Current relay(51) 2.Earth fault relay(51N) 3.Under Voltage relay(27) 4.Fuse failure relay(98) 5.Antipumping relay(94) 6.Trip circuit supervision relay(95) 7.Trip annunciation relay(30A, B) 8.Lockout relay(86) 9.Check synchronization relay)
9.2.9	Sliding Contact (Fixed & Moving)	25Sets		
9.2.7	Bus bar to MCC module Lira Contact Assembly ( Bus-end & MCC Module-end)	5Sets for each type and rating		
9.2.8	Indicating Lamps complete assembly			
9.2.8.1	Red	20Sets		20Sets
9.2.8.2	Amber	20Sets		20Sets
9.2.8.3	Green	20Sets		20Sets
9.2.9	Push Button (On/Off) Complete Assembly	10Sets		
9.2.10	CT	1No.for each type and rating		
9.2.11	Ammeter	1No. for each type and rating		
9.2.12	Control Transformer	1No. for each type and rating		1No 415/240V -5KVA
9.2.13	Off Delay/ On Delay Timer	5Nos.for each type and rating		
9.2.14	Switch Fuse Unit	5Nos.for each type and rating		32/16A,32A/25A,6 3/32A,63/63A,125/ 100A,250/250A,40 0/400A Each 5 No's
9.2.15	Terminal Block			
9.2.15.1	Power Terminal Block	10% of total nos. for each type and rating used in the system		10No's (10 Various types of TB's )
9.2.15.2	Control Terminal Block	10% of total nos. for each type and rating used in the system		10No's (10 Various types of TB's )
9.2.15.3	End Plate for Power & Control Terminal Block	Each type 25Nos.		
9.3	Energy Meter	1No. For each type &rating	for Two unit	
10.0	DC Starter Panel/DCDB			Only scanner air fan DC starter box is applicable. Only applicable items under cl no 10 only will be offered. Applicable items are those which are installed in the system.
10.1	DC Power Contactor complete assembly	1No. for each type and Rating		
10.2	Power Contact Spare Kit	2Sets for each type and rating		
10.3	Coil for Power Contactor	2Nos.		
10.4	Control Contactor complete assembly	5Nos.		
10.5	Control Contact Spare Kit	5Sets for each type and rating		
10.6	Coil for Control Contactor	5Nos.		



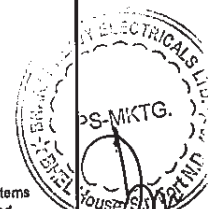
Sl. No.	Equipment/Package Name	Quantity Required per unit*	Remarks	Remarks (BHEL)
10.1	On/Off Delay Timer	1No. for each type and Rating		
10.8	Indicating Lamps complete assembly			
10.8.1	Red	3Sets		
10.8.2	Amber	3Sets		
10.8.3	Green	3Sets		
10.9	Push Button (On/Off) Complete Assembly	2Nos. for each colour		
10.10	MCCB	1No. for each type and Rating		
10.11	Power Fuse	3Nos. for each type and Rating		
10.12	Control Fuse	5Nos each type and rating		
10.13	Thermal Over Load Relay	1No. each type and rating		
10.14	Ammeter	1No. each type and rating		
10.15	Switch Fuse Unit	5Nos. for each type and rating		
	Any Electronic Components/PCB used in the system			
10.16	Terminal Block			
10.16.1	Power Terminal Block	10% of total nos. for each type and rating used in the system		
10.16.2	Control Terminal Block	10% of total nos. for each type and rating used in the system		
10.16.3	End Plate for Power & Control Terminal Block	Each type 25Nos.		
11.0	Protective Relaying system			
11.1	11 KV & 3.3 KV System			
11.1.1	Numerical Relay			
11.1.1.1	Feeder/Transformer Protection	2Nos. each type and rating		
11.1.1.2	Motor Protection	5Nos. each type and rating		
11.1.2	Conventional (Electromagnetic/Static type) Relay	10% for each type and rating or minimum one (1) no. whichever is more		
11.2	415V System			
11.2.1	Numerical Relay			
11.2.1.1	Feeder/Transformer Protection	2Nos. each type and rating		
11.2.1.2	Motor Protection	5Nos. each type and rating		
11.2.2	Conventional (Electromagnetic/Static type) Relay	10% for each type and rating or minimum one (1) no. whichever is more		
11.3	Generator Protection System			
11.3.1	Numerical Relay	10% for each type and rating or minimum one (1) no. whichever is more		
11.3.2	MCBs	2Nos. for each type	For two units	
11.3.3	Lockout relays, Auxiliary Relays, Interposing Relay,	2Nos. for each type	For two units	
11.3.4	Metrosil Surge Diveter	10% for each type and rating or minimum one (2) no. whichever is more	For two units	
11.3.4	Fuses	20% (round off to next higher digit with minimum 2 nos.) of each type and rating	For two units	
12.0	UPS (Main UPS for DCS System)			
12.1	Fuse	3 (Three) times of total quantity of each type of fuses used in the system (for Two Units)		
12.2	SCR	10% of total quantity of each type used in the system or minimum 2(two) nos. whichever is more.		
12.3	Diode	10% of total quantity of each type used in the system or minimum 2(two) nos. whichever is more.		
12.4	IGBT	2 (two) nos.		
12.5	Electronic Module/ PCB			
12.6	Static Switch	1 (one) no. each type of		



12.5.2	Inverter	1 (one) no. each type of Electronic Card/PCB/modules used in the system		
12.5.3	Static voltage Regulator	1 (one) no. each type of Electronic Card/PCB/modules used in the system		
12.5.4	Charger	1 (one) no. each type of Electronic Card/PCB/modules used in the system		
12.6	UPS Battery			
12.6.1	Battery Cell (Uncharged, Dry)	8 nos.		
12.6.2	Inter connecting cell strips	10 nos.		
12.6.3	Vent cap	10 nos.		
12.6.4	Hydrometer	1 no.		
12.6.5	Rubber gloves	1 pair		
12.6.6	Voltmeter for measuring cell voltage (Center zero type)	1 no.		
12.6.7	Funnel	1 no.		
12.6.8	Jug	1 no.		
12.6.12	Apron & Goggles	1 set		
12.6.10	Cell lifting puller	1 no.		
12.6.11	Insulated socket spanner with handle	1 no.		
12.6.12	Terminal screw with bellaville washer	5% of total quantity used	for Two units	
12.6.13	Plastic filling bottle	1 no.		
12.6.14	Thermometer	1 no.		
12.7	For other applicable items SI No.10 & 6 of this document shall be followed.			Not Applicable
12.6.12	Apron & Goggles	1 set		
12.6.10	Cell lifting puller	1 no.		
12.6.11	Insulated socket spanner with handle	1 no.		
12.6.12	Terminal screw with bellaville washer	5% of total quantity used	for Two units	
12.6.13	Plastic filling bottle	1 no.		
12.6.14	Thermometer	1 no.		
12.7	For other applicable items SI No.10 & 6 of this			Not Applicable
13.0	Control Panel/Desk Mounted Items			
13.1	Push Button			
13.1.1	Complete assembly	5Nos for each colour		
13.1.2	Contact Element (1NO + 1NC) Block	20Nos.		
13.2	Selector Switch	10Nos. for each type and		
13.3	Meter (Analog or Digital)			
13.3.1	Ammeter	1No. for each type and range		
13.3.2	Voltmeter	1No. for each type and range		
13.3.3	Frequency	1No. for each type and range		
13.3.4	MW	1No. for each type and range		
13.3.5	MVAR	1No. for each type and range		
13.3.6	Power Factor	1No. for each type and range		
13.3.7	Synchroscope	1No. for each type and range		
13.4	Indicating Lamps complete assembly	10Nos. for each Colour		
13.5	Mimic Lamps	10Nos. for each Colour		
13.6	MCB	2Nos. for each type and rating		
13.7	Door Limit Switch	2Nos.		
13.8	Annunciation system			
13.8.1	Lamp Box with Facia & Lamps (LED type)	25Nos.		
13.8.2	Hooter	1No.		
13.8.3	Each type of PCB (for non-PLC driven system)	1(one) no.		
14.0	Actuator			Applicable items under cl no 14 only will be offered. Applicable items are those which are installed in the system.
14.1	Complete set of Actuator	1No. for each type and rating	for Two unit	(1No. for each type and rating)
14.2	Limit Switch	2 Nos each type and rating		
14.3	Torque Switch	2 Nos each type and rating		
14.4	Auxiliary Contact	1 no each type and rating		
14.5	Motor	1 no each type and rating	for Two unit	
14.6	Complete Seal kit	1Set for each type and rating	for Two unit	
14.7	Complete O-Ring Set	1Set		
15.0	illumination			
15.1	Comptalux Lamp 100 W	10 nos.		
15.2	High Pressure Mercury Vapour Lamp 155W	20 nos.		
15.3	High Pressure Sodium Vapour Lamp 70W	100 nos.		
15.5	High Pressure Sodium Vapour Lamp 250W	20 nos.		
15.6	High Pressure Sodium Vapour Lamp 400W	10 nos.		
15.7	High Pressure Mercury Vapour Lamp 400W	20 nos.		
15.8	Ignitors (Separate type) for High Pressure Sodium	150nos.		
15.9	Ballast for 1 x 125 W High Pressure Mercury Vapour Lamp	15 nos.		
15.10	Ballast for 1 x 400 W High Pressure Mercury Vapour Lamp	15 nos.		
15.11	Ballast for 1 x 70 W High Pressure Sodium Vapour Lamp	150 nos.		
15.13	Ballast for 1 x 250 W High Pressure Sodium Vapour Lamp	25 nos.		

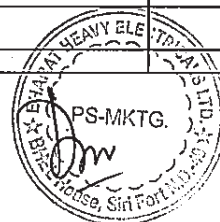
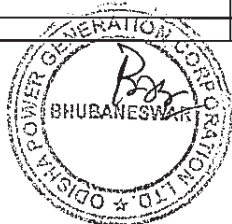


Sl. No.	Equipment/Package Name	Quantity Required per unit*	Remarks	Remarks (BHEL)
15.14	Ballast for 1 x 400 W High Pressure Sodium Vapour Lamp	25 nos.		
15.15	Capacitor for 1 x 125 W High Pressure Mercury	50 Nos.		
15.16	Capacitor for 1 x 400 W High Pressure Mercury Vapour	50 Nos.		
15.17	Capacitor for 1 x 70 W High Pressure Sodium Vapour Lamp	50 Nos.		
15.19	Capacitor for 1 x 250 W High Pressure Sodium Vapour	50 Nos.		
15.20	Capacitor for 1 x 400 W High Pressure Sodium Vapour	50 Nos.		
15.21	Clockswitch type Time Switch	25 Nos.		
15.22	Miniature Circuit Breakers (M.C. Bs)			
15.22.1	1-Pole 20 Amps.	20Nos.		
15.22.2	2-Pole 20 Amps.	10Nos.		
15.22.3	2-Pole 16 Amps.	10Nos.		
6.0	<b>Cable &amp; Accessories</b>			
16.1	11KV Grade HT Power Cable	500Mtrs of each type, size & rating of Cables	for Two units	
16.2	3.3KV Grade HT Power Cable	500Mtrs of each type, size & rating of Cables		
16.3	LT Power Cable	1(one)Km of each type, size & rating of Cables		
16.4	Control Cable	2(two)Km. of each type, size & rating of Cables		
16.5	Trailing Cable			Not Applicable
	Elevator	One set of full length of each size/type of cables as used for each type of Elevator	for Two units	
16.5.1				
	Electrical Hoist	One set of full length of each size/type of cables as used for each type of Electrical Hoist	for Two units	1 set for ESP
16.5.2				
16.6	Gland & lugs	20% of each type, size &		
17.0	<b>Neutral Grounding Resistor</b>			
17.1	Brown glazed Porcelain insulators for supporting between mounting frame and each Resistor Assembly	2 Nos.		Applicable items considered.
17.2	Interposing insulator assembly	2 Nos.		
17.3	Ceramic and Micanite insulator for supporting between	2 Nos.		
18.0	<b>DG Set</b>			
18.1	<b>Diesel Engine</b>			
18.1.1	Element Corrosion Resistor	8 nos.		if Applicable
18.1.2	Element lub oil Filter	8 nos.		
18.1.3	Element lub oil by pass Filter	8 nos.		
18.1.4	Element Fuel Filter	16 Nos.		if Applicable
18.1.5	Plate corrosion Resistor	16 Nos.		
18.1.6	Element Air cleaner outer	2 Nos.		
18.1.7	Element Air cleaner Inner	2 Nos.		
18.1.8	Fuel Oil Pump	1 No.		
18.1.9	Turbo-charger	2 Nos.		
18.1.10	Engine - starter Motor	1 No.		
18.1.11	Lub Oil Pump	1 No.		
18.1.12	Injector	2 Nos.		
18.1.13	Piston rings & liner set	16 Nos.		
18.2	<b>Alternator</b>			
18.2.1	Rotating Rectifiers (Diode)	4 Nos.		
18.2.2	Reference Voltage Adjuster	2 Nos.		if Applicable
18.2.3	Varistor	4 Nos.		if Applicable
18.2.4	Exciter PCB	2 Nos.		
18.2.5	AC Module	1 No.		if Applicable
18.3	<b>AMF Panel</b>			
18.3.1	Annunciation window	2 Nos.		
18.3.2	Electronic Timer	2 Nos.		Incl. in Sl. No. 18.3.1
18.3.3	Indicating Lamps	16 Nos.		ISG- Incl. in Sl. No. 18.3.1
18.3.4	Push Button	4 Nos.		Incl. in Sl. No. 18.3.1
18.4	For other applicable items Sl No.10 & 6 of this document shall be followed.	Item & Quantity same as indicated in Electrical list 'B' of Sl No.10 & 6		if applicable
19.0	<b>Plant 220V DC System &amp; Other DC system of Various Voltage Levels</b>			
19.1	<b>Battery</b>			
19.1.1	Battery Cell (Uncharged, Dry)	5 nos for each type and rating		
19.1.2	Inter connecting cell strips	5 nos for each type and rating		
19.1.3	Vent plug	5 nos		
19.1.4	Teak wood cable clamps with hardware	2 Nos.		
19.1.5	Hydrometer	1 No.		



Applicable items considered

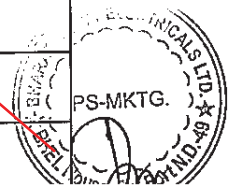
19.1.6	Rubber gloves	1 pair		are those which are installed in the system.  DD (24 V DC system) offered. 19.3 is not applicable
19.1.7	Voltmeter for measuring cell voltage (Center zero type)	1 no.		
19.1.8	Insulated socket spanner with handle	1 no.		
19.1.9	Thermometer	1 no.		
19.2	Float -cum- Boost Charger			
19.2.1	Fuses & fuse links	100% of total quantity for each type & rating of fuses used in the system		
19.2.2	SCR	2Nos. for each type and rating		
19.2.3	Diode	2Nos. for each type and rating		
19.2.4	Indicating lamps	4Nos.		
19.2.5	Electronic Module/ PCB/Card	1 (one) No. each type used in the system		
19.2.6	pulse transformer	1 set		
19.3	For other applicable items SI No.10 & 6 of this document shall be followed.	Item & Quantity same as indicated in Electrical list 'B' of SI No.10 & 6		
20	Motor			
20.1	HT Motor (other than BFP Motor)			
20.1.1	Driving End Bearing	1No. (or 1Set as applicable) for each type and rating of Motor		
20.1.2	Non-Driving End Bearing	1No. (or 1Set as applicable) for each type and rating of Motor		
20.1.3	Cooling Fan Internal & External	1Set for each type and rating of Motor		
20.1.4	Bearing Temperature Gauge Driving & Non-Driving End	1Set for each type and rating of Motor		
20.1.5	Phase-Segregated Terminal Box	1Set for each type and rating of Motor		
20.1.6	Neutral End Terminal Bushing with Fasteners	1No. for each type and rating of Motor		
20.1.7	RTD for Bearing Temperature	1No. for each type and rating of Motor		
20.1.8	Motor Space Heater	1No. for each type and rating of Motor		
20.1.9	Complete Set of Coupling	1Set for each Application		
20.2	BFP Motor			
20.2.1	HT Bushing	1Set		
20.2.2	Elastomould Jointing Kit	1Set		
20.2.3	Driving End & Non-Driving End Bearing	1Set		
20.2.4	Oil Seal Ring	1Set		
20.2.5	Bearing Temperature Gauge Driving & Non-Driving End	1Set		
20.2.6	RTD for Bearing Temperature	1Set		
20.2.7	Motor Space Heater	1Set		
20.3	415 Volt Motor (above 30KW Rating)			
20.3.1	End Shield Cover Driving & Non-Driving End	1Set for each type and rating of Motor		
20.3.2	Driving End & Non-Driving End Bearing	1Set for each type and rating of Motor		
20.3.3	Cooling Fan	1No. for each type and rating of Motor		
20.3.4	Motor Space Heater	1No. for each type and rating of Motor		
20.3.5	Motor Terminal Block	1No. for each type and rating of Motor		
20.3.6	Complete Set of Coupling	1Set for each Application		
20.4	415 Volt Motor (Upto 30KW Rating)			
20.4.1	Driving End & Non-Driving End Bearing	1Set for each type and rating of Motor		
20.4.2	Cooling Fan	1No. for each type and rating of Motor		
20.4.3	Motor Terminal Block	1No. for each type and rating of Motor		
20.4.4	Complete Set of Coupling	1Set for each Application		
20.5	D C Motors			
20.5.1	Carbon brushes	10 sets each type		
20.5.2	Brush assemblies	2 sets each type		
20.5.3	Terminal blocks	2 sets each type		
20.5.4	Heaters	2 sets each type		
20.5.5	Pulleys	2 sets each type		
20.5.6	Bearings (DE and NDE) for each type and rating of motor	4 sets		
21	Generator Circuit Breaker			




Sl. No.	Equipment/Package Name	Quantity Required per unit*	Remarks	Remarks (BHEL)
21.1	Support insulator of each type	10% of the total number.		Applicable items CONSIDERED. Applicable items are those which are installed in the system.
21.2	Circuit Breaker closing coil	1 no.		
21.3	Circuit Breaker trip coil	1 no.		
21.4	Breaker fixed contact (main & arcing)	1 sets each.		
21.5	Breaker moving contact (main & arcing)	1 sets each.		
21.6	SF6 Bottle	3 nos.		
21.7	Gas filling unit (for SF6 breaker)	1 no.		
21.8	CTs of different ratings (1 phase unit)	1 nos. each.		
21.9	VTs of different rating (1 phase unit)	1 nos. each.		
21.1	Disconnecting switch, earth switch, Start switch complete with operating mechanism (1 phase unit)	1 nos. each.		
21.11	Lightning arrester (1 phase unit)	1 nos. each.		
21.12	Surge capacitor (1 phase unit)	1 nos. each.		
21.13	Circuit Breaker complete operating mechanism	1 set		
21.14	Isolating switch, Selector switch, breaker control switch, position indicators, Contactor/ Relays, Push button.	10% of the total number, minimum 1 no. of each type		
21.15	Power and Control fuses / CIRCUIT BREAKERS of different ratings	10% of total quantity.		
21.16	Indicating lamp	10% of total quantity.		
21.17	Auxiliary Switch assembly	1 set each for CIRCUIT BREAKERS and switches		
	Total			

### C. Control & Instrumentation

Sl. No.	Equipment/Package Name	Quantity Required per unit*	Remarks (BHEL)
1	DDCMIS /MMIPIS Items		detailed item wise list meeting tender specification shall be furnished during detailed Egg stage.
1.1	Multifunction Processor (Controller) Unit	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.	
1.2	Binary Input Module	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.	
1.3	Binary Input Module for SOE Inputs (if applicable)	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.	Not applicable
1.4	Pulse Input Module (if applicable)	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.	Not applicable
1.5	Analog Input Module (4 to 20mA DC input type)	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.	
1.6	Analog Input Module (Thermocouple input type)	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.	
1.7	Analog Input Module (RTD input type)	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.	
1.8	Analog Output Module (4 to 20mA DC output type)	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.	
1.9	Pulse Output Module (if applicable)	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.	Not applicable




Manufacturer's Name & Address		STANDARD QUALITY PLAN		BHEL Doc No.:	
		INDEX	Vendor Q.P. NO.	PROJECT:	PE- V1 -XXX- 165-N008
			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					
DRY RUN TEST PROCEDURE FOR BALL SEPARATOR HYDRO STATIC TEST PROCEDURE LEAK TIGHTNESS TEST PROCEDURE PACKING PROCEDURE					
<b>LEGEND:</b> * Records identified 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		

Manufacturer's Name & Address		STANDARD QUALITY PLAN				BHEL Doc No.:	
Item : Ball Separator		Vendor Q.P. NO. PACKAGE : COLTCS				PROJECT :	
P.O. No.		Date :				CUSTOMER :	
Characteristics Checked		Page 02 of 15				PURCHASER :	
Class		Acceptance Norms				CONSULTANT :	
Type of Check		Form of Record				Agency	
3		6				M C O	
4		7				D' " 10	
5		8				Remarks	
6		9				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 sheet	Approved sheet
		Surface defects	Minor	Visual	100%	Approved sheet	Inspection report / Raw material flow sheet
		Sub Surface Defects	Major	Ultrasonic test	100%	ASME SA 435	Inspection report
[b]	Nozzle Pipes	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample/heat	Approved sheet	Inspection report / Lab test report/Raw material flow sheet
		Surface defects	Minor	Visual	100%	Approved sheet	Inspection report / Raw material flow sheet
		Leak Tightness	Major	Hydrostatic test	100%	Approved sheet	Inspection report / Raw material flow sheet
[c]	Main Flange	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample/cast & heat / batch	Approved sheet	Inspection report / Lab test report/Raw material flow sheet
		Heat treatment (Normalizing)	Major	Verification	HT Chart	Approved sheet	Manufacturer's Certificate
		Surface defects	Critical	Magnetic particle test	100%	Approved sheet	Inspection report
		Sub-surface defects	Critical	Ultrasonic test	100%	ASME SA609 / SA 435	Inspection report
[d]	Screen Shaft	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample/heat	Approved sheet	Inspection report / Lab test report/Raw material flow sheet
LEGEND		* Records identified with "STAR" shall be essentially included by contractor in QA Documentation.					
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		Indicate "P" - Perform, "V" - Witness and "V" - Verification					
Manufacturer / Sub-Contractor Signature		Contractor				Reviewed By	
						Name & Sign. Of approving authority & Seal	

Manufacturer's Name & Address		STANDARD QUALITY PLAN					BHEL Doc No.: PE-V1-XXX-165-N008	
P.O. No.		Item : Ball Separator		Vendor Q.P. NO. : COLTCS		PROJECT:		
Component / Operation		Date :		PACKAGE : COLTCS		CUSTOMER:		
Characteristics Checked		Reference Documents		Acceptance Norms		PURCHASER:		
Class		Quantum of Check		Page 03 of 15		CONSULTANT:		
Type of Check		Type of Check		Format of Record		Agency		
3		4		5		M C O		
3		4		5		D- 10		
1	Surface defects on machined area	Critical	Penetrant test	100%	ASME Sec.VIII Div.1 Appendix 8	Inspection report	* P V V	11
[e]	Sub-surface defects	Critical	Ultrasonic test	100%	ASME SA745	Inspection report	* P V V	
	Chemical properties & Physical Properties	Major	Chemical Analysis & Mechanical test	One sample / heat	Approved dig/Data sheet	Mil Test Certificate / Lab test report/Raw material flow sheet	* P V V	
	Corrosion Resistance	Major	ICC	One/heat	ASTM A 923	Test Report/Lab test report	* P V V	
	Surface Defects	Minor	Visual	100%	Approved dig/Data sheet	Inspection report/ Raw material Flow sheet	- P V V	
[f]	Ball Extraction Nozzle Pip (Duplex Stainless Steel)	Major	Chemical Analysis & Mechanical test	One sample / heat	Approved dig/Data sheet	Mil Test Certificate / Lab test report/Raw material flow sheet	* P V V	
	Surface Defects	Minor	Visual	100%	Approved dig/Data sheet	Inspection report/ Raw material Flow sheet	- P V V	
	Leak Tightness	Major	Hydrostatic Test	100%	Approved dig/Data sheet	Manufacturers Certificate	* P V V	
1.2.0	Inprocess Quality Control	Critical	Scrutiny	100%	ASME Sec IX	QW 482 of ASME Sec IX	* P V V	
1.2.1	Welding procedure specification	Critical	Physical test	100%	ASME Sec IX	QW 483 of ASME Sec IX	* P V V	Welding procedure already approved by BHEL/RGA/GJDN/VTVU shall be employed for this job.
1.2.2	Welding procedure qualification	Critical	Radiography	100%	ASME Sec IX	QW 484 of ASME Sec IX	* P V V	Welders already qualified by BHEL/RGA/GJDN/VTVU shall be employed for this job.
1.2.3	Welder performance qualification	Major	Template, visual	100%	Manufacturing Drawing	Log book	P WV -	BHEL to witness > 20mm thick butt joint
1.2.4	Fit-up of butt weld	Major	Template, visual	100%	Manufacturing Drawing	Log book	P -	
1.2.5	Fit-up of shell flange and nozzle assembly to shell	Major	Template, visual	100%	Manufacturing Drawing	Log book	P -	
		<b>LEGEND</b>						
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		C - Contractor / Contractor / O - Owner						
		Indicate 'P' - Perform, 'W' - Witness and 'V' - Verification						
Manufacturer / Sub-Contractor Signature		Contractor Signature						Reviewed By
								Name & Sign. Of approving authority & Seal

Manufacturer's Name & Address		STANDARD QUALITY PLAN				BHEL Doc No.:						
P.O. No.		Item : Ball Separator	Vendor Q.P. NO.:	PACKAGE : COLTCS	PROJECT:	PE-V1-XXX-165-N008						
Characteristics Checked		Quantum of Check	Reference Documents	Date :	PURCHASER:							
Class		Type of Check	Acceptance Norms	Page 04 of 15	CONSULTANT:							
3		4	7	8	M C O							
2		5	6	9	D' " 10							
1		6	7	8	11							
<b>Weld quality for Pressure Parts</b>												
1.2.6	Root run	Surface defects	Major	Penetrant test / Visual	100%	ASME Sec.VIII Div.1 Appendix 8	Operation Process Sheet	-	P	V	V	
1.2.7	Completed butt welds	1. Surface defects	Major	Penetrant test	100%	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 Appendix 47, UW 52	Radiographs & Inspection report	*	P	V	V	
		Surface defects	Major	Penetrant test	100%	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	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	Painting and Protection	Protection Layer	Major	Visual	100%	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	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	Inspection report	*	P	W	W	
<b>LEGEND</b>												
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Indicate : "P" - Perform, "W" - Witness and "V" - Verification												
Manufacturer / Sub-Contractor Signature		Contractor		Reviewed By		Name & Sign. Of approving authority & Seal						

Manufacturer's Name & Address		STANDARD QUALITY PLAN				BHEL Doc No.: PE-V1-XXX-165-N008	
P.O. No.		Item : Ball Separator		Vendor Q.P. NO.		PROJECT:	
Characteristics Checked		Reference Documents		Date:		CUSTOMER:	
Class		Quantity of Check		Acceptance Norms		PURCHASER:	
Type of Check		Format of Record		Agency		CONSULTANT:	
3		6		M C O		Remarks	
4		7		D** 10		11	
1.3.0	Rubber Lining for ball Separator Shell, V.Piece & skid IC Pipe.						
1.3.1	Tensile elongation and hardness Major	Physical test	One per lot	Manufacturer's procedure	Manufacturer's test certificate	P	V
	Polymer Identification	Flame test	One per lot	For Semi Ebonite	Inspection report	*	P
	% Change in weight after 24 hrs immersion in sea water at 70 degrees	Immersion test (bleeding test)	One per lot	Ebonite Polymer Ebonite catches fire, catches fire and On removal from fire & continues to burn	Inspection report	*	P
1.3.2	Surface preparation of items to be lined	Visual	100%	ASTM D 471	Inspection report	*	P
	Temperature, Pressure and time	Process monitoring	100%	SA 2.5	Manufacturer's inspection	P	-
1.3.3	Vulcanizing	Major	100%	Manufacturer's procedure	Process Procedure	P	-
1.3.4	Vulcanized rubber lined items	Major	One per lot	Approved drawing and 6374/Equivalent	Inspection report	*	P
	Adhesion, Visual defects, thickness and hardness	Measurement visual inspection	100%	Visual. Approved drawing and BS 6374/Equivalent	Inspection report	*	P
	Spark test for Pin holes at 5 kv/mm	Spark test for Pin holes	100%	Approved drawing and 6374/Equivalent	Inspection report	*	P
LEGEND							
* Records identified with "STAR" shall be essentially included by contractor in QA Documentation.							
-- M : Manufacturer / Manufacturer's Sub-contractor							
C : Contractor							
ID : Owner							
Indicate : "P" - Perform, "W" - Witness and "V" - Verification							
Manufacturer / Sub-Contractor Signature		Contractor Signature		Reviewed By		Name & Sign. Of approving authority & Seal	

Manufacturer's Name & Address		STANDARD QUALITY PLAN												
 P.O. No.		Item : WORM GEAR & ACTUATORS		Vendor Q.P. NO.		PACKAGE : COLTCS		BHEL Doc No. : PE- V1 -XXX- 165-N008		PROJECT :				
		Quantum of Check		Reference Documents		Date :		PURCHASER :		CONSULTANT :				
Sl. No.	Component / Operation	Class	Type of Check	Quantum of Check	Reference Documents	Approved Data Sheet	Accepted Data Sheet	Format of Record	Agency	M	C	O	Remarks	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.4.0	Complete Unit of Worm gear	Critical	Functional Test	100%	Approved Data Sheet	Manufacturer test certificate								
	Reduction Ratio	Critical	Functional Test	100%	Approved Data Sheet									
	Angle of Rotation													
	Input Torque													
	Output Torque													
	Degree of protection	Critical	Water & Dust Ingress tests	Type test	Approved Data Sheet	Type test certificate								
1.5.0	Actuators	Major	Electrical test	100%	Supplier catalogue ADS	Supplier catalogue / Manufacturer TC								
	Routine Test	Major	Electrical test	100%	Supplier catalogue ADS	Supplier catalogue / Manufacturer TC								
	Make, Range, Model	Major	Visual	100%	Supplier catalogue ADS	Supplier catalogue / Inspection Report								
	Assembly check alongwith ball valves	Major	Visual	100%	Supplier catalogue ADS	Supplier catalogue / Inspection Report								
	Functional check alongwith settings/auxiliary contacts	Major	Visual	100%	Supplier catalogue ADS	Supplier catalogue / Inspection Report								
Note: ADS - APPROVED DATA SHEET														
<b>LEGEND</b> * Records identified 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 Signature														
Reviewed By													Name & Sgn. Of approving authority & Seal	

Manufacturer's Name & Address		STANDARD QUALITY PLAN		BHEL Doc No.:									
P.O. No.		Vendor Q.P. NO:		PROJECT:									
Item : Ball Recirculation Skid & PACKAGE : COLTCS		Date : 07 of 15		PURCHASER:									
Ball Vessel		Page 07 of 15		CONSULTANT:									
Quantum of Check		Acceptance Norms		Agency									
3		7		M C D									
4		8		10									
5		9		11									
2.0.0	Complete Skid												
	Recirculating Skid with ball vessel, recirculation tank, and ball overage monitor	Major	Visual & Measurement	100%	Approved Drawing	Inspection report	*	P	V	V			
2.1.0	Ball Vessel												
	Sub-critical												
	Housing Shell, Nozzle flanges and dished end	Major	Chemical Analysis & Mechanical test	One sample/test	Approved sheet	MIT Test Certificate / Ish test report / raw material flow sheet	*	P	V	V			
	Surface defects	Minor	Visual	100%	Approved sheet	MIT Inspection report	*	P	V	V			
	Sub-surface defects	Major	Ultrasonic test	100%	ASME Sec IX-35	Inspection report	-	P	V	V	Plates > 20mm Thk only (UT - Full Volume)		
2.2.0	Inprocess Quality Control												
2.2.1	Welding procedure specification	Critical	Scrutiny	100%	ASME Sec IX	QW 482 of ASME Sec IX	*	P	V	V			
2.2.2	Welding procedure qualification	Critical	Physical test	100%	ASME Sec IX	QW 483 of ASME Sec IX	*	P	V	V	Welding procedure already approved by BHEL/RONG/JDN/VTVU shall be employed for this job.		
2.2.3	Welder performance qualification	Critical	Radiography	100%	ASME Sec IX	QW 484 of ASME Sec IX	*	P	V	V	Welders already qualified by BHEL/RONG/JDN/VTVU shall be employed for this job.		
2.2.4	Dished end for ball vessel	Major	Template	100%	Manufacturing Drawing	Inspection report	-	P	V	V			
	Surface defects	Critical	Penetrant test	100%	ASME Sec VIII DN-1 Appendix B	Inspection report	-	P	V	V			
		<b>LEGEND</b>											
		* Records identified with "STAR" shall be essentially included by contractor in QA Documentation.											
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		C - Contractor											
		Indicate "P" - Perform, "W" - Witness and "V" - Verification											
Manufacturer / Sub-Contractor Signature		Contractor				Reviewed By						Name & Sign. Of approving authority & Seal	



Manufacturer's Name & Address		STANDARD QUALITY PLAN		BHEL Doc No.:						
P.O. No.		Vendor Q.P. NO.		PROJECT:						
Item : RECIRCULATING PUMP		PACKAGE : COLTCS		CUSTOMER:						
Date :		PURCHASER:		CONSULTANT:						
Page 9 of 15		Agency		Remarks						
Acceptance Norms		Format of Record		D- 11-10						
Quantum of Check		8		9						
Reference Documents		7		10						
Type of Check		5		11						
Class		4								
Characteristics Checked		3								
2.3.0	Raw material control									
2.3.1	Casing	Chemical/Physical properties	Major	Chemical & Physical analysis	Approved dtp/ Data sheet	Manufacturer's Certificate	Test	P	V	
		Surface defects	Minor	Visual	Approved dtp/ Data sheet	MTC / Inspection report	Test	P	V	
2.3.2	Impeller, Sleeve	Physical and Chemical properties	Major	Physical and Chemical analysis	Approved dtp/ Data sheet	Manufacturer's Certificate	Test	P	V	
2.3.3	Shaft	Physical and Chemical properties	Major	Physical and Chemical analysis	Approved dtp/ Data sheet	Manufacturer's Certificate	Test	P	V	
		Sub-Surface defects	Major	Ultrasonic Test	ASME SA.745	MTC / Inspection report	Test	P	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)	Manufacturing Standard	Inspection report	Test	P	V	
2.3.6	Shaft	Surface defects	Critical	Penetrant test	ASME Sec.VIII Div.1 Appendix 8	Inspection report	Test	P	V	
2.3.7	Impeller	Residual static/dynamic imbalance	Major	Static/dynamic balancing	ISO:1940	Inspection report	Test	P	V	
2.3.8	All components	Workmanship, finish and dimensions	Major	Measurement, visual examination	Manufacturing drawing	Log book / job card	Test	P	-	
2.3.9	Assembly, control, final inspection / test									
	Performance Test	a) Q Va, Head, Q Va, Pumpa efficiency / Va, Power, Vibration and Noise	Critical	Performance test	Approved curve, approved sheet, IS 5120	Approved data sheet	Test	P	V	
		b) Dimensions, workmanship and finish	Major	Measurement, visual	Data sheet	Data sheet	Inspection report, plotted curves	Test	P	V
		c) Noise level	Major	-	-	85 db at 1 meter distance				
2.3.10	Complete pump	Completeness, correctness, cleanliness	Major	Visual examination	Approved data sheet / Mfg. Dwg.	Approved data sheet / Mfg. Dwg.	Check list / inspection report	Test	P	V
		<b>LEGEND</b>		* Records identified with "STAR" shall be essentially included by contractor in QA Documentation.						
		** M. Manufacturer / Manufacturer's Sub-contractor		C. Contractor / G. Owner						
		Indicate "P" - Perform, "W" - Witness and "V" - Verification		Reviewed By						
Manufacturer / Sub-Contractor Signature		Contractor Signature		Name & Sign. Of approving authority & Seal						

Manufacturer's Name & Address		STANDARD QUALITY PLAN					BHEL Doc No.:
P.O. No.		Item : BALL VALVES	Vendor Q.P. NO:	PACKAGE : COLTCS		PROJECT:	PE- V1 -XXX- 165-N008
Characteristics Checked		Quantum of Check	Reference Documents	Date : Page 10 of 15	Acceptance Norms	Format of Record	Remarks
1	2	3	4	5	6	7	8
2.4.0	Ball valves						
2.4.1	Materials						
	Body and Tail end pieces	Chemical & Physical analysis	Major	Chemical & Physical analysis	One Sample/Cast /heat	Approved drg/ Data sheet	Manufacturer's T.C.
2.4.2	Ball	Chemical/Physical properties	Major	Chemical & Physical analysis	One Sample/Cast /heat	Approved drg/ Data sheet	Manufacturer's T.C.
2.4.3	Stem	Chemical/Physical properties	Major	Chemical & Physical analysis	One Sample/Cast /heat	Approved drg/ Data sheet	Manufacturer's T.C.
2.4.4	In-process inspection						
2.4.5	Machining of body, end, pieces, ball	Dimension	Major	Measurement	100%	Approved drg/Data sheet	Log book
2.4.6	a) Surface defects	Critical		Penetrant test	100%	ASME Sec.VIII Div.1 Appendix 3	Inspection report
	b) Hardness	Major		Hardness testing	Random	Approved drg/Data sheet	Inspection report
2.4.7	Assembly	a) Dimensions	Major	Measurement	100%	EN ISO 17252	Manufacturer's T.C.
		b) Opening / Closing	Major	Operation	100%	As per approved data sheet	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 & Appd. Data sheet	Manufacturer's T.C.
	b) Seat test	Leakage	Critical	Hydraulic test	100%	EN 12266-1&2/API 598/ Appd data sheet & Appd. Data sheet	Manufacturer's T.C.
	c) Seat	Leakage	Critical	Air test	100%	EN 12266-1&2/API 598/ Appd data sheet & Appd. Data sheet	Manufacturer's T.C.
		LEGEND					
		* Records identified 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 Signature		Reviewed By			
				Name & Sign. Of approving authority & Seal			

Manufacturer's Name & Address		STANDARD QUALITY PLAN		BHEL Doc No.: PE-V1-XXX-165-N008							
P.O. No.		Vendor Q.P. NO:		PROJECT:							
Item : RECIRCULATING PUMP MOTOR		PACKAGE : COLTCS		CUSTOMER:							
V PIECE		Date :		PURCHASER:							
Page 11 of 15		Acceptance		CONSULTANT:							
Format of		Agency		Remarks							
Record		M C O		D* ** 10							
9		8		11							
1	2	3	4	5	6	7	8	9	10	11	
SI No.	Component / Operation	Characteristics	Class	Type of	Quantum of	Reference	Acceptance	Format of	Agency	Remarks	
		Checked		Check	Check	Documents	Norms	Record	M C O		
2.5.0	Motor	Routine test, No Load test & IR	Major	Electrical test	100% test	IS 325	IS 325	Manufacturer test Certificate	* P	V	Review of supplier TC
		Make, Rating	Major	Verification	100%	Appd dig/Data sheet	Appd dig/Data sheet	Inspection report	* V	V	
3.1.0	V - Piece	Degree of Protection	Critical	Verification	Type test	IP 55	IP 55	Manufacturer's test Certificate	* V	V	
	Raw material inspection	Chemical & Physical properties	Major	Chemical mechanical tests	One sample/test	Approved dig/Data sheet	Approved dig/Data sheet	Mill Test Certificate / lab test report / raw material flow sheet	* P	V	
	In process inspection	b) Surface defects	Major	Visual	100%	Approved dig/ Data sheet	Approved dig/ Data sheet	MTC / Inspection report	* P	V	
		c) Sub-surface defects	Critical	Radiography test	10% of total butt weld length	ASME Sec.VIII Div.1 Appendix 4	ASME Sec.VIII Div.1 Appendix 4	Radiographs and inspection report	* P	V	
		d) Hydro Static Test	Critical	Hydrostatic Pr. @ 1.5 times design pr (positive) (Duration 30 minutes)	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1	Inspection report	* P	V	
<p><b>LEGEND</b></p> <p>* Records identified with "STAR" shall be essentially included by contractor in QA Documentation.</p> <p>** M - Manufacturer / Manufacturer's Sub-contractor</p> <p>C - Contractor</p> <p>O - Owner</p> <p>Indicate "P" - Perform, "V" - Witness and "V" - Verification</p>											
Manufacturer / Sub-Contractor Signature									Reviewed By		Name & Sign. Of approving authority & Seal

Manufacturer's Name & Address		STANDARD QUALITY PLAN		Vendor Q.P. NO.:		BHEL Doc No.:		PROJECT:			
P.O. No.		Item : Ball Monitoring System (Ball Oversize Monitor)		PACKAGE : COLTCS		PE- V1 -XXX- 165-N008					
Component/ Operation		Type of Check		Date : Page 12 of 15		PURCHASER:		CONSULTANT:			
Class		Reference Documents		Norms		Format of Record		Agency			
Checked		Quantum of Check		Approved sheet		Record		M C O			
3		6		7		8		D' 10			
1	Raw Material Housing shell, Flanges	Chemical properties Major	Chemical Analysis	One sample/heat sheet	Approved sheet	dig/Data sheet	MI Test Certificate / lab test report/raw material flow sheet	* P	V	V	if fabricated type
4.1.0		Physical properties Major	Physical test	One sample / cast/heat/ batch	Approved sheet	dig/Data sheet	MI Test Certificate / lab test report/raw material flow sheet	* P	V	V	
		Surface defects Minor	Visual	100%	Approved sheet	dig/Data sheet	MI Test Certificate/inspection report	* P	V	V	
		Sub-surface defects Major	Ultrasonic test	100%	ASME SA-435	ASME SA-435	MI 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/RQA/GJDNVTUV shall be employed for this job.
4.2.3	Welder performance qualification	Weld soundness Critical	Radiography	100%	ASME Sec IX	ASME Sec IX	QW 484 of ASME Sec IX	* P	V	V	Welders already qualified by BHEL/RQA/GJDNVTUV shall be employed for this job.
4.2.4	Fabricated Shell	1. Surface defects (fret welds) Major	Penetrant test	100%	ASME Sec VIII DN-1 Appendix 6	ASME Sec VIII DN-1 Appendix 6	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 pressure (Duration 30 mins)	100%	ASME Sec VIII DN-1	No leakage	Inspection report	* P	W	V	Hydrostatic test shall be conducted alongwith Recirculating acid assembly
		4. Functional Test Major	Functional	100%	Approved procedure	Approved procedure	-	-	P	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											
Indicate "P" - Perform, "W" - Witness and "V" - Verification											
Manufacturer / Sub-Contractor Signature											
Contractor Signature											
Reviewed By											
Name & Sign. Of approving authority & Seal											

Manufacturer's Name & Address		STANDARD QUALITY PLAN				BHEL Doc No.: PE-VI-XXX-165-N008				
P.O. No.		Vendor Q.P. NO:		PROJECT:		CUSTOMER:				
Item : Pressure Gauge, DP Gauge, DP Switch, DP Transmitter		PACKAGE : COLTCS		PURCHASER:		CONSULTANT:				
Date :		Date :		Date :		Date :				
Cleaning Balls		Page 13 of 15		PACKAGE : COLTCS		Remarks				
Sl. No.	Component / Operation	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	Agency	Remarks	
1		4	5	6	7	8	9	M C O		
								** 10	11	
5.0.0	In process quality control	Make, Range and Model	Visual	100%	Approved Sheet	Approved Data Sheet	Manufacturer test certificate	* P V V		
		Calibration	Calibration test	100%	Approved Sheet	Approved Data Sheet	Manufacturer test certificate	* V V V		
		Degree of Protection	Critical	Type, Test Certificate	Approved Sheet	Approved Data Sheet	Manufacturer test certificate	* V V V	For Pressure gauge, DP Gauge, DP Switch	
6.0.0	Cleaning Balls									
		Dimensions	Critical	Random	Approved Data Sheet	Approved Data Sheet	Manufacturer's test certificate	* P V V	Quality and type of balls to be checked with datasheets	
		Type Size	Measurement							
7.0.0	All Components / Equipments	Painting Dry film thickness and visual	Major	Random	Painting schedule	Painting schedule	Inspection report	* P V V		
		Painting	Major	100%	MFG. Procedure	MFG. Procedure	Inspection report	* P V -		
<p><b>LEGEND</b></p> <ul style="list-style-type: none"> <li>- Records identified with "STAR" shall be essentially included by contractor in QA Documentation</li> <li>* Manufacturer / Manufacturer's Sub-contractor</li> <li>C - Contractor</li> <li>O - Overall</li> <li>Indicate : P - Perform, W - Witness and V - Verification</li> </ul>										
Manufacturer / Sub-Contractor Signature								Reviewed By		Name & Sign. Of approving authority & Seal

BHEL Logo		Manufacturer's Name & Address			STANDARD QUALITY PLAN			BHEL Doc No.:		
P.O. No.		Item : Starter Panel			Vendor Q.P. NO.			PROJECT:		
P.O. No.		Reference Documents			Date :			CUSTOMER:		
P.O. No.		Quantum of Check			Page 14 of 15			PURCHASER:		
P.O. No.		Type of Check			Acceptance Norms			CONSULTANT:		
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**TITLE : TECHNICAL SPECIFICATION  
FOR  
CONDENSER ON LOAD TUBE CLEANING  
SYSTEMS (COLTCS)**

**SPEC. NO. PE-TS- 391-165-N002**

**VOLUME : IIB**

**SECTION : D**

**REV. NO. 0**

**DATE : 04.06.2014**

**SHEET 1 of 1**

**SECTION D2  
STANDARD TECHNICAL SPECIFICATION  
FOR  
ELECTRICAL SYSTEMS**



TITLE :  
**GENERAL TECHNICAL REQUIREMENTS**  
  
**FOR**  
  
**LV MOTORS**

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

**GENERAL TECHNICAL REQUIREMENTS**

**FOR**

**LV MOTORS**

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



TITLE :  
**GENERAL TECHNICAL REQUIREMENTS**  
  
**FOR**  
  
**LV MOTORS**

SPECIFICATION NO.  
PE-SS-999-506-E101  
VOLUME NO. : **II-B**  
SECTION : **D**  
REV NO. : **00** DATE : 29/08/2005  
SHEET : 1 OF 4

## 1.0 INTENT OF SPECIFICATION

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

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

## 2.0 CODES AND STANDARDS

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

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

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

## 3.0 DESIGN REQUIREMENTS

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

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

### 3.3 Starting Requirements

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

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



TITLE :  
**GENERAL TECHNICAL REQUIREMENTS**  
  
**FOR**  
  
**LV MOTORS**

SPECIFICATION NO.  
PE-SS-999-506-E101  
VOLUME NO. : **II-B**  
SECTION : **D**  
REV NO. : **00** DATE : 29/08/2005  
SHEET : 2 OF 4

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

3.3.3 The following frequency of starts shall apply

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

#### 3.4 **Running Requirements**

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

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

#### 3.5 **Stress During bus Transfer**

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

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

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

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


#### 4.0 **CONSTRUCTIONAL FEATURES**

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

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

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

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

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

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



TITLE :  
**GENERAL TECHNICAL REQUIREMENTS**  
  
**FOR**  
  
**LV MOTORS**

SPECIFICATION NO.  
PE-SS-999-506-E101  
VOLUME NO. : **II-B**  
SECTION : **D**  
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SHEET : 4 OF 4


- 4.9.1 Motors provided for similar drives shall be interchangeable.
- 4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.
- 4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.
- 4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.
- 4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.
- 4.9.6 Name plate with all particulars as per IS: 325 shall be provided
- 4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.

#### 5.0 INSPECTION AND TESTING

- 5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.
- 5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.
- 5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.
- 5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.

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

- a) OGA drawing showing the position of terminal boxes, earthing connections etc.
- b) Arrangement drawing of terminal boxes.
- c) Characteristic curves:  
*(To be given for motor above 55 kW unless otherwise specified in Data Sheet).*
  - i) Current vs. time at rated voltage and minimum starting voltage.
  - ii) Speed vs. time at rated voltage and minimum starting voltage.
  - iii) Torque vs. speed at rated voltage and minimum voltage.  
For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.
  - iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.

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



**QUALITY PLAN**

SHEET 2 OF 2

CUSTOMER :

PROJECT

SPECIFICATION :

BIDDER/ :

TITLE

NUMBER :

VENDOR

QUALITY PLAN  
NUMBER PED-506-00-Q-006, REV-01

SPECIFICATION :

SYSTEM

ITEM AC ELECT. MOTORS BELOW 55KW (LV)

SECTION

VOLUME III

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



**QUALITY PLAN**

SHEET 1 OF 9

CUSTOMER :

BIDDER/ VENDOR :

SYSTEM

PROJECT

TITLE

QUALITY PLAN

NUMBER PED-506-00-Q-007, REV-03

ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)

SPECIFICATION :

NUMBER :

SPECIFICATION :

TITLE

SECTION

VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.0	RAW MATERIAL & BOUGHT OUT CONTROL											
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	2	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVENT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	2	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVENT IS/	SUPPLIER'S TC	3	-	2	HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S M DRG.	ANUFR'S DRG.	LOG BOOK	3	-	2	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	2	
<b>BHEL</b>			<b>PARTICULARS</b>			<b>BIDDER/VENDOR</b>						
			<b>NAME</b>									
			<b>SIGNATURE</b>									
			<b>DATE</b>						<b>BIDDER'S/VENDORS COMPANY SEAL</b>			



**QUALITY PLAN**

SHEET 2 OF 9

CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

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



**QUALITY PLAN**

CUSTOMER :

PROJECT

SPECIFICATION :

BIDDER/ VENDOR :

QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03

NUMBER :  
SPECIFICATION :  
TITLE

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SYSTEM

ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)

SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.  2. OTHER CHARACTERISTICS	MA  MA	VISUAL  TEST	100%  SAMPLE	-  MANUF'S SPEC.	NO VISUAL DEFECTS  MANUF'S SPEC.	INSPT. REPORT  LOG BOOK AND OR SUPPLIER'S TC	3  3	-  -	2  2	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.  2. DIMENSIONS INCLUDING BURS HEIGHT  3. ACCEPTANCE TESTS	MA  MA  MA	VISUAL  MEASUREMENT  ELECT. & MECH TESTS	100%  SAMPLE  -DO-	-  MANUFR'S DRG. .  MANUF'S SPEC./ RELEVANT IS	NO VISUAL DEFECTS (FREE FROM BURS)  MANUFR'S DRG.  RELEVANT IS	LOG BOOK  -DO-  SUPPLIER'S TC	3  3  3	-  -	-  2  2	
1.9	CONDUCTORS	1. SURFACE FINISH  2. ELECT. PROP, & MECH. PROP	MA  MA	VISUAL  ELECT. & MECH. TEST	100%  SAMPLES	-  RELEVANT IS/ BS OR OTHER STANDARDS	FREE FROM VISUAL DEFECTS  RELEVANT IS/ BS OR OTHER STANDARDS	LOG BOOK  SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3*  3	-  -	2*  2	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY BHEL/CUSTOMER.
<b>BHEL</b>			<b>PARTICULARS</b>			<b>BIDDER/VENDOR</b>						
			<b>NAME</b>									
			<b>SIGNATURE</b>									
			<b>DATE</b>			<b>BIDDER'S/VENDORS COMPANY SEAL</b>						



**QUALITY PLAN**

SHEET 4 OF 9

CUSTOMER :

BIDDER/ VENDOR :

SYSTEM :

PROJECT TITLE

QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03

ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)

SPECIFICATION :

NUMBER :

SPECIFICATION : TITLE

SECTION VOLUME III

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



**QUALITY PLAN**

SHEET 5 OF 9

CUSTOMER :

PROJECT

SPECIFICATION :

BIDDER/ :

TITLE

NUMBER :

VENDOR

QUALITY PLAN

SPECIFICATION :

SYSTEM

NUMBER PED-506-00-Q-007, REV-03

TITLE

ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)

SECTION VOLUME III

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



**QUALITY PLAN**

SHEET 6 OF 9

CUSTOMER :

PROJECT TITLE

SPECIFICATION : NUMBER :

BIDDER/ VENDOR

QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03

SPECIFICATION : TITLE

SYSTEM

ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)

SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-	(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-	
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1	
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC. SPEC. SPEC.	MANUFR'S SPEC. /BHEL	Log Book	2	-	-	
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	FOR MV MOTOR		
2.6	IMPREGNATION	1.VISCOSITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-	
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-	
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	THREE DIPS TO BE GIVEN
<b>BHEL</b>			<b>PARTICULARS</b>		<b>BIDDER/VENDOR</b>							
			<b>NAME</b>									
			<b>SIGNATURE</b>									
			<b>DATE</b>					<b>BIDDER'S/VENDORS COMPANY SEAL</b>				



**QUALITY PLAN**

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CUSTOMER :

PROJECT

SPECIFICATION :

BIDDER/  
VENDOR

QUALITY PLAN  
NUMBER PED-506-00-Q-007, REV-03

NUMBER :  
SPECIFICATION :  
TITLE

SYSTEM

ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)

SECTION

VOLUME III

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



**QUALITY PLAN**

SHEET 8 OF 9

CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE		
SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC.	MA	ELECT.TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	2	1*	1	* NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 <sup>s</sup>	1	<sup>s</sup> NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1 <sup>s</sup>	1	<sup>s</sup> NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 <sup>s</sup>	1	<sup>s</sup> NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 <sup>s</sup>	1	<sup>s</sup> NOTE - 2
		8. NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1 <sup>s</sup>	1	<sup>s</sup> NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1 <sup>s</sup>	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY <sup>s</sup> NOTE - 2

<b>BHEL</b>			<b>PARTICULARS</b>			<b>BIDDER/VENDOR</b>					
			NAME								
			SIGNATURE								
			DATE						BIDDER'S/VENDORS COMPANY SEAL		



**QUALITY PLAN**

SHEET 9 OF 9

CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11

NOTES:

- 1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.
- 2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON.
- 3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED.
- 4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.

Legends for Inspection agency

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

- P. PERFORM  
W. WITNESS  
V. VERIFY

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



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

**SPEC. NO. PE-TS- 391-165-N002**

**VOLUME : IIB**

**SECTION : D**

**REV. NO. 0**

**DATE : 04.06.2014**

**SHEET 1 of 1**

**SECTION D3  
STANDARD TECHNICAL SPECIFICATION  
FOR  
C&I SYSTEMS**

## **2.0.0**

### **MEASUREMENT & CONTROL SPECIFICATION**

#### **2.1.0 GENERAL TECHNICAL REQUIREMENTS**

#### **2.2.0 SPECIFICATION OF PLC SYSTEM**

#### **2.3.0 MEASURING INSTRUMENTS**

#### **2.4.0 INSTRUMENT STUB DETAILS & INSTALLATION DIAGRAMS**


#### **2.5.0 MEASUREMENT & CONTROL PHILOSOPHY**

#### **2.6.0 CODES & STANDARDS**

#### **2.7.0 KKS PHILOSOPHY**

## **2.1.0**

### **GENERAL TECHNICAL REQUIREMENTS**

	<b>SPECIFICATION FOR CONTROL &amp; INSTRUMENTATION FOR AUX PACKAGES</b>	SPECIFICATION NO.:	
		VOLUME	
		SUB SECTION	
		REV. NO.	DATE :
		SHEET	OF

**GENERAL REQUIREMENT**

- 1.0 Bidder shall provide complete and independent control & instrumentation system with all accessories, auxiliaries and associated equipments for the safe, efficient and reliable operation of auxiliary systems.
- 2.0 The quantity of instruments for auxiliary system shall be as per tender P & ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price implication.
- 3.0 Measuring instruments/equipment and subsystems offered by the bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further all the instruments shall be of proven reliability, accuracy, and acceptable international standards and shall be subject to employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specification, ranges, makes/ numbers as approved by the employer' during detail engineering.
- 4.0 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/ erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments; sensors, switches etc for external connection including spare contacts shall be wired out to suitably located junction boxes.
- 5.0 The customer specification attached as Specific Technical Requirement will supercede the Data sheets, if there is any mismatch.

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4.00.03 Seller shall furnish all required information to fully satisfy Buyer regarding successful operation and high reliability of products / systems furnished.

4.00.04 "maxDNA" based DDCMIS is already installed in the existing units of OPGC's IB TPP. To optimize inventory and for system experts, Buyer prefers for maxDNA DDCMIS system for the proposed 2X660 MW units.

5.00.00 **WARRANTY**

5.00.01 ~~The Bidder shall provide an unlimited warranty on all equipment and software for one year after the start of the warranty period, i.e. after satisfactory completion of initial operations. This warranty shall include repair, replacement or correction of identified software or hardware discrepancies at no cost.~~



5.00.02 No repairs / replacement shall normally be carried out by the Buyer except under the direct supervision and responsibility of Seller's Technical Advisors when the plant is under the supervision of Seller's supervisory engineers. If in the event of any emergency, in the judgment of the Buyer, delay would cause serious loss or damage, repairs may be made by the Buyer or a third party chosen by the Buyer without advance notice to the Seller and the cost of such work shall be paid by the Seller.

5.00.03 In case of any hardware failure which hampers normal operation, the Seller during the warranty period must provide on-site technical expertise to repair/rectify the problem within a week ~~and if any component is not available at site, the Bidder must arrange to supply these components at site within another 48 hours. If a software problem is identified, this problem shall be corrected within one week.~~



5.00.04 Prior to substantial completion, the Seller shall provide the list of parts and expandable utilized for the period in DDCMIS operation. During the FAT of DDCMIS the Seller shall demonstrate the utilization and expandability and the same shall be ascertained as part of Capability test.

5.00.05 The Seller shall depute and/or station additional specialist to rectify the problem to ensure 99.7% availability of system.

6.00.00 **DESIGN CRITERIA**

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

6.01.00 **GENERAL**



6.01.01 Instrumentation, control and automation shall be designed, manufactured and installed taking into consideration the philosophy to satisfy the following requirements:

- a) State-of-the-art proven technology.
- b) Maximum safety for plant personnel & equipment.



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- c) Reliable and efficient operation under all operating condition.
- d) High system availability by introduction of adequate redundancies at various levels and low down time.
- e) Diagnostics capability to pinpoint failure areas.
- f) Integrated control & information processing and handling capability to help operators and management levels of the plant to make accurate and effective operating decisions to run the units in optimum and fuel-efficient regimes.
- g) Uniformity of instrumentation, control and automation including high degree of simplicity, operability and maintainability.
- h) Use of public domain software and hardware for easy up gradation.
- i) System flexibility and modular expansion capability. Modular System design shall be adopted to facilitate easy system expansion. The system shall have the capability and facility for hardware expansion through the addition of controller modules, I/O cards, peripherals like Large Video Screen (LVS), operator workstations (OWS), printers etc., while the existing system is fully operational. The system shall have the capability to add any new control loops, groups/subgroups in control system, while the existing system is fully operational.

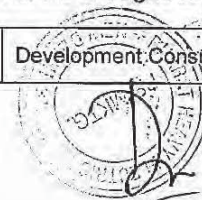
6.01.02 All instrumentation, control and automation devices and accessories shall be designed with the following considerations:


- a) Stable in spite of temperature fluctuations.
- b) Able to withstand high humidity.
- c) Weather proof.
- d) Dust proof.
- e) Corrosion resistant.
- f) Erosion resistant.
- g) Able to withstand high vibration.
- h) Easily accessible for operation & maintenance.

6.01.03 All parts subject to high pressure, temperature or other severe duty shall be of materials and construction suitable for the service conditions and long operating life.

6.01.04 Components of instruments, control devices, accessories, piping etc. which contact steam, condensate or boiler feed water shall be manufactured from copper-free materials.

6.01.05 Latest version of hardware and software available at the time of system designing shall be provided. In case of future up-gradation of software, Seller shall remain committed to upgrade the supplied system with the new version within the warranty period. Beyond the warranty period and during the remaining life of the plant, any up gradation in hardware and software shall be brought to the notice of



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Buyer and shall indicate whether it shall be possible to upgrade the system by replacing certain pieces/components of hardware / software.

- 6.01.06 Seller shall ensure that supplied controls & instruments should be supported by the supplier such that spare parts are guaranteed to be available for purchase for a period of 10 (Ten) years. Similarly the service shall also be guaranteed for a period of 10 (Ten) years.
- 6.01.07 NOT IN USE
- 6.01.08 Instrumentation & Control System envisaged shall be adequate for control & monitoring of significant variables, in accordance with the requirements of the process, to meet all operational requirements and provide safety controls needed for the plant and auxiliaries. Any improvement in system design beyond what has been specified may be accepted provided the project schedule and the functional and operational requirements of the plant remain unaffected.
- 6.01.09 For the sake of completeness of the system for each application and in order to ensure desired performance & safety measures, any hardware or software item as required, shall be in the scope of Seller irrespective of their explicit or implicit inclusion in the accompanying document. Seller shall be responsible for proper functioning of the system as a whole or any part thereof and shall render guarantee for all addition/deletion.
- 6.01.10 DDCMIS & PLC systems shall have their independent redundant Electronic Earth pits for system grounding. These earth pits shall be separate from the Electrical earth pits and located away from the HT equipments. Panel AC safety ground / Protection earth shall be connected to the Station Electrical earth Pit. Complete supply of above shall be in BTG scope whereas erection shall be in BOP scope.
- 6.01.11 Technical details furnished in the accompanying documents which are subject to change in future within reasonable limits which Seller shall abide by.
- 6.02.00 **STANDARDIZATION AND UNIFORMITY OF HARDWARE**

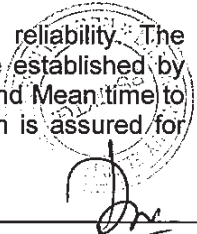
To ensure smooth and optimal maintenance, easy interchangeability and efficient spare parts management of various I&C instruments / equipment, the Seller shall **ensure make reasonable efforts** that all instruments / devices are of the same make, series and family of hardware. For example, all 4-20mA electronic transmitters / transducers, control hardware, control valves, actuators and other instruments / local devices etc. being furnished by the Seller for steam generator, turbine generator and other auxiliaries shall be of the same make and series for similar applications, except for the instrument integral to equipment such as SG, TG, BFP, Compressor etc. which may be manufacturer specific.



6.03.00 **RELIABILITY & AVAILABILITY**



All components and systems offered shall be of established reliability. The minimum target reliability of each component / module shall be established by taking into consideration its Mean time between failure (MTBF) and Mean time to repair (MTTR), such that the availability of the complete system is assured for 99.7%.



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- 6.03.02 In order to establish the target reliability Seller shall perform necessary availability tests ~~and burn-in tests~~ for major systems. **Burn-in / Elevated Temperature tests-reports, not older than 5 (five) years shall be furnished for Buyer / Consultant review.** Surge protection for solid state systems, selection of proper materials, manufacturing processes, quality controlled components and parts, adequate derating of electronic components and parts shall be ensured to meet the reliability and life expectancy goals.
  - 6.03.03 Redundancy and continuous self-checking features shall be incorporated in system design with automatic transfer to healthy redundant circuits to enhance the reliability of the complete system.
  - 6.03.04 The Seller shall submit typical detailed reliability calculations as per OEM standard for each system/equipment which (with the help of a schematic of various sub-system connected in series or in parallel as the case may be and MTBF & MTTR values for the various equipments) shall show that availability calculation is as per IEEE Standard-P1046.
  - 6.03.05 When more than one device uses the same measurement or control signal, the transmitter and other components / module shall be fully equipped to provide all signal requirements. The system shall be arranged so that the failure of any monitoring device or control components or spurious intermediate grounding in the signal path shall not open the signal loop nor cause the loss or malfunction of signal to other devices using the same signal.
  - 6.03.06 To ensure availability, adequate redundancy in system design shall be provided at hardware, software and sensor level to satisfy the availability criteria of 99.7%. For the protection system, independent sensing device shall be provided to ensure adequate safety of plant equipment.
  - 6.04.00 **OPERABILITY & MAINTAINABILITY**
  - 6.04.01 The system shall be designed such that any 'single-failure' should not lead to loss of availability of the plant, modification in operating routine or degradation of performance. This shall be achieved by judicious introduction of redundancy at all critical levels like providing redundant power supply, hot-standby multi loop controllers, redundant IO modules (for all critical application), redundant IO network and data hi-ways, redundant communication modules, duplicating console functions and servers and redundant field instruments. The plant operator remains totally transparent to 'single-failures'.
- Seller shall furnish his proposed redundancy concept in the offer.
- 6.04.02 Control system shall be designed in a fail safe mode so that loss of signal, loss of excitation, loss of motive power or failure of any component shall not cause a hazardous condition for the plant & personnel and at the same time prevent occurrence of false trips. All modulating control valves shall be in stay put condition during any of the above failures.
  - 6.04.03 The types of failure which shall be taken into account for ensuring operability of the plant shall not be limited to the following:

a) Failures of sensors or transmitters.

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- b) Failure of controller during automatic operation.
- c) Loss of motive power to final control elements.
- d) Loss of control power.
- e) Loss of instrument air.

6.04.04 The unit control consoles shall be designed for operation of the unit with minimum operational manpower deployment. Seller shall ensure proper operability and also take into account protections to minimize accidental maloperations.

6.04.05 The choice of hardware shall take into account sound maintainability principles and techniques and shall not be limited to the following:

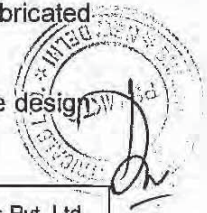
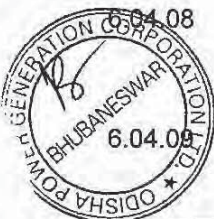
- a) Standardization of parts.
- b) Minimum use for special tools.
- c) Modular and hot replacement.
- d) Logical grouping of functions.
- e) Separate and non-interactive adjustability.
- f) Malfunction identification facility through self-diagnostics.
- g) Easy removal, replacement and repair.
- h) Easy assembly and disassembly.
- i) Fool-proof design providing proper identification and other features to preclude improper mounting and installation.
- j) Redundancy of critical parts.
- k) Unique system-hardware identifiability by assigning sub-racks / sub-rack sections to specific control loops with no mutual sharing of input / output cards between different loops.

6.04.06 On-line testing, self-checking & diagnostic facility of DDCMIS & PLC's shall be provided with indication for easy identification of the faulty module, while the unit is in operation. The system shall continuously check health of its modules including its redundant part and shall permit carrying out of the on-line dynamic test and self-diagnostic checks while maintaining safe condition without endangering the safety of equipment and without having any influence on the process being controlled.

6.04.07 Instruments shall have optimum response time as mentioned in Vol. II E section - VI.

6.04.08 Intercommunications in between sub-racks and system termination cabinets and in between sub racks and other panels shall be made by prefabricated connectors and cables with mechanical latch.

Adequate diagnostic, simulation & test facility shall be incorporated in the design as detailed in Vol. II E Section - VI.



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6.05.00 SECURITY AND FAILURE PHILOSOPHY

6.05.01 General

It is essential that interlock, protection, supervision and automatic control of the I&C system shall have integrity higher than the plant items they control. Control & instrumentation system shall meet the following requirements:

- a) No single failure shall cause the complete failure of the control.
- b) No single fault shall cause the protection system to spuriously operate or cause the protection system to become inoperative or / cause a trip or derate the unit.
- c) The grouping of the control functions into system blocks shall be arranged so that failure of any one block shall only partly degrade the control of the overall system and such degradation shall be manageable by the operator intervention.
- d) Control system shall be structured with redundancy so that no single failure within the control system can cause the failure of duty plant and at the same time cause the standby plant to be unavailable.
- e) Due to control system failure if a final control element or plant item does not respond then that item or control element shall go into a fail safe condition or in stay put condition as per the process requirement.
- f) Measure shall be taken on the action of IO due to loss and restoration of power. For example dual outputs such as separate start and stop outputs for motor starters/breakers etc. shall be provided. For turboset auxiliaries one relay will be used for start/stop as per proven standard motor control software.
- g) Fault on a cable does not cause loss of more than a minimum tolerable functionality of the system.

To meet the above requirement, control system shall incorporate redundancy with continuous self checking so that any internal fault can be detected prior to resulting any disturbance in the process. Protection and safety systems shall incorporate both channel redundancy and measurement redundancy with self checking and adequate test facilities.

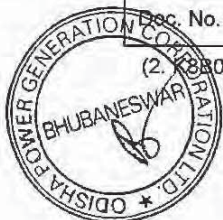
Redundancy of components and systems shall be dictated by availability criteria to ensure the system availability target as well as safety considerations are fully met.

6.05.02 Measurement & Channel Redundancy

To meet the stringent failure and self checking requirement criteria for the control system, measurement redundancy shall be provided for all the critical parameters. Such measurement for the function of control, indication & protection shall be provided along with control channel redundancy so that integrity of the measurement and control is ensured. Throughout the control system the security and validity of signals representing plant measurements (both analog and digital), which are used for control and protection purposes are to be ensured adhering to the following design principles.

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- a) Where a plant measurement is to be duplicated or triplicated such signals shall be separately feed to the different input modules.
- b) Signals after the security and validity checking by means of voting, averaging, median, difference monitoring or similar technique shall be transmitted to the control functions of sequencing, modulating and protection.
- c) Three independent measurements shall be provided for the critical protection functions except for vibration protection (2oo2). Control and direct indication shall be derived from the median value of measurements. High deviation from the median value shall be alarmed and removed from the median signal.
- d) Where double measurements are used, provision shall be made for the selection of either measurement as the duty signal and continuous monitoring of difference between the signals. Services for such measurement redundancy are specified in the subsequent sections of the specification.
- e) Three control channels shall be provided incorporating 2 out of 3 voting for protection of all critical equipment (such as Boiler Protection). For EHG control, Turbine protection and Generator protection etc., two control channels configured in 2 out of 2 with fail safe design can be adopted. For all other cases two control channels in hot standby redundancy philosophy can be adopted.

**6.05.03 Security**

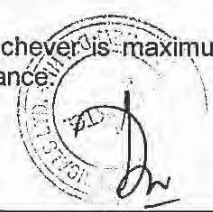
- a) System mode key switch or password to prevent tampering of system program.
- b) Redundant elements of the system shall not be exposed to the common hazards. For example routing of the redundant network cable through separate cable raceway, using separate cabinet / separate rack for redundant controller and redundant IO modules.
- c) Cables shall be armoured and with FRLS property.
- d) Use of high temperature withstanding cable in high temperature zone such as Main & BFP drives Turbine area.
- e) Proven hardware / firewalling and gateway antivirus shall be provided to secure DDCMIS network from various interconnected Private & public network.



6.06.00 Each C&I cables shall have at least 20% or one no., whichever is maximum, spare wire capacity above the used cores for future maintenance.

6.07.00 NOT IN USE

6.08.00 NOT IN USE



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6.09.00 NOT IN USE

6.10.00 **INSTRUMENT ACCURACY, STANDARD SCALES AND RANGES**

6.10.01 **Instrument Accuracy**

- a) Accuracy of linear instruments shall meet the specified accuracy over its span.
- b) Flow meter shall meet the specified accuracy criteria when operating between 25 and 100 percent of full-scale flow value. The accuracy guarantee shall include the effect of errors in the differential head measuring device, square root converter and signal generator.
- c) Level measurement shall be linear with respect to the measured level based on a specific gravity of 1.00.
- d) Wherever the measured parameter like flow is influenced by process pressure & temperature, required correction against pressure and temperature shall be introduced for such measurement.
- e) Temperature compensation shall produce corrections over a flow range from 10 percent to 100 percent of maximum flow subject to a plus or minus tolerance of one-half of one percent of the maximum flow.

6.10.02 **Instrument Scale Displays**

- a) All displays shall be in engineering units. Instrument scales displayed on screen shall have graduations with scale divisions based on multiples of 10. The smallest division shall preferably be a whole number approximately 1% of the scale range if not otherwise impracticable.
- b) Pressure instrument shall have the unit suffixed with 'a' or 'g' to indicate absolute or gauge pressure, respectively.
- c) Scales and charts of all instruments shall have linear graduations

6.10.03 **Instrument Ranges**

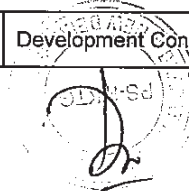
Unless otherwise impractical, Instrument range shall be selected in such a way so that the normal reading lies within 50% to 70% of full scale for linear parameters and within 70% to 90% of full scale for flow measurements. Deviation indicators shall have the null position at mid scale. The normal operating parameter shall be identified with a clear green mark.

6.11.00 **ENVIRONMENTAL CONDITIONS**

6.11.01 Control & Instrumentation system shall be suitable for continuous operation in the environmental condition as per the project metrological data provided elsewhere in the specification and shall meet the minimum design requirement of 50 Deg.C and 95% RH.

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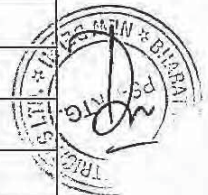




Equipment which can not meet the stipulated environmental condition shall be installed in air conditioned environment. Air conditioned area for the I&C system shall not be limited to the rooms for UPS, DDCMIS, Computers, Servers, PLC based system & Chemical analyzers of SWAS.

- 6.11.02 Particulate contamination from fly ash and coal dust and gaseous contaminants such as SO<sub>2</sub> and other flue gas constituents in the coal fired plant can have deleterious effect on printed circuit board, connectors and components. This hazard shall be taken into design considerations.
- 6.11.03 Vibration transmitted from plant equipment can cause connection to become loose and can physically fatigue components in the system. Manufacture of the system shall include features such as locking devices, anti vibration pads etc. In general I&C component / equipment shall be installed away from the vibration zone.
- 6.11.04 Protection against lightning shall be considered by providing proper grounding, metal oxide varistors, spark gap lightning arrestor, optical isolator and isolation transformer.
- 6.11.05 Considering the high ambient noise and electromagnetic interference prevailing in power plant, it is recommended that soft communication links between off-site PLC and plant DDCMIS shall be based on dual Optical Fiber Communication (OFC) medium. Redundant cable shall be laid separately. Necessary ports / converters shall be provided.
- 6.11.06 Instruments, devices and equipments for location in outdoors/indoor/air-conditioned areas shall be designed to suit the environmental conditions indicated below and shall be suitable for continuous operation in the operating environment of a coal fired station and also during periods of air conditioning failure without any loss of function, or departure from the specification requirements covered under this specification.

Ambient Temperature (Outside Cabinet)	Pressure	Relative Humidity	Atmosphere	Required Protection Class of Panels / Cabinets / Desks
<b>Outdoor Location</b>				
55 °C (max.)	Atmosphere	100% (max.)	Air (Dirty)	IP 55***
4 °C (min.)	Atmosphere	5% (min.)	Air (Dirty)	IP 55***
<b>Indoor Location</b>				
50 °C (max.)	Atmosphere	95% (max.)	Air	IP 54**
4 °C (min.)	Atmosphere	5% (min.)	Air	IP 54**
<b>Air Conditioned Areas</b>				
24 ±5 °C (normal)	Atmosphere	95% (max.)	Air	IP 22



50 °C (max.) * 40 °C (max.) *	Atmosphere	5% (min.)	Air	IP 22
* During Air-conditioning failure. ** For non-ventilated enclosures. For ventilated enclosures, protection class shall be IP 42. *** With a suitable canopy at the top to prevent ingress of dripping water				

6.11.07 The construction of electrical enclosures located in areas subject to conditions classified in the National Electrical Code (NEC) as hazardous shall be of a type designated suitable for the environment in which they are located.

6.11.08 Junction boxes and pull boxes shall be in accordance with the requirements of NEC, Article 370, Paragraphs 18, 19, 20 and 21 and shall be without knockouts.

**6.12.00 NAME PLATE**

Each instrument / item of plant shall have nameplate, permanently attached to it in a prominent position, made of non-hygroscopic & non-corrosive material (generally stainless steel) upon which is to be engraved the manufacturer's name, instrument type / model number, range, Voltage rating, serial number and weight. In addition to description of instrument there should be the KKS numbering on the nameplate.

6.12.01 Items of plant such as valves etc. which are subject to handling, are to be provided with nameplate or label generally made of stainless steel with engraving filled with enamel paint, suitably mounted or affixed with strong rustproof chain.

6.12.02 Stainless steel tag plate shall be wired to the instrument. Inscription on equipment (labels) shall be in English.

**7.00.00 CODES AND STANDARDS**

7.00.01 Instruments such as Gauge glass, thermowells, control valves, flow elements and other on line devices mounted on the pipeline, vessel etc. which comes under the purview of Indian Boiler Regulation Act (IBR) shall be IBR certified. It shall be responsibility of Seller to obtain the necessary approval of the concerned Authority / Chief Inspector of Boilers for the design and design calculations, GA drawing, manufacturing and erection procedure as called for in the IBR Act.

7.00.02 The design, construction and testing of all equipment, facilities, components and systems shall be in accordance with standards/ codes issued by Bureau of Indian Standards (BIS) and/or equivalent international standards/ codes. A non-exhaustive list of reputed international standards is given below:

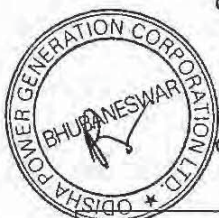
- a) American National Standards Institute (ANSI)
- b) American Petroleum Institute (API)
- c) American Society of Mechanical Engineers (ASME)
- d) American Society of Testing and Materials (ASTM)
- e) American Water Works Association (AWWA)



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selection switch shall be in Breaker / MCC (Refer electrical volume of the specification). Local emergency stop pushbutton shall always be activated irrespective of the position of selection switch. For turbo sets, a maintenance switch shall be provided in the MCC. The related auxiliary will be processed in the control system. For D.C. emergency oil pumps such a switch will not be provided.

- 8.00.27 Pneumatic tubing for the control valve / damper hook up including integral tubing of valve / damper shall be of stainless steel material.
- 8.00.28 Process fluids shall not be piped directly to instruments located in Central Control Room (CCR) and Control Equipment Room (CER) area.
- 8.00.29 Wherever DP type transmitter is used for flow measurement, square root extraction to be performed in the DDCMIS / PLC.
- 8.00.30 Ergonomically & aesthetically designed furniture viz. control desks & chairs shall be provided at the control rooms for various workstations. Similarly, furniture shall be provided for equipment like programming stations, PCs and various peripherals at computer room/equipment room. Control desk and Video wall shall be from reputed manufacturer/s. Control room interior shall be designed with latest state of the art design prevailing in the modern power plant. Seller shall pay attention for the aesthetic, ergonomic and the interior lighting for the control room.
- 8.00.31 The steam and water analysis system shall be designed in accordance with the recommendation as per ASME PTC 19.11 Part II, Water and Steam in Power Cycle. For detail, refer Section VII of this volume.
- 8.00.32 KKS identification system shall be adopted for the tagging. Seller shall follow the KKS Tag numbering philosophy while preparing all instrumentation & control related documents like P & ID, Instrument List, Drive List, Logic & Loop Diagrams, Junction Box Schedule, Cable Schedule & Interconnection Diagram etc.
- 8.00.33 The SI / MKS system of units shall be used for design, drawings, diagrams, instruments etc.
- 8.00.34 **Alarm Annunciation System**
  - a) For DDCMIS / PLC controlled plant areas, alarm shall be displayed in DDCMIS / PLC operator stations. In addition alarms shall also be displayed on the LVS, wherever provided, in conventional windows form. On each LVS there shall at least three / four rows of windows on the top of the screen for display of alarm.
  - b) Critical alarms required for safe shutdown shall be displayed in the conventional alarm windows on the backup Unit control panel. For turbo sets all alarms indications shall be via DDCMIS.
  - c) Conventional microprocessor based window type alarms in relay based local control panels wherever required shall be provided. For DDCMIS / PEC controlled system / panel, alarm sequence shall be configured in their respective PLC / DDCMIS.
  - d) ISA guideline shall be followed while designing the alarm system.



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**8.00.35 Local Instruments**

Required local gauges and level indicators shall be provided for start-up, commissioning and recommissioning of equipment, calibration and setting of other instruments and shall not be limited to the following.

- a) Heat exchanger & Cooler shall have upstream & downstream pressure & temperature gauges.
- b) Pump shall have its suction and discharge pressure gauges.
- c) NOT IN USE
- d) All high capacity tanks such as condensate storage tank etc. shall have float & tape level indicator. Smaller non critical tanks such as potable / service water tanks shall have float & board type level indicators. Magnetic type level indicators for low pressure and temperature critical application such as condenser hotwell, LP heaters, chemical dosing tanks etc. All other applications shall have either reflex or transparent gauges depending upon the fluid.

**8.00.36 Vibration Monitoring System**

Continuous on line vibration monitoring and analysis of rotating equipment shall be performed by proven & latest Microprocessor based "Vibration Monitoring & Analysis Systems". It shall measure and display vibration and machine analysis data of Turbine supervisory instruments for Turbine, Generator & Exciter, BFP drive turbine & pump and of HT drives such as Motor driven BFP, CEP, ID fans, FD fans, PA fans, SA fans, Coal mill motor, ~~Boiler circulation water pumps~~, Gas recirculation fans (if proposed), ACWP etc.

Each HT drive (200 KW & above) shall be provided with vibration sensors on the DE and NDE bearings of motors and fans / pumps. On each bearing there shall be two vibration sensors, one in X direction and other in Y direction along with key phasor for on line vibration monitoring and analysis. For detail Seller shall refer to Section-VI of this volume.

A common computer aided on line Vibration monitoring & Analysis System shall be provided on per unit basis to monitor and analyze the machine data received from Turbine Supervisory Instruments (TSI) system for Turbo Generator & Turbine driven BFP and also from the Vibration Monitors of HT motor & their driven equipment. Analysis system shall be knowledge based and guide the maintenance engineer & operator to detect the fault and to take corrective action.

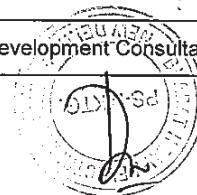
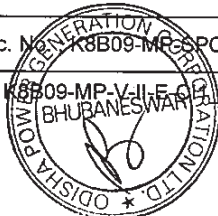


**8.00.37 Process Connection & Instrument Hook Up**

- a) Instrument piping installation shall be as per standard "Fossil Fuel Power Plant Instrument Piping Installation, ANSI/ISA-77.70-1994".
- b) The process connection shall be a minimum of ½ inch (12.7 mm) nominal pipe size for service conditions when pressures are 900 psig (6.21 MPa) or less, and temperatures are 800°F (426.67 Deg.C) or less. The minimum size shall be ¾ inch (19.05 mm) for conditions that exceed either of those limits.

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Shutoff valves shall be designed for maximum design pressure and temperature of the piping system and shall be located as close as possible to the process tap connections. If the process line is smaller than the appropriate takeoff connection size, the connection shall be the same size as the source.

- c) The lines between the shutoff valves (root valve) and the instruments shall have design pressures as follows:

For sub-critical steam services, the lines shall be designed for process design pressure at saturated temperature; for all other services, the line shall be designed for process piping design pressure and temperature. To prevent plugging and obtain sufficient mechanical strength, the inside diameter of the tube or pipe shall not be less than 0.360 inch (9.14 mm) and shall have a minimum wall thickness of 0.049 inch (1.25 mm). ANSI B31.1, Section 104, shall be followed for calculating minimum wall thickness required for a given pressure and temperature.

- d) Blowdown valves shall be the gradual opening type. For steam service, these valves shall be suitable for the maximum design pressure of the process line and its corresponding saturated steam temperature. For all other services, the blow down valve shall be designed for the process piping design pressure and temperature.

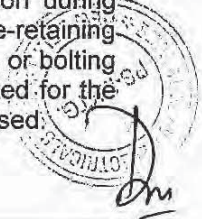
- e) Each instrument shall have its own independent connection to the process except for instruments located on standpipe. In this case only the connections to the vessel are common. Each instrument shall be connected independently to the standpipe through isolation valve. Standpipe shall have isolation / block valves for connection with the process.

- f) Root valves of two numbers for process pressure of 40 Kg/cm<sup>2</sup> and above and single for process pressure less than 40 Kg/cm<sup>2</sup> as per piping specification shall be provided.

- g) Separate stubs and take-off points with thermo well / root valves shall be provided for performance guarantee test and shall not be shared with online measuring instruments.

- h) Isolation valve and blow down drain valve adequate for duty requirement and for withstanding continuous design pressure and temperature of main process medium shall be provided in the instrument hook up scheme. Instrument isolation valve and Instrument blow down valve near to the instrument shall be of gradual opening type. For process pressure equal or above 40 kg/sq.cm double blow down valves shall be used before connecting to blow down header.

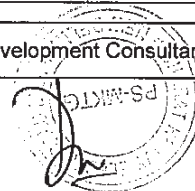
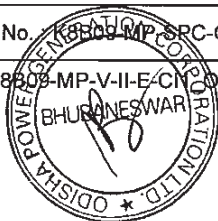
- i) Manifold valve shall be installed close to / at the instrument. The valves shall be of the gradual opening type and shall be capable of operation during maximum design pressure and temperature. Materials for pressure-retaining parts such as the body, bonnet, disc, pipe plugs, fittings, tube stubs, or bolting shall be as required by ANSI B31.1. Packing materials shall be rated for the pressure and temperature service intended. Asbestos shall not be used.





- j) Size of impulse pipe for pressure measurement in air and flue gas duct path of boiler shall not be less than ¾" NB. To prevent Ash deposition blockage, in dust bearing gas streams an instrument tap air purge system shall be provided.
- k) All local instruments viz. pressure and temperature gauges, pressure and temperature switches, transmitters as equipment supply shall be mounted on gauge boards & instrument racks located at convenient place near to the equipment.
- l) Other pipe and duct mounted pressure and temperature gauges shall be installed at tapping point located at a readable distance.
- m) Transmitters & switches installed at outdoor location shall be mounted in closed type Local Instrument Enclosure (LIE). For indoor areas, open type Local Instrument Rack (LIR) with canopy shall be used for installation of transmitters and process switches. Drain from LIE / LIR shall be connected to nearby plant drainage system.
- n) Process connection for instruments on line and vessel shall be in accordance to standards such as ASME and other recognized international standards. Table below indicates the type of connection generally to be used for the various types of instruments. Seller shall furnish detail of tapping points with drawing during detailed engineering for Consultant approval.

INSTRUMENTS	EQUIPMENT / PIPE SIDE	INSTRUMENT SIDE
<b>Level Instruments</b>		
Internal Displacer	4" – Flanged	4" - Flanged
External Displacer	2" – Flanged	2" - Flanged
Level gauge	¾" –Flanged	¾" - Flanged
DP Type	½" (min.)-welded 1" – welded for vessel like HP heaters, LP heaters, De-aerator etc. application	½"- NPT
External cage Level switch	1"- welded	1"- welded
<b>Flow Instruments</b>		
DP Type	½" - welded in general 1" – welded for high pressure / temperature main steam, feed water, PRDS etc. application	½" - NPT
<b>Pressure Instruments</b>		
Conventional	½" (min.)-welded 1"- welded for high pressure/ temperature main steam,	½" - NPT

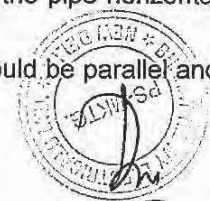
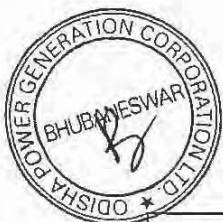




INSTRUMENTS	EQUIPMENT / PIPE SIDE	INSTRUMENT SIDE
	feed water, PRDS etc. application	
Diaphragm type-HFO application	3"- Flanged	3"- Flanged
<b>Temperature Instruments</b>		
Thermowell	Generally - M 33 X2 (M) 1½" Flanged- For air/FG path application	½" NPT
<b>Analyzer</b>		
Liquid analyzer	½"- 1" – welded	½"

- o) Rotameter shall generally be flanged type except if less than ½", in such case connection shall be screwed type.
- p) For level measurement by DP cell low level taps on the vessel shall be made horizontal to avoid plugging.
- q) Impulse pipes shall be clamped at suitable interval not exceeding 1.5 meter. Process pipe shall not be used for supporting the impulse pipe.
- r) Impulse pipe shall be seamless type and conform to ANSI B 16.11.
- s) Fittings shall be forged steel and conform to ANSI B 16.11. Threads of piping component shall be of tapered construction.
- t) Instrument blow down header shall in no case be lower than the material grade ASTM A 106 Gr. C.
- u) Siphon shall be provided in the impulse pipe or tube to protect the instruments where fluid temperature is 100 °C or more.
- v) Impulse pipes shall be suitably insulated so as not to be affected by the variation of surrounding temperature.
- w) Tap orientation shall be as follows :
  - i) For liquid service, within 45 Degree at lower half of the pipe horizontal plane.
  - ii) For gas service, within 90 Degree at upper half of the pipe horizontal plane.
  - iii) For steam service, within 45 Degree at upper half of the pipe horizontal plane.

As a rule tap orientation of high and low pressure side should be parallel and symmetrical.





- x) Pressure & Differential pressure instruments in steam and liquid services shall be located below the taps and the piping shall be sloped to avoid formation of air pocket.
- y) Pressure & Differential pressure instruments in gas service shall be located above the taps and the piping shall be sloped to avoid formation of any liquid.
- z) Impulse pipe including taps for furnace, flue gas and coal mill application shall be provided with air purge connection. Differential instruments for such application shall have continuous and as well as intermittent purging. Whereas, pressure measurement shall have only intermittent purging.
- aa) Material of impulse pipe for the instruments mounted on rack and enclosure shall be same as that of main process pipe except stainless steel tube of Gr. 316H or better shall be provided for connection in between impulse pipe (from tee connection on impulse pipe) and instrument manifold valve & instruments. Impulse pipe, tubes, fittings and accessories shall have the same design pressure and temperature applicable for the related main pipe. For type and specification refer to section VI of this volume.
- bb) Length of the impulse pipe shall not be more than 15 meter for non compressible fluids and 12 meter for compressible fluid.
- cc) Instruments installation philosophy is shown in the reference Drawing No. K8B09-DWG-I-0060. Seller shall furnish the drawing and documents showing the installation detail of instruments along with Bill of materials at detailing stage for Consultant's approval.

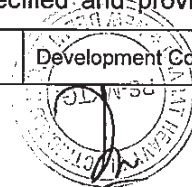
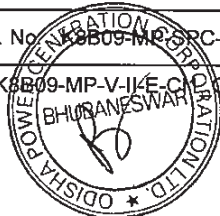
**8.00.38 Electrical Power Supply Systems**

The power supply system shall be designed to meet the electric power requirements of various I&C systems including DDCMIS and shall be configured as described below:

- a) Total DC load requirement for SG-C&I system, TG-C&I system and for Station-C&I and miscellaneous loads shall be provided.  
DC system shall comprise of 2x100% 24V DC batteries, 2x100% redundant chargers, 2 x 100% DC distribution boards etc.
- b) For MMIPIS portion of DDCMIS including peripherals like monitors, printers, disks etc. and other systems such as SWAS, panel instruments, vibration monitoring system, PLC etc., requiring stabilized AC power, Seller shall furnish a redundant UPS system.
- c) For other SG / TG related instruments, the power supply shall be derived from either the 24 VDC or UPS as per specific requirement of the equipment supplier and as approved by Consultant during detailed engineering.
- d) For power supply to PLC & other Instruments & Control system in BTG area that require stabilized AC power, Seller shall provide UPS power from the unit UPS system mentioned in (b) above.
- e) Wherever, hot back-up for redundant system components like controllers, processors, I/O modules etc. have been specified and provided, the same

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shall be powered through two separate power supply feeders.

For technical detail, Seller shall refer to electrical specification Vol. IIF for the UPS and 24V DC system.

- 8.00.39 High pressure steam drain lines (viz. MS line drains etc.) shall be monitored for passing condition of the closed valves by suitably providing metal temperature element on the pipe at upstream of the valves.
- 8.00.40 End position of the manually operated suction valves of critical pumps shall be monitored.


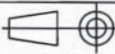


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## 2.2.0 SPECIFICATION OF PLC SYSTEM


# STANDARD DOCUMENTS FOR PLC SYSTEM

<b>PROJECT</b>		<b>REVIEWED BY</b>				
	BHARAT HEAVY ELECTRICALS LTD. POWER SECTOR PROJECTS ENGINEERING MANAGEMENT NOIDA	DEPT	NAME	SIGN	DATE	
		CODE	DESIGN	RK/VKV	<i>[Signature]</i>	19/03/14
		I	CHD	SSB	<i>[Signature]</i>	19/03/14
		APPD	MAM/DP	<i>[Signature]</i>	19/03/14	
<b>TITLE</b> STANDARD DOCUMENTS FOR PLC SYSTEM						
		DEPT.	SCALE	DRAWING NO.		
		SIGN		(PES-145-36)		
		DATE		(PE-DC-999-145-1036-1)		
			SHEET	1 OF 15	REV. 00	

# INDEX

SNo.	DESCRIPTION	PAGE NO.
1.	SPECIFICATION FOR PLC SYSTEM (PE-DC-999-145-I036-1)	3
2.	DATASHEET FOR PLC SYSTEM (PES-145-36)	14

<b>TITLE    STANDARD DOCUMENT FOR PLC SYSTEM</b>									
							DEPT.	SCALE	DRAWING NO.
							SIGN		(PE-DC-999-145-I036-1)
							DATE		(PES-145-36)
								SHEET 2 OF 15	


	<b>TITLE:</b> <b>SPECIFICATION FOR  PROGRAMMABLE LOGIC  CONTROLLER SYSTEM</b>	SPECIFICATION NO. PES-145-36	
		VOLUME <b>II-B</b>	
		SECTION <b>D</b>	
		REV. NO. 03	DATE: 18.03.2014
		SHEET 1	OF 11

## 1. SCOPE

This specification covers the Design, Manufacture, Assembly, Inspection and Testing at manufacturer's works, proper packing and delivery to site, erection & commissioning, site acceptance test of the PLC Control & Monitoring System comprising PLC Control panel/Remote I/O panel (housing Processors, I/O cards, power supply packs etc.), Operator workstations(OWS), Printers, Annunciation system, UPS, cables and all other equipment and accessories required for completeness of the system as mentioned in different sections of this specification.

## 2. GENERAL

- 2.1. The offered PLC shall be of Industrial Grade and from Original Equipment manufacturer (OEM).
- 2.2. The PLC shall perform protection logic, interlock and sequential control functions such as binary logic operation, set/reset operation, timers, counters, logic blocks, math functions, input quality checking engineering unit conversion, Boolean functions & PID control (Analog logic function) etc.
- 2.3. The system shall be redundant in processor, power supply and communication interfaces unless otherwise specified. The control of all drives and equipment shall be effected through the keyboard/mouse / panel mounted push button / control switches as per Data sheets-A&B. The system shall include self-diagnostic features not limited to the following:-
  - Memory Faults, both PROM and EPROM
  - Processor Faults
  - Communication Faults
  - I/O interface or address faults
  - Voltage signal discrepancy on input and output
  - Power supply faults
  - Output loop check
  - Channel level diagnostics such as fault monitoring, contact bounce filtering etc.
  - Failure of main or I/O processor
- 2.4. The system shall have facility for connecting to Main Plant's Distributed control system (DCS) using hardware/software interface for two-way transfer of signals.
- 2.5. The mimic shall be displayed on the OWS screen and may also be provided on the control desk/panel (as per Datasheet).
- 2.6. In case OWS is provided, HMI functions like trends, curves, bar charts, historical storage of data, logs and reports etc. shall be provided in addition to Plant schematics. The necessary catalogue / literature elaborating the features of HMI shall be supplied along with the bid.
- 2.7. It shall be possible to use the same OWS as programming station.
- 2.8. The PLC system shall be sized to meet process/system requirements as per the approved P&IDs and Control write-up.
- 2.9. The PLC system shall be designed to ensure that no single device failure should result in failure of any other device.

	<b>TITLE:</b> <b>SPECIFICATION FOR  PROGRAMMABLE LOGIC  CONTROLLER SYSTEM</b>	SPECIFICATION NO. PES-145-36	
		VOLUME <b>II-B</b>	
		SECTION <b>D</b>	
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- 2.10. Signal multiplication where required shall be done in PLC. Use of relays for multiplication of contacts (for control, monitoring and alarm) is not acceptable. The control/ monitoring components on the control panel/ desk shall be driven through I/O modules.
- 2.11. Bidder shall provide all software on CDs along with required software licenses .The original CDs of installed operating & application software shall be maintained by bidder. Software modification and up gradation (as & when required) shall also be covered under the vendor scope without any cost implication.
- 2.12. PLC programming console shall be provided with industry proven antivirus software with perpetual license (free version not acceptable).

### 3. TECHNICAL REQUIREMENTS

Details of various PLC system components shall be inclusive of but not limited to the following:

#### 3.1. CODES AND STANDARDS


- 3.1.1. The equipment covered under this specification shall meet the requirements of latest edition of all applicable codes and standards like ANSI, NEMA, IEEE, IEC, NEC & IS.
- 3.1.2. PLC shall conform to IEC: 61131
- 3.1.3. The offered PLC shall comply with safety standards as per Data sheet-A&B.

#### 3.2. CONTROL PANEL

- 3.2.1. PLC control panel shall be freestanding type with provision for mimic display, push-button stations, control switches, indicating lamps, metering instruments like Indicators, ammeters etc. and facia windows for critical alarms.
- 3.2.2. The salient features of construction shall be:

Sheet material: Cold rolled sheet steel  
Frame thickness: Not less than 3.0mm  
Enclosure thickness: Not less than 2.5 mm for load bearing sections (mounted with instruments) and not less than 1.6 mm for others  
Gland plate thickness: 3.0mm  
Base channel: ISMC 100 with anti-vibration mounting & foundation bolts.


- 3.2.3. Each panel shall be identified by a name plate, which shall be of non-rusting metal or three ply lamicolod, with engraved lettering.

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- 3.2.4. Vendor shall indicate earthing details along with bid.
- 3.2.5. 25 x 6 mm Copper ground bus to be provided for each panel.
- 3.2.6. 240V AC single phase, thermostatically controlled space heaters shall be provided. Each free standing panel shall have a door switch operated fluorescent lamp and a 240V AC plug point.
- 3.2.7. Painting treatment shall be as per IS: 6005. Two coats of lead oxide primer shall be followed by powder coating. Paint shade shall be as specified in the "Data sheet for PLC system"-Data Sheet-A&B. Project specific paint shade, if applicable, shall be followed.
- 3.2.8. Panel internal wiring shall be as per NEC and NEMA standard.
- 3.2.9. TB points in terminal block shall be cage clamp type/screw type.
- 3.2.10. The annunciation system shall be facia window type, driven by the PLC. Audible alarm, Acknowledge, Reset and lamp test facility shall be provided as per ISA sequence – S18.1, M.

### 3.3. PROCESSORS

- 3.3.1. The microprocessors shall be 32 bit, and Hot redundant.
- 3.3.2. Hot redundancy: PLC shall be provided with two processors (Main processing unit and memories) one for normal operation and one as hot standby. In case of failure of working processor, there shall be an appropriate alarm and simultaneously the hot standby processor shall take over the complete operation automatically. This transfer from main processor to standby processor shall be bump less and shall not cause any disturbance whatsoever. In the event of both processors failing, the system shall revert to fail safe mode. It shall be possible to keep any of the processor as master and other as standby.
- 3.3.3. An authorized forcing facility shall be provided for changing the status of inputs and outputs, timers and flags to facilitate fault finding and other testing requirements.
- 3.3.4. The standby processor shall be updated automatically in line with the changes made in the working processor.
- 3.3.5. In the event of any replacement of the processor, synchronization of the replaced processor shall be automatic upon live insertion.
- 3.3.6. The cycle time for input scanning, execution of logics, overheads and output scan shall not exceed 120 m sec.
- 3.3.7. The processor & memory shall be loaded up to 50% at normal conditions and maximum up to 60% under worst loading conditions.
- 3.3.8. The memories shall be field expandable. Memory capacity shall be sufficient for complete system operation and have a capability for at least 20% expansion in future.
- 3.3.9. Memory shall be non-volatile, preferably EEPROM type. However, in case volatile memory is provided, battery backup shall be provided for a minimum of three months to keep the stored program intact. Battery drain indication shall be provided at least 1 week before the battery gets drained and same shall be annunciated in OWS.

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### 3.4. INPUT / OUTPUT Modules

3.4.1. Input/output card assignments shall be modular i.e. no single card shall be assigned with more than one drive of a particular sub-system. The maximum number of channels per I/O module shall be as follows.

- Analog Input Module: 16
- Analog Output Module: 16
- Binary Input Module: 32
- Binary Output Module: 32
- Analog Input/output combined: 16
- Binary Input/output combined: 32

3.4.2. On line module replacement (hot swappable): All modules cards shall have quick disconnect terminations allowing for card replacement without disconnection of external wiring and without switching off the power supply.

3.4.3. Each I/O shall be protected against the reversal of polarity of the power voltage to I/O.

3.4.4. 10% spare capacity shall be ensured in each card channel assignment. Overall minimum 20% spare channels shall be provided.


3.4.5. Output command to MCC/Switchgear shall be through coupling relays, whose mounting location shall be as per "Data sheet A & B for PLC System". In case coupling relays are located in PLC Panel, the same shall be in PLC vendor's scope of supply.

3.4.6. Status feedback from MCC shall be in the form of potential free contact.

### 3.5. DATA BUS/ I/O BUS

3.5.1. The Data bus connecting PLC and HMI work stations shall be TCP/IP on Ethernet.

3.5.2. The Data bus and I/O bus communication medium shall be twisted pair shield copper conductor for indoor locations and those areas not subjected to induced signals. Repeaters/signal amplifiers shall not be used. Copper conductor cable used shall be Category-5 or better. The communication medium shall be Fibre optic cable in the event any portion of communication cable run is in outdoor or where distances are beyond 500 meters.

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### 3.6. OPERATOR WORK STATION (OWS)

3.6.1. The OWS and Keyboard shall be desktop mounted and shall be used for controlling, monitoring and programming function.

3.6.2. Colour CRT(s) with keyboard and mouse shall be as per Data Sheet-A&B. CRT shall have graphic display facility.

3.6.3. The OWS shall be with Windows based operating system having necessary Engineering/Configuring software.

3.6.4 Specification of OWS

#### (a) CPU

- |                           |  |
|---------------------------|--|
| 1. Processor              | 32 Bit or better                                       |
| 2. Main Memory            | Min. 1 GB and expandable to at least 4 GB              |
| 3. Hard drive             | Min 40 GB  |
| 4. Floppy drive           | 3.5", 1.44 MB  |
| 5. Removable bulk storage | DVD (R/RW)   |
| 6. Graphic memory         | Min. 16 MB   |
| 7. Auto controller        | 16 bit or better                                       |
| 8. Operating system       | Window XP or better                                    |
| 9. Communication ports    | 2 serial, 1 parallel, 8 Nos. USB, Dual 100 MB Ethernet |
| 10. Expansion slot        | 3 Nos. or more   |

#### (b) Monitor


- |                         |   |
|-------------------------|---|
| 1. Type                 | LCD colour monitor (TFT based)                                  |
| 2. Screen diagonal      | 22" (approx.) flat  |
| 3. Display              | XGA or better   |
| 4. Degree of Protection | IP-30   |
| 5. External controls    | Brightness, Contrast, Horizontal/vertical amplification & shift |
| 6. Power supply         | 240 VAC, 50 Hz, 1 phase   |
| 7. Version              | Industrial grade  |

#### (c) Keyboard & Mouse

- |                    |   |
|--------------------|---|
| 1. Type            | Flat spill membrane or positive depression type ASCII |
| 2. Life expectancy | 50 Million cycles per key                             |
| 3. Version         | Industrial  |
| 4. Mouse           | Optical   |

### 3.7. PRINTER

Printers shall be provided as per Data Sheet-A&B.

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### 3.8. COMMUNICATION WITH PLANT DCS/ THIRD PARTY SYSTEM

- 3.8.1. The PLC system shall be provided with hardwired/serial interface for communication with plant DCS. Hardwired outputs from PLC shall be isolated. Necessary isolators shall be part of PLC.
- 3.8.2. Serial communication to / from DCS where provided shall be engineered to ensure that signal communication time from / to DCS shall not exceed 1 seconds for control / feedback.
- 3.8.3. Serial communication to DCS shall be OPC (Data access 2.0), Ethernet based TCP/IP Protocol. Alternatively the serial communication shall be MODBUS protocol on RS 485 network.
- 3.8.4. Data transmitted from PLC to DCS shall include all information necessary for the DCS graphic displays to monitor and control the process equipment and PLC. Such data may include pertinent analog and digital status information, interlock, alarms and maintenance conditions. Data transmitted from DCS to the PLC shall include necessary signals to provide operator control interface from DCS for the process/ equipment being controlled by PLC.
- 3.8.5. Bidder to include 'Light interface units, converters, Ethernet switch, accessories etc. at both ends viz PLC and DCS for connectivity to other system. The bidder's terminal point shall be Ethernet port in case of copper medium connection to DCS or LIU in case of Fiber optic medium for connectivity with plant DCS. In case distance between PLC & DCS is greater than 1.8 Km, single mode of optical fiber cable with compatible accessories shall be used. For distance less than 1.8 Km multimode optical fiber ports shall be used.


### 3.9. POWER SUPPLY Scheme

- 3.9.1. PLC Panel and I/O Cabinets: PLC system shall be provided with 2x100% UPS fed from Two Nos. redundant 415V, 3-ph feeders, as per the scheme PE-SD-999-145-001, sh-08 of 08. Each UPS shall have 30 minutes back up. Input feeder failure shall be monitored in the PLC system. Necessary redundant power pack and transformers shall be provided (in the PLC panel) to derive the power supply for control desk, PLC panel and input / output cabinets etc
- 3.9.2. Remote I/O panels: Similar power supply arrangement as for PLC panels shall be provided if it is not possible to extend the power cable form UPS of PLC panels.
- 3.9.3. Each OWS and associated HMI peripherals shall be provided with a feeder from Either one of the UPS

## 4. DRAWING/DOCUMENT AND DATA TO BE FURNISHED AFTER AWARD OF THE CONTRACT:

### 4.1. For Approval:

- PLC system configuration drawing along with functional write-up.
- Input/output signal list.
- BOM of PLC
- List of PLC controlled devices
- Control panel/control desk GA drawings.
- Control desk/panel component layout drawing.
- Control panel/control desk Foundation detail and cutout drawings.

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- Power distribution scheme.
- Block logic diagrams/ Ladder diagram mimic.
- Annunciation list.
- PLC control room layout drawing.
- List of soft signal exchange with Plant DCS.
- List of mandatory spares.
- UPS load calculation details.
- Quality plan
- FAT
- Data Sheet-C
- CRT display
- Power supply scheme for PLC system, HMI & peripherals, Remote I/O etc.


#### 4.2. For Information:

- Cable schedule and cable interconnection drawing( in BHEL approved format)
  - Between Field and PLC
  - Between Field and MCC
  - Between MCC and PLC
- Electronic earthing requirements.
- Panel Heat dissipation data
- Product/component catalogues.
- Operation & Maintenance Manual on CDs.
- Softcopy of Final/As-built drawings on CDs.
- Calculation for Processor, Memory & Data bus loading

The above list is the minimum requirements. Additional documents/calculations required shall be finalized during contract stage.

#### 5. DRAWINGS AND DOCUMENTS TO BE SUBMITTED ALONG WITH THE BID

- Proposed PLC system configuration drawing with write-up
- Product catalogues and specifications for PLC as well as HMI application.
- Proposed power supply schemes for PLC system, peripherals, and Remote I/O panels.


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## **6. TESTING AND INSPECTION**

- 6.1. The bidder shall adopt suitable quality assurance program to ensure that the equipments offered will meet the specification requirements in full.
- 6.2. BHEL's standard Quality Plan for PLC is enclosed with the specification. The bidder shall furnish his acceptance to BHEL's QP and submit the signed and stamped copy of QP along with the offer.
- 6.3. The complete PLC system, including all instrument and devices shall be subjected to standard factory tests (i.e. Type Tests and Routine Tests) as per relevant IS, NEMA, IEEE, IEC.
- 6.4. Factory Acceptance Test-FAT (Functional Tests) shall be performed prior to shipment and Owner/Purchaser shall be notified 15 days before the schedules dates of the test.
- 6.5. The certificates for following type tests, as per IEC Standard, shall be submitted: -
  - Surge protection test as per IEC-225-4
  - Dry heat test as per IEC-68-2-2
  - Damp Heat test as per IEC-68-2-3
  - Vibration Heat test as per IEC-68-2-6
  - Electrostatic discharge test as per IEC-801-2 or equivalent
  - Radio frequency Immunity test as per IEC-801-6 or equivalent
  - Electromagnetic Immunity test as per IEC-801-3 or equivalent

## **7. SPARES AND CONSUMABLES**

- 7.1. Commissioning Spares and consumables  
The bidder shall supply all commissioning spares and consumables 'as required' during Start-up, as part of the main equipment supply.
- 7.2. Mandatory Spares  
The bidder shall offer along with main offer, the Mandatory Spares as specified elsewhere in the specification. The Mandatory Spares offered shall be of the same make and type as the main equipment.
- 7.3. Recommended Spares  
The bidder shall furnish a list of Recommended Spares indicating the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation along with unit rate against each item to enable BHEL/BHEL's Customer to place a separate order later, if required.
- 7.4. Special Tools & Tackles  
The bidder shall supply all Special Tools & Tackles 'as required' during Start-up and further maintenance of the system, as part of the main equipment supply.
- 7.5. Spares, Service support  
Bidder shall provide availability of spares and service support for minimum 15 years after guarantee period.

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## 8. MARKING AND PACKING

### 8.1. Marking:

A stainless steel name-plate shall be permanently fixed on each equipment giving its Tag/serial Number and salient technical specification.

### 8.2. Packing:

All equipment/materials shall be suitably packed and protected for the entire period of dispatch, storage and erection against impact, abrasion, corrosion, incidental damage due to vermin, sunlight, high temperature, rain, moisture, humidity, dust, sea-water spray (where applicable) as well as rough handling and delays in transit and storage in open.

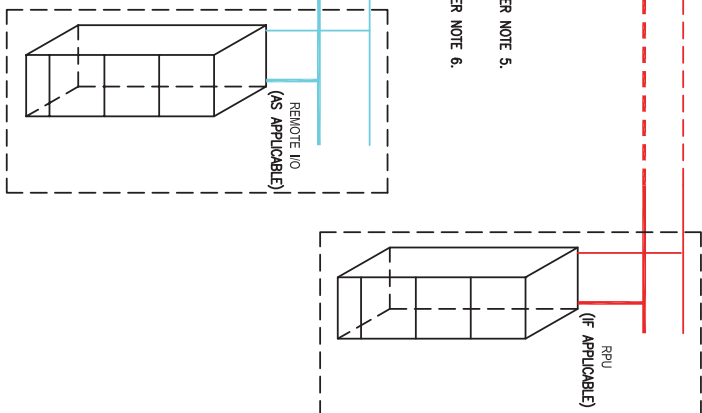
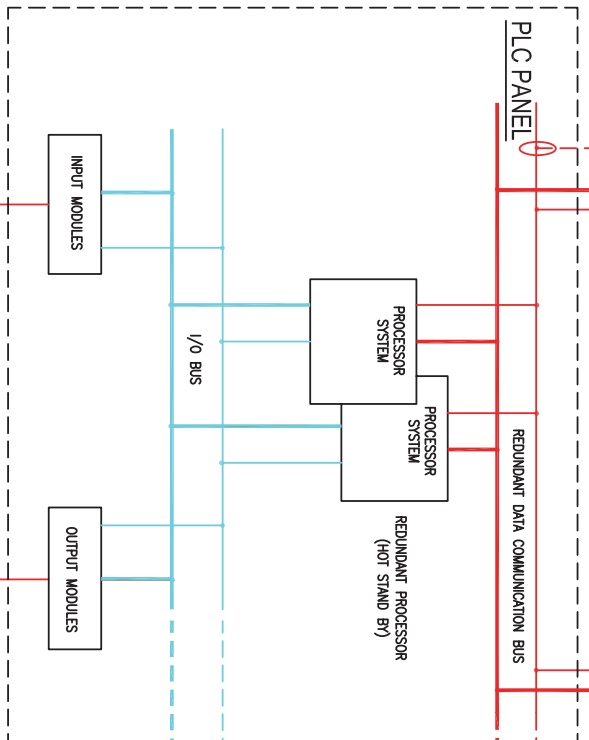
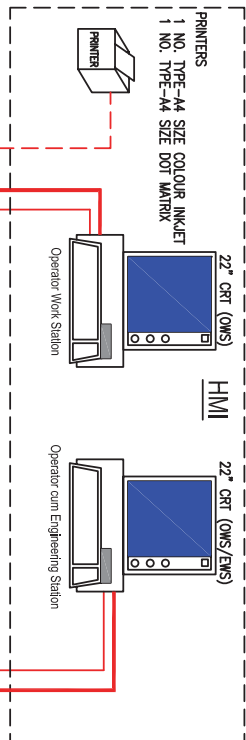
## 9. PERFORMANCE AND GUARANTEE

The PLC system shall be guaranteed to meet the performance requirement as specified and also for trouble-free continuous operation for 12 months from the date of commissioning or 18 months from the date of delivery at site whichever is later unless specified otherwise in Vol-II B Section - B or Section - C.

## 10. APPLICABLE DATA SHEET FORMS

This document shall be read with the following data sheet forms :

- Data Sheet A & B for PLC system - PE-DC-999-145-I036-1
- Data Sheet C for PLC system - PE-DC-999-145-I036-2




- NOTES:**
- 1) TABLE TOP OWS/EWS SHALL BE 22" OR AVAILABLE INDUSTRY STANDARD.
  - 2) GRAPHIC USER INTERFACE OF COLTCS SHALL BE PANEL MOUNTED. NO. & SIZE OF GUI SHALL BE AS PER DATASHEET
  - 3) PLC SYSTEM SHALL HAVE REDUNDANCY IN PROCESSOR AND COMMUNICATION SYSTEM.
  - 4) UPS POWER SUPPLY SHALL BE PROVIDED FOR PLC PANEL(S), OWS/EWS AND NETWORK COMPONENTS.
  - 5) POWER SUPPLY ARRANGEMENT FOR PLC SYSTEM SHALL BE AS SHOWN ON SHEET 4 OF 4.
  - 6) PLC PANEL SHALL HAVE PROVISION TO ACCEPT TIME SYNC. SIGNAL (NTP/IRIG-B) FROM MASTER CLOCK SYSTEM (PLANT AREA).
  - 7) PLC PANEL SHALL HAVE PROVISION FOR DATA EXCHANGE (OPC/MODBUS) WITH PLANT DCS.


- LEGEND:-**
- PROGRAMMABLE LOGIC CONTROLLER
  - DISTRIBUTED CONTROL SYSTEM
  - UNINTERRUPTED POWER SUPPLY
  - OPERATOR WORK STATION/ ENGINEERING WORK STATION
  - HUMAN MACHINE INTERFACE
  - NETWORK TIME PROTOCOL
  - OLE PROCESS CONTROL
  - MOULDED CASE CIRCUIT BREAKER
  - MINATURE CIRCUIT BREAKER
  - REMOTE PROCESSING UNIT



PLC SYSTEM CONFIGURATION			
DRG. NO.	REV. No.	DATE	SHEET
PE-DM-391-145-1900	01	14.03.14	03 OF 04

	<b>DATA SHEET FOR PLC SYSTEM</b>		SPECIFICATION NO.: PE-DC-999-145-1036-1	
			VOLUME II B	
			SECTION D	
			REV. NO. 03	DATE: 18.03.2014
			SHEET 1	OF 2
Data Sheet No.: PES-145-36-DS1-0				
<b>Data Sheet A &amp; B</b>				
DATA SHEET-A FOR PLC SYSTEM (TO BE FILLED BY PURCHASER)			DATA SHEET – B (TO BE FILLED BY BIDDER)	
<b>GENERAL</b>	PROJECT			
	SERVICE			
	QUANTITY	<input type="checkbox"/> UNITISED	<input type="checkbox"/> COMMON	
	LOCATION	<input checked="" type="checkbox"/> INDOOR <input type="checkbox"/> AC	<input type="checkbox"/> OUTDOOR <input checked="" type="checkbox"/> NON-AC*	
<b>PLC EQUIPMENT</b>	MAKE / MODEL NO.	BIDDER TO INDICATE		
	<b>PROCESSOR</b>	REDUNDANT WITH HOT STANDBY		
	DATA BUS (HMI)	<input type="checkbox"/> COPPER WIRE	<input type="checkbox"/> FIBRE OPTIC	
	DATA BUS (I/O - CPU)	<input type="checkbox"/> COPPER WIRE	<input type="checkbox"/> FIBRE OPTIC	
	DATA BUS (REMOTE I/O - CPU)	<input type="checkbox"/> COPPER WIRE	<input checked="" type="checkbox"/> FIBRE OPTIC	
	FIELD CONTACTS INTERROGATION VOLTAGE	<input checked="" type="checkbox"/> 24 V DC	<input type="checkbox"/> 48 V DC	<input type="checkbox"/> 110 V AC
	LOCATION OF COUPLING RELAYS	<input checked="" type="checkbox"/> MCC	<input type="checkbox"/> PLC PANEL	
	DESKTOP OWS QUANTITY	<input type="checkbox"/> ONE <input checked="" type="checkbox"/> TWO <input type="checkbox"/> _____ <input type="checkbox"/> DESKTOP VERSION <input type="checkbox"/> SERVER VERSION <input checked="" type="checkbox"/> WORK STATION VERSION REQUIREMENT OF OWS IN CCR <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO QUANTITY _____		
	DESKTOP MONITOR TYPE	<input type="checkbox"/> 19" <input checked="" type="checkbox"/> 22" <b>TFT/CRT MONITOR</b> <input checked="" type="checkbox"/> GIU <input type="checkbox"/> OTHERS		
	PRINTER	INKJET <input type="checkbox"/> A3_NOS <input type="checkbox"/> A4_NOS LASER B/W <input type="checkbox"/> A3_NOS <input type="checkbox"/> A4_NOS COLOR INKJET <input type="checkbox"/> A3_NOS <input type="checkbox"/> A4_NOS COLOR LASER <input checked="" type="checkbox"/> A3_NOS <input checked="" type="checkbox"/> A4_NOS		
PROGRAMMING / CONFIGURATION FACILITY	A) <input type="checkbox"/> HAND HELD <input type="checkbox"/> LAPTOP B) ENGINEERING SOFTWARE <input checked="" type="checkbox"/> ONE OWS <input type="checkbox"/> ALL OWS <input type="checkbox"/> _____			
SAFETY STANDARD	<input type="checkbox"/> SIL-3 <input type="checkbox"/> SIL-2 <input type="checkbox"/> NIL			
<b>SPARE LIST</b>	COMPUTER FURNITURE	BOQ <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO INDUSTRIAL GRADE <input type="checkbox"/> YES <input type="checkbox"/> NO		
	SPARE LIST	<input type="checkbox"/> START UP & COMMISSIONING <input checked="" type="checkbox"/> MANDATORY SPARE <input type="checkbox"/> RECOMMENDED		
	SPARE LIST ATTACHED	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
<b>REDUNDANCY</b>	CPU	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
	POWER SUPPLY	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
	COMMUNICATION	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
	I/O CARD	<input type="checkbox"/> YES <input type="checkbox"/> NO		
	OTHER ELECTRONICS	<input type="checkbox"/> YES <input type="checkbox"/> NO		

Printer shall be as per C&I scope sheet.

	<b>DATA SHEET FOR PLC SYSTEM</b>		SPECIFICATION NO.: PE-DC-999-145-I036-1	
			VOLUME II B	
			SECTION D	
			REV. NO. 03	DATE: 18.03.2014
			SHEET 2	OF 2
Data Sheet No.: PES-145-36-DS1-0				
<b>Data Sheet A &amp; B</b>				
DATA SHEET-A FOR PLC SYSTEM (TO BE FILLED BY PURCHASER)			DATA SHEET – B (TO BE FILLED BY BIDDER)	
<b>No. of CHANNELS PER CARD</b>	ANALOG INPUT	<input checked="" type="checkbox"/> 8 NOs	<input checked="" type="checkbox"/> 16 NOs	
	ANALOG OUTPUT	<input checked="" type="checkbox"/> 8 NOs	<input checked="" type="checkbox"/> 16 NOs	
	BINARY INPUT	<input checked="" type="checkbox"/> 16 NOs	<input checked="" type="checkbox"/> 32 NOs	
	BINARY OUTPUT	<input checked="" type="checkbox"/> 16 NOs	<input checked="" type="checkbox"/> 32 NOs	
	RTD**	4 NOs		
	THERMOCOUPLE**	8 NOs		
ELECTRONIC CARD ISOLATION		<input type="checkbox"/> GALVANIC <input checked="" type="checkbox"/> OPTICAL <input type="checkbox"/> OTHER		
<b>PANEL</b>	QUANTITY	BIDDER TO INDICATE		
	CLASS OF PROTECTION(Refer Location of PLC)	IP-65		
	REMOTE I/O PANEL	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO AC REQUIREMENT <input type="checkbox"/> YES <input type="checkbox"/> NO		
	COLOUR#	RAL 7032		
	BACK-UP DESK	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO		
	MIMIC	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO IF YES, THEN <input type="checkbox"/> PANEL MOUNTED GUI <input type="checkbox"/> ACRYLIC		
	CONTROL HARDWARE	<input checked="" type="checkbox"/> PB <input checked="" type="checkbox"/> INDICATORS <input type="checkbox"/> FACIAS _____ Nos. <input checked="" type="checkbox"/> OTHERS		Alarm facia to be decided during detailed engineering
	CONFORMAL COATING	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO		
<b>COMMUNICATION WITH OTHER SYSTEM</b>	HARDWIRED	<input type="checkbox"/> YES (Critical Signals only) <input type="checkbox"/> NO		
	PURPOSE	<input type="checkbox"/> CONTROL <input checked="" type="checkbox"/> MONITORING		
	MEDIUM	<input type="checkbox"/> UTP <input checked="" type="checkbox"/> FIBRE OPTIC <input type="checkbox"/> OTHERS		
	TIME SYNCHRONIZATION SIGNAL FORMAT	<input type="checkbox"/> PULSE <input type="checkbox"/> RS-485 <input checked="" type="checkbox"/> IIRIG-B <input type="checkbox"/> NTP		
	SOFTLINK	<input type="checkbox"/> MODBUS <input checked="" type="checkbox"/> OPC IF MODBUS THEN <input type="checkbox"/> RS-485 <input type="checkbox"/> ETHERNET		
	SERIAL LINK	COMMUNICATION PORT TYPE _____		
<b>POWER SUPPLY INPUT FEEDER</b>	PLC PANEL	BIDDER TO INDICATE LOAD DATA		
	REMOTE I/O PANEL	BIDDER TO INDICATE LOAD DATA		
<b>POWER SUPPLY</b>	SOURCE \$\$	<input type="checkbox"/> UPS(INDUSTRIAL GRADE) <input type="checkbox"/> 24V DC CHARGER		UPS feeder shall be from main plant UPS (BHEL SCOPE)
	BATTERY TYPE	<input type="checkbox"/> Ni-Cd <input type="checkbox"/> LEAD ACID <input type="checkbox"/> OTHERS		
	BACK-UP TIME	<input type="checkbox"/> 30 MINS <input checked="" type="checkbox"/> 60 MINS <input type="checkbox"/> OTHERS		
	BATTERY CONFIGURATION	<input type="checkbox"/> 1X100% <input checked="" type="checkbox"/> 2X100% <input type="checkbox"/> 2X50%		
<b>CUSTOMER TRAINING</b>	TRAINING	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
	NO OF DAYS	7 DAYS		
	LOCATION	<input checked="" type="checkbox"/> VENDOR'S WORK <input type="checkbox"/> PROJECT SITE <input type="checkbox"/> OTHERS		

\*IF THE LOCATION IS INDOOR,KINDLY SPECIFY IF PLC PANEL IS PLACED IN AC OR NON-AC ENVIRONMENT.


\*\*SHALL NOT BE APPLICABLE IF TEMPERATURE TRANSMITTERS ARE ENVISAGED.

# PROJECT SPECIFIC PAINT SHADES, IF APPLICABLE TO BE USED.

\$\$ CHECK & REPLACE WITH MAIN UPS SLD IF POWER SUPPLY IS NOT APPROVED BY CUSTOMER.

SPECIFIC TECHNICAL REQUIREMENTS

FORM NO. PEM-6866-0

	<p><b>DATA SHEET FOR PLC SYSTEM</b></p>	SPECIFICATION NO.:	
		VOLUME II    B	
		SECTION D	
		REV. NO.    02	DATE:            19.07.2008
		SHEET        1	OF                1
Data Sheet No.: PES-145-36-DS2-0			
<b>Data Sheet C</b>			
DATA SHEET – C (TO BE FILLED BY BIDDER AFTER AWARD OF CONTRACT)			
<b>GENERAL*</b>	PROJECT		
	SERVICE		
	QUANTITY		
	LOCATION		
<b>PLC EQUIPMENT</b>	MAKE / MODEL NO.		
	<b>PROCESSOR</b>		
	DATA BUS (HMI)		
	DATA BUS (I/O - CPU)		
	DATA BUS (REMOTE I/O - CPU)		
	FIELD CONTACTS INTERROGATION VOLTAGE		
	LOCATION OF COUPLING RELAYS		
	DESKTOP OWS QUANTITY		
	DESKTOP MONITOR TYPE		
	PRINTER (A4) - QUANTITY		
	PRINTER (A4) - MODEL		
	PROGRAMMING / CONFIGURATION FACILITY		
	SAFETY STANDARD		
	COMPUTER FURNITURE		
<b>PANEL</b>	QUANTITY		
	CLASS OF PROTECTION		
	REMOTE I/O PANEL		
	COLOUR		
	BACK-UP DESK		
	MIMIC		
	CONTROL HARDWARE		
<b>COMMUNICATION TO OTHER SYSTEM</b>	HARDWIRED		
	PURPOSE		
	MEDIUM		
	TIME SYNCHRONIZATION SIGNAL FORMAT		
	SOFTLINK		
	SERIAL LINK		
<b>POWER SUPPLY INPUT FEEDER</b>	PLC PANEL		
	REMOTE I/O PANEL		

**2.3.0**

**MEASURING INSTRUMENTS**

**VOLUME : IIE**

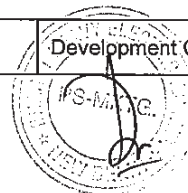
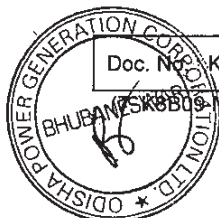
**SECTION-VI**

**TECHNICAL SPECIFICATION - INSTRUMENTS AND SYSTEMS**

1.00.00 ~~FIELD INSTRUMENTS~~  
 For TG - I&C (SAG Portion), ~~HART based Field process transmitters shall be possible only for pressure and delta pressure transmitters~~

1.01.00 **PRESSURE, DIFFERENTIAL PRESSURE, FLOW AND LEVEL TRANSMITTER**

- 01. Working Principle : Smart
- 02. Type : 2-Wire
- 03. Output signal : Simultaneous transmission of digital and 4-20 mA DC signal. HART protocol.
- 04. Signal Processing Unit : Silicon solid-state electronic circuitry
- 05. Measuring element : Capsule/Diaphragm
- 06. Element material : AISI-316 (Stainless Steel) or better
- 07. Over Pressure : 150% of maximum pressure
- 08. Turn-down ratio : 10:1 for vacuum / very low pressure application.  
30:1 for other application
- 09. Span and Zero : Continuous non-interacting tamper proof, remote as well as manual adjustable from instrument with zero suppression and elevation facility.
- 10. Enclosure : Epoxy coated Die cast aluminium. IP-65 (Explosion proof for NEC Class-1, Division 1 area) with ½" NPT (F) cable entry.
- 11. Output Indicator : LCD type
- 12. Body : Forged Carbon Steel (SS for DM Water)
- 13. Operating Voltage : 24 V DC ± 10%
- 14. Load : 600 Ohms (min.) at 24 Volts DC
- 15. Performance :-





10. Accessories : a) Mounting accessories, prefab cable etc.  
b) ½" NPT cable gland

**1.06.00 CLAMP ON TYPE ULTRASONIC FLOW TRANSMITTER**

01. Type : Single Channel, Transit time Ultrasonic
02. Transducer : Clamp on type
03. Accuracy : ± 1 % of span or better
04. Repeatability : 0.1 to 0.3% with unchanged transducer position
05. Response Time : 0-99 sec user programmable
06. Rangeability : 40:1
07. Output signal : Two (2) 4-20 mA DC isolated output  
One (1) Pulse output
08. Output contacts : 2 NO & 2 NC Potential free changeover contacts @ 5A 230V AC for each set point.
09. Communication Interface : RS 485, supported by Modbus protocol
10. Enclosure Class : IP 65
11. Output Indicator for instantaneous Flow Rate, Velocity & Totalized flow : LCD Graphic display with membrane type key pad
12. Operating Voltage : 240 VAC (UPS) or 24 VDC
13. Load : 600 Ohms (min.) at 24 volts DC.
14. Transmitter Mounting : 2" pipe mounted or Wall Mounted type
15. Nameplate : Tag number and service engraved SS tag plate
16. Ambient Temperature : 55 Deg.C.for Transmitter  
(-) 20 to 100 Deg. C for Transducer
17. Accessories : a) Installation accessories with stainless steel clamping fixture with rigid rail, chain or strap  
b) ½" NPT Cable gland

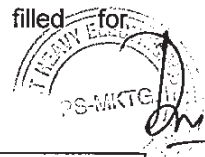
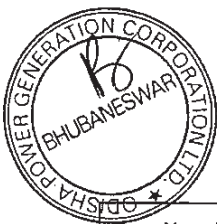


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- 07. Accuracy :  $\pm 2\%$  of full scale detection or better for on-line type and  $\pm 4\%$  of full-scale detection or better for by-pass type.
- 08. Nameplate : Tag number, service engraved in stainless steel tag plate
- 09. Accessories : Slip-on orifice plate of 316-SS and taps of CS / SS as per application. Applicable CS / SS Isolation valves and SS Range Orifice - for bypass type rotameters.

**1.09.00 PRESSURE GAUGE AND DIFFERENTIAL PRESSURE GAUGE**

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



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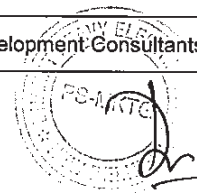


- b) Stainless steel Diaphragm seals for corrosive, viscous and solid-bearing or slurry type process fluids.
- c) Gauge saver wherever required
- d) 3-Way stainless steel Gauge valve for pressure gauges. Process connection 1/2" NPT.
- e) 5-valve SS316 manifold constructed from barstock for differential pressure gauge. Process connection 1/2" NPT.
- f) Union, nut & tail piece and other Installation accessories as required.

- 16. Applicable standard : IS-3624 / 1996
- 17. Electrical Contact rating : Not applicable
- 18. Nameplate : Tag number, service engraved in stainless steel tag plate

**1.10.00 TEMPERATURE GAUGE**

- 01. Type : Bimetallic & all angle tiltable
- 02. Sensing Element Material : Bimetal strip helix
- 03. Stem Diameter : 1/4"
- 04. Stem Material : AISI 304
- 05. Thermometer connection to well : 1/2" NPT / SS 304
- 06. Case Material : Sturdy, corrosion resistant series 304 stainless steel case and bezel.
- 07. Dial Size : 5" in general
- 08. Scale : Anti parallax heavy gauge aluminum with white matte finish glare free. Black lettering on white background.
- 09. Pointer : Balanced, lightweight aluminum with matte black finish.
- 10. Dampener : Dampening pointer oscillation
- 11. Mounting : Surface with adjustable angle.
- 12. Over range Protection : 150 % of range or more



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- 03. Input : Thermocouple K / E & R and RTD (Pt 100)-3/4 wire
- 04. Isolation : 500V AC
- 05. Output Signal : Simultaneous transmission of digital and 4-20 mA DC signal. HART protocol.
- 06. Signal Processing Circuitry : Microprocessor based Solid State Electronic
- 07. Span and Zero : Adjustable in field, Non-interacting facility for elevation and suppression of zero.
- 08. Enclosure Class : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
- 09. Output Indicator : LCD type
- 10. Span Adjustability : Yes
- 11. Nameplate : Tag number to be engraved on metallic tag plate rigidly fixed to the body.
- 12. Body : Die Cast aluminum
- 13. Operating Voltage : 16-48 V dc
- 14. Load : 600 Ohms at 24V DC (Min.)
- 15. Performance
  - a) Accuracy : 0.4% of span
  - b) Repeatability :  $\pm 0.05\%$  of span
  - c) Cold Junction Compensation: Built-in
  - d) Calibration : As per N.I.S.T Monograph 125 for T/C and European Curve Alpha = 0.00385 for RTD
- 16. Accessories :
  - a) Universal mounting bracket suitable for pipe and surface mounting.
  - b) Hi-tensile Carbon Steel U-bolts.
  - c) 1/2" NPT cable gland


**1.14.00 PRESSURE SWITCH AND DIFFERENTIAL PRESSURE SWITCH**

- 01. Type :
  - a) Piston for high pressure application
  - b) Bellow / Diaphragm for low pressure application
- 02. Sensing element material : AISI SS-316. All other wetted part SS316.



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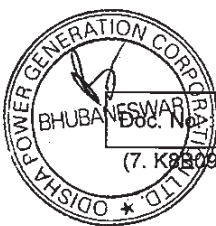
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- 03. Case Material : Epoxy coated Die-cast aluminum alloy with neoprene gasket.
- 04. Setter Scale : Required.
- 05. Over range : 150 % of maximum pressure
- 06. Adjustments : Internal Set Point adjustable over span
- 07. Process Connection : 1/2" NPT (M) bottom connected
- 08. Switch configuration : One DPDT (Two SPDT)
- 09. Switch Rating : 240V, 5A AC/220V, 0.5A DC
- 10. Switch Type : Snap acting, shock & vibration proof
- 11. Terminal Block : Suitable for full ring lugs for cable connection.
- 12. Cable connection : ½" NPT conduit connection or compression gland.
- 13. Enclosure Class : IP-65 (Explosion proof for NEC Class-1, Division 1 area).
- 14. Performance : Repeat accuracy ±1.0%
- 15. Nameplate : Tag number, service engraved in stainless steel tag plate
- 16. Accessories :
  - a) Remote diaphragm seal with SS-316 capillary for viscous & corrosive application. MOC of seal material shall be as per process fluid requirement.
  - b) Retention ring and screws for surface mounting.
  - c) 1/2" NPT 2 Valve SS-316 manifold constructed from bar stock for pressure switch
  - d) 1/2" NPT 3-Valve SS-316 manifold constructed from bar stock for DP switch
  - e) ½" NPT cable gland

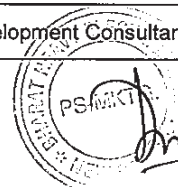
**1.15.00 TEMPERATURE SWITCH**

- 01. Type : Bimetallic / gas filled-in
- 02. Stem /Bulb Material : AISI SS-316
- 03. Capillary : SS Capillary & Flexible armour



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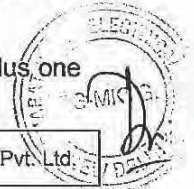
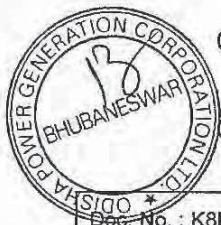
08. Feature : No perceptible drop of pressure on opening the drain port.

**1.26.00 SOLENOID VALVE**

- 01. Operating Principle : Electromagnetic (noiseless)
- 02. Coil voltage rating : 24V DC (in general) other 220V DC /240V AC /110V AC as per manufacturer recommendation.
- 03. Ways : 3 ways in general other depending on requirement
- 04. Port size : 1/4" NPT all ports
- 05. Body : SS Bar Stock
- 06. Trim : AISI SS-316
- 07. Manual Operator : In built
- 08. Duty : Suitable for continuous energization
- 09. Sealing : Airtight and leak proof
- 10. Fluid Temperature : 0-150 ° C (approx.)
- 11. Coil Enclosure : Stainless Steel
- 12. Insulation : Class-H
- 13. Coil Casing : IP-65 (Explosion proof for NEC Class-1, Division-1 area)
- 14. Mounting : On pipe or on panel
- 15. Cable Connection : ½" NPT cable gland
- 16. Accessories : Mounting brackets, nuts and bolts as required.
- 17. Special feature : a) LED indication  
b) Double coil type.

**1.27.00 ORIFICE PLATE**

- 01. Application : Low fluid velocity flow measurement
- 02. Design Standard : Concentric as per ASME PTC 19.5 (part-II), ISA RP-3.2 or BS-1042, Part-I
- 03. Tapings : Flanged weld neck. No. as required plus one additional pair of taps





~~codes specified and in accordance with the detailed specification. All sources of material shall be disclosed and relevant test certificates for the physical and chemical properties of the material shall be made available to the Buyer before the final shop inspection.~~

7.01.02 **Hydrostatic Test**

All piping shall be subjected to the hydrostatic test pressure at shop for a duration of 30 minutes (min) as required by the IBR or any other applicable standards. Test pressure shall be at least 1.5 times the design pressure.

Hydrostatic test of all pipes coming under IBR shall be offered for witnessing by the representative of the Inspecting Authority recognised by IBR.

**In lieu of Hydro test 100% UT + ECT shall be conducted on all raw piping at Pipe Manufacturer shop. Fabricated piping spools shall be subjected to Hydro test or 100% RT / UT of weld joints. All fillet welds shall be MP / DP checked.**



7.01.03 **Wall Thickness Tests**

Wall thickness tests shall be made on a length of pipe of each type to determine the actual wall thickness at outer wall of bend on such piping.

The tests shall be done before fabrication on the piping system and results submitted to Buyer for acceptance.

7.02.00 **Capacity Tests for Pipe Supports**

Each constant load and spring support shall be tested before delivery to ensure that the variation in support capacity provided through the specified ranges (i.e. the difference in load between hot conditions and cold condition) does not exceed 6 percent for constant load supports and 20 percent for variable spring supports.

All materials shall be of tested quality. Hanger springs shall be properly calibrated.

7.03.00 **Testing of Valves & Specialties at Works**

7.03.01 All materials shall be of tested quality and the Seller shall submit the relevant material test certificate for the acceptance of Buyer.

7.03.02 All Valves and Specialties as well as counter flanges to be used in steam service shall have IBR certification marked on them and IBR certificates in appropriate proforma shall be submitted.

7.03.03 Gate valves shall be subjected to shop tests in accordance with API-598 including the high-pressure closure test. Globe valves shall be tested in accordance with BS-1873 and check valves in accordance with BS-1868.



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7.03.04 All gaskets used for test shall be of the same material and design as specified for the finished product.

7.03.05 Each relief valve shall be subjected to hydrostatic test, seat pressure test, seat leakage test and test for relieving capacity.

The valve body test pressure shall be ~~at least twice~~ **1.5 times** of the set pressure.



The seat test pressure should be at least equal to the set pressure. During this test, the valve seat shall be demonstrated to be watertight for a period of at least two (2) minutes.

7.03.06 Functional tests : The fully assembled or completed valves including the operators and accessories shall be functionally tested to demonstrate the operability of the valve and the operator. This may be done by cycling typical valves 3 or 4 times from open to close position. The manual operation of the motor operated valves using the manual override to demonstrate freedom from friction shall also be conducted.

7.03.07 All Control valves shall be tested in accordance with the quality assurance programme agreed between the Buyer and Seller which shall meet the requirements of IBR and other applicable codes mentioned elsewhere in the specifications. The tests shall include but not be limited to the following:

Non destructive test as per ANSI B-16.34

Hydrostatic shell test in accordance with ANSI B 16.34 prior to seat leakage test.

Valve closure test and seat leakage test in accordance with ANSI- B 16.34 and as per the leakage class.

Functional test: The fully assembled valves including actuators control devices and accessories shall be functionally tested to demonstrate times from open to close position.

CV test: CV test ~~shall be carried out as~~ **report not older than 5 (five) years** type test on each size, type and design of the valves as per ISA 75.02 standard and test report shall be furnished for Buyer's acceptance.



7.04.00 **Tests on Strainers and Traps at Works**

7.04.01 All strainers shall be subjected to hydrostatic test. The test pressure shall be twice the design pressure.

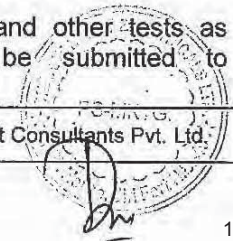
7.04.02 All steam traps shall be subjected to hydrostatic test at twice the design pressure. IBR certification shall be furnished for all steam traps.

Test reports and certificates of the mentioned tests and other tests as required to ensure satisfactory operation shall be submitted to



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Buyer/Consultant before despatch of equipment IBR certification as required shall be furnished.

7.06.00 All rubber lining should be subjected to tests as per IS: 4682 (Part-I).

7.07.00 **Tests at Site**

Erection Contractor in the presence of the Seller shall carry out tests at site to prove to the Buyer / Seller that the equipment of the plant complies with requirements stipulated and is erected in accordance with requirements. Before the plant is put on trial run the Erection Contractor in the presence of the Buyer / Seller shall be required to conduct tests to demonstrate to the Buyer that each item of the plant is capable of correctly performing the functions for which it was specified. These tests may be conducted concurrently with those required under commissioning sequence. Tests required shall in general be as follows:

- a) All piping, valves and specialties after installation, shall be tested hydraulically at a pressure, one and a half times that of the maximum design/working pressure in the system for a minimum duration of thirty (30) minutes to check against leak tightness.
- b) All manually operated valves/gates shall be operated throughout 100% of the travel and these should function without any trouble whatsoever.
- c) Visual check on all structural components, welding, painting etc. and if doubt arises these shall be tested again.
- d) All test instruments and equipment shall be furnished by the Seller to the satisfaction of the Buyer.
- e) Checks on electrical items as mentioned in relevant electrical specification.

7.08.00 **Installation Guidelines (for design)**

7.08.01 For all steam blowing lines temporary strainers shall be installed at the equipment terminals so as to prevent any inflow of particles where that may cause any damage or harmful effect. For example, such strainers shall be placed on main steam and hot reheat line terminals at turbine end unless the turbine stop valves/interceptor valves have integral strainers suitable for the purpose. The temporary strainers shall be kept on line for sometime after the plant starts normal operation, as per the discretion of the Buyer. So, the design of strainers shall be based on the design conditions of the pipes on which they are installed. Where flow meters are to be installed in pipes requiring steam blowing, initially the pipes shall be erected with the flow meter branch pipes replaced by temporary spool pieces. After the end of steam blowing operation the temporary spool pieces shall be removed and the flow meter branch pieces shall be erected in position. In case such a pipe has also to be subject to cold pull- up, temporary anchoring of the main pipe on either ends of the temporary spool piece shall be done before replacing it by the flow-meter branch pipe.

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All piping shall be installed in a manner such that expansion shall take place in the direction desired so that vibrations shall be minimised. The Seller shall be responsible for the expansion provisions and flexibility of all field run piping. No piping shall be cold-sprung or cold-pulled unless there remains absolutely no other means to bring down the hot stress or terminal forces/moments within acceptable limit. All such cold pull up shall be shown in the piping drawings, along with a write-up describing clearly the method adopted for cold-pulling. All necessary attachments for cold-pulling, along with temporary anchors, as and wherever required, shall be provided.

The forces and moments on the temporary anchors and attachments shall be submitted. The cold pull-ups and all the above-mentioned documents shall be subject to the approval of the Consultant.

7.08.02

All expansion bellows shall be installed with a minimum of two tie rods or bolts across each bellows to prevent the bellows from opening under pressure. The connection of the tie rods or bolts to the pipe shall make adequate provision for angular movement of the pipe and bellows.

Pump suction pipes shall be installed in such a manner that no air can be trapped in the suction piping. Suction pipes shall be supported in such a manner that there shall be no high spots where air can be trapped. The in trades of suction branch lines shall be in no place lower than the in trades of the manifold at the point where the branch line connects to the manifold.

Standard "Factory Made" fittings shall be used in all piping. Shop or site fabricated mitred fittings shall not be used, except for Large Diameter Piping unless accepted by the Buyer.



7.08.03

During erection no weights must be lifted by means of tackle fastened to the beams or slabs of the floor or roof except where provision has been specifically made for this purpose.


Supporting straps around flanges of pipes or valves or around welded joints shall not be accepted. Anchors shall be attached to pipe by approved means. All supports should be shop fabricated and should be positioned before erection of the piping takes place and near to joints and valves wherever possible.

7.08.04

The Seller shall provide all the necessary wall boxes and collars where pipes pass through walls, floors and roofs, also the necessary supports for any trenched pipes. Roof collars shall be fitted with a high sealing to prevent water falling through the holes.

The wall boxes and floor collars shall be constructed so that they can if necessary be erected after the pipes are in position. Pipes passing through roof collars shall be provided with an approved pipe sleeves, weather hood and cowl which shall be fixed by the Seller. Floor collars shall extend to an approved height above the floor level and the pipes shall be fitted with hoods where required.



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7.08.05 Drain pipe work shall be designed as per ANSI B31.1.

High pressure drains (above 40 kg/sq.cm) shall have two valves in series and that near the condenser or flash box shall be motor operated arranged to open and close to ensure minimum wear on one valve.

No part of any drain line may be below its terminal point at the condenser, drain collection header or other drain vessel. All drain manifold connections to the condenser or flash tank must be above the maximum water level in the tank

High-pressure drains shall have a screw-down non-return valve at the point of discharge near the manifold of the Flash tank to prevent back flow of flashed steam.

Drain line should be connected at a 45 degree angle to the manifold axial centerline with the drain line discharge pointing towards the condenser.

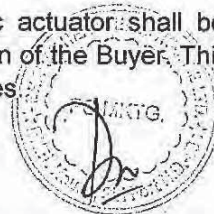
Low-pressure drains shall have steam traps of an approved design complete with strainers, isolating valves and by-pass valves.

Low-pressure drains shall have an isolating valve at the point of take-off from the pipe or vessel to be drained or as near as possible for convenient operation.

Drain pockets of an approved size and construction shall be provided for all steam lines.

Arrangement of valves in the drain line shall be as shown in the Seller's P & I Diagram.

7.08.06 All electrical actuators and pneumatic/hydraulic actuator shall be erected, aligned, adjusted and finally set to the satisfaction of the Buyer. This includes adjustment and setting of torque and limit switches



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8.00.00 **DRAWINGS, DATA, INFORMATION & MANUALS**

8.01.00 Not used.

8.02.00 **After Award of Contract**

8.02.01 Layout drawings as well as Isometric drawings (for line sizes NB 50 mm and larger) showing the routing of various piping and location of hangers, restraints, anchors, valves etc.

8.02.02 Detail fabrication drawings of all shop fabricated piping system indicating design parameters and complete bill of material (Relevant Standards and grades to be indicated) and information/ data pertaining to the hydrostatic and non-destructive test requirements.

8.02.03 Detail dimensioned drawing of each valve, specialties, indicating tag no., pressure rating, manufacturing standard, bill of material and hydrostatic test pressures. The drawing shall include the end preparation details and shall indicate the position of the hand wheel/operator. Technical particulars of motor operators wherever applicable shall also be indicated.

8.02.04 Detail dimensioned drawing of each type of hangers and supports including guides, anchors, snubbers etc. with bill of materials (relevant standards and grades to be indicated).

8.02.05 General arrangement drawing for each hanger/support/anchor etc. indicating identification number, auxiliary supporting structural details, other details and information as required in the specification and typical details of Hangers & supports drawing enclosed with the specification.

8.02.06 Wiring diagram for all limit switches of motor operated valves.

8.02.07 Detail drawing with design calculation for the special Y-fittings on pipes, if any.


8.02.08 The loading data required for design of structures.

8.02.09 **Miscellaneous Data/Documents**

a) Complete schedule of pipe lines in a format as accepted by the Buyer / Consultant indicating at least the line number, line description, pipe class (as per specification designation) design pressure and temperature, hydrostatic test pressure, insulation thickness, valve specification code, pipe material indicating standard and grade, number of BW/SW/Flanged joints and whether IBR certification needed

b) Complete schedule of valves in format as approved by the Buyer/Consultant indicating at least tag no, location, size, pressure



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class, design parameters, operation, make, quantity, special requirement if any etc.

- c) Bill of material of hangers and supports in a format approved by the Buyer/Consultant indicating at least the hanger/support number, type, operating load, cold setting load, Hydrostatic test load, movement of attachment point in X, Y and Z direction, line no. on which the hanger/support is located, insulation thickness of the pipe line, hanger rod length, angular deflection of hanger rod from vertical under hot and cold conditions etc.
- d) Approval certificates from IBR in relevant forms regarding design, fabrication and testing of piping and valves for the piping system, which are under the purview of IBR.
- e) Design calculation for pipe wall thickness finally adopted.
- f) Reinforcement calculations as per ANSI B 31.1 for all set on type branch connections.
- g) A document containing the flexibility analysis procedure and results showing the forces and moments at various support points, anchors, equipment terminals etc. as elaborated before in this specification.
- h) Procedure of shop and site tests, test reports and test certificates for all tests conducted at shop.
- i) Quality assurance schedule, including report containing all pertinent details of the heat-treating cycle for all pipes, fittings, valves, specialties etc.
- j) Detailed erection procedure for piping, valves, specialties and auxiliary equipment including complete details of welding of joints to be done at site. All necessary instructions/recommendation shall be given for satisfactory erection of piping, valves specialties and auxiliary equipment.
- k) Erection, operation and maintenance manuals.



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5.17.02 **Controller**

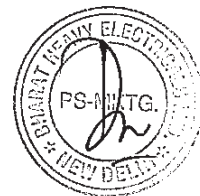
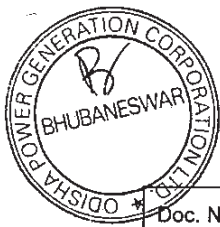
- 01. Type : Microprocessor based, multi-loop and multi-function
- 02. Word length : 32 bits
- 03. Register add cycle time : 1 microsecond
- 04. Instruction cycle time : 75 microseconds (max.)
- 05. Memory : EPROM & EEPROM and RAM (battery backed up) as required.
- 06. Redundancy Supported : Yes
- 07. Switch over time : **5 milli-sec. Instantaneous without any loss of data**
- 08. Mounting : Sub-rack
- 09. Configuration : From LAPTOP through front plug and from Engineering Terminal through DDCMIS data highway.
- 10. Features :
  - a) Power fail hold
  - b) Automatic restoration on power
  - c) Diagnostic display
  - d) Status display LED



5.17.03 **Operator's work Stations / Other's work Stations**

a) **CPU**

- 01. Processor : 32 / 64 bit
- 02. Memory : 1 GB
- 03. Hard drive : 40 GB SCSI or better
- 04. Floppy drive : 3½", 1.44MB
- 05. Removable bulk storage : DVD (R/RW)
- 06. Audio controller : 16-bit or better
- 07. Operating system : WIN NT or higher





b) **Monitor**

- 01. Type : LCD colour monitor (TFT based)
- 02. Screen diagonal : 22" (approx.) flat
- 03. Display : XGA or better
- 04. Resolution : 1024 X 768 or better
- 05. Degree of protection : IP-30 / as per approved sub vendor's standard.
- 06. External Controls : Brightness, contrast, Horizontal / Vertical amplification & shift
- 07. Power supply : 240 V, 50 Hz, 1 phase
- 08. Version : To suit industrial application.



c) **Key Board & Mouse**

- 01. Type : ~~Flat spill proof membrane or~~ Positive depression type ASCII.
- 02. Life Expectancy : 50 million cycles per key
- 03. Version : To suit industrial application
- 04. Mouse : Optical mouse



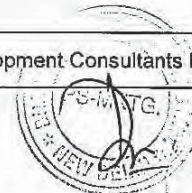
d) **Accessories**

kVM extender cable as required to install the CPUs away from the control desk in CPU rack/s located in CER / behind the video wall.

5.17.04 **Servers**

a) **CPU**

- 01. Processor : 64 Bit
- 02. Memory : 1 GB
- 03. Hard drive : 3 X 40 GB (min.) SCSI, Hot swappable
- 04. RAID : SCSI channels, Hardware RAID 5 implemented
- 05. Power supply : Redundant hot swappable
- 06. Floppy drive : 3 1/2", 1.44MB



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- 07. Removable bulk storage : DVD 6 GB (R/RW)
- 08. Operating system : Latest windows
- 09. UPS : with 30 min battery backup
- 10. Software : Additional comprehensive disk maintenance utility for disk clean sweep /crash guard/antivirus etc.

**b) Monitor**

- 01. Type : LCD colour monitor (TFT based)
- 02. Screen diagonal : 22" (approx.) flat
- 03. Display : XGA or better
- 04. Resolution : 1024 X 768 or better
- 05. Degree of protection : IP-30
- 06. External Controls : Brightness, contrast, Horizontal / Vertical amplification & shift
- 07. Version : To suit industrial application.

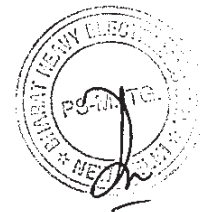
**c) Key Board & Mouse**

- 01. Type : Flat spill proof membrane or Positive depression type ASCII.
- 02. Life Expectancy : 50 million cycles per key
- 03. Version : To suit industrial application
- 04. Mouse : Optical mouse

**5.17.05 Specification of PC**

**a) CPU**

- 01. Processor : 32 bit
- 02. Main Memory : 1 GB expandable to 4 GB
- 03. Hard drive : 40 GB
- 04. Floppy drive : 3½", 1.44MB
- 05. Removable bulk storage : DVD (R/RW)
- 06. Graphic memory : 16 MB



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- 07. Audio controller : 16-bit or better
- 08. Operating system : WIN XP
- 09. Communication ports : 2 serial, one parallel, 8 USB, Dual 100Mbps Ethernet
- 10 expansion slots : 3

**b) Monitor**


- 01. Type : LCD colour monitor (TFT based)
- 02. Screen diagonal : 22" (approx.) flat
- 03. Display : XGA or better
- 04. Resolution : 1024 X 768 or better
- 05. Degree of protection : IP-30
- 06. External Controls : Brightness, contrast, Horizontal / Vertical amplification & shift
- 07. Power supply : 240 V, 50 Hz, 1 phase
- 08. Version : To suit industrial application.

**c) Key Board & Mouse**

- 01. Type : Flat spill proof membrane or Positive depression type ASCII.
- 02. Life Expectancy : 50 million cycles per key
- 03. Version : To suit industrial application
- 04. Mouse : Optical mouse

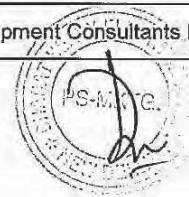
**5.17.06 Large Video Screen (LVS)**

**a) Display Screen and Projection Device**

- 01. Type of Screen : ~~LCD with black screen~~ LED based 
- 02. Screen size : 67 inch (diagonal)
- 03. Contrast ratio : 1200:1 (typical)
- 04. Angle of Vision : 180 Degree Horizontal
- 05. Resolution : XGA (1024 X 768) or better
- 06. Junction Interface : Seamless screen to screen alignment to configure in to a video wall.



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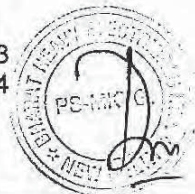





- 07. Aspect Ratio : 4:3
- b) **Graphic controller unit**
  - 01. Type : Pentium based 32 bit or higher
  - 02. Data inputs : RGB & Video
  - 03. Display control : TCP / IP / RS 232 / RS 422
  - 04. Peripherals : Mouse / Keyboard
  - 05. CD Drive : CD ROM
  - 06. Output : DVI / Video
  - 07. Power supply : Redundant hot swappable
  - 08. Software : Licensed version of software.
- c) **Graphic User Interface (GUI) Unit**
  - 01. Type : 32 bit or higher
  - 02. Memory : 1 GB (min.)
  - 03. Hard disk : 40GB
  - 04. CD Drive : CD ROM
  - 05. Operating System : Windows NT or latest
  - 06. Output : To Graphic control unit for control window positioning, size, connection to any display device etc.
  - 07. Software : Licensed version of software.

**5.17.07 Laser Printer**

- 01. Type : Colour laser, tabletop
- 02. Paper size : A3 / A4
- 03. Speed : 6 ppm (color) for A3/ 4 ppm (color) for A4  
24 ppm (B&W) for A3 / 16 ppm (color) for A4
- 04. Resolution : 600 dpi
- 05. Duty cycle : Heavy duty  
- at least 5000 pages / month for A3  
- at least 3000 pages / month for A4
- 06. First page out time : =< 1 min for color



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- 07. Paper input capacity : 3000 sheets for A3  
500 sheets for A4
- 08. Communication port : Ethernet Port in addition to standard parallel port
- 09. Accessories : a) Additional cartridge  
b) Printer stand

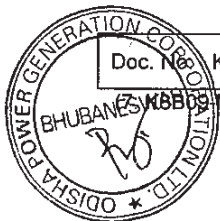
**5.17.08 Dot Matrix Printer**

- 01. No. of Needles : 24 Pin
- 02. Printing speed : 300 characters per second (approx.)
- 03. Character dimension : 9 x 8
- 06. Communication port : Ethernet Port in addition to standard parallel port
- 07. Size of paper : Fanfold, A4, A3
- 08. Reliability : MTBF more than 8000 Hrs.
- 09. Noise level : Less than 60 dBA
- 10. Ribbon life : 2 million characters
- 11. Diagnostics : Self diagnostic. LED error code display, Audio alarm – paper exhausted
- 12. No. of copies : Minimum Original plus 3 (three)
- 13. Accessories : a) Ribbon  
b) Printer stand  
c) Table top receiving tray  
d) Interface cable  
e) Paper tear box.  
f) Network interface

**5.18.00 PERFORMANCE REQUIREMENT OF THE DDCMIS (NOT APPLICABLE FOR TURBO SET SYSTEM)**

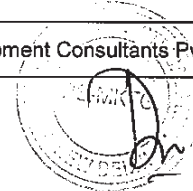
**5.18.01 Performance Requirements for Closed Loop Control System**

- a) The DDCMIS shall permit the performance of the following dynamic load tests while maintaining safe furnace conditions, major process parameters and without endangering other equipment. All tests shall be performed with the system in automatic mode :
  - i) Drop 50 percent of maximum load capability from approximately full load



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- 03. Contact : 4 change over contacts
- 04. Contact rating : 240 V /5A (A.C) / 220V /0.2A (D.C)
- 05. VA Burden : Shall match the DDCMIS /PLC O/P module
- 06. Operating range : 70 to 110% of rated voltage.
- 07. Insulation : 2 kV for 1 minute between terminal & earth.
- 08. Mechanical life : 20 million operations
- 09. Coil protection : Diode
- 10. Indication : Coil on LED
- 11. Enclosure : Transparent cover
- 12. Connection : Screw terminals.
- 13. Mounting : Projection mounting inside panel / DIN rail mounting

3.00.00 **NOT IN USE**

4.00.00 **CONTROL DESK / PANEL / RACK / ENCLOSURE**

4.00.01 **General**

- a) All unit control desks, panels, system cabinets, local panels and local instrument enclosures, racks shall be furnished fully wired with necessary provision for convenience outlets, internal lighting, grounding, ventilation, space heating, anti-vibration pads, internal piping, detachable lifting hook and accessories as per IS:5039-1969 as required for completeness of the system.
- b) Convenient and logical approach to operational interfaces and to enhance aesthetics in the overall view of the panel /desk shall be considered.
- c) All panels, desks, cabinets shall be free standing type and have bottom entry for cables unless otherwise specified. The bottom of desks, panels, cabinets, enclosures shall be sealed with bottom plate, compression cable glands and fire proof sealing material to prevent ingress of dust and propagation of fire. Thickness of gland plate shall not be less than 3 mm.
- d) Panels and cabinets shall be constructed from steel sheet reinforced as required to provide true surface and adequate support for devices mounted thereon. Thickness of the steel plate shall conform to the requirements of UL 50 or equivalent standard. Panels and cabinets shall be of adequate strength to support mounted components and to support a concentrated load of 100 Kilograms on their top after erection.





- e) For items susceptible to vibration, suitable rubber gaskets or padding shall be provided to prevent damage or malfunction.
- f) All electronic system cabinets shall be designed for 50 deg C operating under maximum ambient temperature without air conditioning system in service. Further cabinets, panels shall be so designed that temperature rise due to heat load does not exceed 10 deg. C above ambient temperature under all operating conditions. Necessary louvers, fans, limited packing density, adequate spacing between instruments, devices etc. shall be provided to maintain temperature rise within permissible limits.
- g) Desk, panels, cabinets enclosures wiring and piping shall be arranged to enable the removal of instruments and devices without unduly disturbing them.
- h) All panels, desks, enclosures interiors shall be illuminated with rapid start fluorescent strip fixtures with door actuated switches. Door switch terminals shall be shrouded. All illuminated lights shall be provided with individual switch in parallel with door switch.
- i) Sufficient number of power receptacles with disconnect switches shall be installed within panels, desks, enclosure and racks.
- j) Seller shall provide the unit control desk (UCD) and unit control panel (UCP) which shall be mounted in the unit control rooms.
- k) The local instrument enclosures / racks shall be provided locally for mounting of electronic transmitters and switches, etc.
- l) All panels, desks, cabinets shall be properly grounded. The grounding scheme shall be as approved by the Consultant.
- m) Exterior steel surface shall be sand blasted, ground smooth, filled, primed, sanded and smooth enamel painted to give a good finish subject to minimum paint thickness of 65-75 microns for sheet thickness of 3 mm and 50 microns for sheet thickness of 2mm. Minimum 2 coats of primer and two sprays of final finish colour shall be applied to all surfaces.
- n) The colour of the panels shall be glossy white ~~with fire resistant paint~~ in the panel interior. External colour of the panels shall be as light grey RAL 7032 for UCP / ECP / LIE / LIR and other system cabinets, etc.
- o) Due consideration shall be given to the ergonomics of unit control desks, unit control panels and the control room design. The design shall conform to the DIN 33414 (Ergonomical design of control room), Part-2 for cognitive factors and Part-4 for arrangement principles.
- p) Panel / cabinet shall have detachable type eyebolt on top for lifting.
- q) Panel shall be provided with three point latch and lock.
- r) Pocket shall be provided on the inner side of panel doors for keeping drawings & documents.





- s) Nameplates on the panel and terminal blocks shall be provided.
- t) All items like MCB, Terminals, instruments, lamps etc. inside the panels / cabinets shall be neatly arranged with easy access/ maintenance approach to avoid undue disturbing the wiring.
- u) Power supply feeders shall be double so that a single failure shall not affect the operation of the unit. Required isolation & protection through MCB shall be provided in all cases. Alarm shall be provided against failure of a single power supply.
- v) Crating of the panels and desks shall be suitable for protection against shock, vibration, inappropriate handling and inclement weather conditions during transportation and warehousing. All panel mounted equipment shall have adequate protection against damage during handling, transit and storage. Suitable desiccant shall be used inside the packing case.

**4.00.02 Surface Preparation and Painting**

All sheet metal panel/ desk exterior steel surfaces shall be sand blasted, ground smooth and painted as specified below:

- a) Suitable filler shall be applied to all pits, blemishes and voids in the surface. The filler shall be sanded so that surfaces are level and flat; corners are smooth and even. Exposed raw metal edges shall be ground burr-free. The entire surface shall be blast clean to remove rust and scale and all other residue due to the fabrication operation. Oil, grease and salts etc. shall be removed from the panels by one or more solvent cleaning methods prior to blasting.

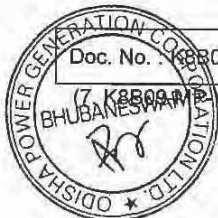
Two spray coats of epoxy primer shall be applied to all exterior and interior surfaces, each coat of primer shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final finish color (Catalyzed epoxy or polyurethane) shall be applied to all surface of dry film thickness 2.0 Mil.

- b) Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections, shall not be acceptable.
- c) Colour shade for the control desk shall be finalized during detailed engineering.

**4.00.03 Wiring**

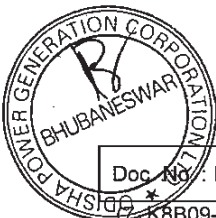
All control and instrument wiring used within the panels shall conform to IEC standards and shall be factory installed and tested at the works. All interior wiring shall be installed neatly. Features shall not be limited to the following :

- a) All spare contacts of relays, switches and push buttons shall be wired up to the terminal blocks. All interconnections between sections of panels/desks shall be furnished.



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- b) Each wire shall be identified at both ends with wire designation as per approved wiring diagram. Heat shrinkable type ferrules with indelible computerized print shall be used with cross- identification.
- c) All wire termination shall be made with insulated sleeve and crimping type lugs. All external connections shall be made with one wire per terminal. Wire shall not be spliced or tapped between terminals. Wires shall not be looped around the terminal screws or studs.
- d) Internal wiring should be terminated uniformly on one side of the terminal block leaving the other side available for termination of outgoing cables.
- e) Thermocouple lead wires, analyzer measuring lead wires, or any other lead wires carrying measuring signal of the order of low milli volt or micro volt or mA shall be electrically and physically isolated from other high voltage AC and DC wiring.
- f) Wires shall be dressed and run in trays or troughs with clamp-on type covers. Wirings may be neatly bunched in groups by non-metallic cleats or bands. Each group shall be adequately supported along its run to prevent sagging or strain on termination.
- g) Where pre-fabricated cables are used for direct connection to electronic cubicles plug-in type connectors shall be used.
- h) Shield wires of field signal cables shall be terminated on separate earthed terminals at panel end.
- i) Wiring to door mounted devices shall be provided with multi-strand wires of (49 strands minimum) adequate loop lengths of hinge-wire so that multiple door openings shall not cause fatigue failure of the conductor.
- j) Wiring shall be arranged to enable instruments or devices to be removed and/or serviced without unduly disturbing the wiring. No wire shall be routed across the face or rear of any device in a manner, which shall impede the opening of covers or obstruct access to leads, terminals or devices.
- k) Panel internal wiring shall follow distinct color-coding to segregate different voltage levels viz. 24V DC, 110V AC, 240V AC, 220V DC etc.
- l) Wire shall be multistranded annealed flexible high purity copper conductor ~~with heat resistant FRLS PVC insulation and shall pass vertical flame test per IPCEAS-4984.~~
- m) Conductor sizes used for internal wiring shall not be lower than the followings:
  - i) Power supply / receptacle : 2.5 sq. mm or higher as per load. / illumination wiring
  - ii) 4-20mA DC current : 0.5 Sq. mm and low voltage signal upto 48V DC
- n) Identification of conductors shall be done by insulation color-coding identified on drawings or by printed wiring lists.



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- o) 20% spare conductor shall be provided in the field cable for future use.

**4.00.04 Grounding**

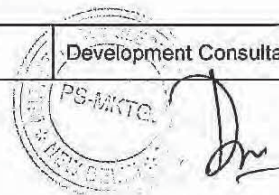
- a) System cabinet AC and DC ground shall be electrically isolated from each other and also electrically isolated from the Instrumentation signal ground. All the above ground shall be individually connected to the single point on the ground pit. Dedicated redundant earth pit shall be provided which shall be away from the HV equipment. This earth pit shall not be shared with other electrical equipment ground and shall also be insulated from other electrical system ground to ensure single point grounding of the system. Grounding resistance shall be better than 1.0 ohm. IEEE guideline shall be followed while designing the grounding system.
- b) All panels and cabinets shall be provided with a continuous tinned copper ground bus bar of minimum 25 mm x 6 mm cross section, extending along the entire length of the panel / desk / cabinet assembly. This signal ground bus shall be bolted to the panel structure on the insulated post. All shield wires shall be connected to this bus for onward connection to the earth pit. System DC power ground shall also be connected to the earth pit in similar way.
- c) The panel /desk /enclosure /JB ground shall have two (2) bolt drilling with GI bolts and nuts at each end to connect to GI / copper flat ground riser or by means of insulated copper ground cable of required cross section with lug for protection ground.
- d) Each circuit requiring grounding shall be individually and directly connected to the panel ground bus.
- e) Signal cable shields shall be grounded at the panel end only and shall never be left open. The ground in between panels of a shipping section shall be firmly looped.
- f) Manufacturer recommendation and scheme shall be followed for all system panel grounding.
- g) Electrical transmitters and switching devices, operating at a voltage less than 50V shall be grounded through the steel structure.

**4.00.05 Miniature Circuit Breakers (MCB)**

MCB shall be used for protection and isolation of logic circuit and power distribution circuit.

**4.00.06 Fuse Blocks**

Where fuse blocks are required by the specifications or the manufacturer's design, they shall be modular type with bakelite frame and reinforced retaining clips. Blocks shall be class H.2 pole, screw terminal fuse blocks. Blocks for other current and voltage ratings shall be similar in construction.



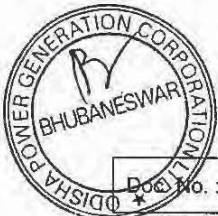



#### 4.00.07 Fuses

Where slow blow fuses are required for protection of instruments /devices they shall have ampere ratings of 1/4, 1/2, 1 or 2. Where fast acting fuses are required for protection of equipment they shall have ampere ratings of 1, 3, 6, 10, 15, 20 or 30. Indicating fuses or blocks to quickly identify a failed fuse shall be provided to the extent possible.

#### 4.00.08 Terminal Blocks

- a) Terminals shall be chromated galvanized DIN rail mounted screw less cage clamp type. Terminals shall have screwed connection for conductor cross-section above 2.5 mm<sup>2</sup>. Terminal blocks shall conform to IEC 947-7-1.
- b) The characteristics of the terminal blocks shall be as follows.
  - i) High contact force, independent of conductor cross-section and large contact surface area.
  - ii) Integrated self-loosening protection to avoid shifting of contact surface that may allow contamination of connection point.
  - iii) Inspection and maintenance free (resistant to thermal aging and vibration)
  - iv) Low and constant voltage drop
- c) Material of the clamping yoke of screwed terminals shall be electroplated, chromated, case hardened steel with high strength clamping screw. For screw less terminals, the tension spring shall be made of high quality, non-rusting, acid-resistant steel. The current bar shall be of tin-lead plated copper or brass.
- d) Terminals shall be of non flammable suitable thermoplastic material such as polyamide.
- e) Terminal blocks shall be mounted vertically in panels and cubicles with clearance for at least 100 mm between two sets and between wall and terminal block. Bottom of the terminal block shall be at least 200 mm above the cable gland plate for bottom entry type panels.
- f) Terminal blocks shall be provided with white marking strips / self-adhesive marker cards. Power terminals shall have protection covers.
- g) At least 20 percent spare unwired terminals shall be provided for all panels /cabinets /desks /junction box etc. This shall be in addition to spare wired terminals of spare IO channels and wired spare modules.
- h) For extending 24 V DC supply to panels, the size of the terminals shall be decided based on voltage drop and not based on current.
- i) The last terminal in a rail-mounted assembly shall be closed with an end plate and end bracket.



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- j) For visual and electrical separation of terminal groups, partition plates shall be provided, which can be push fitted after forming an assembly.
- k) The terminals for DDCMIS / PLC input/output connections to SWGR/MCC, actuator starter, solenoid valves etc. shall be provided.. Technical detail for the same shall be finalized during detailed engineering.
- l) It shall also be possible to use jumper plugs through the above test plug socket to connect adjacent terminals. Adequate number of short circuit jumper plugs shall be provided for the purpose.
- m) Where more than one connection to a terminal block is required, two tier terminals shall be used.
- n) Terminal blocks shall preferably be assigned different colors depending upon voltage and current levels.

**4.00.09 Nameplates and Labels**

- a) Nameplate shall be furnished for each instrument or device mounted on the panel/desk.
- b) The material shall be laminated phenolic, 3 mm thick with white letters on black background.
- c) The nameplates for panels / consoles shall be provided both on the front and the rear.
- d) Nameplates for all devices shall be located adjacent to the respective devices.
- e) All such nameplates, instruction plates, lubrication charts etc. shall be with English inscriptions.

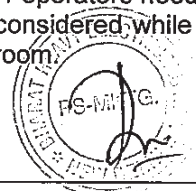
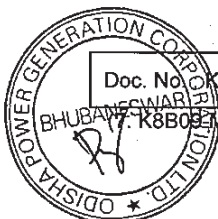
**4.00.10 Wiring Diagram**

Each panel & enclosure shall have drawing pockets to store the relevant drawings of the respective panels. For the junction box printed wiring schedule engraved in black on white bakelite sheet shall be suitably affixed inside the junction box.

**4.01.00 CONTROL DESKS**


4.01.01 All devices mounted on the panel / desks shall be flush type. Instruments / devices shall be so mounted that the removal and replacement can be accomplished individually without interruption of services to others.

4.01.02 Desk shall be ergonomically designed to suit the user / operators needs on a 24 x 7 basis. Aesthetic, ergoonomy and lighting shall be considered while positioning of the desk, large video screen and panels in control room.



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- 4.01.03 Control desk shall be free standing floor mounting type tabletop design with compartments for locating the computers and other hardware. Desk shall be of latest technology aesthetic design and constructed from aluminium extrusion with high pressure laminate 25 mm thick MDF board for work surface as per Consultant's approved colour. Aluminium structure shall be anodized or powder coated paint finish.
- 4.01.04 All monitors with retractable keyboard, emergency push buttons like MFT, Turbine trip & Unit trip shall be provided on the desk. Desk shall be arranged in arc like shape without any sharp edges. Edges shall be extruded PVC or rounded post-formed laminate. Exact profile & shape shall be finalized during detailed engineering.
- 4.01.05 It shall be modular, scalable and industrially rugged and shall have load carrying capacity at least for a combined weight of 22" TFT Monitors, keyboards, Telephones, Intercom on continuous basis. CPU units of the OWS shall preferably be installed on a CPU rack away from the control room operating area for better aesthetic. Rack may be located behind the Video wall. Peripheral (Video, Keyboard and mouse) interface cable shall be extended with KVM extender cables.
- 4.01.06 Desk should have concealed cable trays and wire management system, which shall be easily accessible for maintenance. The cable management should be designed to support vertical and horizontal cables with proper hardware and accessibility. Cable tray shall be designed from steel with powder coated paint finish.
- 4.01.07 Design shall include earthing bolts on left side end and right side end of the Desk.
- 4.01.08 Telephone and intercom stands shall be provided on the desk. Computers, UPS Multimedia speakers, shall be placed at back of the desk. Back installed items shall be suitably concealed from front view.
- 4.01.09 The desks shall be complete with vibration dampener and foot leveler.
- 4.02.00 **UNIT CONTROL PANEL (BACK UP PANEL) / ELECTRICAL PANEL**
- 4.02.01 Panel shall be of freestanding type vertical panel with doors at the back. Construction shall be made from sheet steel of thickness not less than 3mm with mosaic grid structure of approximate size 24 X 48 on the front surface. Grid shall be heat resistant, flame retardant, self extinguishing, shrinkage free, non reflecting type. Finish shall be mat type without flaring.
- 4.02.02 Electrical Panel construction & design shall be similar to back up panel. Required control switches, meters, indicators, synchronizer, excitation control switch, annunciation window etc. alongwith associated mimic diagram shall be provided for manual synchronization of generator.



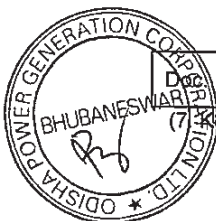
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4.03.00 SYSTEM CABINETS / PANELS

- 01. Material of construction : Cold rolled steel sheet
- 02. Thickness of Sheet :
  - a) 3.0 mm for faces supporting instruments / terminals.
  - b) 2 mm for other sides and top 2 mm thickness for load bearing and 1.6 mm for non-load bearing.
- 03. Construction : Welded throughout as per (metallic parts) approved National Standards.
- 04. Panel height : 2200 mm (approx)
- 05. Doors : Full height front & rear door, recessed, turned back edges. Double door for panel width more than 800 mm.
  - a) Thickness of Sheet : 2 mm
  - b) Hinges : Concealed stainless steel type
  - c) Door latches : Three point type
  - d) Door gaskets : Neoprene rubber on fixed frame to result dust proof / weather proof enclosure.
  - e) Opening of the doors : Outward
  - f) Louvers : With removable wire mesh to ensure dust and vermin proof.
- 06. Color of interior : Glossy white ~~with fire resistant paint~~
- 07. Colour external : Light grey RAL 7032
- 08. Painting : Epoxy powder coated or better
- 09. Gland plates : Removable 3 mm thick (bottom)
- 10. Cable entry : Bottom
- 11. Hardware :
  - a) Anti vibration pad- 15 mm
  - b) Predrilled base channel ISMC - 100 or equivalent for all sides.
  - c) Stainless steel buff- finished 2 mm thick kick plate for all sides.
  - d) Stainless steel scratch strips along desk edges fixed with pan-head recessed screws.

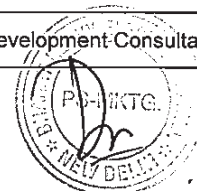


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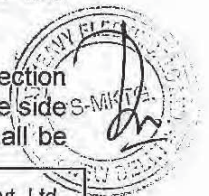
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- e) Rubber strips to ensure air tightness between kick plate and finished floor.
- f) Detachable lifting hook / Eye bolt
- g) Drawing pocket at front & rear door
- h) Door switch, lamps, thermostat, heaters and fans
- i) Door lock with master key

12. Enclosure Protection : As per environment condition of the area of installation. Refer Section-I of this vol.

#### 4.04.00 LOCAL INSTRUMENT RACKS & ENCLOSURE

- a) Transmitters, switches and devices located in the field shall be grouped together and shall be installed in the Enclosure in case of outdoor area such as Boiler area etc. and in Open Type Rack in case of covered area such as TG Building. Racks and enclosure shall be factory prefabricated & painted and complete with internal piping, tubing, manifold valve, isolation valves, blowdown valves, integral junction box, wiring, illumination etc. with outside access doors, Continuous purging arrangement shall be provided for all air and flue gas applications.
- b) No more than six instruments shall be grouped in a single rack /enclosure. Easy maintenance accessibility shall be considered while designing the structural part. Exact grouping and requirement for open and closed racks shall be finalized during detailed engineering.
- c) The local instrument enclosures shall be constructed from 2.0 mm thick sheet plate and shall be of modular construction with one or more modules and two end assemblies bolted together to form an enclosure. Major load-bearing posts shall be suitably supported by gusset plates or moment members. Vibration dampeners shall be installed for supporting each enclosure. The internal layout shall be such that the impulse piping/ blow down lines are accessible through rear doors of the enclosure and the transmitters etc. are accessible from front side for easy maintenance. Gaskets shall be used in between all mating sections to achieve protection class of IP-55. Enclosure doors shall have three point lock.
- d) The local instrument racks shall be free standing type constructed from suitable 3 mm thick channel frame of steel and shall be provided with a canopy at top to protect the equipment mounted in racks from falling objects, water etc. The canopy shall not be less than 3 mm thick steel and extended beyond the ends of the rack.
- e) Bulk heads, especially designed to provide isolation from process line vibration shall be provided. Bulkhead plates shall be removable type and thickness of not less than 6 mm shall be employed.
- f) The junction box for enclosure and racks shall conform to IP 65 protection class. Junction box shall be provided as an integral compartment at one side of the enclosure / rack with front opening type door. Junction box shall be



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complete with DIN rail mounted terminals, MCB, receptacles and earth bar. All wiring shall be laid in PVC cable tray. Cable gland plate shall be provided for cable entry from bottom. Earth bar shall be made of tinned copper continuous and of 25 X 6 MM size.

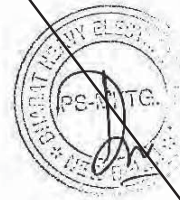
- g) Each rack shall be provided with receptacle, light fixture with wire guard and lighting switch. Light fixtures shall be installed on the ceilings of rack / enclosure.
- h) Type, size and material grade of the impulse pipes, fittings and valves are listed elsewhere in this specification.
- i) Drawing K8B09-DWG-I-0200 shall be referred for typical arrangement of Local instrument enclosure and rack. Seller shall furnish the drawing and documents showing detail arrangement of racks and enclosure and hook up alongwith instrument grouping at detailing stage for Consultant's approval.

**5.00.00 DISTRIBUTED DIGITAL CONTROL, MONITORING AND INFORMATION SYSTEM (DDCMIS)**

The microprocessor based distributed digital control, monitoring & information system (DDCMIS) shall be provided for the safe and efficient operation of steam generator, turbine generator and all auxiliaries under all regimes of operation.

**5.01.00 GENERAL REQUIREMENTS**

- a) The requirements for distributed digital control monitoring and information system (DDCMIS) are indicated on functional basis in this specification. Seller shall be responsible for engineering, selection and connection of all components and sub-systems to form a complete system whose performance is in accordance with functional, hardware, parametric and other requirements of this specifications. It is not the intent or purpose of this specification to specify all individual system components since the Seller has full responsibility for engineering and furnishing of a complete system.
- b) DDCMIS shall basically consist of :
  - i) Control system of boiler, turbine & balance of plant, electrical system namely SG - C&I, TG - C&I & Station - C&I including their respective measurement system.
  - ii) Man-Machine interface and plant Information system (MMIPIS).
  - iii) System programming & documentation facility.
  - iv) Performance Calculation Station (PCS)
  - v) Data communication system (DCS).
  - vi) Sequence of events (SOE) recording system.
  - vii) Annunciation system.
  - viii) Station LAN
  - ix) Master & slave cock system.



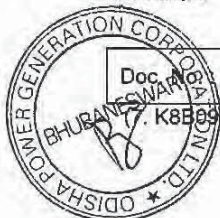
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- 08. Maximum rated conductor temp. in normal operation : 85 °C
- 09. Armour : Galvanized single round steel wire armouring as per IS 3975.
- 10. Core Identification : As per IS 1554 (Part I)
- 11. Outer Sheath colour : Black
- 12. Tests :
  - a) Oxygen Index: Min.29 at room temp. (ASTM-D-2863)
  - b) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I
  - c) Temp Index : Min 250 °C at 21Oxy. Ind. (ASTM-D-2863)
  - d) Smoke Density Rating : Max. 60% (ASTM-D-2843).
  - e) Flammability Test : as per IEC 332 Part-I
  - f) Swedish Chimney Test-SS-424-1475 F3
  - g) Insulation Resistance 100 M Ohm / Km Min
  - h) High voltage test (3 kV for 5 minutes)
  - i) Rodent & Termite repulsion test (Presence of lead shall be confirmed)
  - k) Routine Test
  - l) Type Test

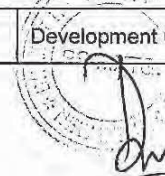
**9.05.00 OPTICAL FIBER CABLE**

9.05.01 This specification defines the minimum general requirements for the Design, manufacture, supply, inspection, installation, testing & commissioning of multimode & monomode optical fiber cables and accessories, such as fiber distribution (patch) panels, adapters, connectors, joint boxes, pigtailed and other components, as required to complete the system. Seller shall consider all related activities, such as cable stripping, cable entry in boxes and panels, cable fiber splicing/fusion, cable performance testing and other services, to achieve a properly documented and operational cable network.

9.05.02 Fiber Optic Cables shall be installed on cable tray, duct bank, cable trench installation as necessary. For outdoor applications the cable shall be armoured



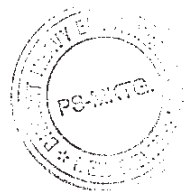
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with Poly Ethylene sheathing. Cable shall be routed through suitable grade HDPE permanently lubricated protection pipe as per IS 4984, IS 12235 & TEC.G/CDS-08 /01 of suitable size @ 53% fill factor.

- 9.05.03 The Optical Fiber core shall be of ultra pure fused silica glass coated with UV-cured acrylate suitable to withstand temperature of about 80°C (continuous).
- 9.05.04 Fiber optic cable shall be of loose tube design. Typically, fibers shall be housed in-groups of 6 (minimum) within gel-filled buffer tubes to protect against ingress of moisture and vibration. The tubes shall be manufactured with industry standard material like Poly-Butelene Terathylate (PBT). They shall be colored for easy identification. Buffer tubes shall be approachable with industry standard tools and practices. The buffer tubes shall be stranded around the Central Strength Member utilizing Reverse Oscillating Lay (ROL). Blank fillers shall be used as necessary to maintain circular cable structure. Cable shall withstand water penetration when tested with a one meter static head or equivalent continuous pressure applied at one end of a one meter length of filled cable for one hour. No water shall leak through the open cable end.
- 9.05.05 The central strength member of the cable shall be Fiberglass Reinforced Plastic (FRP) or other material with equivalent mechanical strength to provide both tensile and anti buckling strength to the cable.
- 9.05.06 In addition to central strength member, additional strengthening substance like aramid yarns shall be helically applied over the cable core to provide additional tensile strength to the cable.
- 9.05.07 The cable shall be of dual jacket & armoured. Inner sheath consists of a medium density polyethylene (MDPE) jacket extruded over the cable core. Two highly visible ripcords are placed under the jacket to aid in sheath removal. A co-polymer coated steel tape is corrugated and wrapped around the inner jacket to provide additional cable compression strength and rodent protection. The armor is covered with an outer black FRLS MDPE jacket. A ripcord is also placed underneath the armor for easy outer jacket removal.
- 9.05.08 Minimum bending radius shall be equal or more to 15 D. A continuous strength member shall be provided for the entire length of the cables. Every tube and fiber shall be colour coded to provide easy identification. The outer sheath shall be marked to show fiber type and cable classification at suitable intervals.
- 9.05.09 Minimum 100% spare cores over the actual use shall be provided.
- 9.05.10 The entire length of each cable shall be marked with the following items:
  - a) Manufacturer's Name
  - b) Month and year of manufacturer
  - c) Coded description of the cable based on Telcordia's (Bellcore) SR-2014 Suggested Optical Cable Code (SOCC).
  - d) Sheath Identification Number
  - e) Sequential Length Marking in meter



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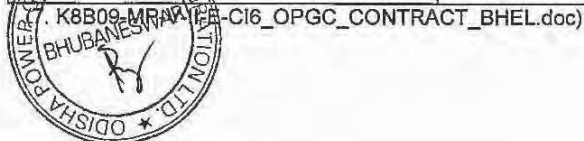
f) A Telephone Handset symbol to distinguish communication from power cable as per NESC section –35 G.


9.05.11 Fiber optic cable shall provide a long life expectancy of minimum 25 years and shall meet the industrial standard of continuous operation at temperature of 55 Deg.C and humidity to 100% without degradation to optical or mechanical performance.

9.05.12 Optical fiber used in the plant shall generally conform to the following specification.

SPECIFICATION FOR ITU G.652 MONOMODE FIBER		
1.	Cladding Diameter	125 $\mu\text{m} \pm 1.0 \mu\text{m}$
2.	Nominal Core Diameter	8.3 $\mu\text{m} \pm 1.0 \mu\text{m}$
3.	Fiber core count	6 core (minimum)
4.	Cladding non-circularity	$\leq 0.8\%$
5.	Maximum attenuation at	
	(a) 1310 nm (b) 1550 nm	< 0.5 dB/km < 0.5 dB/km
6.	Index of refraction	
	(a) 1310 nm (b) 1550 nm	< 1.467 < 1.468
7.	Zero Dispersion	
	(a) 1300 ~ 1324 nm	< 0.093 ps/Km/nm
8.	Proof Test	$\geq 1\%$
9.	Fiber Curl (ROC)	$\geq 4.0 \text{ m}$
10.	Macro-bend Test on Fiber	$\leq 0.1 \text{ dB}$

SPECIFICATION FOR ITU G.651 MULTI MODE FIBER		
1.	Cladding Diameter	125 $\mu\text{m} \pm 2.0 \mu\text{m}$
2.	Nominal Core Diameter	50 $\mu\text{m} \pm 3.0 \mu\text{m}$
3.	Fiber core count	6 core (minimum)
4.	Cladding non-circularity	$\leq 3.0\%$
5.	Maximum attenuation at	
	(a) 850 nm (b) 1300 nm	< 3.5 dB/km < 1.0 dB/km
6.	Group index of refraction	
	(b) 850 nm (c) 1300 nm	< 1.483 < 1.479
7.	Proof Test	$\geq 1\%$



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SPECIFICATION FOR ITU G.651 MULTI MODE FIBER		
8.	Fiber Curl (ROC)	≥ 4.0 m
9.	Macro-bend Test on Fiber	≤ 0.1 dB

#### 9.05.13 CABLE ASSEMBLY

##### (a) Optical Fiber Environmental Splice Enclosure

Optical fiber environmental splice joint enclosures shall be re-enterable and rack / wall mountable. The interior splice case shall be equipped to mechanically accommodate single-mode optical fibers connected by the fusion method. Splice case shall be equipped to organize the splice trays and the required service loops of buffered incoming optical fibers and outgoing 'pigtailed' in such a way that allows each completed splice and associated optical fiber to be maintained in an unstrained configuration. Splice enclosure shall be dust and weather proof.

##### (b) Fiber Optic Distribution Patch Panel

Fiber optic distribution panels shall be provided as required. Fiber optic distribution panels shall be of a standard wall mounted sheet metal enclosure type. Fiber optic distribution panels shall be equipped to secure optical fiber patch cables and pigtails to prevent damage during all operation and maintenance functions. In general splice enclosure are envisaged. However, if no optical fiber splice enclosures are implemented, then the fiber optic distribution panels shall be equipped with splice trays for storage and protection of fusion splice connections of single-mode fiber optic cable and pigtails. Each fiber optic distribution panel shall be fully equipped with 'SC' type bulkhead connector sleeves or equivalent. Unused sleeve ports shall be equipped with reusable caps to prevent the intrusion of dust.

##### (c) Pigtail and Patch Cord

All pigtails shall be factory SC-connectorized, and satisfy specified performance for optical links. All unused pigtails (including spares) shall be terminated with the connector to a bulkhead connector sleeve, protected by a reusable cap on the opposite sleeve port, to prevent the intrusion of foreign material or dust. All necessary connectorized pigtails shall be provided in the lengths required.

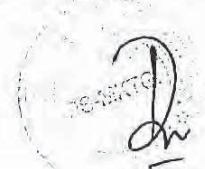
#### 9.05.14 FIBER OPTIC TOOL KIT

##### 1) Optical Time Domain Reflectometer

a) A recording optical time domain reflectometer (OTDR) shall be utilized to test for end-to-end continuity and attenuation of each optical fiber. The OTDR shall be equipped with data storage, printer, help feature, compare trace features and OTDR software. The data storage unit must include a built-in floppy disk drive capable of storing a minimum of 100 test traces.

b) Data traces saved to disk shall include the following labels:

- Fiber Identification (ID) with a minimum of 10 characters
- Cable ID with a minimum of 10 characters



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- OTDR location with a minimum of 20 characters
  - Far End location with a minimum of 20 characters
  - Test Operator initials with a minimum of 3 characters
- c) The printer shall preferably be an internal printer. The printer shall be able to print data traces within 30 seconds or less. The machine settings used to repeat tests at a later time shall include: index, range, wavelength, average time, pulse width and scale settings. The test results (on printout) shall provide information including: loss, distance, reflectance, date and time.
- d) The requirements for the compare trace feature include the ability to recall two historical traces from a diskette and display them simultaneously for analysis and printing. The compare trace must compute and display a single graph representing any differences between two traces. The compare trace must be able to recall historical traces from a diskette and perform the same tests on connected live fibers. The compare trace shall perform a two point loss measurement test for any two particular fibers in a comparison analysis. The losses between the two points on each fiber shall be displayed, and the differences between the two readings clearly shown.
- e) The OTDR must be equipped with software to support all of the required functions. The software shall provide for printing of whole set of traces (batch print) with minimal commands eliminating the time spent for printing traces individually.
- f) Seller shall provide all mounting accessories, cables and connectors required to establish data communication.

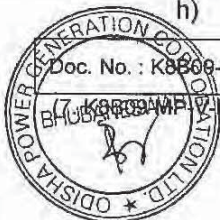
#### II) Fiber Optic Splicer, Terminator And Tool Kit Box

Seller shall provide new unused tools comprise of Splicer and Fusion Jointer and tool kit comprise of cutter, stripper, polishing tool, handheld microscope, heat shrinkable sleeve, scissor, knife etc. as required for maintenance and commissioning.

#### III) Tests

Following minimum test as per any approved standards shall be carried out on the cables

- a) Attenuation And Dispersion Characteristics Tests
- b) Proof Tests
- c) Macro-Bend Resistance Test
- d) Mechanical Tests
- e) Low And High Temperature Cable Bend Test
- f) Impact Resistance Test
- g) Compressive Strength Test
- h) Tensile Strength Test





- i) Cable Twist Test
- j) Cable Cyclic Flexing Test
- k) Environmental Characteristics Test
- l) Temperature Cycling Test
- m) Color Permanence Test Cable Aging Test
- n) Water Penetration Test
- o) Lightning Test
- p) Routine Test / Sample Test

#### 10.00.00 ERECTION HARDWARE

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

#### 10.01.00 ELECTRICAL ACCESSORIES

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

##### a) Rigid Steel Conduit

- i) Conduits up to and including 25 mm shall be of 16 SWG and conduits above 25 mm shall be of 14 SWG. Minimum size of conduits shall be 19 mm.
- ii) Each piece of conduit shall be straight, free from blister and other defects and covered with capped bushing at both ends.
- iii) All rigid conduit couplings and elbows shall be hot dip galvanized rigid mild steel in accordance with ANSI C 80.1 and UL6. The conduit interior and exterior surfaces shall have a continuous zinc coating with an over coat of transparent enamel or zinc chromate. Conduits shall be furnished in standard length of 3 meters, threaded at both ends.
- iv) All conduit fittings shall conform to the requirements of ANSI C 80.4 and UL-514 where these standards apply.

##### b) Flexible Conduit

- i) Flexible conduit shall be of three layer construction of very high quality of lead coated steel. Outside and inside layer shall be reinforced with heat resistant material.
- ii) Lead coating outside and inside of the conduit steel surface shall provide a non-corrosive characteristic particularly in acidic atmosphere. Besides flexibility, this shall be strong enough to stay at the desired profile without support and shall be durable and strong so as to offer sufficient mechanical protection. It shall also be fully liquid










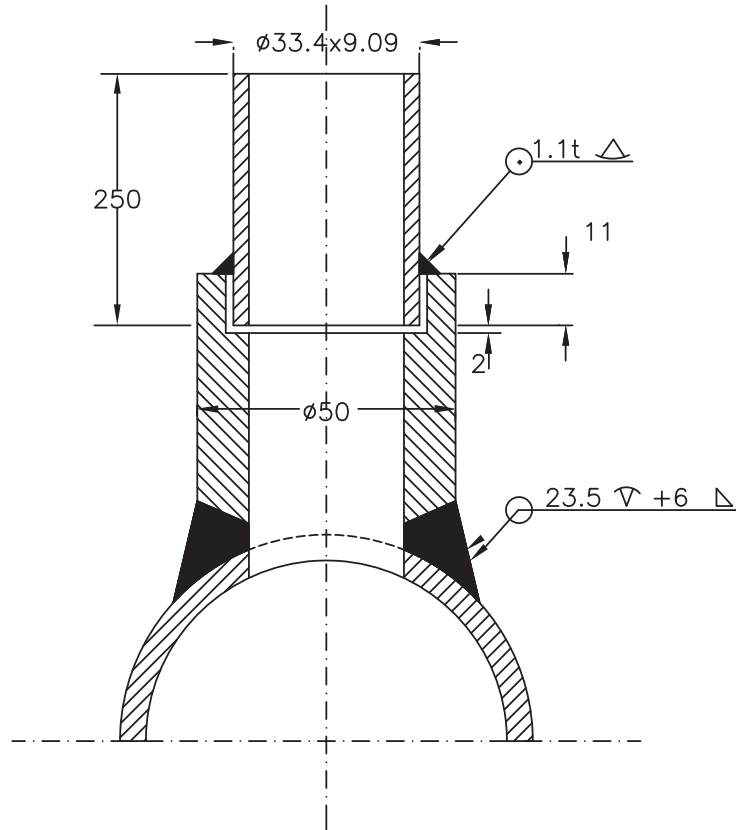
**2.4.0**

**INSTRUMENT STUB DETAILS &  
INSTALLATION DIAGRAMS**

# INSTRUMENT STUB DETAILS PRESSURE/TEMPERATURE STUB

1. THIS DOCUMENT COVERS STUB DETAILS FOR NORMAL MEASUREMENT
2. THE STUB DETAILS PERTAIN TO PEM PIPINGS/INSTRUMENTS

JOB NO. 391	 ODDISHA POWER GENERATION CORPORATION LTD.																
STATUS CONTRACT	 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS																
PRINT SCALE: 	PROJECT: IB THERMAL POWER STATION, BANHARPALI 2x660MW UNITS 3&4																
REV. DATED. A/D 17/02/13 2/13 17/02/13 2/13	 BHARAT HEAVY ELECTRICALS LTD. POWER SECTION PROJECT ENGINEERING MANAGEMENT NOIDA																
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>DEPT CODE</th> <th>NAME</th> <th>SIGN</th> <th>DATE</th> </tr> </thead> <tbody> <tr> <td>DSGN</td> <td>AKS</td> <td></td> <td>18.07.13</td> </tr> <tr> <td>CHD</td> <td>SSB</td> <td></td> <td>16.07.13</td> </tr> <tr> <td>APPD</td> <td>MAW</td> <td></td> <td>18.07.13</td> </tr> </tbody> </table>	DEPT CODE	NAME	SIGN	DATE	DSGN	AKS		18.07.13	CHD	SSB		16.07.13	APPD	MAW		18.07.13
DEPT CODE	NAME	SIGN	DATE														
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CHD	SSB		16.07.13														
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THIS DOCUMENT IS REVISED IN LINE WITH CUSTOMER COMMENTS REC'D IN MISC LETTER REF NO. DRGG/ETG/3558/28-11-2013	TITLE: INSTRUMENT STUB DETAILS (PRESSURE/TEMPERATURE STUBS)																
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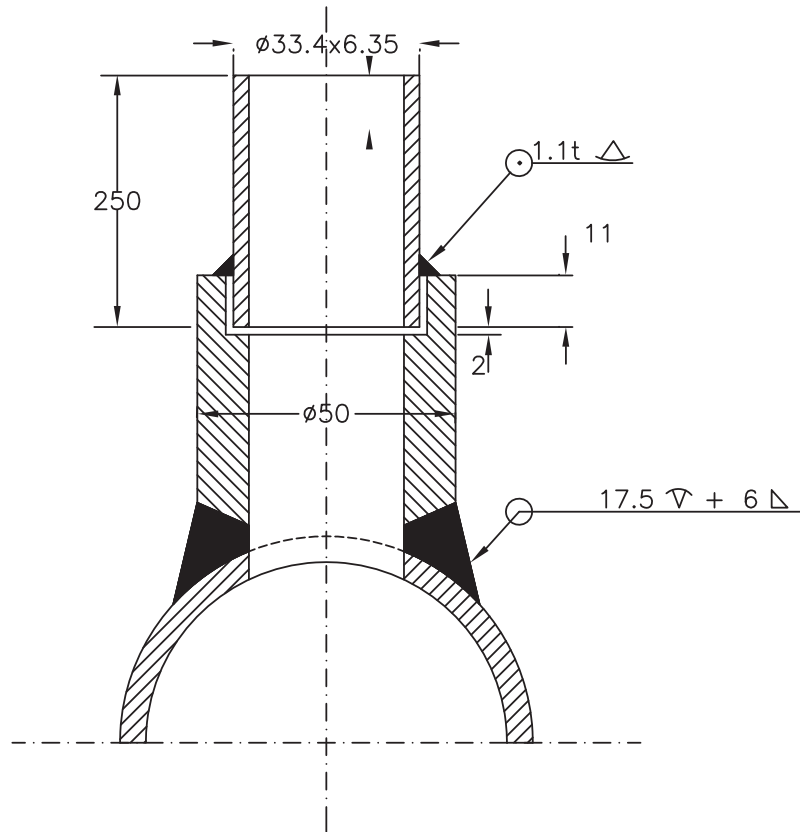
**NOTE :**

1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ASME B16.11.
2. THE LENGTH OF NIPPLE SHOULD BE 250 MM.
3. STUB LENGTH SHALL BE 44mm.
4. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED
5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY ( 1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES



TITLE :  
**INSTRUMENT STUB DETAILS  
 FOR PRESSURE MEASUREMENT**  
 (SYSTEM PRESS > 40Kg/Cm2 AND CLASS 9000 #)

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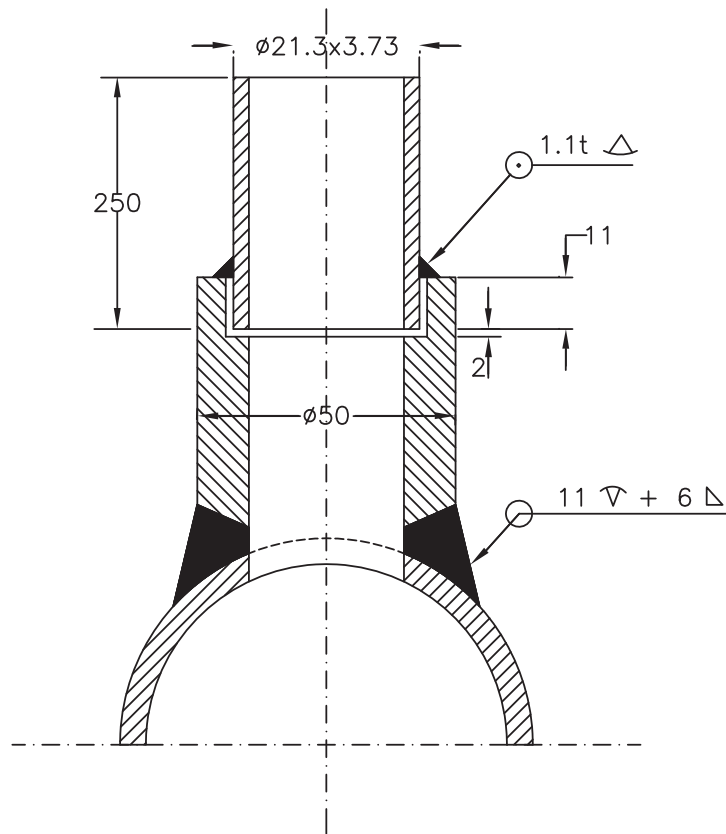
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TITLE :  
**INSTRUMENT STUB DETAILS  
 FOR PRESSURE MEASUREMENT**  
 (SYSTEM PRESS > 40Kg/Cm2, CLASS 6000#)

DRG. NO.  
**PE-DC-387-145-1101**  
 REV. 01  
 SH. 03 OF 08 SHS.



**NOTE :**

1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ASME B16.11.
2. THE LENGTH OF NIPPLE SHALL BE 250 MM.
3. STUB LENGTH SHALL BE 34mm.
4. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED
5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY ( 1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES



TITLE :  
**INSTRUMENT STUB DETAILS**  
**FOR PRESSURE MEASUREMENT**  
 (SYSTEM PRESS UPTO 40Kg/Cm2, CLASS 3000#)

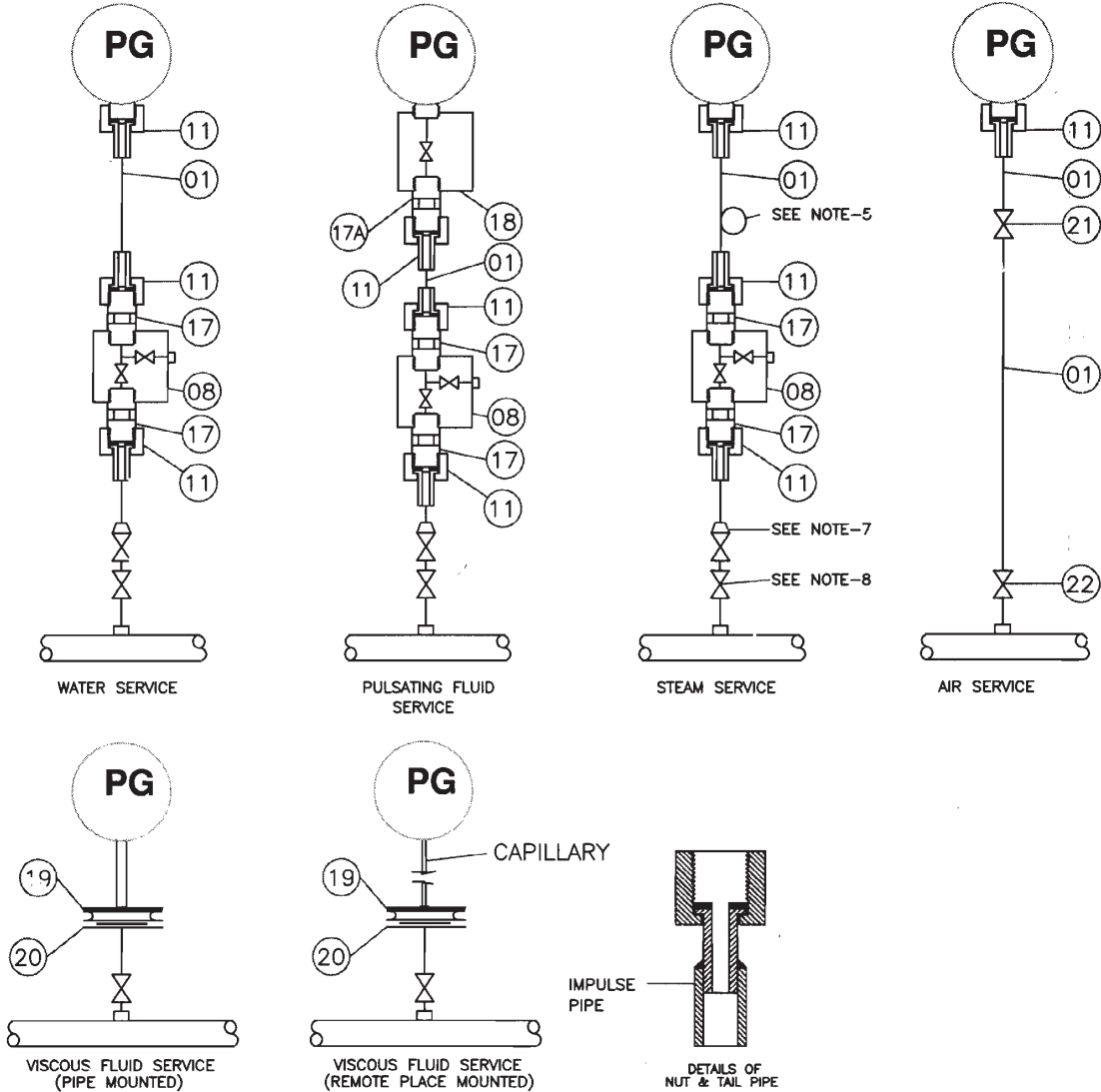
DRG. NO.  
**PE-DG-387-145-1101**  
 REV. 01  
 SH. 04 OF 08 SHS.



TITLE :-

**TYPICAL INSTALLATION DIAGRAM  
FOR PRESSURE GAUGE**

SPECIFICATION NO. PE-SS-999-145-1026	
VOLUME II B	
SECTION D	
REV. NO. 02	DATE 12.12.2000
SHT 05	OF 06



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



TITLE

## TYPICAL INSTALLATION DIAGRAM FOR PRESSURE GAUGE

SPECIFICATION NO. PE-SS-999-14F-1026

VOLUME IIB

SECTION D

REV. NO. 02 DATE 12.12.2000

SHEET 06 OF 06

### NOTES:-

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

SERVICE	IMPULSE PIPE		PIPE FITTINGS	
	MATERIAL	SCHEDULE	MATERIAL	CLASS
i) MAIN STM/HP BYPASS UPSTREAM/ UPSTREAM OF AUX PRDS FROM MS	SA335 Gr P22	SCH.160	ASTM A182 Gr F22	6000
ii) FEED & SPRAY WATER	SA106 Gr C	SCH.160	ASTM A105	6000
iii) PRH/LP BYPASS STEAM	SA335 Gr P22	SCH.80	ASTM A182 Gr F22	6000
iv) CRH TILL HPBP/HPBP DOWNSTREAM/ EXTRN TO HPH 5	SA106 Gr B	SCH.40	ASTM A105	3000
v) CRH TILL AFTER HPBP/EXTRN/ HEATER DRAINS/CONDENSATE AND OTHER LOW PRESS LINE	SA106 Gr B	SCH.40	ASTM A105	3000

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

OPERATING PRESSURE Kg/Cm <sup>2</sup>	OPERATING TEMPERATURE DEG. C	SIZE NB	BODY MATERIAL	QUANTITY NOS.	IMPULSE PIPE SIZE OD THK	
<40	<425	15	FCS	01	21.3	3.73
40-60	<425	15	FCS	02	21.3	3.73
>60	<425	25	FCS	02	33.4	6.35
--	>425	25	FAS	02	33.4	6.35

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



TITLE

TYPICAL INSTALLATION DIAGRAM FOR PRESSURE SWITCH

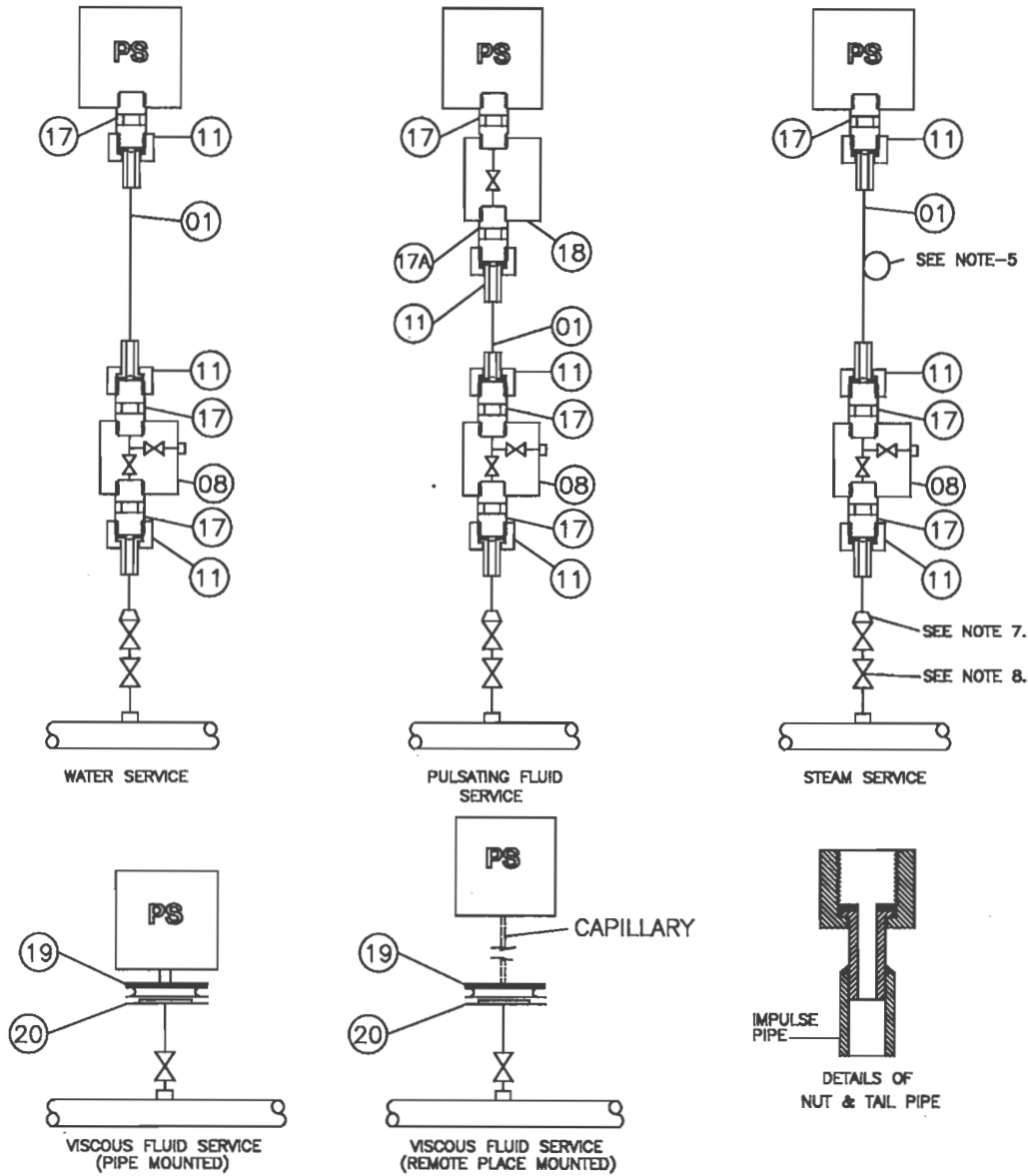
SPECIFICATION NO. PES-145-31

VOLUME IIB

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REV. NO. 02 DATE 20.08.97

SHEET 04 OF 05



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



TITLE

## TYPICAL INSTALLATION DIAGRAM FOR PRESSURE SWITCH

SPECIFICATION NO. PES-145-31

VOLUME IIB

SECTION D

REV. NO. 02      DATE 20.08.97

SHEET 05      OF 05

### NOTES :-

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

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

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

OPERATING PRESS Kg/Cm <sup>2</sup>	OPERATING TEMP DEG. C	SIZE NB	BODY MATERIAL	QUANTITY Nos.
< 40	< 425	15	FCS	01
40-60	< 425	15	FCS	02
> 60	< 425	25	FCS	02
--	> 425	25	FAS	02

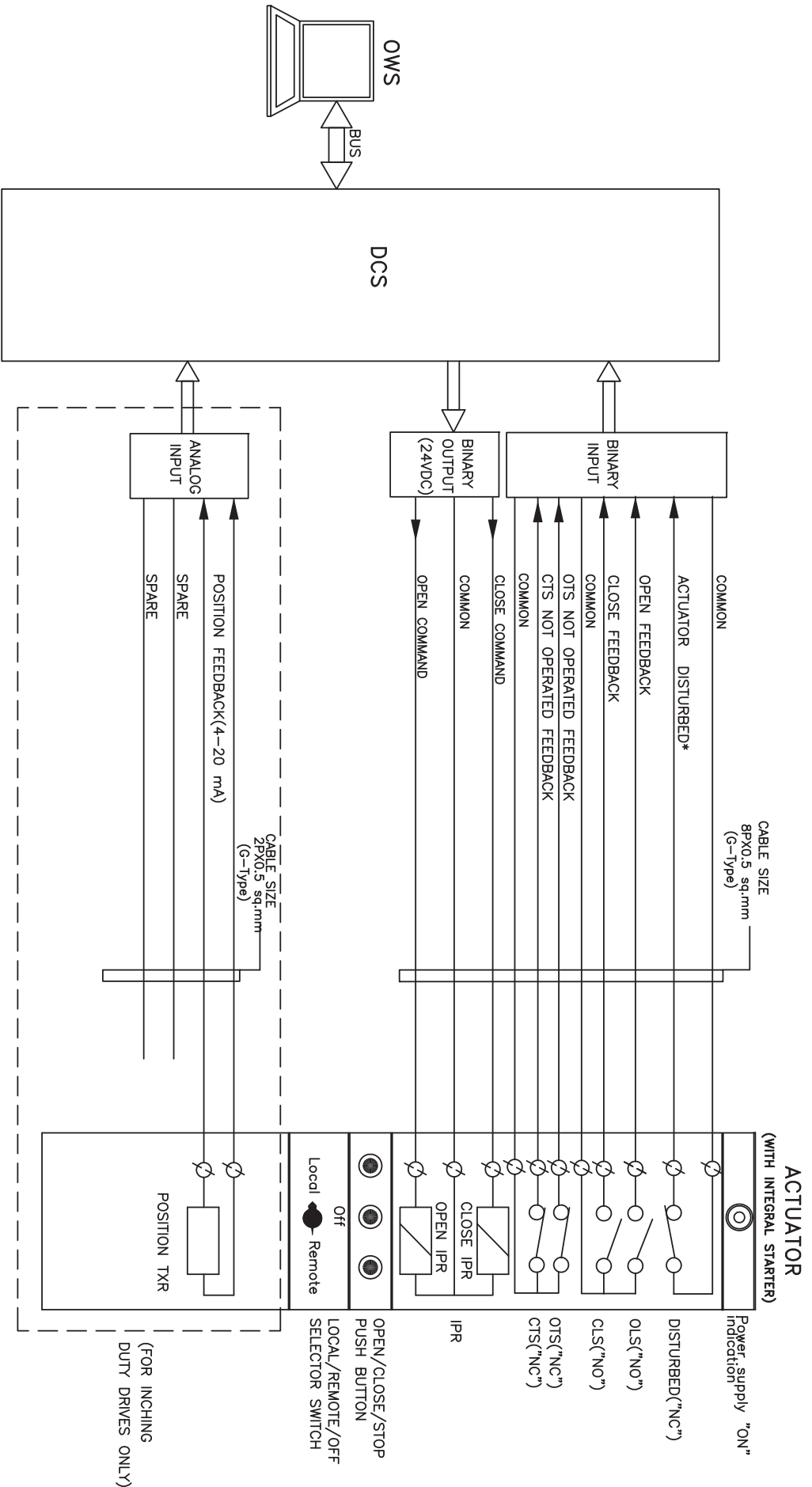
- INSTALLATION FOR DIFF. PRESS SWITCH SHALL BE SIMILAR TO PRESS SWITCH EXCEPT THE FOLLOWING
  - IT SHALL HAVE TWO LIMBS FOR PROCESS CONNECTIONS AND EACH CONNECTION SHALL BE SIMILAR TO THAT SHOWN FOR PRESS SWITCH
  - IT SHALL HAVE FIVE VALVE MANIFOLD IN PLACE OF THREE WAY MANIFOLD

## **2.5.0**

### **MEASUREMENT & CONTROL PHILOSOPHY**

- DRIVE CONTROL PHILOSOPHY**
- MOTORISED VALVE ACTUATOR DATA SHEET**

# DCS INTERFACE FOR BIDIRECTIONAL DRIVE (WITH INTEGRAL STARTER)



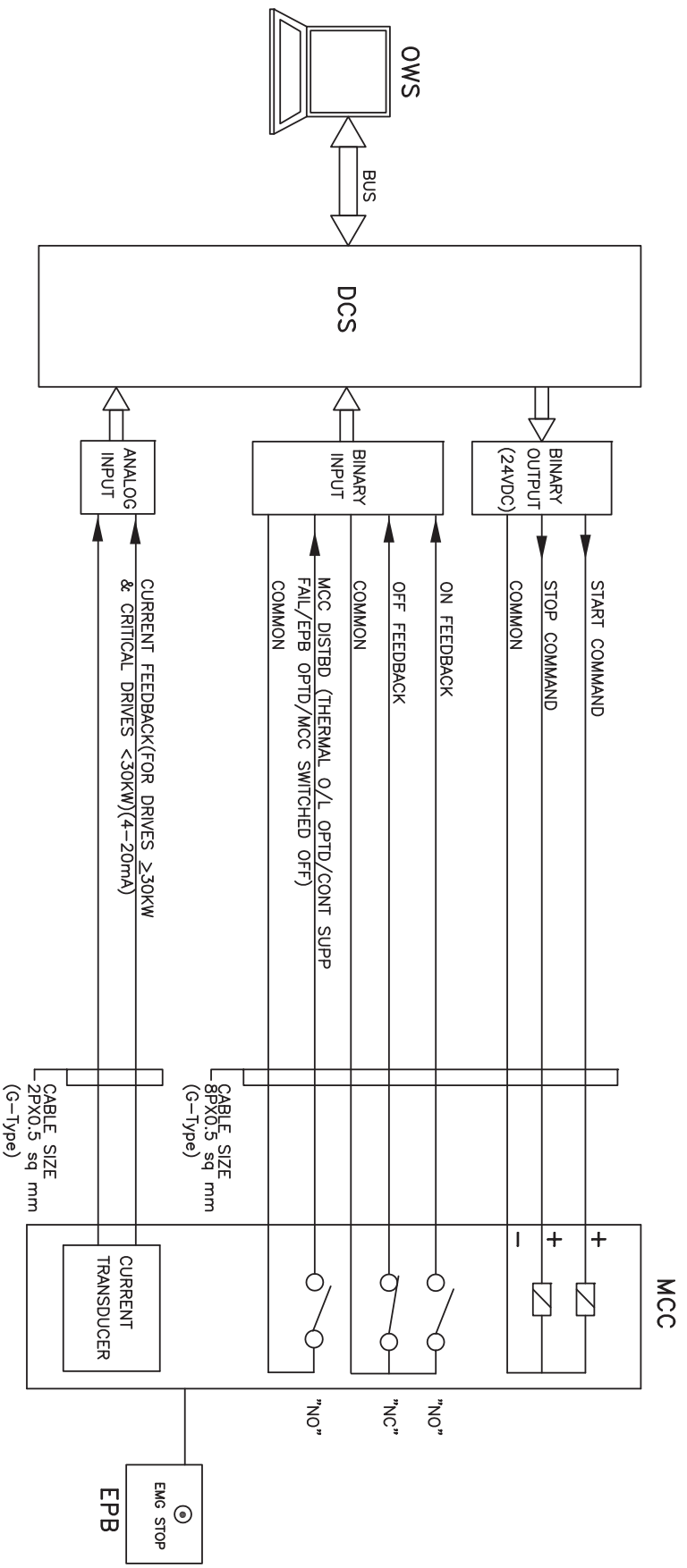
NOTE:


- \* DISTURBED= Loss of Power supply (1 Phase/3 Phase)/
- Loss of control supply/ Motor thermostat trip/
- Thermal over load/
- Local/Off/Remote Sel. switch in local or off mode/
- Stop PB optd.



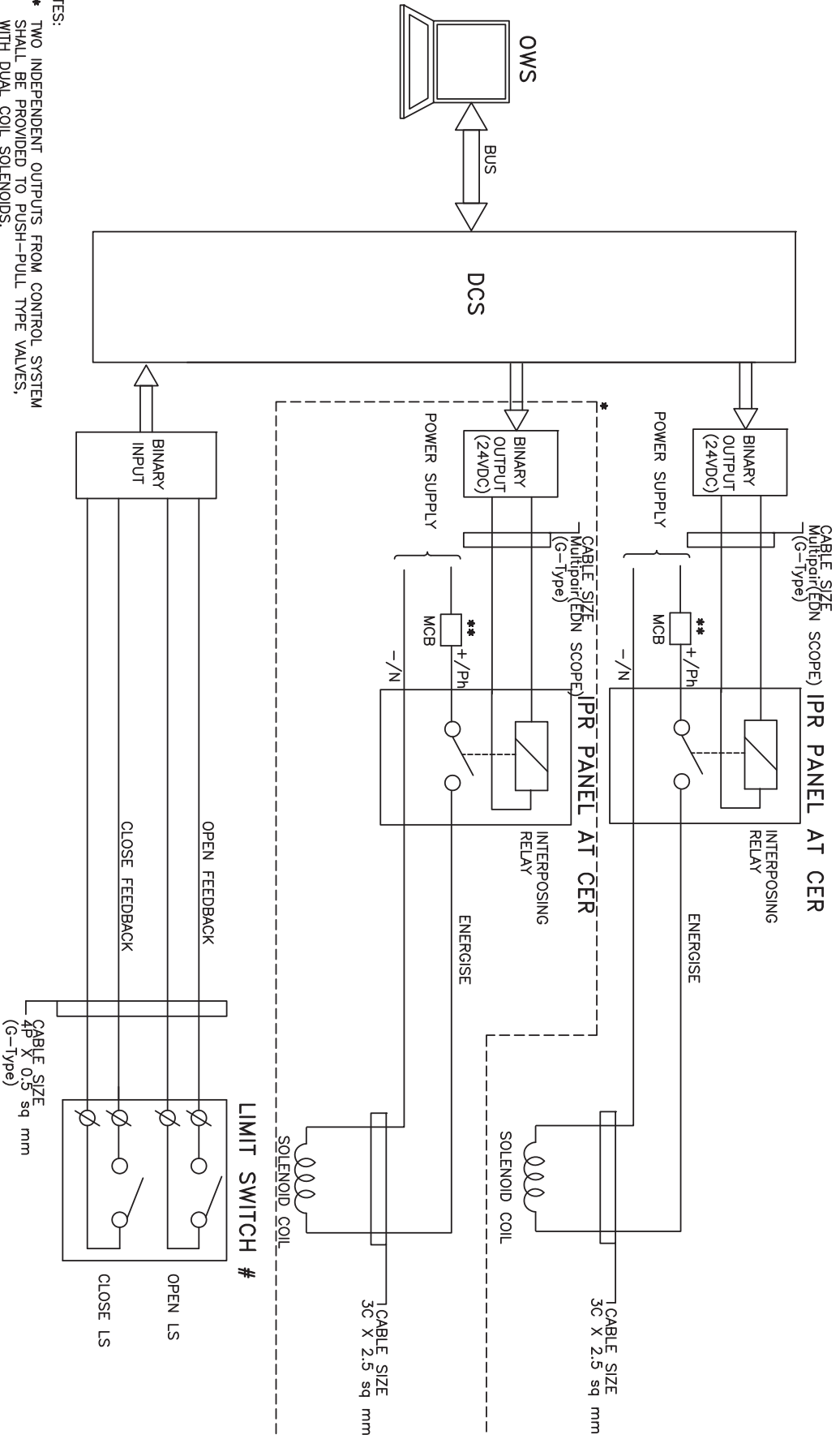
<b>ORISSA POWER GENERATION CORPORATION LIMITED</b>	
2x660MW UNITS 3&4, 1B TPS, BANHARPALL	
TITLE	DDCMIS INTERFACE FOR
BIDIRECTIONAL DRIVE	
DRG.NO.	PE-DM-391-145-1002
DATE	19.02.2013
REV.NO.	00
SHT	7 OF 11

# DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE




	ORISSA POWER GENERATION CORPORATION LIMITED		DRG.NO. PE-DM-391-145-1002
	2x660MW UNITS 3&4, IB TPS, BANHARPALI		DATE 19.02.2013
TITLE DDCMIS INTERFACE FOR UNIDIRECTIONAL LT DRIVE		REV.NO. 00	SHT 8 OF 11

# DCS INTERFACE FOR SOLENOID DRIVE (24V DC / 240V AC UPS)



- NOTES:
- \* TWO INDEPENDENT OUTPUTS FROM CONTROL SYSTEM SHALL BE PROVIDED TO PUSH-PULL TYPE VALVES, WITH DUAL COIL SOLENOIDS.
  - \*\* MCB SHALL BE PROVIDED FOR EACH SOLENOID
  - # FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL VALVE.

ORISSA POWER GENERATION CORPORATION LIMITED	
2x660MW UNITS 3&4, 1B TPS, BANHARPALI	
TITLE	DDCMIS INTERFACE FOR SOLENOID DRIVE
DRG.NO.	PE-DM-391-145-1002
DATE	19.02.2013
REV.NO.	00
SHT	9 OF 11

	Odisha Power Generation Corporation Ltd.	Technical Specification for Main Plant Package	IB TPS – 2 X 660 MW Units 3&4, Jharsuguda, Odisha
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**VOLUME: II-F/1**

**SECTION-III**

**TECHNICAL SPECIFICATION  
FOR  
ELECTRIC MOTOR ACTUATORS**

**1.00.00 SCOPE**

- 1.01.00 This Section covers the general requirements of Electric Motor Actuators for valves, dampers and gates.
- 1.02.00 All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification.
- 1.03.00 The Electric Motor Actuators for valves, dampers and gates supplied by Seller shall be installed by erection contractor appointed by Buyer. The Technical Advisory Personnel of Seller shall be responsible for witnessing and approval of all erection and commissioning works. The Seller shall review the installation requirements mentioned and incorporate necessary requirements in the design.

**2.00.00 CODES & STANDARDS**

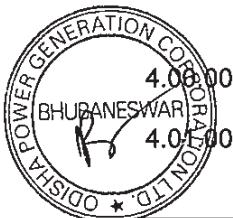
- 2.01.00 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS), IEC, ANSI & NEMA Standards . mentioned in Annexure – D of Section – 1 of Vol. II F1.
- 2.01.02 Equipment and material conforming to any other standards, which ensure equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted.
- 2.01.03 The electrical installation shall meet the requirements of Indian Electricity Rules 1956 as amended up-to-date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

**3.00.00 SERVICE CONDITIONS**

- 3.01.00 The actuator shall be suitable for operation in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash.
- 3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.

**4.00.00 RATING**

- 4.01.00 For isolating service, the actuator shall be rated for three successive open-close operation of the valve/damper or minimum S2-15 minutes.



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4.02.00 For regulating service, the actuator shall be suitably time-rated for the duty cycle involved with necessary number of starts per hour, but in no case less than 150 starts per hour.

4.03.00 A safety factor of 300% shall be used for sizing of operators for valves and dampers and all drive system components. Operators shall be capable of transmitting design torque (including safety factor) within the torque range specified by the actuator manufacturer. The strength of the operator mounting, based on the required operator torque, shall not exceed 30% of the yield strength in any mode of stress.

5.00.00 PERFORMANCE

The actuator shall meet the following performance requirements:

5.01.00 Open and close the valve completely and make leak-tight valve closure without jamming.

5.02.00 Attain full speed operation before valve load is encountered and impart an unseating blow to start the valve in motion (hammer blow effect).

5.03.00 Operate the valve stem at standard stem speed and shall function against design differential pressure across the valve seat.

5.04.00 The motor reduction gearing shall be sufficient to lock the shaft when the motor is de-energised and prevent drift from torque switch spring pressure.

5.05.00 The entire mechanism shall withstand shock resulting from closing with improper setting of limit switches or from lodging of foreign matter under the valve seat.

6.00.00 SPECIFIC REQUIREMENT

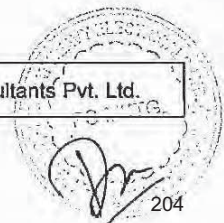
6.01.00 Construction

6.01.01 The actuator shall essentially comprise the drive motor, torque/ limit switches, gear train, clutch, hand wheel, position indicator/ transmitter, in-built thermostat for over load protection, single phase preventer protection, space heater and internal wiring. Actuator shall be integral type.

6.01.02 The actuator enclosure shall be totally enclosed, dust tight, weather-proof suitable for outdoor use without necessity of any canopy.

6.01.03 All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.

6.01.04 The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.



	Odisha Power Generation Corporation Ltd.	Technical Specification for Main Plant Package	IB TPS - 2X660 MW Units 3&4, Jharsuguda, Odisha
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6.02.00 **Motor**

- 6.02.01 The drive motor shall be three phase, squirrel cage, induction machine with minimum Class F insulation and IPW-65 enclosure, designed for high torque and reversing service.
- 6.02.02 The motor shall be designed for full voltage direct on-line start, with starting current limited to 6 times full-load current.
- 6.02.03 The motor shall be capable of starting at 85 percent of rated voltage and running at 80 percent of rated voltage at rated torque and 85 percent rated voltage at 33 percent excess rated torque for a period of 5 minutes each.
- 6.02.04 Earthing terminals shall be provided on either side of the motor.

6.03.00 **Limit Switches**

Each actuator shall be provided with following limit switches: -

- 6.03.01 2 torque limit switches, one for each direction of travel, self-locking, adjustable torque type.
- 6.03.02 ~~4~~ 2 (two)-of-travel limit switches, ~~two~~ one for each direction of travel.
- 6.03.03 2 position limit switches, one for each direction of travel, each adjustable at any position from fully open to fully closed positions of the valve/damper.
- 6.03.04 Each limit switch shall have 2 NO + 2 NC potential free contacts. Contact rating shall be 5A at 240V A.C. or 0.5A at 220V D.C.
- 6.03.05 Limit switches shall be drum type and adjustable to open, close and intermediate position.



6.04.00 **Hand Wheel**

Each actuator shall be provided with a hand wheel for emergency manual operation. The hand wheel shall declutch automatically when the motor is energized.

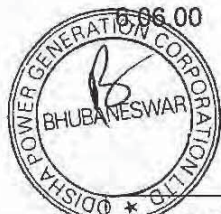
6.05.00 **Position Indicator/Transmitter**

The actuator shall have:

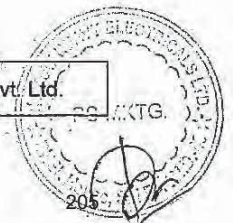
- 6.05.01 One (1) built-in local position indicator for 0-100% travel.
- 6.05.02 One (1) position transmitter, potentiometer type, for remote indicator.

6.06.00 **Space Heater**

A space heater shall be included in the limit switch compartment suitable for 240V, 1 phase, 50 Hz supply.



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**6.07.00 Wiring**

All electrical devices shall be wired up to and terminated in a terminal box. The internal wiring shall be of sufficient size for the power rating involved but in no case less than 1.5 Sq.mm copper. All wiring shall be identified at both ends with ferrules.

**6.08.00 Terminal Box**

The terminal box shall be weather proof, with removable front cover and cable glands for cable connection. The terminal shall be suitable for connection of 2x2.5 Sq.mm copper conductor.

**7.00.00 ACCESSORIES**

As required for the driven equipment, the actuator shall be furnished with starting equipment mounted on the actuator. This shall include :

7.01.00 One (1) triple pole breaker.

7.02.00 One (1) reversing starter, with mechanically interlocked contactors, 3 thermal overload relays, 2 N.O. + 2 N.C. auxiliary contacts for each contactor.

7.03.00 One (1) remote-local selector switch.

7.04.00 CLOSE-STOP-OPEN oil tight push buttons with indication lights.

7.05.00 415/240 V control transformer with primary & secondary fuses.

**8.00.00 TEST**

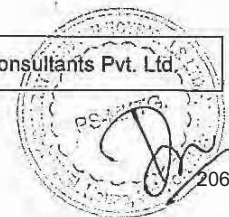
The actuator and all components thereof shall be subject to shop tests as per relevant Standards (Refer Annexure-D of General Electrical Section – 1 Volume F-1) . In addition, if any special test is called for in equipment specification, the same shall be performed.


**9.00.00 DRAWINGS, DATA & MANUALS**

9.01.01 Not used.

9.01.02 To be Submitted after Award of Contract

- a) Actuator Data Sheet
- b) Internal wiring diagram and suggested control schematic
- c) Torque switch and limit switch contact development,
- d) Manufacturer's Catalogue



	Odisha Power Generation Corporation Ltd.	Technical Specification for Main Plant Package	IB TPS - 2X660 MW Units 3&4, Jharsuguda, Odisha
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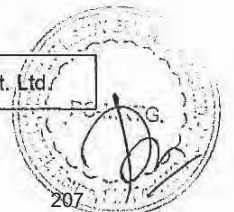
- e) Instruction manual indicating clearly the installation methods, check ups and tests to be carried out before commissioning of the equipment.

9.02.00 The Seller may note that the drawings, data and manuals listed herein are minimum requirements only. The Seller shall ensure that all other necessary write-ups, curves and information required to fully describe the equipment are submitted.



Doc. No. K8B09-MP-SPC-G-001	V.IIF-1/S-III : 5	Development Consultants Pvt. Ltd
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**SPECIFICATION  
FOR  
MOTORISED VALVE ACTUATOR**

SPECIFICATION NO.: PE-SS-350-145-I007

VOLUME

SECTION

REV. NO. 00

DATE: 05.01.10

SHEET 1 OF 3

**Data Sheet A & B**

DATA SHEET-A  
(TO BE FILLED BY PURCHASER)

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

350

<b>GENERAL*</b>	* PROJECT	2x660 MW OPGCL BANAHARPALI TPS		
	OFFER REFERENCE			
	* TAG NO. SERVICE			
	* DUTY	<input type="checkbox"/> ON / OFF	<input type="checkbox"/> INCHING	
	* LINE SIZE (inlet/outlet): MATERIAL			
	* VALVE TYPE	<input type="checkbox"/> GLOBE <input type="checkbox"/> GATE <input type="checkbox"/> REG. GLOBE <input type="checkbox"/> BUTTERFLY		
	* OPENING / CLOSING TIME			
	* WORKING PRESSURE			
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%		
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY		
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY		
ACTUATOR RATED TORQUE	BIDDER TO SPECIFY			
<b>CONSTRUCTION AND SIZING</b>	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF, IP:55		
	MECHANICAL POSITION INDICATOR	TO BE PROVIDED FOR 0-100% TRAVEL		
	BEARINGS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.		
	GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION	METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.		
SIZING	OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. FOR INCHING(REGULATING) SERVICE 150 STARTS/HR MINIMUM			
<b>HANDWHEEL</b>	* REQUIRED	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
	* ORIENTATION	<input type="checkbox"/> TOP MOUNTED <input type="checkbox"/> SIDE MOUNTED		
	TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.			
<b>ELECTRIC ACTUATOR</b>	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY		
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY		
	MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT.		
	ACTUATOR APPLICABLE WIRING DIAGRAM	<input checked="" type="checkbox"/> ENCLOSED (BIDDER TO CONFIRM) A: <input type="checkbox"/> DRG. NO. 3-V-MISC-24227 R00 B: <input type="checkbox"/> DRG. NO. 3-V-MISC-24550 R00 C: <input checked="" type="checkbox"/> DRG. NO. 3-V-MISC-24283 R00 D: <input type="checkbox"/> DRG. NO. 4-V-MISC-90271 R11		
	COLOUR SHADE	<input checked="" type="checkbox"/> BLUE (RAL 5012) ENAMEL <input type="checkbox"/> .....		
	SHAFT RPM	BIDDER TO SPECIFY		
	OLR SET VALUE	BIDDER TO SPECIFY		
	STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY		
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY		
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC		
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER <input type="checkbox"/> 24 VDC <input type="checkbox"/> 110 V		
	@ ENCLOSURE CLASS OF MOTOR	<input type="checkbox"/> IP 65 <input type="checkbox"/> IP 67 <input type="checkbox"/> FLAME PROOF <input checked="" type="checkbox"/> IP 55, TOTALLY ENCL, SELF VENTILATED.		
	@ INSULATION CLASS	<input type="checkbox"/> CLASS-B <input checked="" type="checkbox"/> CLASS-F		
	@ WINDING TEMP PROTECTION	<input checked="" type="checkbox"/> THERMOSTAT (3 Nos., 1 IN EACH PHASE) <input type="checkbox"/> -----		



**SPECIFICATION  
FOR  
MOTORISED VALVE ACTUATOR**

SPECIFICATION NO.: PE-SS-350-145-I007

VOLUME

SECTION

REV. NO. 00

DATE: 05.01.10

SHEET 2 OF 3

**Data Sheet A & B**

DATA SHEET-A  
(TO BE FILLED BY PURCHASER)

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

350

	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED	
<b>INTEGRAL STARTER</b>	INTEGRAL STARTER	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	TYPE OF SWITCHING DEVICE	<input checked="" type="checkbox"/> CONTACTORS <input type="checkbox"/> THYRISTORS	
	TYPE	<input checked="" type="checkbox"/> CONVENTIONAL <input type="checkbox"/> SMART (NON-INTRUSIVE)	
	STEP DOWN CONT. TRANSFORMER	<input checked="" type="checkbox"/> REQUIRED	
	OPEN / CLOSE PB	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	STOP PB	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	INDICATING LAMPS	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	LOCAL REMOTE S/S	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	STATUS CONTACTS FOR MONITORING	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, S/S IN LOCAL, TORQUE SWITCH OPTD. MID WAY)	
<b>INTERPOSING RELAY</b> (Applicable for integral Starter)	INTERPOSING RELAYS	REQUIRED	
	INTERPOSING RELAY (QUANTITY)	<input checked="" type="checkbox"/> 2 NOs. <input type="checkbox"/> 3 NOs.	
	DRIVING VOLTAGE	<input checked="" type="checkbox"/> 20.5 – 24V DC <input type="checkbox"/> _____ V DC	
	DRIVING CURRENT	<input checked="" type="checkbox"/> 125mA MAX <input type="checkbox"/> _____ mA MAX	
	LOAD RESISTANCE	<input checked="" type="checkbox"/> > 192 ohms - <25 k ohms <input type="checkbox"/> > _____ ohms - < _____ ohms	
<b>TORQUE SWITCH</b>	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN / CLOSE	<input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos. / <input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos	
	CONTACT TYPE	2 NO + 2 NC	
	RATING	5A 240V AC AND 0.5A 220V DC	
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE	
	ACCURACY	+3% OF SET VALUE	
<b>LIMIT SWITCH</b>	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN : INT : CLOSE	<input checked="" type="checkbox"/> 1 No <input type="checkbox"/> 2 Nos.     2 Nos. (ADJ.) <input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos.	
	CONTACT TYPE	2 NO + 2 NC	
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC	

	<b>SPECIFICATION FOR MOTORISED VALVE ACTUATOR</b>	SPECIFICATION NO.: PE-SS-350-145-I007		
		VOLUME		
		SECTION		
		REV. NO.	00	DATE: 05.01.10
		SHEET	3	OF 3
<b>Data Sheet A &amp; B</b>				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	

350

<b>POSITION TRANSMITTER</b>	POSITION TRANSMITTER (For inching duty)	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
	MFR & MODEL NO.	BIDDER TO SPECIFY		
	TYPE	<input checked="" type="checkbox"/> ELECTRONIC (2 WIRE) R/I CONVERTER <input type="checkbox"/> ELECTRONIC (2 WIRE) CONTACTLESS		
	SUPPLY	<input checked="" type="checkbox"/> 24V DC <input type="checkbox"/> .....		
	OUTPUT	<input checked="" type="checkbox"/> 4-20mA		
	ACCURACY	± 1% FS		
<b>SPACE HEATER</b>	@SPACE HEATER	REQUIRED		
	@ POWER SUPPLY			
	@ RATING	415v, 3PH, AC FOR RATING > 0.2KW; SINGLE PHASE FOR RATING < 0.2KW		
<b>TERMINAL BOX</b>	MOTOR TERMINAL BOX	REQUIRED		
	ACTUATOR TERMINAL BOX	REQUIRED		
	ENCL CLASS MTR T.B. / ACTUATOR T.B.	<input type="checkbox"/> IP 65    @ <input type="checkbox"/> ..... <input checked="" type="checkbox"/> IP65 <input type="checkbox"/> .....		
	@ EARTHING TERMINAL	REQUIRED		
	PLUG & SOCKET(9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT)	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED <input type="checkbox"/> <input type="checkbox"/> 2 NOS. <input type="checkbox"/> .....		
<b>CABLE GLANDS</b>	@ POWER CABLE GLAND	SIZE:--DURING DETAIL ENGINEERING		
	@ SPACE HEATER CABLE GLAND	SIZE: 2C x 2.5 sq. mm		
	OTHER CONTROL CABLE GLANDS-1	<input checked="" type="checkbox"/> NOT APPLICABLE		
	OTHER CONTROL CABLE GLANDS-2	<input checked="" type="checkbox"/> NOT APPLICABLE		
<b>WEIGHT</b>	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY		_____ Kg.
<b>NOTES:</b> 1. <b>SCOPE:</b> DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY. 2. <b>CODES &amp; STANDARDS:</b> DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATION STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH: IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722 3. TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C. 4. CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED. 5. THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION.THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE. 6. THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%. 7. THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.				
NOTES* = TO BE FILLED BY MPL (LEAD AGENCY).    @= TO BE FILLED BY ES				



## **2.6.0**

### **CODES AND STANDARDS**

50 °C (max.) * 40 °C (max.) *	Atmosphere	5% (min.)	Air	IP 22
* During Air-conditioning failure. ** For non-ventilated enclosures. For ventilated enclosures, protection class shall be IP 42. *** With a suitable canopy at the top to prevent ingress of dripping water				

6.11.07 The construction of electrical enclosures located in areas subject to conditions classified in the National Electrical Code (NEC) as hazardous shall be of a type designated suitable for the environment in which they are located.

6.11.08 Junction boxes and pull boxes shall be in accordance with the requirements of NEC, Article 370, Paragraphs 18, 19, 20 and 21 and shall be without knockouts.

**6.12.00 NAME PLATE**

Each instrument / item of plant shall have nameplate, permanently attached to it in a prominent position, made of non-hygroscopic & non-corrosive material (generally stainless steel) upon which is to be engraved the manufacturer's name, instrument type / model number, range, Voltage rating, serial number and weight. In addition to description of instrument there should be the KKS numbering on the nameplate.

6.12.01 Items of plant such as valves etc. which are subject to handling, are to be provided with nameplate or label generally made of stainless steel with engraving filled with enamel paint, suitably mounted or affixed with strong rustproof chain.

6.12.02 Stainless steel tag plate shall be wired to the instrument. Inscription on equipment (labels) shall be in English.

**7.00.00 CODES AND STANDARDS**

7.00.01 Instruments such as Gauge glass, thermowells, control valves, flow elements and other on line devices mounted on the pipeline, vessel etc. which comes under the purview of Indian Boiler Regulation Act (IBR) shall be IBR certified. It shall be responsibility of Seller to obtain the necessary approval of the concerned Authority / Chief Inspector of Boilers for the design and design calculations, GA drawing, manufacturing and erection procedure as called for in the IBR Act.

7.00.02 The design, construction and testing of all equipment, facilities, components and systems shall be in accordance with standards/ codes issued by Bureau of Indian Standards (BIS) and/or equivalent international standards/ codes. A non-exhaustive list of reputed international standards is given below:

- a) American National Standards Institute (ANSI)
- b) American Petroleum Institute (API)
- c) American Society of Mechanical Engineers (ASME)
- d) American Society of Testing and Materials (ASTM)
- e) American Water Works Association (AWWA)



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- f) American Welding Society (AWS)
- g) British Standards (BS)
- h) Deutsches Institut fur Normung (DIN), Germany
- i) Heat Exchange Institute (HEI), USA
- j) Hydraulic Institute Standards (HIS), USA
- k) International Electrotechnical Commission (IEC)
- l) Institute of Electrical and Electronics Engineers (IEEE)
- m) International Organisation for Standardization (ISO)
- n) National Electric Code (NEC), USA
- o) National Electrical Manufacturers Association (NEMA), USA
- p) National Fire Protection Association (NFPA), USA
- q) Tubular Exchanger Manufacturers Association (TEMA), USA
- r) VDE association for Electrical, Electronic and Information Technologies (VDE), Germany

Other International Standards, equivalent or superior to the above Standards can also be adopted. However, in the event of any conflict between the requirements of the International standards / codes and the requirements of the BIS standards / codes, the latter shall prevail.

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

1) **Temperature Measurement**

- a) Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974).
- b) Temperature Measurement - Thermocouples - ANSI - MC 96.1 - 1982.
- c) Temperature Measurement by electrical resistance thermometers - IS: 2806
- d) Thermometer-element-Platinum resistance - IS: 2848 / DIN 43760.

2) **Pressure Measurement**

- a) Instrument and apparatus for pressure measurement - ASME PTC 19.2 (1964).
- b) Bourdon tube pressure and vacuum gauges - IS: 3624/1996.

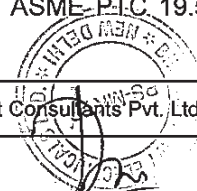
**Flow Measurement**


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



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

4) **Electronic Measuring Instruments and Control Hardware**

- a) Automatic null balancing electrical measuring instruments -ANSI C 39.4 (Rev. 1973), IS 9319
- b) Safety requirements for electrical and electronic measuring and controlling instrumentation - ANSI C 39.5 / 1974.
- c) Compatibility of analog signals for electronic industrial process instruments - ISA-S 50.1: ANSI MC 12.1 / 1975.
- d) Dynamic response testing of process control instrumentation - ANSI MC 4.1 (1975) - ISA -S26 (1968).
- e) Surge withstand capability (SWC) tests - ANSI C 37.90A (1989), IEC / EN 61000-4-4 & IEC / EN 61000-4-5.
- f) Printed circuit boards – IPC-TM-650, IEC 326-2 & IEC 326-4.
- g) General requirements and method of tests for printed wiring boards - IS-7405 (Part-I) /1994, IEC 326-2.
- h) Edge socket connectors - IEC 130-11.
- i) Requirements and methods of testing of wire wrap terminations--DIN 41611 Part-2.
- j) Dimensions of attachment plugs and receptacles- ANSI C73-1973.(Supplement ANSI C73a – 1980)

5) **Instrument Switches and Contacts**

- a) Contact Rating - AC services NEMA ICS Part-2 125, A-600
- b) Contact Rating - DC services NEMA ICS Part-2 125, N-600

6) **Enclosures**

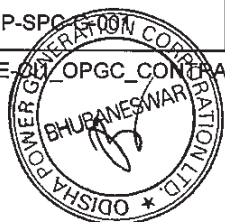
- a) Enclosures for Industrial Controls and Systems–NEMA ICS-6-110.15 through 110.22
- b) Racks, panels and associated equipment -EIA: RS-310-B-1983 (ANSI C83.9 - 1972)

7) **Apparatus, Enclosures and Installation Practices in Hazardous Area**

- a) Classification of hazardous area - NEMA Article 500, Volume-6, 1978.
- b) Electrical Instruments in hazardous dust locations - ISA-RP 12.11.
- c) Intrinsically safe apparatus - NFPA Article 493 Volume-4 1978.
- d) Purged and pressurized enclosure for electrical equipment in hazardous location - NFPA Article 496 Volume-4, 1978.

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**8) Sampling System**

- a) Stainless Steel material of tubing and valves, for sampling system - ASTM A 269-79 GRTO-316.
- b) Submerged helical coil heat exchangers for sample coolers – ASTM D11-98.
- c) Steam and Water Sampling, Conditioning and Analysis in the Power Cycle: ASME PTC 19.11, 2008

**9) Annunciators**

- a) Specifications and guides for the use of general-purpose annunciators - ISA 18.1- (1979) (R2004).
- b) Surge withstands capability tests - ANSI C37.90 -1989 / IEC /EN 61000-4-4 & IEC /EN 61000-4-5.

**10) Interlocks, Protections**

- a) Relays and relay system associated with electric power apparatus - IEEE Standards 3.13.
- b) Surge withstands capability tests - ANSI C37.90 a - 1971 and IEEE Standard 472-1974.
- c) General requirements and tests for switching devices for control and auxiliary circuits including contactor relays - IS-6875 (Part-I)/1973.
- d) Turbine water damage prevention - ASME-TDP-1-2006.
- e) Boiler safety interlocks - NFPA Section 85B, 85D, 85E, 85F, 85G.

**11) UPS System**

- a) Practice and requirements for semi-conductor power rectifiers - ANSI C34.2.
- b) Relays and relay systems associated with electrical power apparatus IEEE Standard - 3.13.
- c) Surge withstands capability tests - ANSI C 70.90 A/1971, IEC-255.4.
- d) Recommended practice for sizing large lead storage batteries for generating stations and sub-stations -IEEE-485.

**12) Control Valves**

- a) Control valve sizing (Incompressible fluids) - ISA-S39.1 / 1972
- b) Control valve capacity test (Incompressible fluids) -ISA-S39.2 / 1972
- c) Control valve sizing (Compressible fluids) - ISA-S39.3 / 1972.





- d) Control valve capacity test (Incompressible fluids) -ISA-S39.4 / 1972.
- e) Control Valve seat leakage – ANSI / FCI 70.2
- f) Face to face dimensions of Control Valves - ANSI B16.10
- g) Control Valve Capacity Test Procedure – ISA – 575.02

**13) Instrument Tubing**

- a) Seamless Carbon Steel Pipe - ASTM-A-106.
- b) Forged carbon steel fittings - ASTM-A-105.
- c) Dimensions of fittings - ANSI-B16.11.
- d) Code for pressure piping, welding, hydrostatic testing - ANSI-B 31.1.
- e) Nomenclature for instrument tube fittings - ISA-RP 42.1 / 1982.
- f) Seamless Stainless Steel Tube ASTM A-213 TP 316 / ASTM A-269 TP 316
- g) Seamless Alloy Steel Pipe ASTM A 335 P22
- h) Seamless Stainless Steel Pipe ASTM A-312 TP 316

**14) Cables**

- a) Thermocouple extension wires / cables - ANSI MC96.1.
- b) Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy-IPCEA S-61-402
- c) Guide for design and installation of cable system in power generating station (insulation, jacket materials) -IEEE Standard 422.
- d) Requirements of vertical tray flame test - IEEE 383
- e) Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B33.
- f) Specification for PVC insulated (heavy duty) electric cables or (Latest revision) equivalent - IS-1554 Part-1
- g) Conductors for insulated electric cables and flexible cords or equivalent - IS-8130, 1984
- h) PVC insulation and sheath of electric cables or equivalent - IS-5831
- i) PVC insulated cables for working voltage upto and including 1100 volts or equivalent - IS-694 (Latest)
- j) Mild steel wires, formed wired and tapes for armouring of cable or equivalent - IS-3975
- k) Test on single vertical insulated wire or cable - IEC 332 (Part-1)
- l) Swedish Chimney Flame Test - SS 424-1475



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- m) Test methods for insulations and sheaths of electric cables and cords - IEC 540
- n) Colour coding of instrumentation cables - VDE 0815
- o) Minimum oxygen concentration to support candle-like combustion of plastics - ASTM D2863
- p) Density of smoke from the burning of decomposition of plastics - ASTM D2843
- q) Test on gases evolved during combustion of materials from cables - IEC 754
- r) Determination of the amount of halogen acid gas - IEC 754 (Part-1)
- s) Methods of test for cables - IS 10810
- t) Drums for electric cables - IS: 10418

**15) Electronic Cards, Subassemblies and Components**

- a) **Unpackaged**
  - i) Vibration : IEC-68.2.6
  - ii) Shock : IEC-68.2.27
  - iii) Drop & Topple : IEC-68.2.31
- b) **Packaged**  
Vibration, Drop & Static Compression - NSTA.
- c) **Electromagnetic Compatibility / Immunity**
  - i) Electrical Fast Transient immunity : IEC / EN 61000-4-4
  - ii) Surge Immunity : IEC / EN 61000-4-5
  - iii) Radiated Electromagnetic Field : EN 61000-4-3
  - iv) Electrostatic Discharge immunity : EN 61000-4-2
  - v) Electromagnetic Emissions : VDE 0871, Class-B

**16) Cable Trays, Conduits**

- a) Guide for the design and installation of cable system in power generating station (cable trays, support systems, conduits)- IEEE Standard 422, NEMA VE-1, NEC-1981. Test Standards NEMA VE-1-1979.
- b) Galvanizing of carbon steel cable trays - ASTM A-386.



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Specific Technical Requirement

2X660MW STPP  
IB TPS UNITS 3 & 4,  
JHARSUGUDA, ODISHA

## 2.7.0 KKS NUMBERING PHILOSOPHY



DOCUMENT TITLE

**KKS NUMBERING PHILOSOPHY**

2X660MW STPP IB TPS UNITS 3 &amp; 4, JHARSUGUDA, ODISHA

**KKS NUMBERING PHILOSOPHY**

For identifying (tagging) an instrument / equipment in Power plant KKS numbering scheme is used. The purpose is to assign a unique number to every equipment in the power plant. For C&I equipment unique number are to be provided up to the signal level so that a unique number Input / Output exist in DCS for every signal.

Normally KKS number is a 10 digit alpha-numeric code and is typically split into the following:

X	X	X	A	A	Y	Y	B	B	B
---	---	---	---	---	---	---	---	---	---

First three digits indicate the Sub-System. The Code for the major system are given as per **Annexure-1**.

Fourth and Fifth digits are the **Numerical Keys at System Code Level** and used to distinguish between main systems having same Alpha Codes.

Sixth and Seventh digits are the **Equipment / Apparatus / Measuring Circuit Code**. The code of various Equipment / Apparatus / Measuring Circuit is shown in **Annexure-2**

Eight, Nine and tenth digits are the **Numerical Keys at Equipment / Apparatus / Measuring Circuit Code** and used to distinguish between various instruments in the same sub-group. Numerical keys at System / Equipment / Apparatus / Measuring Circuit is shown in **Annexure-3**.

**ANNEXURE-1****List of System / Sub-System Codes used in Power Plant:**

- 1) CONDENSER ONLOAD TUBE CLEANING SYSTEM: PAH

**ANNEXURE-2****Standard Equipment Codes:**


AA	Valves including drives, also hand operated
AB	Seclusions, Lock, Gates, Doors
AC	Heat Exchanger
AE	Turning, Driving, Lifting equipment
AF	Continuous conveyors, Feeders
AG	Generator Units
AH	Heating and Cooling Units
AK	Pressing and Packaging equipment
AM	Mixer, Stirrer
AN	Blower, Air Pumps / Fans, Compressor Units
AP	Pump Units
AT	Purification, Drying, Filter
AV	Combustion Equipment e.g. grates

**Standard Apparatus Codes:**

BB	Vessels and Tank
BF	Foundation
BG	Boiler Heating Surfaces
BN	Injector, Ejector
BP	Flow and throughput limitation equipment (Orifice)
BQ	Holdings, Carrying Equipment, Support
BR	Piping, Ducts, Chutes, Compensator
BS	Sound Absorber
BU	Insulations, Sheatings

**Standard Measuring Circuits Codes:**

CD	Density
CE	Electrical Quantities
CF	Flow, throughput
CG	Distance, Length, Position
CK	Time
CL	Level

	DOCUMENT TITLE
	<b>KKS NUMBERING PHILOSOPHY</b>

2X660MW STPP IB TPS UNITS 3 & 4, JHARSUGUDA, ODISHA

CM	Humidity
CQ	Analysis (SWAS)
CS	Speed, Velocity, Frequency
CT	Temperature
CY	Vibration, Expansion

### ANNEXURE-3

### Numerical Keys

#### A) Numerical Keys at System Code Level


- i) Use 10, 20, 30, ..... To distinguish between main systems having same Alpha Codes. Examples:
  - a) Main Steam (Left) and Main Steam (Right)
  - b) BFP – A/B/C
  - c) ID Fan – A/B, FD Fan A/B, AH – A/B
- ii) For branch off from main system path having code say 10, keep the same alpha code and use 11, 12, 13 etc. Similarly for other branch off from main system path having code say 20, keep the same alpha code and use 21, 22, 23 etc and shall carry on further in the same way.
- iii) If the branch off from main system / sub system path is used for some other system, where different alpha codes can be applied, then in that case the said branch line will be designated by the alpha codes of the system to which it is providing the input.

#### B) Numerical keys at Equipment Code level:

There are three numerical keys available for each type of equipment code. Following has been agreed upon considering present practice, better flexibility and ease in sorting.

##### i) Valves and Dampers --- Equipment Code – AA

		<u>N1</u>	<u>N2 N3</u>
Motorised ( <i>on/off duty</i> )	-	0	01 to 50
Motorised ( <i>inching duty</i> )	-	0	51 to 99
Pneumatic (Control)	-	1	01 to 50
Motorised ( <i>thyrestor Control</i> )	-	1	51 to 99
Sol. Operated	-	2	01 to 99
(Open / Close duty (Valves, NRVs, Gate)			

		DOCUMENT TITLE		
		<b>KKS NUMBERING PHILOSOPHY</b> 2X660MW STPP IB TPS UNITS 3 & 4, JHARSUGUDA, ODISHA		
	Hydraulic	-	3	01 to 99
	NRV (Without actuation)	-	4	01 to 99
	Manual	-	5	01 to 99
	Manual	-	6	01 to 99
	Relief & Safety Valves	-	7	01 to 99
	Reserve	-	8	01 to 99
	Reserve	-	9	01 to 99
	<b>ii) Field Instruments</b>			
	Field Transmitters & Analog Signals	-	0	01 to 99
	Field Switches & Binary Signals	-	1	00 to 99
	PG Test Point	-	4	00 to 99
	Gauges	-	5	00 to 99
	Automatic Turbine Tester (ATT)-HWR	-	2	00 to 99
	(Reserved for protection Signals used by Hardwar)			
	<b>Example of Numerical Key Usage:</b>			
	<p>In line with the philosophy adopted for Valves / Dampers /instruments etc. pumps and fans in the main systems (having different system code) can be numbered as AP/N100 and as AP/N101, 102, ..... Where system code is same.</p>			

## **3.0.0**

### **QUALITY ASSURANCE, QUALITY PLANS, INSPECTION & TESTING PROCEDURE**



**VOLUME : IIE**

**SECTION-VIII**

**QUALITY ASSURANCE AND GUIDE LINES FOR ERECTION, TESTING AND COMMISSIONING**

**1.00.00 ERECTION GUIDELINES**

1.00.01 The intent of this section is to provide the general guidelines to be followed for the warehousing, handling, erection, testing, pre commissioning checks and commissioning of various types of instruments and systems.

1.00.02 Equipment manufacturers' recommendation, where available, shall prevail over the guidelines furnished in this section and in case of any contradiction between the stipulations.

1.00.03 The specification shall not be treated as comprehensive. Any activity, not specifically mentioned but felt essential or advisable from good engineering consideration shall be performed.

1.00.04 Instrumentation works shall be performed in accordance with the guide specifications and various drawings and schedules supplied during the execution of work and instructions received from Engineer or his authorized representative(s) from time to time during the execution of this work.

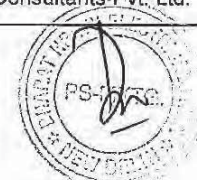
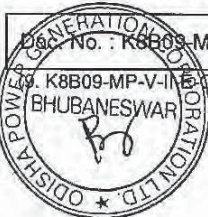
1.00.05 Omission of any specific reference to any method, parts, accessories or material required for proper and efficient execution of the work shall not in any way relieve Seller from his responsibilities of providing such facilities and performing the successful erection, testing and commissioning.


**1.01.00 Impulse Piping, Tubing, Fittings, Valves And Valve Manifolds**

1.01.01 All impulse pipes shall be of seamless type conforming to ANSI B36.10 for schedule numbers, sizes and dimensions etc. The material of the impulse pipe shall be same as that of main process pipe. Impulse pipe shall be of ½ inch or 15NB and tube shall be of 12mm. All fittings, tubes, pipes shall suit the maximum design pressure of process.

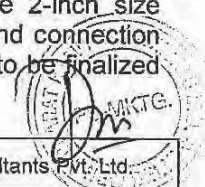
1.01.02 Stainless steel tube shall be provided inside enclosures and racks from tee connection to valve manifold and then to instrument. For high pressure / temperature applications the material shall be ASTM A 213 TP 316H and for other applications material shall be ASTM A 213 TP 316L. The wall thickness of the tube shall be in accordance with the ANSI B31.1 standard.

1.01.03 All fittings shall be forged steel and shall conform to ANSI B16.11. The material of forged tube fittings for shaped application (e.g. tee, elbow etc.) shall be ASTM A182 Gr. 316 H for high pressure / temperature applications (as defined above) and ASTM A182 Gr. 316L for other applications. The material for bar stock tube fitting (for straight application) shall be 316 SS. Metal thickness in the fittings shall be adequate to provide actual bursting strength equal to or greater than those of the impulse pipe or SS tube, with which they are to be used.




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- 1.01.04 The valve manifolds shall be of 316 stainless steel with pressure rating suitable for intended application. 2-valve manifold shall be used for pressure measurements using pressure transmitters / pressure switches and 5-valve manifold shall be used for remaining applications like DP, flow and level measurements.
- 1.01.05 For Pressure / D.P gauges in fluid application two-way globe valve on each impulse line to the instrument and in air / flue gas application two-way gate valve on each impulse line to the instrument shall be provided near the instrument. These shall be in addition to the three ways gauge cock provided along with the pressure / D.P gauges.
- 1.02.00 **Sample Piping System**
- 1.02.01 This shall include piping, fittings, valves and accessories from tapping point up to SWAS conditioning panel located in SWAS room. All sample piping shall be 3/4" NB seamless type of material ASTM A213 TP 316 H, conforming to ANSI B36.19. The schedule number shall be suitable for the particular application.
- 1.02.02 All fittings shall be socket welding type and of material ASTM A182 F316H conforming to ANSI B 16.11.
- 1.02.03 Single and multi tubes shall run with the minimum number of changes in direction. Suitable identification tags shall be provided for easy check up and for proper connections.
- 1.02.04 The valves to be used in sample piping shall be of globe type, forged construction and stainless steel conforming to ASTM A182. The pressure and temperature ratings shall be as per ANSI B16.34. The valve design shall be such that the seats can be re-conditioned and stem and disc can be replaced without removing valve body from the line.
- 1.03.00 **Air Supply Piping**
- 1.03.01 All pneumatic piping, fittings, valves, air filter cum regulator and other accessories required for instrument air for the various pneumatic devices / instruments shall be provided.
- 1.03.02 This shall include air supply to pneumatically operated control valves, actuators, instruments.
- 1.03.03 Individual supply line and control signal line to control valve, 1/4 inch size stainless steel tubing shall be provided. The fittings to be used with tubes shall be of forged stainless steel & screwed type.
- 1.03.04 An instrument air filter cum regulator set with mounting accessories shall be provided for each pneumatic device requiring air supply. The filter regulators shall be suitable for 10 Kg / cm<sup>2</sup> max. inlet pressure. The filter shall be of size 5 microns and of material sintered bronze. The air set shall have 2-inch size pressure gauge and built in filter housing blow down valve. The end connection shall be 1/4 inch / 1/2 inch / 3/4 inch NPT as per the requirement to be finalized during detailed engineering.



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1.03.05 All the isolation valves in the air supply line shall be gate valves as per ASTM B62 inside screw rising stem, screwed female ends as per ASA B2.1. Valve bonnet shall be union type & trim material shall be stainless steel, body rating 150 pounds ASA. The valve sizes shall be 1/2 inch to 2 inch.

1.04.00 Not used.

1.04.01 **Instrument Laboratory**

~~The erection Bidder shall set up a site test laboratory for erection, testing, commissioning and maintenance upto handing over of the plant to Buyer.~~

- ~~a) The shop shall be complete with all testing and calibrating equipment / kit, special tools and tackle required for the systems supplied.~~
- ~~b) Laboratory shall have the complete arrangement, which shall not be limited to the following :-
 
  - ~~i) Distribution of instrument air from portable air compressor up to test benches.~~
  - ~~ii) Test bench shall be complete with air supply distribution points along with necessary air filter regulator, fittings, gauges and valves.~~
  - ~~iii) Internal wiring for distributing voltages of various levels (240V AC, 24V DC, 220V DC etc.) for the test bench.~~
  - ~~iv) Electrical bench shall have required sockets, test points.~~
  - ~~v) Grouting, leveling and proper alignment of test benches, jigs, compressor, vacuum pumps etc.~~~~
- ~~c) Workmanship inside the laboratory shall be in accordance with latest engineering practices.~~
- ~~d) Furnished hereunder is a list of recommended calibration and test equipments required as a minimum for calibration work. Bidder should ensure that any equipment not listed below but required at the time of calibration shall be made available at his own cost. All test equipments and kits shall be approved by NPL / ERTL or any recognized authorities and shall have valid calibration report :-~~

~~Dead Weight Testers (ranges upto 350 kg/cm<sup>2</sup>)~~

~~Pressure gauge comparator (ranges upto 350 kg/cm<sup>2</sup>)~~

~~Oil / Dry bath for temperature instrument calibrations : Maximum temperature = 350 °C~~

~~Manufacturer's Standard~~



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**Standard Mercury in glass thermometers**  
Range : -50 to +50 °C, 0 to 100 °C 0—250 °C

**Standard Gauges for Ranges upto 350 kg/cm<sup>2</sup>**

**U-tube differential manometers / inclined tube manometer Static Pressure; Rating : 7 kg/cm<sup>2</sup>**

**Single Leg Manometers**

Scale : -1500 mm Water 1500 mm hg.  
Static Pressure Rating : 7 kg/cm<sup>2</sup>

**Decade Resistance Box**

**Manufacturer's Standard**

**Multimeters**

**V, mV, A, mA, ohm, continuity**

**Potentiometer / Direct Digital Calibrator (capable of generating and measuring mV)**

**Meggers -250V /500 V**

**Air hydro pump / hydraulic pump**

**Vacuum Pump**

**Instrument air compressor with filters and regulators and deoilers.**

**Current generator 4-20 mA, DC with 24V DC power source.**


**Variac (0-260 VAC continuous output)**

**Line tester**

**Stop watch**

**Barometer**



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**1.05.00 Tools & Tackle And Consumables**

Furnished hereunder is a list of recommended tools & tackle required as a minimum for the work. Seller should ensure that any equipment not listed below but required for completion of the work shall be made available at his own cost.

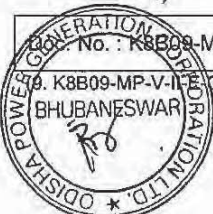
**1.05.01 Tools & Tackle**


01. Engraving machine
02. Sheet punching machine
03. Hand drill with bits of various sizes
04. Welding kit
05. Thread cutter (with different sizes of die)
06. Test pressure gauges for hydraulic testing
07. Materials for scaffolding
08. Materials for rigging
09. Sets of wrenches, spanners, allen keys, crimping and splicing tool, electrical plier, vicegrip plier, line tester and screw drivers in technician tool kit box.
10. Vicegrip
11. Pipe bending jig
12. High speed cutting emery wheel
13. Sheet bending machine
14. Slide caliper
15. Screw gauge
16. Tube cutter
17. Tube bender
18. Hacksaw
19. Soldering iron

**1.05.02 Consumables**

Furnished hereunder is a list of recommended consumables required as a minimum for the work. Seller should ensure that any item not listed below but required for completion of the work shall be made available at his own cost.

- a) Polyethylene sheets for covering field instruments and panels
- b) Grease of approved quality.
- c) Coloured adhesive PVC tapes.
- d) Gaskets and washers of various size and types as required.
- e) Paints of approved quality and shade.
- f) Brass seam/foils for levelling of panels

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- g) All industrial gases like Oxygen, acetylene or inert gases, compressor and all types of electrodes, brazing rods, flux etc. for welding purpose and necessary facilities for testing the welded joints.
- h) Dry seal type thread sealant.
- i) Insulated PVC / Vinyl adhesive tapes, sleeves etc.,
- j) Cable markers and clamps
- k) Cleaning solvent, petrol, rustolene, kerosene etc.
- l) Gland sealing compound
- m) 2 mm thick Aluminum Sheets
- n) Twisted galvanized steel wire
- o) Cutting oil
- p) Teflon tape
- q) Liquid soap, jute cut
- r) Solder and flux
- s) Nuts, bolts, screws and gaskets as required

**2.00.00 QUALITY ASSURANCE, TESTING & INSPECTION**

2.00.01 Equipment and systems furnished under this specification shall be subjected to test witnessed by Buyer. The approval of Buyer or passing of such inspections or tests shall not, however, prejudice the right of Buyer to reject the equipment if it does not comply with the specification when erected or fails to give complete satisfaction in service.

~~2.00.02 Seller shall identify "Customer Hold" items in the offer specifying items that are proposed to be subjected to Buyer's inspection for their dispatch clearance. Seller shall give intimation to Buyer for all inspections sufficiently in advance.~~

2.00.03 Quality assurance documents shall be drawn up by Seller elucidating the test plan for all items subjected to manufacturer internal or Buyer's inspection. The quality control plan shall be finalized and approved by Buyer. All tests shall be performed with certified instruments, which shall be traceable to standard instruments.

**2.01.00 Type Test General Requirements**


2.01.01 The Seller shall furnish the type test reports of all type tests as per relevant standards and codes as well as other specific tests indicated in this specification.

Lists of such tests are given for various equipment in table titled "Type Test Requirement for C&I Systems" at the end of this sub-section. For the balance equipment instrument, type tests may be conducted as per manufactures standard or if required by relevant standard.

Out of the tests listed, Seller / sub-vendor / manufacturer is required to conduct certain type tests specifically for this contract (and witnessed by Buyer or his



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authorized representative) even if the same had been conducted earlier, as clearly indicated subsequently against such tests.

- 2.01.03 For the rest, submission of type test results and certificate shall be acceptable provided.
- The same has been carried out by the Seller / sub-vendor on exactly the same model / rating of equipment.
  - There has been no change in the components from the offered equipment & tested equipment.
  - The test has been carried out as per the latest standards along with amendments as on the date of bid opening.
- 2.01.04 In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the Seller within the quoted price and no extra cost shall be payable by the Buyer on this account
- 2.01.05 As mentioned against certain items, the test certificates for some of the items shall be reviewed and approved by the Seller or his authorized representative and the balance have to be approved by the Buyer.
- 2.01.06 The schedule of conduction of type tests / submission of reports shall be submitted and finalized during pre-award discussion.
- 2.01.07 For the type tests to be conducted, Seller shall submit detailed test procedure for approval by Buyer. This shall clearly specify test setup, instruments to be used, procedure, acceptance norms (wherever applicable), recording of different parameters, interval of recording precautions to be taken etc. for the tests to be carried out.
- ~~2.01.08 Seller shall indicate in his bid, the cost of the type test for each items only for which type tests are to be conducted specifically for this project.~~
- 2.02.00 **Special Requirement for Solid State Equipments / Control Panel, Annunciation & PLC Panel / Systems**

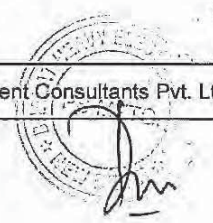
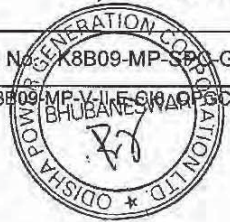
All solid-state logic cabinets shall be tested in manufacturing works as per approved Quality Assurance Program. Tests shall not be limited to the followings:

- All solid-state logic cabinets shall successfully undergo the burn-in test / **elevated temperature test. Reports, not older than 5 (five) years shall be furnished for Buyer / Consultant review. and elevated temperature test prior to shipment from manufacturing works.**
- All solid state logic systems shall be tested for surge withstand capability and electrical noise immunity test in accordance with the requirements of ANSI C37.90 / IEEE-472.
- Radiated immunity test shall be in accordance to IEC 801.3.
- HV & IR Test



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- e) Continuity test
- f) Routine & Acceptance Test as per IS 8623.
- g) Functional checks
- h) Tests for PLC on Programming languages as per IEC 61131
- i) Visual and dimensional checks.

**2.03.00 Tests on Instruments :**

- a. Visual inspection check
- b. Functional check
- c. Calibration accuracy
- d. Repeatability
- e. Hysteresis
- f. Dead Band / Sensitivity

**2.04.00 Tests on Control valves :**

- a) Radiography test
- b) Magnetic particle Inspection
- c) Liquid Penetration Test
- d) Hydrostatic Test
- e) CV Test

**2.05.00 On Site Tests :**

Site tests on the entire integrated system and equipment shall be performed as per approved protocol at different stages of erection, commissioning and trial operation as follows :


- a. Preliminary on site inspection and tests
- b. Pre- commissioning and start up tests including loop checks and interlock & protection checks.
- c. Performance tests for DDCMIS and other important systems as per specification / QAP.

**2.06.00 Loop Checking & Testing**

2.06.01 Loop tests shall be conducted to check the functional performance of all elements comprising the loop, thereby ensuring proper interconnections and operations.

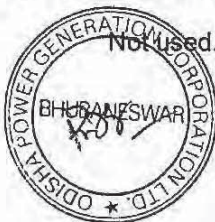
2.06.02 Loop checking shall be performed after calibration, installation, interconnection and leak testing of signal lines is carried out for all instruments.



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- 2.06.03 Before proceeding for loop checking, the installation report and calibration results of individual elements shall be recorded on the pro-forma and shall be approved by Buyer's Engineer for correctness of installation, measurements and calibration results.
- 2.06.04 Loop testing for all control & measurement loops shall be generally performed by simulating process variables at least 0%, 25%, 50%, 75%, and 100% of full scale inputs from field. Detailed procedure shall be submitted to the Buyer's Engineer for approval before proceeding with the loop checking.
- 2.06.05 In case of protection & interlocking systems, field / Receiver switches are simulated for abnormality by disconnecting / connecting the wires at switch terminals. Function of all associated systems are checked including performance of solenoid valves, ON/OFF type control / shutdown valves including proper functioning of Limit Switches and other accessories. Adjustments of Limit Switches wherever necessary also form part of checking of loop performance.
- 2.06.06 Performance of individual loops shall be accepted for an overall accuracy of  $\pm 1.5\%$ . Where deviation is found to exist more than specified limit, Seller shall recalibrate the instruments, which shall also form part of loop testing.
- 2.06.07 After the loop test is complete, the Seller shall connect back any terminations and connections removed for loop checking.
- 2.06.08 A loop shall be considered as complete and handed over only after measurements in that particular loop are completed and certified by Buyer's Engineer-in-charge. Loop checking data sheets shall be duly filled in all respects, approved and accepted by Buyer's Engineer. In case of loops in which certain instruments of the loops are calibrated by other agency, loop checking shall be performed in coordination with the agency involved.
- 2.06.09 Defect, if any, is detected in the calibration of the instruments in the scope of Seller, same shall be rectified. After the calibration has been rechecked, loop checking would be performed again to the satisfaction of Buyer's Engineer.
- 2.06.10 Final certified loop check sheets shall be submitted in 4 (four) copies and 1 (one) soft copy.

3.00.00 **COMMISSIONING**



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**9.00.00 TYPE TEST**

**9.01.00 General Requirements**

- a) The Seller shall furnish the type test reports of all type tests as per relevant standards and codes as well as other specific tests indicated in this specification. List of major tests are furnished below for solid state equipment. For the balance systems & instruments, which are not indicated here, type tests may be conducted as per manufactures standard or if required by relevant standard. For turbo sets type tests are not offered by Seller.
- b) The Seller / sub-vendor / manufacturer is required to conduct certain type tests specifically for this project as specified in respective sections and to be witnessed by Buyer or his authorized representative even if the same had been conducted earlier. In case Buyer decides to waive any of the Type tests for any item based on tests conducted by Seller in the last five years, Test certificates for same shall be provided for review / acceptance and the final decision rests with Buyer.
- c) Submission of type test results and certificate shall be acceptable provided:
  - i) The same has been carried out by the Seller / sub-vendor on exactly the same model / rating of equipment.
  - ii) There has been no change in the components of offered equipment from tested equipment.
  - iii) The test has been carried out as per the latest standards along with amendments.
- d) In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the Seller within the quoted price and no extra cost shall be payable by the Buyer on this account.
- e) The schedule of conduction of type tests / submission of reports indicating the test standard shall be submitted and finalized during pre-award discussion for Buyer's review & approval.
- f) For the type tests to be conducted, Seller shall submit detailed test procedure for approval by Consultant. This shall clearly specify test setup, instruments to be used, procedure, acceptance norms (wherever applicable), recording of different parameters, interval of recording, precautions to be taken etc. for the tests to be carried out.

**9.02.00 Special requirements for Solid State Equipments & Systems**

The type tests reports, as a minimum, over and above the requirements of above clause which are to be submitted for each of the major C&I system shall be as indicated below:

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9.02.01 **Electromagnetic Immunity as per EN 61000-6-22**



- a) Equipment furnished by Seller shall incorporate necessary techniques to eliminate measurement and control problems caused by electromagnetic interferences especially encountered in power plant environment. Equipment, which is vulnerable to such interference, shall be suitably immunized to eliminate possible problems.
- b) Required shielding, input balancing, ripple amplitude and grounding for field signals and for the control systems to achieve an installation with minimum noise coupling from all sources.
- c) Any additional equipment, deliverables required for effectively eliminating the noise problems shall be identified and included.
- d) ~~Radiated radio frequency / Electromagnetic Field immunity as per EN 61000-4-3 or equivalent.~~ **Electromagnetic emission as per EN 61000-6-43**



9.02.02 **Surge-Protection For Solid State Equipment**

All solid state systems/ equipments shall be immuned and able to withstand the electrical noise and surges as encountered in actual service conditions inherent in a power plant. All the solid state systems/ equipments shall be provided with all required protections that needs the surge withstand capability as defined in ANSI 37.90a-1989. Hence, all front end cards which receive external signals like analog input & output modules, binary input & output modules etc. including power supply, data highway, data links shall be provided with protections that meet the surge withstand capability as defined in ANSI 37.90a. Complete details of the features incorporated in electronics systems to meet this requirement, the relevant tests carried out, the test certificates etc. shall be submitted. As an alternative to above, IEC / EN 61000-4-4 & IEC / EN 61000-4-5 for Electrical fast transient / burst and Surge immunity may also be adopted for SWC test.

9.02.03 **Dry Heat test** as per IEC-60068-2-2 or equivalent to determine the ability of the equipment / devices to operate under the environmental temperature condition.

9.02.04 **Damp Heat test** as per IEC-60068-2-3 or equivalent to determine the ability of the device to operate under environmental humidity condition.

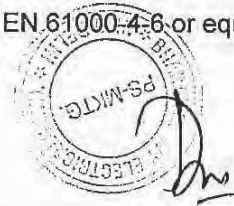
9.02.05 **Vibration test** as per ~~IEC 609454 IEC-60068-2-6 or equivalent~~ to determine the ability of components, equipment and other articles to withstand specified severities of sinusoidal vibration. **Shocks as per IEC 60721-3-3M15.**



9.02.06 **Electrostatic discharge tests** as per EN 61000-4-2 or equivalent.

9.02.07 **Conducted radio frequency immunity test** as per EN 61000-4-6 or equivalent.

9.02.08 **Chemical conditions as per IEC 60721-3-3C1.**



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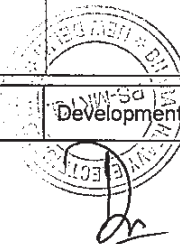
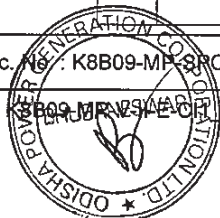


9.02.09 Type Test Requirement for C&I Systems

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Sl. No.	ITEM	TEST REQUIREMENT	STANDARD	TEST TO BE SPECIFICALLY CONDUCTED	APPROVAL REQUIRED ON TEST CERTIFICATE	REMARKS
01.	<u>Narrow Chart Recorder</u>	<u>As per Standard</u>	<u>IS-9319</u>	<u>NO</u>	<u>NO</u>	
02.	<u>Multi-point Recorder</u>	<u>As per Standard</u>	<u>IS-9319</u>	<u>NO</u>	<u>NO</u>	
03.	<u>Vertical Indicators</u>	<u>As per Standard</u>	<u>IS-9319</u>	<u>NO</u>	<u>NO</u>	
04.	<u>Elect. Metering Instruments</u>	<u>As per Standard</u>	<u>IS-1248</u>	<u>NO</u>	<u>YES</u>	
05.	<u>Transducers</u>	<u>As per Standard</u>	<u>IEC-688, IS-12784</u>	<u>NO</u>	<u>YES</u>	
06.	<u>Thermocouples</u>	<u>Degree of Protection Test</u>	<u>IS-2147</u>	<u>NO</u>	<u>NO</u>	
07.	<u>RTD</u>	<u>As per Standard</u>	<u>IEC-751</u>	<u>NO</u>	<u>NO</u>	
08.	<u>C.J.C. Box</u>	<u>Degree of Protection Test Ambient Temp. effect</u>	<u>IS-2147</u> <u>Approved Procedure</u>	<u>NO</u> <u>NO</u>	<u>YES</u> <u>YES</u>	
09.	<u>Electronic Transmitter</u>	<u>As per Standard</u>	<u>BS-6447 / IEC-770</u>	<u>NO</u>	<u>YES</u>	
10.	<u>E/P Converter</u>	<u>As per Standard</u>	<u>Mfr. Standard</u>	<u>NO</u>	<u>YES</u>	
11.	<u>Dust Emission Monitor</u>	<u>Degree of Protection Test</u>	<u>IS-2147</u>	<u>NO</u>	<u>YES</u>	
12.	<u>Instrumentation Cables Twisted &amp; Shielded</u>			<u>YES</u>	<u>YES</u>	
	a) <u>Conductor</u>	<ul style="list-style-type: none"> <li><u>Resistance Test</u></li> <li><u>Diameter Test</u></li> <li><u>Tin Coating Test (drain wire)</u></li> </ul>	<u>VDE-0815</u>  <u>IS-10810</u>			
	b) <u>Insulation</u>	<ul style="list-style-type: none"> <li><u>Loss of mass</u></li> <li><u>Aging in air ovens</u></li> </ul>	<u>VDE-0472</u>  <u>0472 **</u>			
		<ul style="list-style-type: none"> <li><u>Tensile</u></li> </ul>	<u>VDE</u>			

\*\* As per VDE 0207 for Teflon insulated cables



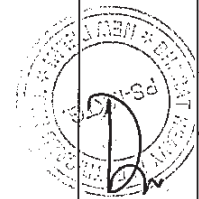
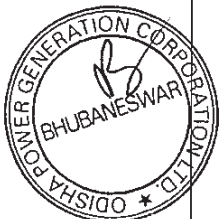


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SL. No.	ITEM	TEST REQUIREMENT	STANDARD	TEST TO BE SPECIFICALLY CONDUCTED	APPROVAL REQUIRED ON TEST CERTIFICATE	REMARKS
		<u>Strength and Elongation</u>	<u>0472 **</u>			
	c) <u>Inner Sheath</u>	<ul style="list-style-type: none"> <li>• <u>Heat Shock</u></li> <li>• <u>Hot Deformation</u></li> <li>• <u>Shrinkage</u></li> <li>• <u>Bleeding &amp; Blooming</u></li> <li>• <u>Loss of mass</u></li> <li>• <u>Heat Shock</u></li> <li>• <u>Cold Bend / Cold Impact Test</u></li> <li>• <u>Hot Deformation</u></li> <li>• <u>Shrinkage</u></li> </ul>	<ul style="list-style-type: none"> <li><u>VDE 0472 **</u></li> <li><u>VDE 0472</u></li> <li><u>VDE 0472</u></li> <li><u>IS-5831</u></li> <li><u>VDE-0472</u></li> <li><u>VDE 0472 **</u></li> <li><u>IS-5831</u></li> <li><u>VDE 0472</u></li> <li><u>VDE 0472</u></li> </ul>			
	d) <u>Outer Sheath</u>	<ul style="list-style-type: none"> <li>• <u>Loss of mass</u></li> <li>• <u>Aging in air ovens</u></li> <li>• <u>Tensile Strength and Elongation Test before and after ageing</u></li> <li>• <u>Heat Shock</u></li> <li>• <u>Hot Deformation</u></li> <li>• <u>Shrinkage</u></li> <li>• <u>Bleeding &amp; Blooming</u></li> <li>• <u>Colour Fastness to Water</u></li> <li>• <u>Cold Bend / Cold Impact Test</u></li> <li>• <u>Oxygen Index Test</u></li> <li>• <u>Smoke Density Test</u></li> <li>• <u>Acid Gas</u></li> </ul>	<ul style="list-style-type: none"> <li><u>VDE-0472</u></li> <li><u>VDE 0472 **</u></li> <li><u>VDE 0472 **</u></li> <li><u>VDE 0472 **</u></li> <li><u>VDE 0472</u></li> <li><u>VDE 0472</u></li> <li><u>IS-5831</u></li> <li><u>IS-5831</u></li> <li><u>IS-5831</u></li> <li><u>ASTMD-2863</u></li> <li><u>ASTMD-2843</u></li> <li><u>IEC-754-I</u></li> </ul>			



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SL No.	ITEM	TEST REQUIREMENT	STANDARD	TEST TO BE SPECIFICALLY CONDUCTED	APPROVAL REQUIRED ON TEST CERTIFICATE	REMARKS
		<u>Generation Test</u>				
	e) <u>Fillers</u>	<ul style="list-style-type: none"> <li>• <u>Oxygen Index Test</u></li> <li>• <u>Smoke Density Test</u></li> <li>• <u>Acid Gas Generation Test</u></li> </ul>	<u>ASTMD-2863</u>  <u>ASTMD-2843</u>  <u>IEC-754-I</u>			
	f) <u>AL-MYLAR Shield</u>	<ul style="list-style-type: none"> <li>• <u>Continuity Test</u></li> <li>• <u>Shield Thickness</u></li> <li>• <u>Overlap Test</u></li> </ul>				
	g) <u>Overall Cable</u>	<ul style="list-style-type: none"> <li>• <u>Noise Interference</u></li> <li>• <u>Flammability</u></li> <li>• <u>Noise Interference</u></li> <li>• <u>Dimensional Checks</u></li> <li>• <u>Cross talk</u></li> <li>• <u>Mutual Capacitance</u></li> <li>• <u>HV Test</u></li> <li>• <u>Drain Wire Continuity</u></li> </ul>	<u>IEEE Transactions</u>  <u>IEEE 383</u>  <u>IS 10810</u>  <u>VDE 0472</u>  <u>VDE 0472</u>			
13.	<u>Pressure Gauge</u>	<ul style="list-style-type: none"> <li>• <u>Degree of Protection Test</u></li> <li>• <u>Temperature Interference Test</u></li> </ul>	<u>IS-2147</u>  <u>IS-3624</u>	<u>NO</u>  <u>NO</u>	<u>NO</u>  <u>NO</u>	
14.	<u>Temperature Gauge</u>	<u>Degree of Protection Test</u>	<u>IS-2147</u>	<u>NO</u>	<u>NO</u>	
15.	<u>Pressure &amp; Differential Pressure Switch</u>	<ul style="list-style-type: none"> <li>• <u>Degree of Protection Test</u></li> <li>• <u>As per Standard</u></li> </ul>	<u>IS-2147</u>  <u>BS 6134</u>	<u>NO</u>  <u>NO</u>	<u>NO</u>  <u>NO</u>	
16.	<u>Level Switch</u>	<u>Degree of Protection Test</u>	<u>IS-2147</u>	<u>NO</u>	<u>NO</u>	
17.	<u>Conductivity Level Switch</u>	<u>Degree of Protection Test</u>	<u>IS-2147</u>	<u>NO</u>	<u>YES</u>	

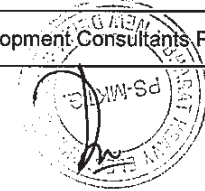


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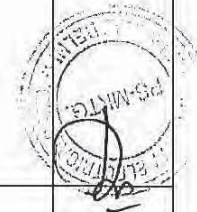
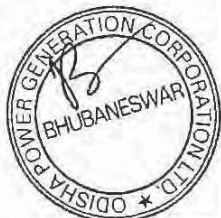


Odisha Power Generation Corporation Ltd.

Technical Specification for Main Plant Package

IB TPS – 2 X 660 MW Units 3 & 4, Jharsuguda, Odisha

Sl. No.	ITEM	TEST REQUIREMENT	STANDARD	TEST TO BE SPECIFICALLY CONDUCTED	APPROVAL REQUIRED ON TEST CERTIFICATE	REMARKS
18.	<b>Battery Charger (including chargers of UPS)</b>	• <b>Degree of Protection Test</b>	<b>IS-2147</b>	<b>NO</b>	<b>YES</b>	
		• <b>Short Circuit current capability</b>	<b>IEC-146-2</b>	<b>NO</b>	<b>YES</b>	
		• <b>Temp. rise test without redundant fans</b>	<b>Approved Procedure, IEC-146-2</b>	<b>YES</b>	<b>YES</b>	
		• <b>SWC Test</b>	<b>Approved Procedure</b>	<b>NO</b>	<b>YES</b>	
		• <b>Efficiency / PF</b>	<b>IEC-146-2, IEC-146</b>	<b>YES</b>	<b>YES</b>	
		• <b>Audible Noise Test</b>	<b>IEC-146-2</b>	<b>NO</b>	<b>YES</b>	
		• <b>Fuse Clearing capability</b>	<b>Approved Procedure</b>	<b>NO</b>	<b>YES</b>	
		• <b>Relative Harmonic Content</b>	<b>Approved Procedure</b>	<b>NO</b>	<b>YES</b>	
		• <b>Radio Interference</b>	<b>IEC-146-4</b>	<b>NO</b>	<b>YES</b>	
		• <b>Over Load Test on Inverter &amp; Charger</b>	<b>Approved Procedure</b>	<b>NO</b>	<b>YES</b>	
		• <b>Restart Test</b>	<b>IEC-146-2</b>	<b>NO</b>	<b>YES</b>	
		• <b>Output Voltage Tolerance</b>	<b>Approved Procedure</b>	<b>NO</b>	<b>YES</b>	
		• <b>Output Voltage Harmonic Content</b>	<b>Approved Procedure</b>	<b>NO</b>	<b>YES</b>	
		• <b>Insulation Test</b>	<b>IEC-146</b>	<b>NO</b>	<b>YES</b>	
• <b>Load Tests</b>	<b>Approved Procedure</b>	<b>YES</b>	<b>YES</b>			
• <b>Preliminary Light Load Test</b>	<b>IEC-146</b>	<b>NO</b>	<b>YES</b>			
• <b>Current Division / Voltage Division</b>	<b>IEC 146-2</b>	<b>NO</b>	<b>YES</b>			
19.	<b>Battery</b>	<b>As per standard</b>	<b>IEC-623 / IS-10918 for Ni-</b>	<b>NO</b>	<b>YES</b>	



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SL. No.	ITEM	TEST REQUIREMENT	STANDARD	TEST TO BE SPECIFICALLY CONDUCTED	APPROVAL REQUIRED ON TEST CERTIFICATE	REMARKS
			Cd IS-1652 for Plate Lead Acid IS-1651 for Lead Acid			
20.	Control Valves	CV Test	ISA 75.02	YES	NO	
21.	Voltage Stabilizers	<ul style="list-style-type: none"> <li>Overload Test</li> <li>Temperature rise test without redundant fans</li> </ul>	Approved Procedure	NO	YES	
		<ul style="list-style-type: none"> <li>Input Voltage Variation Test</li> </ul>	Approved Procedure	NO	YES	
22.	Flow Nozzles & Orifice Plate	Calibration	ASME PTC, BS-1042	YES	NO	
23.	PLCs	All tests as per IEC-1131	IEC-1131			
24.	DDCMIS					
	a) I/O Modules	CMRR & NMRR Verification	Mfr. standard	NO	YES	
	b) Other Modules	CMRR & NMRR Verification	Mfr. standard	NO	YES	
	c) CLCS Systems	Model Test	Approved Procedure	YES	YES	
25.	LIE / LIR / Junction Box	Degree of Protection Test	IS-2147	YES	YES	
26.	Flue Gas O <sub>2</sub> Analyzer	Degree of Protection Test	IS-2147	NO	YES	
27.	Flue Gas CO Analyzer	Degree of Protection Test	IS-2147	NO	YES	
28.	Flue Gas SO <sub>2</sub> Analyzer	Degree of Protection Test	IS-2147	NO	YES	
29.	Flue Gas NO <sub>x</sub> Analyzer	Degree of Protection Test	IS-2147	NO	YES	
30.	Master Slave Clock	Current / Power Efficiency	Approved Procedure IEC-146	NO	YES	

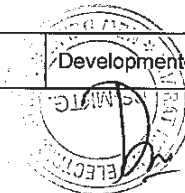


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**10.00.00 TRAINING**

10.00.01 Seller's experienced personnel / engineers shall also provide training courses on offered DDCMIS / PLC to Buyer's engineers in the following areas:

- a) Operator training.
- b) Hardware maintenance training.
- c) Software training.
- d) Any other specialized training as required for system operation and maintenance

10.00.02 The maintenance training shall include lectures and hands on experience on a similar type of equipment / system at manufacturer's works ~~and recently commissioned operating plant~~ and / or training simulator. The details of hardware and software training shall be finalized during detailed engineering and shall be subject to Buyer's acceptance.



**11.00.00 Required no. of hardwired IOs at DDCMIS cabinets to interface Buyer's hardwired BOP signals**

Sl. No.	Area	Hardwired I/O Interface	Type					Total
			DI	DO	AI	AO	RTD	
1	Raw Water Pumps	DDCMIS Remote I/O Cabinet at RWP/HTP	80	30	50	0	0	160
	DM Plant		50	15	10	0	0	75
2	CW System	DDCMIS Remote I/O Cabinet at CWRH	800	180	160	0	160	1300
3	FOHS & Pressurizing	DDCMIS Remote I/O Cabinet at FOPH	100	30	40	10	0	180
4 (a)	CHP	DDCMIS Cabinet in CER	0	0	30	0	0	30
(b)	Switchyard	DDCMIS Cabinet in CER	50	10	20	0	0	80
(c)	Misc.	DDCMIS Cabinet in CER	15	5	4	2	9	35
<b>Total</b>			1025	245	270	20	205	1765

**NOTE: Spare philosophy shall be as detailed in specification Clause 5.00.00 of Vol. II-E, Section VI**



 PEM :: C&I	<b>STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER</b>								QUALITY PLAN NO.: PE-QP-999-145-1036				
									VOLUME IIB				
									SECTION D				
									REV. NO. 01		DATE: 24.08.2007		
								SHEET 1		OF		8	

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records			Remarks
								P	W	V	
1.0	<b>Materials /Components</b>										
1.1	Panels & Control Desks	Physical Inspection for Dimensions, Painting, Cutouts, Lifting / Locking Arrangements, Components, Drawing Pocket, Mounting accessories, Plinth & AV Pads, Cable Gland Plates, Hardwares, Hinges, Louvers & Filters, Fans & Panel Lamps	MA Visia	I	100%	Contract specifications, Approved GA Drawings, BOQ	As per ref documents. No physical damage.	BHEL Quality Inspection Report.	3/2 2	1	
1.2	Power Supply/Packs, Battery & Battery charger, Transformer, UPS.	Physical Inspection Physical Damages Dimensions Mounting Accessories	MA Visia	I	100%	Contract specifications, BOQ.	As per reference documents, Test Report	BHEL Quality Inspection Report.	3/2 2	1	
1.3	Indicating Lamp, Annunciator, Meters, Transducers, Signal Converters, Instruments, Single Loop Controllers	Physical Verification Physical Damages Dimensions Accessories	MA Visia	I	100%	Contract specifications, BOQ.	As per ref documents No physical damage. Test/ Calibration report.	BHEL Quality Inspection Report	3/2 2	1	
1.4	PLC processors, I/O modules, Power Supply modules, Communication modules, Mounting Racks, Ethernet	Physical Inspection <ul style="list-style-type: none"> <li>• Identification Labels</li> <li>• Physical Damages</li> <li>• Quantity</li> <li>• Spare Capacity</li> </ul>	MA Visia	I	100%	Product Catalogue, Data sheets, Approved Configuration diagram, BOQ	As per ref documents. Test Certificates	BHEL Quality Inspection Report.	3/2 2	1	

<b>LEGEND:</b> * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics	\$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.	1 - BHEL 2 - Vendor 3 - Sub-vendor
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 PEM :: C&I	<b>STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER</b>		QUALITY PLAN NO.: <b>PE-QP-999-145-1036</b>	
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			SECTION D	
			REV. NO. 01	DATE: 24.08.2007

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records			Remarks
								P	W	V	
1.5	CPU, Monitor, Keyboard, Mouse, CD Drives, Printers, OS, System Software, Engineering software in the form of Licensed CD.	Physical Inspection Identification Labels, Tech. Specification Physical Damages Accessories Installation arrangements for Computers & Printers	MA	Visual	100%	Contract specifications, Product Catalogue, Approved GA / Configuration drawing, BOQ.	As per reference documents.	BHEL Quality Inspection Report.	3/2 2	1	

<b>LEGEND:</b> * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics	\$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.	1 - BHEL 2 - Vendor 3 - Sub-vendor
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**STANDARD QUALITY PLAN  
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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records			Remarks
								P	W	V	
<b>2.0</b>	<b>Assembly</b>										
2.1	Functional Test for HMI/OWS devices such as Monitors, Keyboards, Mouse, Printers etc.	Operation	MA	Functional	100%	Approved Configuration Diagram & BOQ and FAT	Correct Operation of interconnected Devices of HMI system.	BHEL Quality Inspection Report.	2 1	1	
2.2	Hardware Functional Verification.	Physical arrangement, Wiring check & labeling, Continuity Checking, IR & HV test	MA	Visual/ Electrical	100%	Approved GA Drawing, Panel Wiring Diagram, IR & HV as per relevant International standard	Test Certification	BHEL Quality Inspection Report.	2 2	1	
2.3	Powering Up	Healthiness of all the modules/equipment, associated with Powering of PLC system	MA	Visual /Electrical	100%	Approved power supply scheme	All equipment to be healthy on power ON	BHEL Quality Inspection Report.	2 1	1	
2.4	Burn in test for PLC modules	Healthiness of PLC modules on Continuous Energisation, Temperature maintenance	MA	Visual/ Electrical	100% F	AT Procedure	Test certification as per FAT	BHEL Quality Inspection Report.	2 2	1	

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

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

1 - BHEL  
 2 - Vendor  
 3 - Sub-vendor

 PEM :: C&I	<b>STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER</b>								QUALITY PLAN NO.: PE-QP-999-145-1036				
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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks	

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
<b>3.0</b>	<b>Factory Acceptance Test (FAT)</b>											
3.1	Input Output Functional Verification	I/O configuration, I/O operation	MA	Visual/ Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.2	Processor Verification	Processor configuration, Powering up, standby operation (as applicable) and Loading	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.3	Power Supply Module Verification	Redundancy Operation	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.4	Communication System Verification	Redundancy operation of Communication System, Measurement of Response Time, Communication with third party system	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.5	Diagnostic Verification	Self Diagnostic features of PLC system	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.6	Control Panel/Desk Verification	Operation of PLC driven announcement system, Mosaic, Push buttons & selector switches, Indicating lamps	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.7	Software Verification	(i) Control Logics (ii) Engineering Features (iii) HMI Features	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	

<b>LEGEND:</b> * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics	\$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.	1 - BHEL 2 - Vendor 3 - Sub-vendor
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**STANDARD QUALITY PLAN  
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**FACTORY ACCEPTANCE TEST (FAT) PROCEDURE**

This document covers procedure to conduct/witness PLC system functional tests in order to demonstrate conformity to purchase specifications and related engineering documents. The test shall be conducted at the system suppliers works. The system supplier shall conduct all functional tests before commencing FAT and test results shall be made available during FAT. Vendor must furnish following relevant drawings, duly approved by BHEL Engineering, for reference during FAT.

- a) Technical Specification of PLC.
- b) PLC System Configuration
- c) General Assembly Drawings.
- d) Panel Wiring Diagrams.
- e) Bill of Quantity for PLC System.
- f) Logic Diagram.
- g) HMI Schematics.
- h) Input / Output List.

Further the vendor shall furnish applicable product specification, datasheets, catalogues, test-certificates, and internal inspection records to enable FAT. Vendor shall also submit, to the inspecting agency, his standard test procedure, for clauses given below; where vendor's standard practice has been referred.

**APPLICABLE TEST PROCEDURE:**

**1. Input/Output Functional Verification.**

Check for correctness of addressing of racks, slots and I/O modules as per applicable PLC configuration diagram. Appropriate signal generators shall be used to simulate Inputs and outputs to check operation and SCAN time. Check online replacement of cards, processors, power supply etc.

**2. Processor Verification**

PLC Configuration drawing to be referred for ascertaining

- i) Redundancy

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ii) Type (Hot or Cold)

Both the processors are to be checked for healthiness in case of redundant configuration as per vendor's standard practice. In case of hot redundancy, switchover of control from primary processor to standby processor shall be demonstrated for uninterrupted control and data processing as per vendor's standard practice. Switchover shall be witnessed, by manual power off or resetting the Primary CPU or simulating failure of primary processor. Checking should be by witnessing the lighting up of Processor's LEDs as per manufacturer's product standard.

Vendor shall demonstrate, as per Vendor's standard practice, adequate Loading (Spare Capacity) of Processors, as mentioned in contract specs. This shall be done, by simulating worst load operation of fully integrated PLC system.

**3. Power Supply Module Verification**

Check if PSM is in redundant mode as per specification. Check the healthiness of power supply from both the modules' lamp indication/measurement. Simulate failure of one PSM and verify that standby PSM has taken over without any interruption.

**4. Communication System Verification**

Communication system has to be in line with approved PLC Configuration Diagram. Verify that both the communication buses are intact and connected. Communication between PLC processors, I/O rack, OWS etc. is to be checked through simulation of input data. Simulate the bus failure by disconnection of working bus. Check that the communication continues without interruption or loss of data.

Following response times are to be demonstrated as per vendor's standard practice for conformance to contract specifications:

1. Screen update time
2. I/O scan time
3. SOE resolution time
4. Data transfer time with third party system using Communication Protocol as per Contract specification and as per quantum of data as per approved signal exchange list.

**5. Diagnostic Verification**

Product Catalogue/Literature shall be referred for checking of all diagnostic features. Hardware failure to be simulated by removing an I/O

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**6. Control Panel /Desk Verification**

- i) PLC driven annunciation system should be checked by alarm signal simulation.
- ii) Push Button and selector switch operation should be checked by verification of corresponding change of status of Data Base point.
- iii) Indicating lamp / MIMIC should be checked by corresponding Data Base point simulation.

**7. Software Verification**

- i). Control Logics:- Software switches, lamps and Analog sources shall be used for simulation of field conditions .Control logics shall be checked for its correct functionality as per approved logic schemes
- ii). Engineering features:-
  - a) Online changing of parameters, set points.
  - b) Online modification in Control Logic Diagrams.
  - c) Online configuration of Graphics, Trends, Logs, HSR.
- iii). HMI features:-  
Check for configuration & operation of Graphics, Trends, Logs, HSR and Alarms, in the form of Displays and Printouts, by simulation of Inputs as per approved documents.

**8. Burn in Elevated Temperature test**

Electronic equipments shall be subjected to Burn in elevated temperature test as per the procedure detailed below:


- a) (i) PLC modules are kept at 50 Deg c under continuous energized condition for 48 hours.

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ii) 48 hours test period shall be divided into 4 equal time segments of 12 hours duration each. For every 12 hours duration segment, after lapse of first 11 hours 110% of nominal voltage shall be applied to the panel under test for a period of 30 minutes followed by application of 90% of nominal voltage for the next 30 minutes.

b) Assembled Panels with complete wiring shall be kept under continuous energized condition for 120 hours at ambient temperature. Temperature rise in panels should be below 10 Deg C above ambient.

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

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


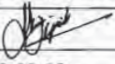

## LEGEND:


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

## NOTE:

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

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

	PREPARED BY	CHECKED BY	APPROVED BY
NAME	SACHIN SRIVASTAVA	DILIP JEJURIKAR	ALKA TUTEJA
SIGNATURE			
DATE	30.09.08	30.09.08	30.09.08

	<b>CHECK LIST FOR PRESSURE / DIFFERENTIAL PRESSURE SWITCH (Mechanical Auxiliary Packages)</b>	SPECIFICATION NO.:	
		VOLUME	
		SECTION	
		REV. NO.	DATE:
		SHEET 2 OF	2
Data Sheet No.: <b>PE-CL-999-145-I031-0</b>			


SL NO	TESTS/CHECKS	QUANTUM OF CHECK	REFERENCE DOC. ACCEPTANCE NORMS	AGENCY			REMARKS
				P	W	V	
1.0	CHECK FOR		APPROVED TECHINICAL REQUIREMENT/ DATA SHEET/ RELEVANT STANDARD / MANUFACTURER CATALOGUE				MFR TO CARRY OUT ROUTINE TEST ON 100%.  WHEN TC FOR MATERIAL FOR THE PROJECT NOT AVAILABLE , COMPLIANCE CERTIFICATE TO BE PROVIDED BY THE MANUFACTUR ER.
	1.1 MODEL NO/TAG NO	100%		M	C	C	
	1.2 RANGE/SCALE	100%		M	C	C	
	1.3 END CONNECTION	100%		M	C	C	
	1.4 SWITCH CONTACT RATING & NOS	100% M			C	C	
2.0	CALIBRATION						
	2.1 REPEATABILITY	100%		M	C	B	
	2.2 DIFFERENTIAL	100%		M	C	B	
	2.3 SET POINT ADJUSTMENT	100% M			C	B	
3.0	OVER PRESSURE & LEAK TEST	100% M			C	C	
4.0	REVIEW OF T.C. FOR MATERIAL OF--						
	5.1 SENSOR	FOR LOT	--		B		
	5.2 MOVEMENT		-	-	B		
	5.3 HOUSING		-	-	B		
5.0	REVIEW OF T.C. FOR DEGREE OF PROTECTION	TYPE TEST	-	-	B		
6.0	REVIEW OF T.C. FOR MICRO SWITCH	FOR LOT	-	-	B		
7.0	ACCESSORIES AS APPLICABLE	100% M		C	C		

**LEGEND:**

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

**NOTE:**

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

	<b>CHECK LIST FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE (Mechanical Auxiliary Packages)</b>	SPECIFICATION NO.:	
		VOLUME	
		SECTION	
		REV. NO.	DATE:
		SHEET 2 OF 2	
Data Sheet No.: PE-CL-999-145-1026-0			

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

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

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

#### **4.0.0**

### **DOCUMENTS TO BE PROVIDED AT BIDDING STAGE**

**The following documents shall be submitted by Bidder at Bidding stage:**

1. Signed & Stamped PLC system configuration drawing with write-up
2. Signed & Stamped power supply schemes for PLC system, peripherals, and Remote I/O panels.
3. Signed & Stamped copy of QAPs & FAT for PLC
4. Filled Datasheet-B for PLC
5. Earthing requirement

## **5.0.0**

### **LIST OF DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT**

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT FOR CONDENSATE POLISHING PLANT (2 X 660 MW BANAHARPALI PROJECT)							
DOCUMENT NUMBER PE-GL-999-145-1100				SHEET 1 of 1			
Sl.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY	CUSTOMER	FROM	USER	REMARKS
<b>INSTRUMENTATION</b>							
1	PE-V9-392-553-1901	INSTRUMENT DATA SHEETS	A	-	VENDOR	C&I	
2	PE-V9-392-553-1902	INSTRUMENT SCHEDULE	I	-	VENDOR	C&I	
3	PE-V9-392-553-1903	INSTRUMENT HOOK UP	A	-	VENDOR	C&I	
4	PE-V9-392-553-1904	FIELD JB TERMINATIONS	I	-	VENDOR	C&I	
5	PE-V9-392-553-1905	QUALITY PLANS (CV, FE, Tx and Analyser)	A	-	VENDOR	C&I	
6	PE-V9-392-553-1906	TRANSMITTER RACK GROUPINGS	I	-	VENDOR	C&I	
7	PE-V9-392-553-1907	DRIVE LIST/SOLENOID/ACTUATOR VALVE LIST WITH LOCATION DATA	A	-	VENDOR	C&I	
8	PE-V9-392-553-1908	CONTROL VALVE DATASHEET WITH VALVE AND ACTUATOR SIZING CALCULATION	A	-	VENDOR	C&I	
9	PE-V9-392-553-1909	CONTROL VALVE NOISE CALCULATION(BOTH HYDRO-STATIC & HYDRO-DYNAMIC)	I	-	VENDOR	C&I	
10	PE-V9-392-553-1910	FLOW ELEMENT DATA SHEET WITH SIZING CALCULATION	A	-	VENDOR	C&I	
11	PE-V9-392-553-1911	THERMOWELL SIZING CALCULATION	I	-	VENDOR	C&I	
<b>PLC PANEL</b>							
1	PE-V9-392-553-1911	PLC CONFIGURATION DRAWING	A	A	VENDOR	C&I	
2	PE-V9-392-553-1912	PLC PANEL GA (INTERNAL & EXTERNAL)	A	-	VENDOR	C&I	
3	PE-V9-392-553-1913	CONTROL SCHEMES (BLOCK LOGIC)	A	-	VENDOR	C&I	
4	PE-V9-392-553-1914	PLC INPUT / OUTPUT SIGNAL LIST	I	-	VENDOR	C&I	
5	PE-V9-392-553-1915	UPS BATTERY CHARGER/ BATTERY DATASHEET	I	\$\$	VENDOR	C&I	Refer Notes Below
6	PE-V9-392-553-1916	UPS SIZING CALCULATIONS	I	-	VENDOR	C&I	
7	PE-V9-392-553-1917	BATTERY SIZING CALCULATIONS	I	-	VENDOR	C&I	
8	PE-V9-392-553-1918	CONTROL DESK LAYOUT / GA DRAWING	A	-	VENDOR	C&I	IF APPLICABLE
9	PE-V9-392-553-1919	PLC OWS/PRINTER FURNITURE BOM	A	-	VENDOR	C&I	
10	PE-V9-392-553-1920	PLC CONTROL ROOM LAYOUT DRAWING	A	-	VENDOR	C&I	
11	PE-V9-392-553-1921	PLC CATALOGUE, OWS & PRINTER CATALOGUES,	I	-	VENDOR	C&I	
12	PE-V9-392-553-1922	PLC QUALITY PLAN & FAT PROCEDURE	A	-	VENDOR	C&I	
13	PE-V9-392-553-1923	LIST OF SIGNAL EXCHANGE WITH DDCMIS (BOTH HARDWIRED & SERIAL INTERFACE IN BHEL FORMAT)	A	-	VENDOR	C&I	
14	PE-V9-392-553-1924	PROCESS GRAPHIC MANUSCRIPTS PLC	I	-	VENDOR	C&I	
15	PE-V9-392-553-1925	PROCESS GRAPHIC MANUSCRIPTS FOR DDCMIS	I	-	VENDOR	C&I	
16	PE-V9-392-553-1926	CABLE SCHEDULE & INTERCONNECTION	I	-	VENDOR	C&I	
17	PE-V9-392-553-1927	PANEL & ELECTRONIC EARTHING REQUIREMENT	I	-	VENDOR	C&I	
18	PE-V9-392-553-1928	PANEL HEAT DISSIPATION DATA	I	-	VENDOR	C&I	
19	PE-V9-392-553-1929	MANDATORY SPARES BILL OF MATERIAL	A	A	VENDOR	C&I	
20	PE-V9-392-553-1930	PLC O & M MANUAL	I	-	VENDOR	C&I	
21	PE-V9-392-553-1931	ANNUNCIATION LIST & SER LIST	A	-	VENDOR	C&I	
22	PE-V9-392-553-1932	I/O ASSIGNMENT INCLUDING NEST LOADING	A	-	VENDOR	C&I	
23	PE-V9-392-553-1933	LIST OF SET POINTS	I	-	VENDOR	C&I	
24	PE-V9-392-553-1934	LIST OF LOGS WITH POINT ASSIGNMENTS	I	-	VENDOR	C&I	
25	PE-V9-392-553-1935	MARSHALLING PHILOSOPHY	A	-	VENDOR	C&I	
26	PE-V9-392-553-1936	HISTORICAL STORAGE AND RETRIEVAL(HSR) SYSTEM DETAILS	A	-	VENDOR	C&I	
27	PE-V9-392-553-1937	PLC CONTROLLER LOADING UNDER WORST LOADING CONDITION CALCULATION	A	-	VENDOR	C&I	
28	PE-V9-392-553-1938	SEQUENCE OF EVENT RECORDER/ ANNUNCIATION & EVENTS CONFIGURATION DIAGRAM/LIST	A	-	VENDOR	C&I	
29	PE-V9-392-553-1939	WIRING DIAGRAMS FOR PANEL LOCAL PANELS, IBS, ACTUATORS etc	I	-	VENDOR	C&I	
30	PE-V9-392-553-1940	UPS BOM, SLD & GA DRAWING	A	-	VENDOR	C&I	
31	PE-V9-392-553-1941	LIST OF SOFTWARES INCLUDED	I	-	VENDOR	C&I	
32	PE-V9-392-553-1942	CONFIRMATION CERTIFICATE FOR THE LATEST VERSION OF SOFTWARE AND HARDWARE USED					
33	PE-V9-392-553-1943	DETAILED MANUFACTURER'S CABLE SPECIFICATION FOR OFFERED CABLE	A	-	VENDOR	C&I	
34	PE-V9-392-553-1944	EQUIPMENT WISE VENDOR'S DETAILS INCLUDING ADDRESS, CONTACT PERSON, TELEPHONE NOS.	I	-	VENDOR	C&I	
35	PE-V9-392-553-1945	TRAINING METHODOLOGY, SCHEDULE, TRAINING MANUALS & ASSESSMENT CRITERIA	A	-	VENDOR	C&I	
36	PE-V9-392-553-1946	UPS O&P	I	-	VENDOR	C&I	
37	PE-V9-392-553-1947	UPS INSTRUCTION MANUALS	I	-	VENDOR	C&I	
38	PE-V9-392-553-1948	HARDWARE & SOFTWARE DESIGN MANUALS	A	-	VENDOR	C&I	
<b>OTHER DOCUMENTS</b>							
1	PE-V9-392-553-1951	LIST OF I&C SPARE PARTS	A	-	VENDOR	C&I	
2	PE-V9-392-553-1952	LIST OF I&C DRAWINGS/DOCUMENTS	A	-	VENDOR	C&I	
3	PE-V9-392-553-1953	ESSENTIAL & START-UP SPARES LIST	A	-	VENDOR	C&I	
4	PE-V9-392-553-1954	DETAILED IMPLEMENTATION SCHEDULE FOR I&C SYSTEM	A	-	VENDOR	C&I	
5	PE-V9-392-553-1955	I&C SYSTEM DESIGN BASIS REPORT INCORPORATING CONTROL PHILOSOPHY/OPERATION PHILOSOPHY/DESIGN PHILOSOPHY/REDUNDANCY PHILOSOPHY	A	-	VENDOR	C&I	
<b>Notes:</b>							
\$\$ - Approval by BHEL if Vendor BBU Item Approval by Customer if Customer BBU Item							



**IB THERMAL POWER STATION, BANHARPALI  
2x660MW UNIT 3&4**


**VOLUME –III**

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

**Specification No. : PE-TS- 391-165-N002 (REV. 0)**



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

	<b>TITLE : TECHNICAL SPECIFICATION</b> <b>FOR</b> <b>CONDENSER ON LOAD TUBE CLEANING</b> <b>SYSTEMS (COLTCS)</b> <b>PREAMBLE</b>	<b>SPEC. NO. PE-TS- 391-165-N002</b>	
		<b>VOLUME : III</b>	
		<b>REV. NO. 0</b>	<b>DATE :04.06.2014</b>
		<b>SHEET 1 OF 1</b>	

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).

	<b>TITLE : TECHNICAL SPECIFICATION FOR CONDENSER ON LOAD TUBE CLEANING SYSTEMS (COLTCS) PREAMBLE</b>	<b>SPEC. NO. PE-TS- 391-165-N002</b>	
		<b>VOLUME : III</b>	
		<b>REV. NO. 0</b>	<b>DATE :04.06.2014</b>
		<b>SHEET 1 OF 1</b>	

**1.2.2 Volume - III TECHNICAL SCHEDULES**

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.

	<b>TITLE : TECHNICAL SPECIFICATION FOR CONDENSER ON LOAD TUBE CLEANING SYSTEMS (COLTCS) PREAMBLE</b>	<b>SPEC. NO. PE-TS- 391-165-N002</b>	
		<b>VOLUME : III</b>	
		<b>REV. NO. 0</b>	<b>DATE :04.06.2014</b>
		<b>SHEET 1 OF 1</b>	

### INDEX

<b>SECTION</b>	<b>TITLE</b>
<b>A</b>	<b>DETAILS TO BE FURNISHED ALONGWITH BID</b>
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A2.	PERFORMANCE GAURANTEE SCHEDULE
A3.	TECHNICAL DEVIATION SCHEDULE
A4.	ELECTRICAL LOAD DATA
A5.	GA DRAWING OF COLTCS/DF
A6.	SCHEDULE OF PRICES
A7.	SCHEDULES OF UNIT PRICES
<b>B</b>	<b>DOCUMENTS TO BE SUBMITTED ON PLACEMENT OF LOI</b>
B1.	DATASHEET – B
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TITLE :  
TECHNICAL SPECIFICATION FOR  
COLTCS

SPEC. NO. PE-TS- 391-165-N002

VOLUME III

SECTION

REV. NO. 0


DATE 04.06.2014

SHEET 1 OF 1

## SECTION A

### SHALL BE FURNISHED ALONGWITH BID


- COMPLIANCE CERTIFICATE
- PERFORMANCE GUARANTEE SCHEDULE
- TECHNICAL DEVIATION SCHEDULE
- ELECTRICAL LOAD DATA
- GA DRG OF COLTCS/DF
- UNIT PRICE SCHEDULE
- TOTAL PRICE SCHEDULE.

	<b>TITLE : COMPLIANCE CERTIFICATE FOR COLTCS</b>	<b>SPEC. NO.</b>	<b>PE-TS- 391-165-N002</b>
	<b>PROJECTS:</b> <b>IB Valley TPS, BANHARPALI, 2x660MW Units 3&amp;4</b>	<b>DATE:</b>	04.06.2014
		<b>SHEET</b>	1 OF 2

### COMPLIANCE CERTIFICATE

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

- a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions with regard to same.
- b) There are no other deviations w.r.t. specification other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'
- c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL/ Customer/Customer's Consultant approval and customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. Charges for 3<sup>rd</sup> party inspection (TUV/ equivalent) for imported components wherever required shall be included by bidder in the base price itself.
- d) Any drawing/ document/ data-sheet/ calculation/ Quality plan/ Instrumentation etc. submitted along with the offer shall be considered for reference only, same shall be subject to BHEL/ Customer/Customer's Consultant approval in the event of order.
- e) The offered materials shall be either equivalent or superior to those specified in the specification. For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.
- f) The commissioning spares including balls shall be supplied on 'As Required Basis' & prices for same included in the base price itself. Prices for special tools & tackles, if any, shall also be included in the base price. Recommended spares for 3 years shall be quoted separately with price indicated separately.
- g) Charges for Installation Checks, Commissioning of equipments, Trial runs and Performance Testing at site shall be included by bidder as per the price format.
- h) All Instruments shall be located in the Instrument Rack (as applicable) to be supplied by bidder.  
  
The instrument rack shall be installed on ball recirculation pump skid for COLTCS with impulse piping, root valves, fittings, accessories, valve manifolds mounted on gauge racks etc. supplied by bidder accordingly.
- i) The main flanges for Ball separator shall be suitable for the forces and moments as per the specification.
- j) Injection nozzles – 2/4 numbers of stubs of 100 NB or size as informed by bidder shall be provided by BHEL. The injection nozzles, counter flanges for the stubs along with nuts, bolts and gaskets shall be supplied by the bidder.
- k) Provision for future installation of Cathodic protection with sacrificial anodes.
- l) Number of balls (Normal as well as abrasive) for COLTCS shall be as specified i.e Number of balls per charge shall be @ 10% of no. of tubes.
- m) The hydrostatic test pressure shall be 1.5 times the design pressure.
- n) All sub - vendors shall be subject to BHEL/ Customer/Customer's Consultant approval in the event of order.

	<b>TITLE : COMPLIANCE CERTIFICATE FOR COLTCS</b>	<b>SPEC. NO.</b>	<b>PE-TS- 391-165-N002</b>
	<b>PROJECTS:</b> <b>IB Valley TPS, BANHARPALI, 2x660MW Units 3&amp;4</b>	<b>DATE:</b>	04.06.2014
		<b>SHEET</b>	2 OF 2

- o) The Performance guarantees of equipments shall stand valid till the satisfactory completion of performance testing & its acceptance by BHEL/ Customer/Customer's Consultant.
- p) The offered COLTCS have been supplied by bidder in the past meeting the customers qualifying criteria of its operation at two sites for minimum period of two years. Any deviation to this criteria shall be suitably highlighted in the deviation schedule.
- q) The orientation of piping around COLTCS shall be finalised during detailed Engg.
- r) Electrical/ C&I :
- All selected motor ratings have minimum 15 % margin over maximum continuous demand of the driven equipment including voltage and frequency variations, temperature rise and other factors.
  - Supply of electrical viz. LT power cables, instrumentation and control cables, cable glands, lugs, cable trays etc. shall be as per specification. Their erection shall be done by BHEL
  - The junction boxes for termination of DPT/ DPS/ Actuator LS/ solenoid valves/ Ball oversize monitor/ Ball recirculating monitor are included in bidders scope. The instrumentation cable and cabling from instruments/ actuators to junction boxes is also included in bidders scope.
  - Valve actuators and controls shall be provided as specified in Data Sheet-A and Project specific requirements as specified in Section C-2 & Section C-3
  - Alarms/ annunciations/ instruments shall be finalised during detailed engineering in the event of order which shall be subject to BHEL/ Customer/Customer's Consultant approval and shall be without any commercial implications to BHEL.



**TITLE : SCHEDULE OF PERFORMANCE GUARANTEES  
FOR  
CONDENSER ON LOAD TUBE CLEANING SYSTEM (COLTCS)**

**SPEC. NO. PE-TS- 391-165-N002**


**VOLUME : III**

**Sheet 1 of 1 Date- 04.06.2014**

<b>S.NO.</b>	<b>DESCRIPTION</b>	<b>UNITS</b>	<b>IB THERMAL POWER STATION, BANHARPALI 2x660MW UNIT 3&amp;4</b>
1.	Pressure drop across the ball collecting Strainers (i.e. between inlet & outlet nozzle) under clean condition and Normal flow condition	MWC	
2	Percentage of ball recovery	%	
3	Life of sponge rubber balls	Weeks	

**PARTICULARS OF BIDDER/ AUTHORISED REPRESENTATIVE**

<b>NAME</b>	<b>DESIGNATION</b>	<b>SIGNATURE</b>	<b>DATE</b>	<b>COMPANY SEAL</b>
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	<b>TITLE</b>	SPECIFICATION NO
	<b>* SCHEDULE OF DEVIATIONS</b>	VOL III
	( ) From Conditions of Contract (Volume – 1) ( ) From General Technical Conditions (Volume – II A ) ( ) From Technical Specifications (Volume –II B)	SHEET..... OF.....

We the undersigned hereby certify that the above mentioned are the only deviations.

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





TITLE :  
PRICE SCHEDULE FOR  
COLTCS  
IB VALLEY TPS, BANHARPALI,  
2x660MW UNITS 3&4

SPEC. NO. PE-TS- 391-165-N002	
VOLUME III	SECTION
REV. NO. 0	DATE 04.06.2014
SHEET 1 OF 1	

- 1.0 Total price for design, manufacture, assembly, inspection, testing, packing for transportation and delivery, including final check up of installation, commissioning, trial run and PG testing of FOUR (4) sets of COLTCS complete in all respect including all accessories & auxiliaries as specified in technical specification and as necessary including mandatory spares, commissioning spares of COLTCS including commission balls and special tools & tackles (as required) for erection & maintenance. Rs/USD/Euro (As applicable)
- 2.0 **Recommended spares** : Item-wise break up with item-wise price to be given as per "Schedule of Recommended Spares" enclosed under Vol. III of technical specification. Rs/USD/Euro (As applicable)

**Note** : Indicate all duties, taxes etc. stating whether included/ excluded in above price.



TITLE :  
**UNIT PRICE SCHEDULE FOR  
COLTCS  
IB VALLEY TPS, BANHARPALI,  
2x660MW UNTS 3&4**

SPEC. NO. PE-TS- 391-165-N002

VOLUME III

SECTION

REV. NO. 0

DATE 04.06.2014

1.0 Unit price for design, manufacture, inspection and testing, packing and delivery of COLTCS for one set complete with all accessories except for clause no. 2 & 3 below. Rs/USD/Euro (As applicable)

2.0 **Lump sum price for 4 sets of COLTCS** Rs/USD/Euro (As applicable)

- Installation checks, Commissioning
- PG test

3.0 **Mandatory spares(as per Annexure)** Rs/USD/Euro (As applicable)

- Lump sump price

**Notes:-**

- Total price of Unit prices given above at sl. No. 1 plus sl. No. 2 plus sl. No. 3 should tally with total price given in Sl. No. (1) of "Schedule of Prices"
- Unit price quoted by bidder, as above, shall be binding for any quantity variation, which is at discretion of purchaser.
- Price of commissioning & erection spares and other accessories not listed above shall be included in price of equipment & shall be supplied with the equipment.
- Indicate all taxes, duties etc. stating whether included/ excluded in above prices.
- Recommended spares item wise breakup with item wise price to be given as per "Schedule of Recommended spares" enclosed under vol-III of technical specification.  
Recommended spares are only for reference purpose and not to be considered for evaluation and ordering purpose.

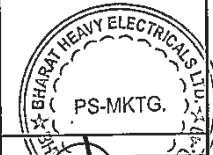
## ANNEXURE- MANDATORY SPARES

(i)	Mechanical	Complete set of Pump without motor- 1 set
		Valve complete assembly- 10% of each type and size of total population or minimum 1 (one) no.)
		Normal Sponge rubber balls & abrasive balls- for one year operation
(ii)	C&I field instruments & PLC as applicable as per C&I list in Annexure-I	
(iii)	Electrical spares as applicable as per electrical list in Annexure-II	

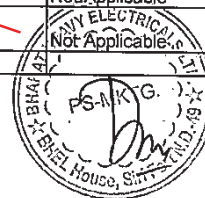
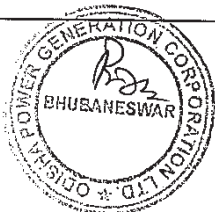
MANDATORY SPARES

ANNEXURE-I

Sl. No.	Equipment/Package Name	Quantity Required per unit*	Remarks (BHEL)
1.31	Toner for colour Laser Printer (for each type)	10 (ten) nos. each colour other than black & 20nos. black	
1.32	Memory Module/ EEPROM Chip	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.	Not applicable
1.33	Battery for RAM Backup	4 (four) nos.	Not applicable
1.34	Fuse: Card mounted type, PCB mounted type, Rack Power supply etc.	Each type of fuse, 25% of total nos. used in the system or minimum 25 nos. whichever is more.	
1.35	Terminal Block	10% of total nos. used in the system for each type and rating.	
<b>2 Large Video Screen</b>			
2.1	Lamp for Large Video Screen Display (DLP type)	15 (fifteen) nos.	
2.2	Video Input Card	1No. each type and model	
2.3	Video output Card	1No. each type and model	
2.4	Interfacing Module/components with DDCMIS	1No. each type and model	
<b>3 PLC System (for each system)</b>			
3.1	CPU Card	1No.	
3.2	Communication Processor Module	1No. for each type	
3.3	Binary Input Card	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.	
3.4	Pulse Input Card (if applicable)	10% of total nos. used in the system or minimum 2(two) nos. whichever is more.	
3.5	Analog Input Card (4 to 20 mA type)	10% of total nos. used in the system or minimum 2(two) nos. whichever is more.	
3.6	Analog Input Card (TC input type)	10% of total nos. used in the system or minimum 2(two) nos. whichever is more.	
3.7	Analog Input Card (RTD input type)	10% of total nos. used in the system or minimum 2(two) nos. whichever is more.	
3.8	Binary Output Card	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.	
3.9	Pulse output Card	1No.	
3.10	Analog Output Card (4 to 20 mA type)	10% of total nos. used in the system or minimum 2(two) nos. whichever is more.	
3.11	Interposing Realy	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.	
3.12	Output Relay modules/ Relay Board & Auxiliary Relay	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.	
3.13	I/O Communication Modules	1No. for each type	
3.14	Prefab-cable with connector for CPU, Communication Card and I/O modules	1No. for each type	
3.15	Networking Modules/Components/Switch	1No. for each type	
3.16	Power Supply Unit for CPU, Communication Card and I/O racks	10% of total nos. used in the system or minimum 2(two) nos. whichever is more for each type and rating.	
3.17	RAM Backup Battery	2 (two) nos.	
3.18	MCB	1No. for each type and rating	
3.19	Special Fuse for the Cards	Each type/rating of fuse, 25% of total nos. used in the system or minimum 25 nos. whichever is more.	
<b>3.20 MMI Unit</b>			
3.20.1	22" Monitor	1No.	
3.20.2	Key Board	1No.	
3.20.3	Mouse/ Trackball	1No.	
3.21	UPS for PLC system (Applicable for 1.5KVA rating or below. For high capacity UPS, refer Electrical List)	One Complete Set	
3.22	Micro PLC system (i.e. integrated CPU & I/O system, where above mentioned components are not applicable)	One Complete Set	



	UNIT	(BILL)
4 Field Instrument		To be supplied wherever applicable
4.1 Electronic Transmitters (Pressure, Differential Pressure, Level, Speed etc.) all types	1(One) no. complete set for each type and model/range used in the system	Pressure transmitters-1No
4.2 Switch (Pressure, Differential Pressure, Level, Flow, Temperature etc.)	1(One) no. of each type & model/range used in the system	Pressure Switch(0-10KG/SQCM)-1No-for APH Flow indicating switch(7-25LPM)-1No- for APH ON-OFF Switch-1No-for APH Go-Switch-1No for APH
<del>4.3 Thermocouple</del>	<del>10% of each type and length of the total nos. used in the system or minimum 2(two) nos. whichever is more.</del>	<del>5No's-for APH</del>
<del>4.4 RTD</del>	<del>10% of each type and length of the total nos. used in the system or minimum 2(two) nos. whichever is more.</del>	<del>2No's-for APH 2No's-for Fans</del>
<del>4.5 Thermo-well for both TC and RTD</del>	<del>One no. for each type and rating/length used in the system</del>	<del>1No's-for APH</del>
4.6 Solenoid Valve		
4.6.1 Complete Solenoid Valve Assembly	2Nos. for each type and rating used in the system	240V-1" AC type-2No's for APH application
4.6.2 Coil (single or double coil type)	10% of total nos. used in the system or minimum 5(five) Nos. whichever is more for each type and rating.	
4.7 Gauge (Pressure, Differential Pressure, Temperature, Level)	10% of total nos. used in the system or minimum 1(one) no. whichever is more for each type and range.	Pressure gauge with needle valve-1No
<del>4.8 Air Filter Regulator complete set with pressure gauges</del>	<del>10Nos.</del>	<del>Filter Regulator lubricator-10No's</del>
<del>4.9 Rotameter</del>	<del>10% of total nos. used in the system or minimum 2(Two) nos. whichever is more for each type, rating, model and size used in the system.</del>	<del>Not Applicable</del>
4.10. Gauge Glass	1No. for each type and size	Not Applicable
4.11 Erection Hardware		Not Applicable



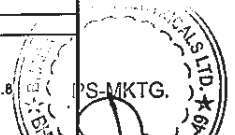
ANNEXURE-II

Sl. No.	Equipment/Package Name	Quantity for Two units	Remarks (BHEL)
6.11	Electrical		
6.11.1	Other Spares as applicable as per the Electrical List	Item & Quantity same as indicated in Electrical list 'B'	
6.11.2	UPS Spares as applicable as per the Electrical List	Item & Quantity same as indicated in Electrical list 'B'	
6.12	C&I Items		
6.12.1	Microprocessor control complete with MMI System	1 Set	
6.12.2	Field Instruments & Others as applicable as per the C&I List	Item & Quantity same as indicated in C&I list 'C'	
6.12.3	PLC system, if any	Item & Quantity same as indicated in C&I list 'C'	
6.13	Air Drying Unit (HOC Type)		
6.13.1	Ejector	1Set for each category of Compressor Dryer	
6.13.2	Steel drum	1Set for each category of Compressor Dryer	
6.13.3	Rotor	1Set for each category of Compressor Dryer	
6.13.4	Desiccant material	1lot	
6.13.5	Bearing	1Set for each category of Compressor Dryer	
6.13.6	Cooler Tube Bunch Assembly	1Set for each category of Compressor Dryer	
6.13.7	Regeneration line control valve	1Set for each category of Compressor Dryer	
6.13.8	Safety Valve	1Set for each category of Compressor Dryer	
6.13.9	Water Separator	1Set for each category of Compressor Dryer	
6.13.10	Electrical Spares as applicable as per the Electrical List	1Set for each category of Compressor Dryer	
6.13.11	Field Instruments & Others as applicable as per the C&I List	1Set for each category of Compressor Dryer	
7.0	Sump Pump		
7.1	Complete set with Level Switch & Motor	10% of the total quantity used in the system for each type and rating or	CONSIDERED IN CL. NO. III(1,2)
7.2	Annunciation System	Item & Quantity same as indicated in C&I list 'C'	

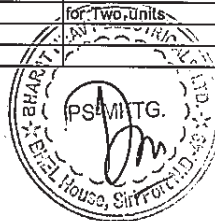
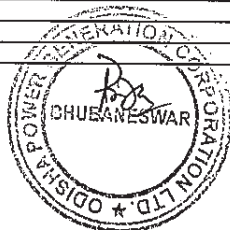
**B. Electrical Packages**

Sl. No.	Equipment/Package Name	Quantity Required per unit*	Remarks	Remarks (BHEL)
I	Electrical Items			
1.0	Generator Transformer (1f)			
1.1	Bushing			
1.1.1	HV	1No.		
1.1.2	HV Neutral	1No.		
1.1.3	LV	2Nos.		
1.2	Winding Temperature Indicator	2Nos.		
1.3	Oil Temperature Indicator	2Nos.		
1.4	Pressure Relief Device or Diaphragm for explosion Relief Vent	2Nos.		
1.5	Magnetic Oil Level Gauge	2Nos.		
1.6	Buchholz Relay	2Nos.		
1.7	Silica Gel Breather	2Nos.		
1.8	CT			
1.8.1	HV Neutral CT for Restricted Earth Fault	1No.		
1.8.2	HV Neutral CT for Standby Earth Fault	1No.		
1.8.3	HV Line CT for Restricted Earth Fault	1No.		
1.8.4	HV Line CT for Differential protection	1No.		
		2Nos		

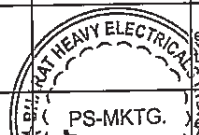
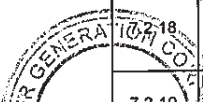
INCLUDED IN 1.8



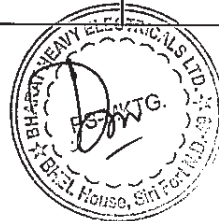
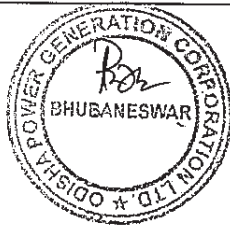
2.1.1	HV	2Nos.		
2.1.2	LV	2Nos.		
2.1.3	LV Neutral	2Nos.		
2.2	Winding Temperature Indicator	2Nos.		
2.3	Oil Temperature Indicator	2Nos.		
2.4	Pressure Relief Device or Diaphragm for explosion Relief Vent	2Nos.		
2.5	Magnetic Oil Level Gauge	2Nos.		
2.6	Buchholz Relay	2Nos.		
2.7	Silica Gel Breather	2Nos.		
2.8	Oil Surge Relay for OLTC	2Nos.		
2.9	LV CT			
2.9.1	LV Neutral CT for Restricted Earth Fault	1No.		
2.9.2	LV Neutral CT for Standby Earth Fault	1No.		
2.9.3	LV Line CT for Restricted Earth Fault	1No.		
3.0	<b>Reserve Auxilliary Transformer</b>			
3.1	Bushing			
3.1.1	HV	1No.		Since only 1 no RAT is offered, spares are offered for one unit only.
3.1.2	LV	1No.		
3.1.3	HV Neutral	1No.		
3.1.4	LV Neutral	1No.		
3.2	Winding Temperature Indicator	1No.		
3.3	Oil Temperature Indicator	1No.		
3.4	Pressure Relief Device or Diaphragm for explosion Relief Vent	1No.		
3.5	Magnetic Oil Level Gauge	1No.		
3.6	Buchholz Relay	1No.		
3.7	Silica Gel Breather	1No.		
3.8	Oil Surge Relay for OLTC	1No.		
4.0	<b>Auxiliary Power Transformers</b>			
4.1	<b>Bushing</b>			
4.1.1	<b>HV</b>	<b>2Nos.</b>		
4.1.2	<b>LV</b>	<b>2Nos.</b>		
4.1.3	<b>LV Neutral</b>	<b>2Nos.</b>		
4.2	<b>Winding Temperature Indicator</b>	<b>2Nos.</b>		
4.3	<b>Oil Temperature Indicator</b>	<b>2Nos.</b>		
4.4	<b>Pressure Relief Device or Diaphragm for explosion Relief Vent</b>	<b>2Nos.</b>		
4.5	<b>Magnetic Oil Level Gauge</b>	<b>2Nos.</b>		
4.6	<b>Buchholz Relay</b>	<b>2Nos.</b>		
4.7	<b>Silica Gel Breather</b>	<b>2Nos.</b>		
5.0	<b>LT Transformers</b>			
5.1	<b>Bushing</b>			
5.1.1	<b>HV</b>	<b>2Nos.</b>		
5.1.2	<b>LV</b>	<b>2Nos.</b>		
5.1.3	<b>LV Neutral</b>	<b>2Nos.</b>		
5.2	<b>Winding Temperature Indicator</b>	<b>2Nos.</b>		
5.4	<b>Pressure Relief Device or Diaphragm for explosion Relief Vent(for Oil type Transformers)</b>	<b>2Nos.</b>		
5.5	<b>Magnetic Oil Level Gauge(for Oil type Transformers)</b>	<b>2Nos.</b>		
5.6	<b>Buchholz Relay(for Oil type Transformers)</b>	<b>2Nos.</b>		
5.7	<b>Silica Gel Breather(for Oil type Transformers)</b>	<b>2Nos.</b>		
5.8	<b>Cooler fan (AN/AF)</b>	<b>2Nos.</b>		
6.0	<b>Bus Duct</b>			
6.1	<b>Generator Bus Duct</b>			
6.1.1	<b>Bus Bar Support Insulator</b>	<b>3Nos.</b>		
6.1.2	<b>Bolt Disconnct Link (single Phase) Rigid Type Complete with hardware rated for :</b>			
6.1.2.1	<b>Main Run &amp; Delta Run</b>	<b>2Nos.</b>		
6.1.2.2	<b>Tap-off</b>	<b>2Nos.</b>		
6.1.3	<b>Flexible Terminal Connetor (Single Phase) complete with hardware rated for:</b>			
6.1.3.1	<b>Generator end</b>	<b>2Nos.</b>		
6.1.3.2	<b>Generator Transformer</b>	<b>2Nos.</b>		
6.1.3.3	<b>Unit Transformer</b>	<b>2Nos.</b>		
6.1.4	<b>Main Run CTs (Line side)</b>			
6.1.4.1	<b>Generator Differential</b>	<b>1No.</b>	for Two units	
6.1.4.2	<b>Digital AVR System</b>	<b>1No.</b>	for Two units	
6.1.4.3	<b>Generator Metering</b>	<b>1No.</b>	for Two units	
6.1.4.4	<b>Backup Impedence Protection</b>	<b>1No.</b>	for Two units	
6.1.5	<b>Tap-off CTs</b>			
6.1.4.1	<b>Unit Transformer Differential</b>	<b>1No.</b>	for Two units	
6.1.4.2	<b>Backup Impedence Protection</b>	<b>1No.</b>	for Two units	
6.1.4.3	<b>Overall Differential</b>	<b>1No.</b>	for Two units	
6.1.6	<b>Voltage Transformer</b>	<b>2Nos.</b>	for Two units	
6.1.7	<b>Surge Capacitor</b>	<b>1No.</b>	for Two units	
6.1.8	<b>Lightning Arrestor</b>	<b>1No.</b>	for Two units	



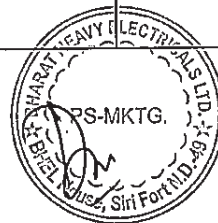
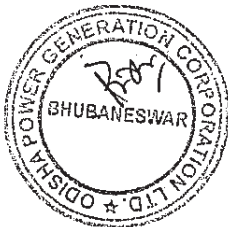
Sl. No.	Equipment/Package Name	Quantity Required per unit*	Remarks	Remarks (BHEL)
6.1.9	Seal-off Bushings for the rating			
6.1.9.1	Main Run & Delta Run	1No.		
6.1.9.2	Tap-off	1No.		
6.1.10	Expansion Bellows for the rating			
6.1.10.1	Main Run & Delta Run	1No.	for Two units	
6.1.10.2	Tap-off	1No.	for Two units	
6.2	11 KV & 3.3 KV Bus Duct			
6.2.1	Bus Support Insulator	15Nos.		
6.2.2	Flexible Terminal Connetor (Single Phase) complete with hardware rated for:	3Nos each type and ratings	for Two units	
6.2.3	Wall Seal-off Bushing	1No each type and ratings	for Two units	
6.2.4	Expansion Bellows	1No each type and ratings	for Two units	
6.3	415 V Bus Duct			
6.3.1	Bus Support Insulator	10Nos.		
6.3.2	Aluminum Flexible	1 set for each type and Rating		
6.3.3	Copper Flexible	1 set for each type and		
6.3.4	Rubber (Neoprene Bellow)	1 set for each type and		
7.0	11 KV & 3.3 KV System			
7.2	11 KV & 3.3 KV Switch Gear			
7.2.1	Trip Coil	10% of the total number.		
7.2.2	Closing Coil	10% of the total number.		
7.2.3	Spring Charging Motor	5Nos.		
7.2.4	Spring Charging Motor with complete Mechanisim	10% of total number of breakers		
7.2.7	Spring Charging Limit Switch	10Nos.		
7.2.6	Thermal Overload for Spring Charging Motor	3Nos.		
7.2.7	Breaker Complete Pole Assembly (Bottle)	3Sets (1set consists of 3nos.)		(set comprising 3 nos. each of C1 & Eaton VI)
7.2.8	Breaker Auxiliary (A & B) Contact Assembly	5Nos		
7.2.9	Breaker Auxiliary (C & D) Contact Assembly	5Nos		
7.2.10	Plug Socket with Prefab cable	5Nos		
7.2.11	Position Limit Switch	10Sets		
7.2.12	Surge Arrester	6Nos.		
7.2.13	Indicating Lamps complete assembly			
7.2.13.1	Red	10% of the total number.		
7.2.13.2	Amber	10% of the total number.		
7.2.13.3	Green	10% of the total number.		
7.2.13.4	Blue	10% of the total number.		
7.2.14	CT	1No. for each type and Rating	for Two units	Set comprising 1 no. each of assumed 15 types)
7.2.15	Transducer	5 Nos. for each type and Rating		
7.2.16	Breaker Control Switch			
7.2.16.1	Trip / Neutral / close Switch	5Nos. for each type and Rating		
7.2.16.2	Swgr / Trial / Normal Switch	5Nos. for each type and Rating		
7.2.16.3	AC Supply On / Off Switch	5Nos. for each type and Rating		
7.2.16.4	DC Supply On / Off Switch	5Nos. for each type and Rating		
7.2.16.7	Motor Heater On /Off Switch	1No. for each type and Rating		
7.2.16.8	DC Supply Source Selector Switch (3-position)	3Nos. for each type and Rating		
7.2.16.7	Ammeter Selector Switch	1 No. for each type and Rating		
7.2.16.8	Voltmeter Selector Switch	1 No. for each type and Rating		
7.2.17	Voltmeter	1 No. for each type and Rating		
	Ammeter	1 No. for each type and Rating		(Set comprising 1 no. each of assumed 15 types)
7.2.10	Breaker Jaw Contact ( Bus-end & Breaker- end) assembly	5Sets. for each type and Rating		(Set comprising 1 no. each of 3 types)



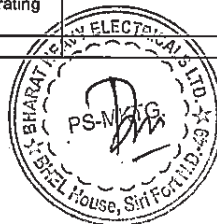
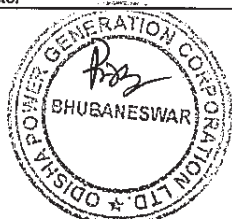
7.3	Energy Meter	1No. For each type & rating	for Two units	(Set comprising 1 no. each of assumed 15 types)
8.0	415V System			
8.1	Air Circuit Breaker			
8.1.1	Trip Coil	<u>10% of the total number.</u>		
8.1.2	Closing Coil	<u>10% of the total number.</u>		
8.1.3	Spring Charging Motor	3Nos.		
8.1.4	Spring Charging Motor with complete Mechanism	<u>10% of total number of breakers</u>		
8.1.5	Spring Charged Limit Switch	5Nos.		
8.1.6	Thermal Overload for Spring Charging Motor	3Nos.		
8.1.7	Breaker Contact			
8.1.7.1	Main Contact (Fixed and moving) assembly	5Sets for each type and rating		
8.1.7.2	Arcing Contact (Fixed and moving) assembly	5Sets for each type and rating		
8.1.7.3	Breaker Jaw Contact ( Bus-end & Breaker- end) assembly	5Sets. for each type and Rating		
8.1.7.4	Sliding Contact (Fixed & Moving)	3Sets.		
8.1.7.5	Breaker Auxiliary Contact Block	5Nos.		
8.1.8	Arcing Chute	3Sets for each type and rating		
8.1.9	Plug Socket with Prefab cable	5Nos		
8.1.10	Position Limit Switch	10Sets		
8.1.11	Indicating Lamps complete assembly			
8.1.11.1	Red	<u>10% of the total number.</u>		RED-15No's
8.1.11.2	Amber	<u>10% of the total number.</u>		AMBER-15No's,
8.1.11.3	Green	<u>10% of the total number.</u>		GREEN-15No's
8.1.11.4	Blue	<u>10% of the total number.</u>		BLUE-15No's
8.1.12	CT	1No. for each type and Rating	for Two units	
8.1.13	Transducer	5 Nos. for each type and Rating		
8.1.14	Breaker Control Switch			
8.1.14.1	Trip / Neutral / close Switch	5Nos. for each type and Rating		
8.1.14.2	Swgr / Trial / Normal Switch (Local/Remote)	5Nos. for each type and Rating		
8.1.14.3	AC Supply On / Off Switch	5Nos. for each type and Rating		
8.1.14.4	DC Supply On / Off Switch	5Nos. for each type and Rating		
8.1.14.5	Motor Heater On /Off Switch	1No. for each type and Rating		
8.1.14.6	DC Supply Source Selector Switch (3-position)	3Nos. for each type and Rating		
8.1.14.7	Ammeter Selector Switch	1 No. for each type and Rating		
8.1.14.8	Voltmeter Selector Switch	1 No. for each type and Rating		
8.1.15	Voltmeter	1 No. for each type and Rating		
8.1.16	Ammeter	1 No. for each type and Rating		
8.1.17	Auxiliary Control Contactor			
8.1.17.1	Auxiliary Control Contactor DC complete	5Nos.		
8.1.17.2	Auxiliary Control Contactor DC spare kits	10Nos.		
8.1.17.3	Auxiliary Control Contactor DC Coils	10Nos.		



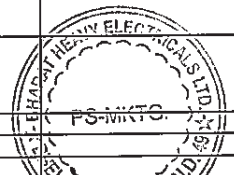
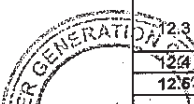
SI. No.	Equipment/Package Name	Quantity Required per unit*	Remarks	Remarks (BHEL)
9.2	PMCC/MCC/ACDB			AS APPLICABLE, CONSIDERED UNDER MRHS SPARES UNDER CL. I (28) OF Mechanical portion  Only applicable items under cl no 9.2 only will be offered. Applicable items are those which are installed in the system.
9.2.1	Contactor			
9.2.1.1	Power Contactor (AC)			
9.2.1.1.1	Power Contactor Complete Assembly	2Nos.for each type and rating		2 sets  (Each set comprises of 8A, 16A, 32A, 63A, 80A, 100A, 125A Contactors-3No's)
9.2.1.1.2	Power Contactor spare kits	5Sets for each type and rating		
9.2.1.1.3	Power Contactor AC Coils	5Nos. Coils for each type and rating		
9.2.1.2	Auxiliary Control Contactor (AC)			
9.2.1.2.1	Auxiliary Control Contactor Complete Assembly	20Nos.for each type and rating		20Set  (Each set comprises of 8A, 16A, 32A, 63A, 80A, 100A, 125A Contactors-3No's)
9.2.1.2.2	Auxiliary Control Contactor spare kits	25Setsfor each type and rating		
9.2.1.2.3	Auxiliary Control Contactor AC Coils	25Nos.for each type and rating		
9.2.2	MCCB (Power Circuit)	2Nos. for each type and rating		2Sets  (Each set comprises of 16A, 32A, 63A, 125 A, 315A, 320A, 400A-1No)
9.2.3	MCB (Control Circuit)	15Nos.for each type and rating		Not applicable
9.2.4	Switch			
9.2.4.1	Local / Remote Selector Switch	10Nos.		
9.2.4.2	MCCB Status (On/off) Monitoring Switch/Contact	5Nos.		
9.2.4.3	Trial / Normal /MCC Selector Switch	10Nos.		
9.2.4.4	MCC module Service Position Limit Switch	5Nos.		



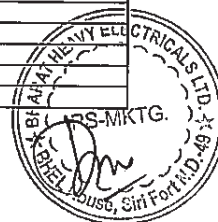
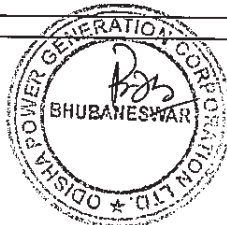
				2Sets
9.2.5	Thermal Overload Relay	2Nos. for each type and rating		1 Set Numerical relay for ACB. (1 Set comprises of 1.Over Current relay(51) 2.Earth fault relay(51N) 3.Under Voltage relay(27) 4.Fuse failure relay(98) 5.Antipumping relay(94) 6.Trip circuit supervision relay(95) 7.Trip annunciation relay(30A, B) 8.Lockout relay(86) 9.Check synchronization relay)
9.2.9	Sliding Contact (Fixed & Moving)	25Sets		
9.2.7	Bus bar to MCC module Lira Contact Assembly ( Bus-end & MCC Module-end)	5Sets for each type and rating		
9.2.8	Indicating Lamps complete assembly			
9.2.8.1	Red	20Sets		20Sets
9.2.8.2	Amber	20Sets		20Sets
9.2.8.3	Green	20Sets		20Sets
9.2.9	Push Button (On/Off) Complete Assembly	10Sets		
9.2.10	CT	1No.for each type and rating		
9.2.11	Ammeter	1No. for each type and rating		
9.2.12	Control Transformer	1No. for each type and rating		1No 415/240V -5KVA
9.2.13	Off Delay/ On Delay Timer	5Nos.for each type and rating		
9.2.14	Switch Fuse Unit	5Nos.for each type and rating		32/16A,32A/25A,6 3/32A,63/63A,125/ 100A,250/250A,40 0/400A Each 5 No's
9.2.15	Terminal Block			
9.2.15.1	Power Terminal Block	10% of total nos. for each type and rating used in the system		10No's (10 Various types of TB's )
9.2.15.2	Control Terminal Block	10% of total nos. for each type and rating used in the system		10No's (10 Various types of TB's )
9.2.15.3	End Plate for Power & Control Terminal Block	Each type 25Nos.		
9.3	Energy Meter	1No. For each type &rating	for Two unit	
10.0	DC Starter Panel/DCDB			Only scanner air fan DC starter box is applicable. Only applicable items under cl no 10 only will be offered. Applicable items are those which are installed in the system.
10.1	DC Power Contactor complete assembly	1No. for each type and Rating		
10.2	Power Contact Spare Kit	2Sets for each type and rating		
10.3	Coil for Power Contactor	2Nos.		
10.4	Control Contactor complete assembly	5Nos.		
10.5	Control Contact Spare Kit	5Sets for each type and rating		
10.6	Coil for Control Contactor	5Nos.		



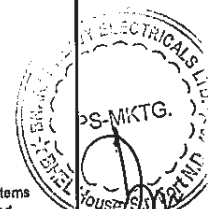
Sl. No.	Equipment/Package Name	Quantity Required per unit*	Remarks	Remarks (BHEL)
10.1	On/Off Delay Timer	1No. for each type and Rating		
10.8	Indicating Lamps complete assembly			
10.8.1	Red	3Sets		
10.8.2	Amber	3Sets		
10.8.3	Green	3Sets		
10.9	Push Button (On/Off) Complete Assembly	2Nos. for each colour		
10.10	MCCB	1No. for each type and Rating		
10.11	Power Fuse	3Nos. for each type and Rating		
10.12	Control Fuse	5Nos each type and rating		
10.13	Thermal Over Load Relay	1No. each type and rating		
10.14	Ammeter	1No. each type and rating		
10.15	Switch Fuse Unit	5Nos. for each type and rating		
	Any Electronic Components/PCB used in the system			
10.16	Terminal Block			
10.16.1	Power Terminal Block	10% of total nos. for each type and rating used in the system		
10.16.2	Control Terminal Block	10% of total nos. for each type and rating used in the system		
10.16.3	End Plate for Power & Control Terminal Block	Each type 25Nos.		
11.0	Protective Relaying system			
11.1	11 KV & 3.3 KV System			
11.1.1	Numerical Relay			
11.1.1.1	Feeder/Transformer Protection	2Nos. each type and rating		
11.1.1.2	Motor Protection	5Nos. each type and rating		
11.1.2	Conventional (Electromagnetic/Static type) Relay	10% for each type and rating or minimum one (1) no. whichever is more		
11.2	415V System			
11.2.1	Numerical Relay			
11.2.1.1	Feeder/Transformer Protection	2Nos. each type and rating		
11.2.1.2	Motor Protection	5Nos. each type and rating		
11.2.2	Conventional (Electromagnetic/Static type) Relay	10% for each type and rating or minimum one (1) no. whichever is more		
11.3	Generator Protection System			
11.3.1	Numerical Relay	10% for each type and rating or minimum one (1) no. whichever is more		
11.3.2	MCBs	2Nos. for each type	For two units	
11.3.3	Lockout relays, Auxiliary Relays, Interposing Relay,	2Nos. for each type	For two units	
11.3.4	Metrosil Surge Diveter	10% for each type and rating or minimum one (2) no. whichever is more	For two units	
11.3.4	Fuses	20% (round off to next higher digit with minimum 2 nos.) of each type and rating	For two units	
12.0	UPS (Main UPS for DCS System)			
12.1	Fuse	3 (Three) times of total quantity of each type of fuses used in the system (for Two Units)		
12.2	SCR	10% of total quantity of each type used in the system or minimum 2(two) nos. whichever is more.		
12.3	Diode	10% of total quantity of each type used in the system or minimum 2(two) nos. whichever is more.		
12.4	IGBT	2 (two) nos.		
12.5	Electronic Module/ PCB			
12.6	Static Switch	1 (one) no. each type of		



12.5.2	Inverter	1 (one) no. each type of Electronic Card/PCB/modules used in the system		
12.5.3	Static voltage Regulator	1 (one) no. each type of Electronic Card/PCB/modules used in the system		
12.5.4	Charger	1 (one) no. each type of Electronic Card/PCB/modules used in the system		
12.6	UPS Battery			
12.6.1	Battery Cell (Uncharged, Dry)	8 nos.		
12.6.2	Inter connecting cell strips	10 nos.		
12.6.3	Vent cap	10 nos.		
12.6.4	Hydrometer	1 no.		
12.6.5	Rubber gloves	1 pair		
12.6.6	Voltmeter for measuring cell voltage (Center zero type)	1 no.		
12.6.7	Funnel	1 no.		
12.6.8	Jug	1 no.		
12.6.12	Apron & Goggles	1 set		
12.6.10	Cell lifting puller	1 no.		
12.6.11	Insulated socket spanner with handle	1 no.		
12.6.12	Terminal screw with bellaville washer	5% of total quantity used	for Two units	
12.6.13	Plastic filling bottle	1 no.		
12.6.14	Thermometer	1 no.		
12.7	For other applicable items SI No.10 & 6 of this document shall be followed.			Not Applicable
12.6.12	Apron & Goggles	1 set		
12.6.10	Cell lifting puller	1 no.		
12.6.11	Insulated socket spanner with handle	1 no.		
12.6.12	Terminal screw with bellaville washer	5% of total quantity used	for Two units	
12.6.13	Plastic filling bottle	1 no.		
12.6.14	Thermometer	1 no.		
12.7	For other applicable items SI No.10 & 6 of this			Not Applicable
13.0	Control Panel/Desk Mounted Items			
13.1	Push Button			
13.1.1	Complete assembly	5Nos for each colour		
13.1.2	Contact Element (1NO + 1NC) Block	20Nos.		
13.2	Selector Switch	10Nos. for each type and		
13.3	Meter (Analog or Digital)			
13.3.1	Ammeter	1No. for each type and range		
13.3.2	Voltmeter	1No. for each type and range		
13.3.3	Frequency	1No. for each type and range		
13.3.4	MW	1No. for each type and range		
13.3.5	MVAR	1No. for each type and range		
13.3.6	Power Factor	1No. for each type and range		
13.3.7	Synchroscope	1No. for each type and range		
13.4	Indicating Lamps complete assembly	10Nos. for each Colour		
13.5	Mimic Lamps	10Nos. for each Colour		
13.6	MCB	2Nos. for each type and rating		
13.7	Door Limit Switch	2Nos.		
13.8	Annunciation system			
13.8.1	Lamp Box with Facia & Lamps (LED type)	25Nos.		
13.8.2	Hooter	1No.		
13.8.3	Each type of PCB (for non-PLC driven system)	1(one) no.		
14.0	Actuator			Applicable items under cl no 14 only will be offered. Applicable items are those which are installed in the system.
14.1	Complete set of Actuator	1No. for each type and rating	for Two unit	(1No. for each type and rating)
14.2	Limit Switch	2 Nos each type and rating		
14.3	Torque Switch	2 Nos each type and rating		
14.4	Auxiliary Contact	1 no each type and rating		
14.5	Motor	1 no each type and rating	for Two unit	
14.6	Complete Seal kit	1Set for each type and rating	for Two unit	
14.7	Complete O-Ring Set	1Set		
15.0	Illumination			
15.1	Comptalux Lamp 100 W	10 nos.		
15.2	High Pressure Mercury Vapour Lamp 155W	20 nos.		
15.3	High Pressure Sodium Vapour Lamp 70W	100 nos.		
15.5	High Pressure Sodium Vapour Lamp 250W	20 nos.		
15.6	High Pressure Sodium Vapour Lamp 400W	10 nos.		
15.7	High Pressure Mercury Vapour Lamp 400W	20 nos.		
15.8	Ignitors (Separate type) for High Pressure Sodium	150nos.		
15.9	Ballast for 1 x 125 W High Pressure Mercury Vapour Lamp	15 nos.		
15.10	Ballast for 1 x 400 W High Pressure Mercury Vapour Lamp	15 nos.		
15.11	Ballast for 1 x 70 W High Pressure Sodium Vapour Lamp	150 nos.		
15.13	Ballast for 1 x 250 W High Pressure Sodium Vapour Lamp	25 nos.		

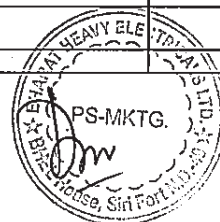
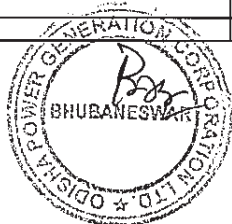


Sl. No.	Equipment/Package Name	Quantity Required per unit*	Remarks	Remarks (BHEL)
15.14	Ballast for 1 x 400 W High Pressure Sodium Vapour Lamp	25 nos.		
15.15	Capacitor for 1 x 125 W High Pressure Mercury	50 Nos.		
15.16	Capacitor for 1 x 400 W High Pressure Mercury Vapour	50 Nos.		
15.17	Capacitor for 1 x 70 W High Pressure Sodium Vapour Lamp	50 Nos.		
15.19	Capacitor for 1 x 250 W High Pressure Sodium Vapour	50 Nos.		
15.20	Capacitor for 1 x 400 W High Pressure Sodium Vapour	50 Nos.		
15.21	Clockswitch type Time Switch	25 Nos.		
15.22	Miniature Circuit Breakers (M.C. Bs)			
15.22.1	1-Pole 20 Amps.	20Nos.		
15.22.2	2-Pole 20 Amps.	10Nos.		
15.22.3	2-Pole 16 Amps.	10Nos.		
6.0	<b>Cable &amp; Accessories</b>			
16.1	11KV Grade HT Power Cable	500Mtrs of each type, size & rating of Cables	for Two units	
16.2	3.3KV Grade HT Power Cable	500Mtrs of each type, size & rating of Cables		
16.3	LT Power Cable	1(one)Km of each type, size & rating of Cables		
16.4	Control Cable	2(two)Km. of each type, size & rating of Cables		
16.5	Trailing Cable			Not Applicable
	Elevator	One set of full length of each size/type of cables as used for each type of Elevator	for Two units	
16.5.1				
	Electrical Hoist	One set of full length of each size/type of cables as used for each type of Electrical Hoist	for Two units	1 set for ESP
16.5.2				
16.6	Gland & lugs	20% of each type, size &		
17.0	<b>Neutral Grounding Resistor</b>			
17.1	Brown glazed Porcelain insulators for supporting between mounting frame and each Resistor Assembly	2 Nos.		Applicable items considered.
17.2	Interposing insulator assembly	2 Nos.		
17.3	Ceramic and Micanite insulator for supporting between	2 Nos.		
18.0	<b>DG Set</b>			
18.1	Diesel Engine			
18.1.1	Element Corrosion Resistor	8 nos.		if Applicable
18.1.2	Element lub oil Filter	8 nos.		
18.1.3	Element lub oil by pass Filter	8 nos.		
18.1.4	Element Fuel Filter	16 Nos.		
18.1.5	Plate corrosion Resistor	16 Nos.		if Applicable
18.1.6	Element Air cleaner outer	2 Nos.		
18.1.7	Element Air cleaner Inner	2 Nos.		
18.1.8	Fuel Oil Pump	1 No.		
18.1.9	Turbo-charger	2 Nos.		
18.1.10	Engine - starter Motor	1 No.		
18.1.11	Lub Oil Pump	1 No.		
18.1.12	Injector	2 Nos.		
18.1.13	Piston rings & liner set	16 Nos.		
18.2	Alternator			
18.2.1	Rotating Rectifiers (Diode)	4 Nos.		
18.2.2	Reference Voltage Adjuster	2 Nos.		if Applicable
18.2.3	Varistor	4 Nos.		if Applicable
18.2.4	Exciter PCB	2 Nos.		
18.2.5	AC Module	1 No.		if Applicable
18.3	AMF Panel			
18.3.1	Annunciation window	2 Nos.		
18.3.2	Electronic Timer	2 Nos.		Incl. in Sl. No. 18.3.1
18.3.3	Indicating Lamps	16 Nos.		ISG- Incl. in Sl. No. 18.3.1
18.3.4	Push Button	4 Nos.		Incl. in Sl. No. 18.3.1
18.4	For other applicable items Sl No.10 & 6 of this document shall be followed.	Item & Quantity same as indicated in Electrical list 'E' of Sl No.10 & 6		if applicable
19.0	<b>Plant 220V DC System &amp; Other DC system of Various Voltage Levels</b>			
19.1	Battery			
19.1.1	Battery Cell (Uncharged, Dry)	5 nos for each type and rating		
19.1.2	Inter connecting cell strips	5 nos for each type and rating		
19.1.3	Vent plug	5 nos		
19.1.4	Teak wood cable clamps with hardware	2 Nos.		
19.1.5	Hydrometer	1 No.		



Applicable items considered

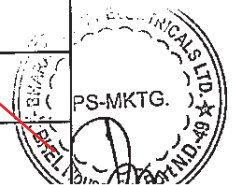
19.1.6	Rubber gloves	1 pair		are those which are installed in the system.  DD (24 V DC system) offered. 19.3 is not applicable
19.1.7	Voltmeter for measuring cell voltage (Center zero type)	1 no.		
19.1.8	Insulated socket spanner with handle	1 no.		
19.1.9	Thermometer	1 no.		
19.2	Float -cum- Boost Charger			
19.2.1	Fuses & fuse links	100% of total quantity for each type & rating of fuses used in the system		
19.2.2	SCR	2Nos. for each type and rating		
19.2.3	Diode	2Nos. for each type and rating		
19.2.4	Indicating lamps	4Nos.		
19.2.5	Electronic Module/ PCB/Card	1 (one) No. each type used in the system		
19.2.6	pulse transformer	1 set		
19.3	For other applicable items SI No.10 & 6 of this document shall be followed.	Item & Quantity same as indicated in Electrical list 'B' of SI No.10 & 6		
20	Motor			
20.1	HT Motor (other than BFP Motor)			
20.1.1	Driving End Bearing	1No. (or 1Set as applicable) for each type and rating of Motor		
20.1.2	Non-Driving End Bearing	1No. (or 1Set as applicable) for each type and rating of Motor		
20.1.3	Cooling Fan Internal & External	1Set for each type and rating of Motor		
20.1.4	Bearing Temperature Gauge Driving & Non-Driving End	1Set for each type and rating of Motor		
20.1.5	Phase-Segregated Terminal Box	1Set for each type and rating of Motor		
20.1.6	Neutral End Terminal Bushing with Fasteners	1No. for each type and rating of Motor		
20.1.7	RTD for Bearing Temperature	1No. for each type and rating of Motor		
20.1.8	Motor Space Heater	1No. for each type and rating of Motor		
20.1.9	Complete Set of Coupling	1Set for each Application		
20.2	BFP Motor			
20.2.1	HT Bushing	1Set		
20.2.2	Elastomould Jointing Kit	1Set		
20.2.3	Driving End & Non-Driving End Bearing	1Set		
20.2.4	Oil Seal Ring	1Set		
20.2.5	Bearing Temperature Gauge Driving & Non-Driving End	1Set		
20.2.6	RTD for Bearing Temperature	1Set		
20.2.7	Motor Space Heater	1Set		
20.3	415 Volt Motor (above 30KW Rating)			
20.3.1	End Shield Cover Driving & Non-Driving End	1Set for each type and rating of Motor		
20.3.2	Driving End & Non-Driving End Bearing	1Set for each type and rating of Motor		
20.3.3	Cooling Fan	1No. for each type and rating of Motor		
20.3.4	Motor Space Heater	1No. for each type and rating of Motor		
20.3.5	Motor Terminal Block	1No. for each type and rating of Motor		
20.3.6	Complete Set of Coupling	1Set for each Application		
20.4	415 Volt Motor (Upto 30KW Rating)			
20.4.1	Driving End & Non-Driving End Bearing	1Set for each type and rating of Motor		
20.4.2	Cooling Fan	1No. for each type and rating of Motor		
20.4.3	Motor Terminal Block	1No. for each type and rating of Motor		
20.4.4	Complete Set of Coupling	1Set for each Application		
20.5	D C Motors			
20.5.1	Carbon brushes	10 sets each type		
20.5.2	Brush assemblies	2 sets each type		
20.5.3	Terminal blocks	2 sets each type		
20.5.4	Heaters	2 sets each type		
20.5.5	Pulleys	2 sets each type		
20.5.6	Bearings (DE and NDE) for each type and rating of motor	4 sets		
21	Generator Circuit Breaker			



Sl. No.	Equipment/Package Name	Quantity Required per unit*	Remarks	Remarks (BHEL)
21.1	Support insulator of each type	10% of the total number.		Applicable items CONSIDERED. Applicable items are those which are installed in the system.
21.2	Circuit Breaker closing coil	1 no.		
21.3	Circuit Breaker trip coil	1 no.		
21.4	Breaker fixed contact (main & arcing)	1 sets each.		
21.5	Breaker moving contact (main & arcing)	1 sets each.		
21.6	SF6 Bottle	3 nos.		
21.7	Gas filling unit (for SF6 breaker)	1 no.		
21.8	CTs of different ratings (1 phase unit)	1 nos. each.		
21.9	VTs of different rating (1 phase unit)	1 nos. each.		
21.1	Disconnecting switch, earth switch, Start switch complete with operating mechanism (1 phase unit)	1 nos. each.		
21.11	Lightning arrester (1 phase unit)	1 nos. each.		
21.12	Surge capacitor (1 phase unit)	1 nos. each.		
21.13	Circuit Breaker complete operating mechanism	1 set		
21.14	Isolating switch, Selector switch, breaker control switch, position indicators, Contactor/ Relays, Push button.	10% of the total number, minimum 1 no. of each type		
21.15	Power and Control fuses / CIRCUIT BREAKERS of different ratings	10% of total quantity.		
21.16	Indicating lamp	10% of total quantity.		
21.17	Auxiliary Switch assembly	1 set each for CIRCUIT BREAKERS and switches		
	Total			

### C. Control & Instrumentation

Sl. No.	Equipment/Package Name	Quantity Required per unit*	Remarks (BHEL)
1	DDCMIS /MMIPIS Items		detailed item wise list meeting tender specification shall be furnished during detailed Egg stage.
1.1	Multifunction Processor (Controller) Unit	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.	
1.2	Binary Input Module	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.	
1.3	Binary Input Module for SOE Inputs (if applicable)	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.	Not applicable
1.4	Pulse Input Module (if applicable)	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.	Not applicable
1.5	Analog Input Module (4 to 20mA DC input type)	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.	
1.6	Analog Input Module (Thermocouple input type)	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.	
1.7	Analog Input Module (RTD input type)	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.	
1.8	Analog Output Module (4 to 20mA DC output type)	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.	
1.9	Pulse Output Module (if applicable)	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.	Not applicable





TITLE :  
TECHNICAL SPECIFICATION FOR  
COLTCS

SPEC. NO. PE-TS- 391-165-N002

VOLUME III

SECTION

REV. NO. 0

DATE 04.06.2014

SHEET 1 OF 1

## SECTION B

SHALL BE FURNISHED ON PLACEMENT OF LOI

- DATASHEET B
- LIST OF SCHEDULES



TITLE :  
TECHNICAL SPECIFICATION FOR  
COLTCS

SPEC. NO. PE-TS- 391-165-N002

VOLUME III

SECTION

REV. NO. 0

DATE 04.06.2014

SHEET 1 OF 1

**SECTION B1**

**DATASHEET B**



Title **DATA SHEET - B**  
**CONDENSER ON LOAD TUBE**  
**CLEANING SYSTEM**  
 (SPONGE RUBBER BALL TYPE)

SPECIFICATION NO.  
**PE-TS-999-165-N001**

VOLUME	III	PART	A
SHEET	I	OF	13

INSTRUCTION TO BIDDER 1. This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB.  
 2. Items which deviate from Specification shall be marked with an asterisk (\*)

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

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



Title **DATA SHEET - B**  
**CONDENSER ON LOAD TUBE**  
**CLEANING SYSTEM**  
 (SPONGE RUBBER BALL TYPE)

SPECIFICATION NO.  
**PE-TS-999-165-N001**

VOLUME	III	PART	A
SHEET	2	OF	13

INSTRUCTION TO BIDDER 1. This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB.

2. Items which deviate from Specification shall be marked with an asterisk (\*)

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

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



Title **DATA SHEET - B**  
**CONDENSER ON LOAD TUBE**  
**CLEANING SYSTEM**  
**(SPONGE RUBBER BALL TYPE)**

SPECIFICATION NO. **PE-TS-999-165-N001**

VOLUME III PART A  
 SHEET 3 OF 13

INSTRUCTION TO BIDDER 1. This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB.  
 2. Items which deviate from Specification shall be marked with an asterisk (\*)

SL.NO.	ITEM	UNIT
PARTICULARS		
4.3	Automatic backwashing of ball separator with ball collection effected by :	
	a) Differential pressure measuring system	YES/ NO
	b) Adjustable timer	YES/ NO
	c) Push button	YES/ NO
4.4	Automatic emergency backwashing of ball separator effected by differential pressure measuring system.	YES/ NO
4.5	Automatic flushing of differential pressure measuring system.	YES/NO
4.6	Automatic ball sorting initiated by push button.	YES/NO
4.7	Whether provision for manual operation of the complete tube cleaning system is made in case of control system failure.	YES/NO
5.0	<b>Ball Separator :</b>	
5.1	Make	
5.2	Nos. provided per set	Nos.
5.3	Code/ Standard	
5.4	Body outer diameter	mm
5.5	Body thickness	mm
5.6	Manhole type & size	mm
5.7	Whether sight glass is provided	
5.8	No. of screens/ strainers provided per each ball separator	Nos.
5.9	Type of arrangement provided to prevent lodging of the debris at the entrance of ball extraction pipes.	

Name of Bidder/ Vendor

Revision Number      0      1      2      3      4

Signature of Bidder/ Vendor  
 Authorised Representative

Date



**Title**  
**DATA SHEET - B**  
**CONDENSER ON LOAD TUBE**  
**CLEANING SYSTEM**  
 (SPONGE RUBBER BALL TYPE)

**SPECIFICATION NO.**  
 PE-TS-999-165-N001

VOLUME	III	PART	A
SHEET	4	OF	13

**INSTRUCTION TO BIDDER** 1 This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB.  
 2. Items which deviate from Specification shall be marked with an asterisk (\*)

SL.NO.	PARTICULARS	ITEM	UNIT
5.10	Clearance between screen/ strainer bars.		mm
5.11	Materials : a) Body/ Housing b) screen/ Strainer section c) Screen/ Strainer shaft d) Hardware for fixing the screen/ Strainer e) Other internal hardware f) External hardware		
5.12.	Lining material (if applicable)		
6.0	<b>Ball Recirculating Pump :</b>		
6.1	Make		
6.2	Nos. provided per set		Mos.
6.2	Design discharge flow		M <sup>3</sup> /hr
6.4	Design discharge pressure		Bar
6.5	Design pump Speed		RPM
6.6	Design pump efficiency		%
6.7	Seal for the pump		
6.8	Materials : a) Casing b) Impeller c) Shaft		
7.0	<b>Ball Collector :</b>		
7.1	Nos. provided per set		Nos.

Name of Bidder/ Vendor					
Revision Number	0	1	2	3	
Signature of Bidder/ Vendor					
Authorised Representative					



**Title**  
**DATA SHEET - B**  
**CONDENSER ON LOAD TUBE**  
**CLEANING SYSTEM**  
**(SPONGE RUBBER BALL TYPE)**

**SPECIFICATION NO.**  
**PE-TS-999-165-N001**

<b>VOLUME</b>	<b>III</b>	<b>PART</b>	<b>A</b>
<b>SHEET</b>	<b>5</b>	<b>OF</b>	<b>13</b>

**INSTRUCTION TO BIDDER**

- This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB.
- Items which deviate from Specification shall be marked with an asterisk (\*)

SL.NO.	PARTICULARS	ITEM	UNIT
7.2	Code/ Standard		
7.3	Whether inspection window/ sight glass is provided.		YES/ NO
7.4	Materials :		
	a) Shell/ Body		
	b) Internals		
7.5	Lining material (if applicable)		
7.6	Whether provision for separating and collecting the undersized balls, is made		YES/ NO.
8.0	<b>Differential Pressure Measuring System:</b>		
8.1	Differential Pressure Switch/ Transmitter		
	a) Type		
	b) Make and Model		
	c) Range		
	d) Accuracy		
	e) Material of sensing element		
	f) No. of contacts	Nos.	
	g) Contact rating		
	h) Enclosure		
	i) Mounting		
8.2	Whether differential Pressure gauge is provided for manual observation.		
8.3	Differential Pressure Gauge :		
	a) Type		
	b) Make and Model		
	c) Range		

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



**Title**  
**DATA SHEET - B**  
**CONDENSER ON LOAD TUBE**  
**CLEANING SYSTEM**  
 (SPONGE RUBBER BALL TYPE)

**SPECIFICATION NO.**  
 PE-TS-999-165-N001

**VOLUME III PART A**  
**SHEET 6 OF 13**

**INSTRUCTION TO BIDDER** 1. This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB.  
 2. Items which deviate from Specification shall be marked with an asterisk (\*)

SL.NO.	ITEM	UNIT
	<b>PARTICULARS</b>	
	d) Accuracy	
	e) Material of sensing element	
	f) No. of contacts	Nos.
	g) Dial size	mm
	h) Enclosure	
	i) Mounting	
8.4	Whether the contacts for differential pressure gauge and switch/ transmitter are independent.	YES/ NO
9.0	<b>Timer for Backwashing</b>	
9.1	Timer make	
9.2	Range of duration setting	
9.3	Range of frequency	
10.0	<b>Ball Monitoring System :</b>	
10.1	Type	
10.2	Maake & Model	
10.3	Whether ball monitoring system is designed to perform the following functions :	
	a) Continuously counting the balls in circulation and giving an alarm calling for investigation of ball losses, when the number of circulating balls falls below a set value	YES/ NO
	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 value.	

**Name of Bidder/ Vendor**

Revision Number

0

1

2

3

4

Signature of Bidder/ Vendor

Authorised Representative

Date



Title **DATA SHEET - B**  
**CONDENSER ON LOAD TUBE**  
**CLEANING SYSTEM**  
 (SPONGE RUBBER BALL TYPE)

SPECIFICATION NO.  
**PE-TS-999-165-N001**

VOLUME	III	PART	A
SHEET	7	OF	13

**INSTRUCTION TO BIDDER**

- This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB.
- Items which deviate from Specification shall be marked with an asterisk (\*)

SL.NO.	PARTICULARS	ITEM	UNIT
10.4	Whether electronic processor of the ball monitoring system is provided with the following		
	a) Indicators for		
	◆ Required basic ball charge		YES/ NO
	◆ Recirculating Ball quantity		YES/ NO
	◆ Oversized ball quantity		YES/ NO
	b) Time counters for		
	◆ Total cleaning system operating hours		YES/ NO.
	◆ Cleaning system operating hours with sufficient number of oversized balls		YES/NO
	c) Recorder for ball consumption		YES/NO
10.5	Whether provision for Self-testing and Self Calibration are made		YES/NO
11.0	Cleaning Balls :		
11.1	Type		
11.2	Size	mm	
11.3	Specific gravity		
11.4	Material		
11.5	Hardness		
11.6	Total Ball recirculation quantity per set	Nos.	
11.7	abrasive coated ball recirculation quantity per set - (if any)	No.s	
12.0	Piping :		
12.1	Ball Extraction Piping		

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



**Title**  
**DATA SHEET - B**  
**CONDENSER ON LOAD TUBE**  
**CLEANING SYSTEM**  
**(SPONGE RUBBER BALL TYPE)**

**SPECIFICATION NO.**  
**PE-TS-990-165-N001**

<b>VOLUME</b>	<b>III</b>	<b>PART</b>	<b>A</b>
<b>SHEET</b>	<b>8</b>	<b>OF</b>	<b>13</b>

**INSTRUCTION TO BIDDER**

- This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB.
- Items which deviate from Specification shall be marked with an asterisk (\*)

SL.NO.	ITEM	UNIT
12.2	Ball Transport Piping	
	a) OD x thicknes	mm x mm
	b) Material	
	c) Length of piping being supplied	M
12.3	Differential pressure measuring system flushing piping.	
	a) OD x thicknes	mm x mm
	b) Material	
	c) Length of piping being supplied	M
2.4	Any other	
3.0	<b>Valves (Indicate Type of Valves)</b>	
3.1	Sizes	: mm
3.2	Nos. provided per set	Nos.
3.3	<b>Materials</b>	
	a) Body	
	b) Disc/ Trim	
	c) Shaft	
3.0	<b>Distributors</b>	
3.1	Nos. provided per set	Nos.
3.2	<b>Materials :</b>	
	a) Body	
	b) Sight glass	
	c) Sight glass flanges	
	d) Internal parts	

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



Title	<b>DATA SHEET - B</b>			SPECIFICATION NO.
	<b>CONDENSER ON LOAD TUBE</b>			PE-TS-999-165-N001
	<b>CLEANING SYSTEM</b>			VOLUME III PART A
<b>(SPONGE RUBBER BALL TYPE)</b>			SHEET 9 OF 13	

**INSTRUCTION TO BIDDER**

1. This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB.

2. Items which deviate from Specification shall be marked with an asterisk (\*)

SL.NO. PARTICULARS	ITEM	UNIT
14.3	Lining material (if applicable)	
15.0	Injection Nozzles :	
15.1	Nos. provided per each CW inlet pipe	Nos.
15.2	Size of the stubs to be provided in CW inlet pipe for installing the injection nozzles.	mm
15.3	Material	
15.4	Lining material (if applicable)	
16.0	Actuators :	
16.1	Actuators for ball separator :	
	a) Nos. provided per ball separator	No.s
	b) Type & make	
	c) Motor rating	KW
16.2	Actuators for ball collector	
	a) Nos. provided per ball collector.	No.s
	b) Type & make	
	c) Motor rating	KW
16.3	Actuators for Valves:	
	a) Nos. provided per set	No.s
	b) Type & motor	
	c) Motor rating	KW
16.4	Any other	

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



**Title**  
**DATA SHEET - B**  
**CONDENSER ON LOAD TUBE**  
**CLEANING SYSTEM**  
 (SPONGE RUBBER BALL TYPE)

**SPECIFICATION NO.**  
 PE-TS-999-165-N001

**VOLUME III PART A**  
**SHEET 10 OF 13**

**INSTRUCTION TO BIDDER**

- This data sheet shall be read in conjunction with Specification No. PES-179-0: Section - D, Volume - IIB.
- Items which deviate from Specification shall be marked with an asterisk (\*)

SL.NO.	ITEM	UNIT
17.0	Electric Drive Motors	
17.1	Drive motor for recirculating pump :	
	a) Type and make	
	b) Rating	KW
17.2	Drive motor for differential pressure measuring system flushing pump (if applicable)	
	a) Type and make	
	b) Rating	KW
17.3	Any other.	
18.0	Control Panel	
18.1	Type	
18.2	Model & Manufacturer	
18.3	Operating Voltage/ frequency	V/ Hz
18.4	Control Voltage/ frequency	V/ Hz
18.5	Materials of housing and door	
18.6	Protections/ interlocks provided for :	
18.7	Class of Protection	
18.8	Control Hardware	
18.8	Alarms/ Annunciations provided for :	
18.9	Indicators provided for :	
18.10	Whether interconnecting control and power cabling between the control panel and various drive is included in the offer.	
19.0	Pressure gauges :	
19.1	Manufacturer & Type, Model	

<b>Name of Bidder/ Vendor</b>					
<b>Revision Number</b>	0	1	2	3	4
<b>Signature of Bidder/ Vendor Authorised Representative</b>					
<b>Date</b>					



Title **DATA SHEET - B**  
**CONDENSER ON LOAD TUBE**  
**CLEANING SYSTEM**  
 (SPONGE RUBBER BALL TYPE)

SPECIFICATION NO. **PE-TS-999-165-N001**  
 VOLUME III PART A  
 SHEET 11 OF 13

**INSTRUCTION TO BIDDER** 1. This data sheet shall be read in conjunction with Specification No. PES-179-01 / Section - D, Volume - IIB.  
 2. Items which deviate from Specification shall be marked with an asterisk (\*)

SL.NO.	ITEM	UNIT
19.2	Nos. provided per set	Nos.
19.3	Location	
19.4	Dial size	mm
19.5	Range & Accuracy	
19.6	Materials of construction :	
	a) Sensing element	
	b) Movement	
	c) Casing	
19.7	Enclosure	
19.8	Mounting	
20.0	Counter Flanges :	
20.1	Whether counter flanges complete with gaskets, bolts and nuts etc. for all terminal points are included in the offer.	YES/ NO
20.2	Type	
20.3	Rating	
20.4	Materials	
	a) Flanges	
	b) Bolts and Nuts	
	c) Gaskets	
20.5	Code/ Standard	
21.0	Whether lifting arrangement is provided for various equipments.	YES/ NO.
22.0	Whether ball recirculating pump, ball collector with interconnecting piping and valves are mounted on a single frame.	YES/ NO
23.0	Whether supports (wherever necessary) complete with foundation plates, bolts, nuts, inserts etc. are included in the offer.	YES/ NO

Name of Bidder/ Vendor \_\_\_\_\_

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



**Title**  
**DATA SHEET - B**  
**CONDENSER ON LOAD TUBE**  
**CLEANING SYSTEM**  
 (SPONGE RUBBER BALL TYPE)

**SPECIFICATION NO.**  
 PE-TS-999-165-N001

VOLUME	III	PART	A
SHEET	12	OF	13

**INSTRUCTION TO BIDDER**

- This data sheet shall be read in conjunction with Specification No PES-179-01 Section - D, Volume - IIB.
- Items which deviate from Specification shall be marked with an asterisk (\*)

SL.NO.	PARTICULARS	ITEM	UNIT
24.0	<b>Shop Inspection and Tests</b>		
24.1	Whether all the tests and inspections as detailed in the specification/ quality plan are carried out.		YES/NO
24.2	<b>Hydrostatic Test :</b>		
	a) Test Pressure	Bar (g)	
	<ul style="list-style-type: none"> <li>◆ Ball Separator</li> <li>◆ Recirculating Pump</li> <li>◆ Ball Collector</li> <li>◆ Distributors</li> <li>◆ Injection nozzles</li> <li>◆ Piping &amp; Valves</li> </ul>		
	a) Test duration	Minutes	
24.3	<b>Lekage Test :</b>		
	a) Test Pressure	Bar (g)	
	b) Test duration	Minutes	
25.0	<b>Painting :</b>		
25.1	<b>External Surfaces :</b>		
	a) Surface Preparation		
	b) Primer		
	a) Finish		
25.2	<b>Internal Surfaces :</b>		
	a) Surface Preparation		
	b) Primer		
	a) Finish		
26.0	<b>Weights :</b>		
26.1	Empty Weight		Kg.
	a) Ball Separator		

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



Title **DATA SHEET - B**  
**CONDENSER ON LOAD TUBE**  
**CLEANING SYSTEM**  
 (SPONGE RUBBER BALL TYPE)

SPECIFICATION NO.  
**PE-TS-999-165-N001**

VOLUME	III	PART	A
SHEET	13	OF	13


INSTRUCTION TO BIDDER 1. This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB.  
 2. Items which deviate from Specification shall be marked with an asterisk (\*)

SL.NO.	ITEM	UNIT
	<b>PARTICULARS</b>	
	b) Recirculating pump c) Ball collector d) recirculating unit	
26.2	Operating weight	kg
	a) Ball Separator b) Recirculating pump c) Ball collector d) recirculating unit	
26.3	Weight of the heaviest equipment/ assembly to be handled.	kg.
27.0	<b>Overall Dimensions</b>	
27.1	Ball Separator	
27.2	Recirculating Unit	
28.0	<b>Other information (if any )</b>	
	G:\MSEVASH\DS-COTCS.RTF	

Name of Bidder/ Vendor


Revision Number	0	1	2	3	4
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Signature of Bidder/ Vendor Authorised Representative					
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	TITLE	SPECIFICATION NO.
	<b>MOTOR</b>  <b>DATA SHEET - B</b>	VOLUME III
		SECTION
		REV NO. 00 DATE 29/08/2005
		SHEET 1 OF 2


S. No.	Description	Data to be filled by successful bidder
<b>A.</b>	<b>General</b>	
1	Manufacturer & country of origin	
2	Motor type	
3	Type of starting	
4	Name of the equipment driven by motor & Quantity	
5	Maximum Power requirement of driven equipment	
6	Rated speed of Driven Equipment	
7	Design ambient temperature	
<b>B.</b>	<b>Design and Performance Data</b>	
1	Frame size & type designation	
2	Type of duty	
3	Rated Voltage	
4	Permissible variation for	
5	a) Voltage	
6	b) Frequency	
7	c) Combined voltage & frequency	
8	Rated output at design ambient temp (by resistance method)	
9	Synchronous speed & Rated slip	
10	Minimum permissible starting voltage	
11	Starting time in sec with mechanism coupled	
12	a) At rated voltage	
13	b) At min starting voltage	
14	Locked rotor current as percentage of FLC (including IS tolerance)	
15	Torque	
	a) Starting	
	b) Maximum	
16	Permissible temp rise at rated output over ambient temp & method	
17	Noise level at 1.0 m (dB)	
18	Amplitude of vibration	
19	Efficiency & P.F. at rated voltage & frequency	
	a) At 100% load	
	c) At 75% load	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			


	TITLE	SPECIFICATION NO.
	<b>MOTOR</b>  <b>DATA SHEET - B</b>	VOLUME III
		SECTION
		REV NO. 00 DATE 29/08/2005
		SHEET 2 OF 2

S. No.	Description	Data to be filled by successful bidder
	c) At starting	
<b>C.</b>	<b>Constructional Features</b>	
1	Method of connection of motor driven equipment	
2	Applicable Standard	
3	DOP of Enclosure	
4	Method of cooling	
5	Class of insulation	
6	Main terminal box	
	a) Type	
	b) Power Cable details (Conductor, size, armour/unarmour)	
	c) Cable Gland & lugs details (Size, type & material)	
	d) Permissible Fault level ( kArms & duration in sec)	
7	Space heater details (Voltage & watts)	
8	Flame proof motor details (if applicable)	
	a) Enclosure	
	b) suitability for hazardous area	
	i Zone	O / I / II
	ii Group	IIA / IIB / IIC
9	No. of Stator winding	
10	Winding connection	
11	Kind of rotor winding	
12	Kind of bearings	
13	Direction of rotation when viewed from NDE	
14	Paint Shade & type	
15	Net weight of motor	
16	Outline mounting drawing No (To be enclosed as annexure)	
<b>D.</b>	<b>Characteristic curves/ drawings</b> (To be enclosed for motors of rating $\geq 55KW$ )	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

	<b>DATA SHEET FOR PLC SYSTEM</b>		SPECIFICATION NO.: PE-DC-999-145-1036-1	
			VOLUME II B	
			SECTION D	
			REV. NO. 03	DATE: 18.03.2014
			SHEET 1	OF 2
Data Sheet No.: PES-145-36-DS1-0				
<b>Data Sheet A &amp; B</b>				
DATA SHEET-A FOR PLC SYSTEM (TO BE FILLED BY PURCHASER)			DATA SHEET – B (TO BE FILLED BY BIDDER)	
<b>GENERAL</b>	PROJECT			
	SERVICE			
	QUANTITY	<input type="checkbox"/> UNITISED	<input type="checkbox"/> COMMON	
	LOCATION	<input checked="" type="checkbox"/> INDOOR <input type="checkbox"/> AC	<input type="checkbox"/> OUTDOOR <input checked="" type="checkbox"/> NON-AC*	
<b>PLC EQUIPMENT</b>	MAKE / MODEL NO.	BIDDER TO INDICATE		
	<b>PROCESSOR</b>	REDUNDANT WITH HOT STANDBY		
	DATA BUS (HMI)	<input type="checkbox"/> COPPER WIRE	<input type="checkbox"/> FIBRE OPTIC	
	DATA BUS (I/O - CPU)	<input type="checkbox"/> COPPER WIRE	<input type="checkbox"/> FIBRE OPTIC	
	DATA BUS (REMOTE I/O - CPU)	<input type="checkbox"/> COPPER WIRE	<input checked="" type="checkbox"/> FIBRE OPTIC	
	FIELD CONTACTS INTERROGATION VOLTAGE	<input checked="" type="checkbox"/> 24 V DC	<input type="checkbox"/> 48 V DC	<input type="checkbox"/> 110 V AC
	LOCATION OF COUPLING RELAYS	<input checked="" type="checkbox"/> MCC	<input type="checkbox"/> PLC PANEL	
	DESKTOP OWS QUANTITY	<input type="checkbox"/> ONE <input checked="" type="checkbox"/> TWO <input type="checkbox"/> _____ <input type="checkbox"/> DESKTOP VERSION <input type="checkbox"/> SERVER VERSION <input checked="" type="checkbox"/> WORK STATION VERSION REQUIREMENT OF OWS IN CCR <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO QUANTITY _____		
	DESKTOP MONITOR TYPE	<input type="checkbox"/> 19" <input checked="" type="checkbox"/> 22" <b>TFT/CRT MONITOR</b> <input checked="" type="checkbox"/> GIU <input type="checkbox"/> OTHERS		
	PRINTER	INKJET <input type="checkbox"/> A3_NOS <input type="checkbox"/> A4_NOS LASER B/W <input type="checkbox"/> A3_NOS <input type="checkbox"/> A4_NOS COLOR INKJET <input type="checkbox"/> A3_NOS <input type="checkbox"/> A4_NOS COLOR LASER <input checked="" type="checkbox"/> A3_NOS <input checked="" type="checkbox"/> A4_NOS		
PROGRAMMING / CONFIGURATION FACILITY	A) <input type="checkbox"/> HAND HELD <input type="checkbox"/> LAPTOP B) ENGINEERING SOFTWARE <input checked="" type="checkbox"/> ONE OWS <input type="checkbox"/> ALL OWS <input type="checkbox"/> _____			
SAFETY STANDARD	<input type="checkbox"/> SIL-3 <input type="checkbox"/> SIL-2 <input type="checkbox"/> NIL			
<b>SPARE LIST</b>	COMPUTER FURNITURE	BOQ <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO INDUSTRIAL GRADE <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> START UP & COMMISSIONING		
	SPARE LIST	<input checked="" type="checkbox"/> MANDATORY SPARE <input type="checkbox"/> RECOMMENDED		
	SPARE LIST ATTACHED	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
<b>REDUNDANCY</b>	CPU	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
	POWER SUPPLY	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
	COMMUNICATION	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
	I/O CARD	<input type="checkbox"/> YES <input type="checkbox"/> NO		
	OTHER ELECTRONICS	<input type="checkbox"/> YES <input type="checkbox"/> NO		

Printer shall be as per C&I scope sheet.

	<b>DATA SHEET FOR PLC SYSTEM</b>		SPECIFICATION NO.: PE-DC-999-145-I036-1	
			VOLUME II B	
			SECTION D	
			REV. NO. 03	DATE: 18.03.2014
			SHEET 2	OF 2
Data Sheet No.: PES-145-36-DS1-0				
<b>Data Sheet A &amp; B</b>				
DATA SHEET-A FOR PLC SYSTEM (TO BE FILLED BY PURCHASER)			DATA SHEET – B (TO BE FILLED BY BIDDER)	
<b>No. of CHANNELS PER CARD</b>	ANALOG INPUT	<input checked="" type="checkbox"/> 8 NOs	<input checked="" type="checkbox"/> 16 NOs	
	ANALOG OUTPUT	<input checked="" type="checkbox"/> 8 NOs	<input checked="" type="checkbox"/> 16 NOs	
	BINARY INPUT	<input checked="" type="checkbox"/> 16 NOs	<input checked="" type="checkbox"/> 32 NOs	
	BINARY OUTPUT	<input checked="" type="checkbox"/> 16 NOs	<input checked="" type="checkbox"/> 32 NOs	
	RTD**	4 NOs		
	THERMOCOUPLE**	8 NOs		
ELECTRONIC CARD ISOLATION		<input type="checkbox"/> GALVANIC <input checked="" type="checkbox"/> OPTICAL <input type="checkbox"/> OTHER		
<b>PANEL</b>	QUANTITY	BIDDER TO INDICATE		
	CLASS OF PROTECTION(Refer Location of PLC)	IP-65		
	REMOTE I/O PANEL	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO AC REQUIREMENT <input type="checkbox"/> YES <input type="checkbox"/> NO		
	COLOUR#	RAL 7032		
	BACK-UP DESK	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO		
	MIMIC	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO IF YES, THEN <input type="checkbox"/> PANEL MOUNTED GUI <input type="checkbox"/> ACRYLIC		
	CONTROL HARDWARE	<input checked="" type="checkbox"/> PB <input checked="" type="checkbox"/> INDICATORS <input type="checkbox"/> FACIAS _____ Nos. <input checked="" type="checkbox"/> OTHERS		Alarm facia to be decided during detailed engineering
	CONFORMAL COATING	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO		
<b>COMMUNICATION WITH OTHER SYSTEM</b>	HARDWIRED	<input type="checkbox"/> YES (Critical Signals only) NO		
	PURPOSE	<input type="checkbox"/> CONTROL <input checked="" type="checkbox"/> MONITORING		
	MEDIUM	<input type="checkbox"/> UTP <input checked="" type="checkbox"/> FIBRE OPTIC <input type="checkbox"/> OTHERS		
	TIME SYNCHRONIZATION SIGNAL FORMAT	<input type="checkbox"/> PULSE <input type="checkbox"/> RS-485 <input checked="" type="checkbox"/> IIRIG-B <input type="checkbox"/> NTP		
	SOFTLINK	<input type="checkbox"/> MODBUS <input checked="" type="checkbox"/> OPC IF MODBUS THEN <input type="checkbox"/> RS-485 <input type="checkbox"/> ETHERNET		
	SERIAL LINK	COMMUNICATION PORT TYPE _____		
<b>POWER SUPPLY INPUT FEEDER</b>	PLC PANEL	BIDDER TO INDICATE LOAD DATA		
	REMOTE I/O PANEL	BIDDER TO INDICATE LOAD DATA		
<b>POWER SUPPLY</b>	SOURCE \$\$	<input type="checkbox"/> UPS(INDUSTRIAL GRADE) <input type="checkbox"/> 24V DC CHARGER		UPS feeder shall be from main plant UPS (BHEL SCOPE)
	BATTERY TYPE	<input type="checkbox"/> Ni-Cd <input type="checkbox"/> LEAD ACID <input type="checkbox"/> OTHERS		
	BACK-UP TIME	<input type="checkbox"/> 30 MINS <input checked="" type="checkbox"/> 60 MINS <input type="checkbox"/> OTHERS		
	BATTERY CONFIGURATION	<input type="checkbox"/> 1X100% <input checked="" type="checkbox"/> 2X100% <input type="checkbox"/> 2X50%		
<b>CUSTOMER TRAINING</b>	TRAINING	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
	NO OF DAYS	7 DAYS		
	LOCATION	<input checked="" type="checkbox"/> VENDOR'S WORK <input type="checkbox"/> PROJECT SITE <input type="checkbox"/> OTHERS		

\*IF THE LOCATION IS INDOOR,KINDLY SPECIFY IF PLC PANEL IS PLACED IN AC OR NON-AC ENVIRONMENT.


\*\*SHALL NOT BE APPLICABLE IF TEMPERATURE TRANSMITTERS ARE ENVISAGED.

# PROJECT SPECIFIC PAINT SHADES, IF APPLICABLE TO BE USED.

\$\$ CHECK & REPLACE WITH MAIN UPS SLD IF POWER SUPPLY IS NOT APPROVED BY CUSTOMER.

SPECIFIC TECHNICAL REQUIREMENTS

FORM NO. PEM-6866-0

	<p><b>DATA SHEET FOR PLC SYSTEM</b></p>	SPECIFICATION NO.:			
		VOLUME II    B			
		SECTION D			
		REV. NO.    02	DATE:	19.07.2008	
		SHEET	1 OF	1	
Data Sheet No.: PES-145-36-DS2-0					
<b>Data Sheet C</b>					
DATA SHEET – C (TO BE FILLED BY BIDDER AFTER AWARD OF CONTRACT)					
<b>GENERAL*</b>	PROJECT				
	SERVICE				
	QUANTITY				
	LOCATION				
<b>PLC EQUIPMENT</b>	MAKE / MODEL NO.				
	<b>PROCESSOR</b>				
	DATA BUS (HMI)				
	DATA BUS (I/O - CPU)				
	DATA BUS (REMOTE I/O - CPU)				
	FIELD CONTACTS INTERROGATION VOLTAGE				
	LOCATION OF COUPLING RELAYS				
	DESKTOP OWS QUANTITY				
	DESKTOP MONITOR TYPE				
	PRINTER (A4) - QUANTITY				
	PRINTER (A4) - MODEL				
	PROGRAMMING / CONFIGURATION FACILITY				
	SAFETY STANDARD				
	COMPUTER FURNITURE				
<b>PANEL</b>	QUANTITY				
	CLASS OF PROTECTION				
	REMOTE I/O PANEL				
	COLOUR				
	BACK-UP DESK				
	MIMIC				
	CONTROL HARDWARE				
<b>COMMUNICATION TO OTHER SYSTEM</b>	HARDWIRED				
	PURPOSE				
	MEDIUM				
	TIME SYNCHRONIZATION SIGNAL FORMAT				
	SOFTLINK				
	SERIAL LINK				
<b>POWER SUPPLY INPUT FEEDER</b>	PLC PANEL				
	REMOTE I/O PANEL				



**SPECIFICATION  
FOR  
MOTORISED VALVE ACTUATOR**

SPECIFICATION NO.: PE-SS-350-145-I007

VOLUME

SECTION

REV. NO. 00

DATE: 05.01.10

SHEET 1 OF 3

**Data Sheet A & B**

DATA SHEET-A  
(TO BE FILLED BY PURCHASER)

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

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<b>GENERAL*</b>	* PROJECT	<b>2x660 MW OPGCL BANAHARPALI TPS</b>	
	OFFER REFERENCE		
	* TAG NO. SERVICE		
	* DUTY	<input type="checkbox"/> ON / OFF	<input type="checkbox"/> INCHING
	* LINE SIZE (inlet/outlet): MATERIAL		
	* VALVE TYPE	<input type="checkbox"/> GLOBE <input type="checkbox"/> GATE <input type="checkbox"/> REG. GLOBE <input type="checkbox"/> BUTTERFLY	
	* OPENING / CLOSING TIME		
	* WORKING PRESSURE		
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%	
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY	
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY	
ACTUATOR RATED TORQUE	BIDDER TO SPECIFY		
<b>CONSTRUCTION AND SIZING</b>	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF, IP:55	
	MECHANICAL POSITION INDICATOR	TO BE PROVIDED FOR 0-100% TRAVEL	
	BEARINGS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.	
	GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION	METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.	
	SIZING	OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. FOR INCHING(REGULATING) SERVICE 150 STARTS/HR MINIMUM	
<b>HANDWHEEL</b>	* REQUIRED	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	
	* ORIENTATION	<input type="checkbox"/> TOP MOUNTED <input type="checkbox"/> SIDE MOUNTED	
	TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.		
<b>ELECTRIC ACTUATOR</b>	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY	
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY	
	MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT.	
	ACTUATOR APPLICABLE WIRING DIAGRAM	<input checked="" type="checkbox"/> ENCLOSED (BIDDER TO CONFIRM) A: <input type="checkbox"/> DRG. NO. 3-V-MISC-24227 R00 B: <input type="checkbox"/> DRG. NO. 3-V-MISC-24550 R00 C: <input checked="" type="checkbox"/> DRG. NO. 3-V-MISC-24283 R00 D: <input type="checkbox"/> DRG. NO. 4-V-MISC-90271 R11	
	COLOUR SHADE	<input checked="" type="checkbox"/> BLUE (RAL 5012) ENAMEL <input type="checkbox"/> .....	
	SHAFT RPM	BIDDER TO SPECIFY	
	OLR SET VALUE	BIDDER TO SPECIFY	
	STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY	
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY	
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC	
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER <input type="checkbox"/> 24 VDC <input type="checkbox"/> 110 V	
	@ ENCLOSURE CLASS OF MOTOR	<input type="checkbox"/> IP 65 <input type="checkbox"/> IP 67 <input type="checkbox"/> FLAME PROOF <input checked="" type="checkbox"/> IP 55, TOTALLY ENCL, SELF VENTILATED.	
	@ INSULATION CLASS	<input type="checkbox"/> CLASS-B <input checked="" type="checkbox"/> CLASS-F	
	@ WINDING TEMP PROTECTION	<input checked="" type="checkbox"/> THERMOSTAT (3 Nos., 1 IN EACH PHASE) <input type="checkbox"/> -----	



**SPECIFICATION  
FOR  
MOTORISED VALVE ACTUATOR**

SPECIFICATION NO.: PE-SS-350-145-I007

VOLUME

SECTION

REV. NO. 00

DATE: 05.01.10

SHEET 2 OF 3


**Data Sheet A & B**

DATA SHEET-A  
(TO BE FILLED BY PURCHASER)

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

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	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED	
<b>INTEGRAL STARTER</b>	INTEGRAL STARTER	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	TYPE OF SWITCHING DEVICE	<input checked="" type="checkbox"/> CONTACTORS <input type="checkbox"/> THYRISTORS	
	TYPE	<input checked="" type="checkbox"/> CONVENTIONAL <input type="checkbox"/> SMART (NON-INTRUSIVE)	
	STEP DOWN CONT. TRANSFORMER	<input checked="" type="checkbox"/> REQUIRED	
	OPEN / CLOSE PB	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	STOP PB	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	INDICATING LAMPS	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	LOCAL REMOTE S/S	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	STATUS CONTACTS FOR MONITORING	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, S/S IN LOCAL, TORQUE SWITCH OPTD. MID WAY)	
<b>INTERPOSING RELAY</b> (Applicable for integral Starter)	INTERPOSING RELAYS	REQUIRED	
	INTERPOSING RELAY (QUANTITY)	<input checked="" type="checkbox"/> 2 NOs. <input type="checkbox"/> 3 NOs.	
	DRIVING VOLTAGE	<input checked="" type="checkbox"/> 20.5 – 24V DC <input type="checkbox"/> _____ V DC	
	DRIVING CURRENT	<input checked="" type="checkbox"/> 125mA MAX <input type="checkbox"/> _____ mA MAX	
	LOAD RESISTANCE	<input checked="" type="checkbox"/> > 192 ohms - <25 k ohms <input type="checkbox"/> > _____ ohms - < _____ ohms	
<b>TORQUE SWITCH</b>	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN / CLOSE	<input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos. / <input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos	
	CONTACT TYPE	2 NO + 2 NC	
	RATING	5A 240V AC AND 0.5A 220V DC	
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE	
	ACCURACY	+3% OF SET VALUE	
<b>LIMIT SWITCH</b>	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN : INT : CLOSE	<input checked="" type="checkbox"/> 1 No <input type="checkbox"/> 2 Nos. 2 Nos. (ADJ.) <input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos.	
	CONTACT TYPE	2 NO + 2 NC	
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC	

	<b>SPECIFICATION FOR MOTORISED VALVE ACTUATOR</b>	SPECIFICATION NO.: PE-SS-350-145-I007		
		VOLUME		
		SECTION		
		REV. NO.	00	DATE: 05.01.10
		SHEET	3	OF 3
<b>Data Sheet A &amp; B</b>				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	

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<b>POSITION TRANSMITTER</b>	POSITION TRANSMITTER (For inching duty)	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
	MFR & MODEL NO.	BIDDER TO SPECIFY		
	TYPE	<input checked="" type="checkbox"/> ELECTRONIC (2 WIRE) R/I CONVERTER <input type="checkbox"/> ELECTRONIC (2 WIRE) CONTACTLESS		
	SUPPLY	<input checked="" type="checkbox"/> 24V DC <input type="checkbox"/> .....		
	OUTPUT	<input checked="" type="checkbox"/> 4-20mA		
	ACCURACY	± 1% FS		
<b>SPACE HEATER</b>	@SPACE HEATER	REQUIRED		
	@ POWER SUPPLY			
	@ RATING	415v, 3PH, AC FOR RATING > 0.2KW; SINGLE PHASE FOR RATING < 0.2KW		
<b>TERMINAL BOX</b>	MOTOR TERMINAL BOX	REQUIRED		
	ACTUATOR TERMINAL BOX	REQUIRED		
	ENCL CLASS MTR T.B. / ACTUATOR T.B.	<input type="checkbox"/> IP 65    @ <input type="checkbox"/> ..... <input checked="" type="checkbox"/> IP65 <input type="checkbox"/> .....		
	@ EARTHING TERMINAL	REQUIRED		
	PLUG & SOCKET(9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT)	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED <input type="checkbox"/> <input type="checkbox"/> 2 NOS. <input type="checkbox"/> .....		
<b>CABLE GLANDS</b>	@ POWER CABLE GLAND	SIZE:--DURING DETAIL ENGINEERING		
	@ SPACE HEATER CABLE GLAND	SIZE: 2C x 2.5 sq. mm		
	OTHER CONTROL CABLE GLANDS-1	<input checked="" type="checkbox"/> NOT APPLICABLE		
	OTHER CONTROL CABLE GLANDS-2	<input checked="" type="checkbox"/> NOT APPLICABLE		
<b>WEIGHT</b>	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY		_____ Kg.
<b>NOTES:</b> <ol style="list-style-type: none"> <li><b>SCOPE:</b> DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.</li> <li><b>CODES &amp; STANDARDS:</b> DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATIONAL STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH: IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722</li> <li>TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.</li> <li>CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED.</li> <li>THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION. THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE.</li> <li>THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE &amp; FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%.</li> <li>THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.</li> </ol>				
NOTES* = TO BE FILLED BY MPL (LEAD AGENCY).    @ = TO BE FILLED BY ES				



TITLE :  
TECHNICAL SPECIFICATION FOR  
COLTCS

SPEC. NO. PE-TS- 391-165-N002

VOLUME III

SECTION

REV. NO. 0

DATE 04.06.2014

SHEET 1 OF 1

**SECTION B2**  
**LIST OF SCHEDULES**

**CHECKLIST - LIST OF SCHEDULES**

Sl. No.	Form No.	Description	Tick Applicable Forms
1.	PEM-6024	Schedule of Drawings/Catalogues submitted with Bid.	✓
2.	PEM-6025@	Schedule of Occurrence of Key Events of Delivery, Erection & Commissioning	
3.	PEM-6026	Schedule of Equipment Manufacture. Despatch and Shipment to Site.	✓
4.	PEM-6027	Schedule of Weights & Dimensions.	
5.	PEM-6028@	Schedule of Performance Guarantee	
6.	PEM-6030	Inspection Schedule	✓
7.	PEM-6031	Schedule of Cement and Steel and Quarterly Cement Requirement.	
8.	PEM-6032	Schedule of Quarterly Requirement of Reinforcing Bars and Structural Steel.	
9.	PEM-6033@	Bill of Quantities (Civil Works)	
10.	PEM-6035	Schedule of Bidder's Proposed Construction/ Site Fabrication Facilities.	
11.	PEM-6036	Schedule of Deviations.	✓
12.	PEM-6040	Schedule of Declaration	✓
13.	PEM-6041	Quality Plan	✓
14.	PEM-6042	Vendor's Drawings/ Documents Schedule	✓
15.	PEM-6043@	Schedule of Occurrence of Key Events for Civil/Structural Works	
16.	PEM-6046	Inspection Request.	✓
17.	PEM-6051@	Schedule of Prices.	✓
18.	PEM-6052@	Schedule of Unit prices	✓
19.	PEM-6053	Schedule of Prices for Commissioning & Mandatory Spares.	✓
20.	PEM-6054	Schedule of Prices for Recommended Spares.	✓
21.	PEM-6055	Schedule Prices for Erection and Maintenance Tools & Tackles.	✓
22.	PEM-6057	Schedule of Daily & Overtime Rates.	
23.	PEM-6058	Schedule of Hire charges for Construction/ Site Fabrication Facilities.	

**For Forms marked with @ certain information to be filled by DEs before issuing to bidder.**

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**SCHEDULE OF DRAWINGS/CATALOGUES  
SUBMITTED WITH BID**

SPECIFICATION NO:

VOL III

SHEET..... OF.....

**Section C/D enclosed with the specification indicate the drawings / catalogues to be furnished with the bid. The bidder in addition to furnishing the same, can also include any other drawings / catalogues which he may desire to submit with the bid. This schedule duly lists out such drawings as enclosed by the bidder with the bid.**

DRAWING/ CATALOGUE NUMBER	DESCRIPTION	NUMBER OF SHEETS

**PARTICULARS OF BIDDER / AUTHORISED REPRESENTATIVE**

NAME	DESIGNATION	SIGNATURE	DATE	COMPANY SEAL
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**SCHEDULE OF  
WEIGHTS & DIMENSIONS**

SPECIFICATION NO:

VOL III

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The bidder shall state below the weights and dimensions of various packages for shipment covering the complete scope.

Description of Package(S)	Dimension (in meters)	Weight (in tones)

PARTICULARS OF BIDDER / AUTHORISED REPRESENTATIVE

NAME	DESIGNATION	SIGNATURE	DATE	COMPANY SEAL



**SCHEDULE OF EQUIPMENT,  
MANUFACTURE, DESPATCH AND  
SHIPMENT TO SITE**

SPECIFICATION NO:

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Equipment/Major Bought-out items	Time for Manufacture/ Procurement from Date of issues of Letter of intent (Weeks)	Time for Test Dismantling Packing & Ready for Despatch (Weeks)	Time required fro Shipment to Site (Weeks)	Total Time from Date of Issue of Letter of intent to Shipment to Site (Weeks)

We, the undersigned hereby undertake to meet the schedule in weeks fro manufacture, dispatch and shipment of each equipment and procurement of major boughtout items as listed above.

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

**INSTRUCTIONS FOR FILLING QUALITY PLAN**  
(Form No. PEM-6042-0)

The Quality Plan shall include all the Quality Control Measures and Checks adopted by the Vendor to ensure that the material component assembly services supplied by him meet will meet the requirements as per specifications and good practices. They shall include all stages of operation such as materials, processes, manufacture, assembly, packing and despatch. The following guide lines may be noted.

- Column 1- Serial Number—
- Column 2- Component/Operation- The component and/or operation being checked shall be given here.
- Column 3- Characteristics check- The characteristics being checked shall be given here, e.g., chemical composition, mechanical properties, leak tightness, surface defects etc..
- Column 4- Category - 'CR' stands for critical characteristic - affecting safety of equipment and personnel  
'MA' stands for major characteristic - affecting safety of equipment and personnel  
'MI' stands for minor characteristic - affecting appearance etc
- Column 5- Type/Method of check e.g. chemical analysis tensile testing, hydraulic test, visual examination radiography etc.
- Column 6- Extent of check, such as, 100, 10, 1 per heat etc.
- Column 7- Reference Documents - Documents, such as technical specification, drawings, standard specifications (IS, BS ETC.) procedure, etc. according to which check is done.
- Column 8- Acceptance Norms - Standards etc. according to which acceptability or otherwise of the characteristics being checked is decided.
- Column 9- Format of Record - Formats, log sheets, reports, etc. in which the observations are recorded. Standard log sheets, reports, formats etc. of the Vendors shall be numbered and such reference numbers shall be included here.
- Column 10- Agency - The agency which performs the test/instruction shall be written in sub-column 'W'  
The agency which verifies test certificates/inspection records and carries out audit check of the components/operation shall be written in sub-column 'V'  
The agencies are codified '1' stands for (BHEL)  
as 1,2 & 3 '1' \* means the operation shall be cleared by BHEL before the start of the next operation.  
'2' Stands for Vendor  
'3' stands for sub-Vendor of the Vendor and so on.
- Example :
- Entry '3' in column 'P' means test/inspection to be performed by sub-Vendor's QC.
- Entry '2' in column 'W' means test/inspection to be witnessed by Vendor's QC
- Entry '1' in column 'V' means verification shall be done by BHEL and next stage to be started only after the hold point is cleared by BHEL
- Column II- Remarks - Any special remarks shall be given here

**NOTES**

- 1 In absence of correlation with the test certificate(s) (e.g. material identification) samples shall be drawn by BHEL and all tests as per relevant specifications shall be carried out in their presence or in recognized Government Laboratory.
- 2 When materials and components are initially identified and stamped by BHEL QS engineer, the identification marks shall be preserved till despatch. Wherever this is not possible, the identification mark shall be transferred to the components in the presence of BHEL QS Engineer unless otherwise agreed.
- 3 For castings and forgings integral test specimens shall be provided. When this is not possible for casting, they shall be poured in the presence of BHEL QS Engineer unless otherwise, if witnessing of test by BHEL, is called for.
- 4 When welders qualified by reputed inspection agencies or statutory bodies are not available, qualification tests shall be conducted in the presence of BHEL QS Engineer.
- 5 This Quality Plan is liable to be modified as per the requirements of approved drawings and changes in technical specifications drawings. If there are contradictions in respect of column 7 & 8 between this Quality Plan and the approved drawings specifications, the latter shall prevail.
- 6 Whenever inspection by BHEL's Purchaser Third Party Statutory authorities are mandatory, this shall be complied with.
- 7 Inspection reports log sheets test reports certificate etc shall be furnished to BHEL of the appropriate status or at the time of final inspection as required.
- 8 This Quality Plan is also applicable to states of the order scope of supply of Vendor.



**INSPECTION SCHEDULE**

SPECIFICATION NO

VOL III

SHEET..... OF.....

S No.	ITEM/COMPONENT	PLACE & ADDRESS OF TEST / INSPECTION	SCHEDULE D DATE OF INSPECTION	DURATION OF TEST / INSPECTION (IN DAYS)

This schedule shall be in the line with specification and quality plan requirements. The information in this form shall be furnished after receipt of LOI/PO.

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



<b>QUALITY PLAN</b>		SHEET OF		CUSTOMER		PROJECT TITLE		SPECIFICATION NUMBER											
										BIDDER/VENDOR		QUALITY PLAN NUMBER		SPECIFICATION TITLE					
COMPONENT / OPERATION		CHARACTERISTIC CHECK		CAT		TYPE/METHOD OF CHECK		EXTENT OF CHECK		REFERENCE DOCUMENT		ACCEPTANCE NORM		FORMAT OF RECORD		AGENCY		REMARKS	
S. No.	2	3	4	5	6	7	8	9	10	11	P	W	V						
BHEL										BIDDER / VENDOR									
NAME										SIGNATURE									
DATE										BIDDER/VENDOR COMPANY SEAL									



**INSPECTION SCHEDULE**

SPECIFICATION NO

VOL III

SHEET..... OF.....

S No.	ITEM/COMPONENT	PLACE & ADDRESS OF TEST / INSPECTION	SCHEDULE D DATE OF INSPECTION	DURATION OF TEST / INSPECTION (IN DAYS)

This schedule shall be in the line with specification and quality plan requirements. The information in this form shall be furnished after receipt of LOI/PO.

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

	<b>TITLE</b> * <b>SCHEDULE OF DECLARATIONS</b>	SPECIFICATION NO
		VOL III
		SHEET..... OF.....

\* Bidder shall include this schedule both in technical and Price offers

**DECLARATION**

I .....certify that all the technical data and information pertaining to this specification are correct and are true representation of the equipment/system covered by our format proposal number Dated ..... and there is no deviation to the specification.

I hereby certify that I am duly authorized representative of the Bidder's company whose name appears above my signature.

Biders Company Name .....

Authorised representative's Signature .....

Name .....

Bider's Name The bidder hereby agrees to fully comply with the requirements and intent of this specification for the price indicated

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



	<b>TITLE</b> <b>* SCHEDULE OF PRICE FOR ERECTION AND MAINTENANCE TOOLS &amp; TACKLES</b>	SPECIFICATION NO
		VOL III
		SHEET..... OF.....

**\*Unpriced schedule shall also be furnished along with Part A- Schedule in technical bid**  
 The bidder shall be given below the list of erection and maintenance tools and tackles as offered by him. This shall also include the customer's list of maintenance tools. If specified in Section – C / Section - D

S. No	DESCRIPTION OF TOOLS & TACKLES	QUANTITY OFFERED	UNIT PRICE (Rs.)	TOTAL PRICE (Rs.)

**NOTE :** The hire charges for vendors equipment called for in this schedule shall include the cost of consumables, operation services, descriptions, wear and tear as well as vendor's over head and profit (These rates will be payable by customer to the vendor, only if the customer's requires the use of this equipment for carrying out his own work out side the scope of this contract).

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





**\*SCHEDULE OF PRICES FOR COMMISSIONING AND MANDATORY SPARES**

SPECIFICATION NO
VOL III
SHEET..... OF.....

**\*Unpriced schedule shall also be furnished along with Part A- Schedule in technical bid**  
 The bidder shall indicate here the quantity required for erection / commissioning and mandatory spares for equipment as listed in Section C / Section – D. If the listed spares are not adequate then the bidder shall indicate those and additional spares considered necessary by him.

Type	Manufacturer's Drawing No / Part of spare	Description	Material	Quantity per Unit / Equipment	Quantity Recommended	If Set, Nos. Per Set	Delivery Period (Weeks)	Unit Price (Rs.)	Total Price (Rs.)
Erection & Commissioning									
Mandatory Spares									
Additional Spares Mandatory Erection / Commissioning									

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