

**TAMILNADU GENERATION AND DISTRIBUTION
CORPORATION LIMITED**

**2 x 800 MW UPPUR STPP
(STAGE-I, UNIT- 1 & 2) BTG PACKAGE**

**TECHNICAL SPECIFICATIONS
FOR
CHEMICAL DOSING SYSTEM**

SPECIFICATION NO.: PE-TS-425-154-A001, R0



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



TITLE:
**2 X 800 MW UPPUR STPP (STAGE-I, UNIT 1
 & 2) BTG PACKAGE**

**TECHNICAL SPECIFICATION FOR
 CHEMICAL DOSING SYSTEM**

SPECIFICATION NO. PE-TS-425-154-A001

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REV.NO. 00 DATE : 15.11.2017

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PROJECT INFORMATION

SPECIFICATION FOR BTG EPC CONTRACT

VOLUME II – GENERAL & SCHEDULES

CHAPTER 1

PROJECT SYNOPSIS

1.0 GENERAL BACKGROUND AND SALIENT FEATURES

1.1 Introduction

Tamilnadu Generation and Distribution Corporation owns the proposed green-field 1600 MW (2 units of 800 MW each) Coal Based Thermal Power Station. The Project Site is located in Uppur, Valamavoor and Thiruppalaikudi villages of Thiruvadanai Taluk, Ramanathapuram District.

1.2 Location

The proposed site for main power plant is located at Uppur in Ramnathpuram District of Tamil Nadu.

The nearest Railway station is Thiruppalaikudi Railway Station, 3Kms from site

ECR Connecting Ramanathapuram and Pattukottai is the nearest road access.

The nearest airport is at Madurai at a distance of 140 km.

The nearest port is Tuticorin located at a distance of 130 km.

1.3 Type of Plant

The proposed 2 x 800 MW Super-Critical Power Project consists of coal fired steam generator connected to a reheat type steam turbine generator along with all the required auxiliaries. Circulating cooling water system is envisaged for condenser cooling.

The description and salient technical data of the Steam Generator, Steam Turbine Generator, Auxiliary systems, Electrical, Control & Instrumentation, Civil etc. are explained elsewhere in the specification:

1.4 PROJECT INFORMATION



2 x 800 MW Supercritical Coal Based Uppur
Thermal Power Project
Spec. No. SE/E/T&H(P)/OT No.01 /2015-16



1.1	Owner	:	Tamil Nadu Generation and Distribution Corporation Limited (TANGEDCO)	
1.2	Project Title	:	2 x 800 MW Uppur Thermal Power Project	
1.3	Owner's Engineer	:	Desein Private Limited; New Delhi	
1.4	Project Site Location	:	Place	Uppur
			State	Tamil Nadu
			Country	India
1.5	Nearest Railway Station	:	Ramanathapuram at 28 KM away	
1.6	Nearest City	:	Ramanathapuram	
1.7	Nearest Highway	:	ECR Connecting Ramanathapuram and Pattukottai	
1.8	Nearest Airport	:	Domestic air port at Madurai (140 KM)	
1.9	Nearest Sea Port	:	Tuticorin Port (130 KM)	
1.10	Site Elevation	:	+ 4.5 m	
1.11	CLIMATOLOGICAL DATA	:		
i.)	HIGHEST TEMPERATURE RECORDED	:	37.8°C	
ii.)	MINIMUM TEMPERATURE RECORDED	:	22.3°C	
iii.)	DRY BULB TEMPERATURE (DBT) FOR DESIGN PURPOSE	:	30 ± 10°C 50°C (for electrical equipment)	
iv.)	RELATIVE HUMIDITY FOR DESIGN PURPOSE	:	75 ± 15%	
v.)	ANNUAL RAINFALL	:	827 mm (avg.)	
1.12	Source of Water (Distance from site)	:	Sea	
1.13	Primary Fuel & Source	:	Imported Coal (Indonesia and S. Africa)	
1.14	Startup Fuel & Source	:	HFO/ L.D.O. (Domestic)	
1.15	Earthquake Data	:	Zone III as defined in IS: 1893-2002	

1.5 Access to Site

Site is well connected and located along ECR Connecting Ramanathapuram and Pattukottai. Site is well connected by rail also.

1.6 Plant Rating, Capacity, Availability, PLF

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Each of the two units shall have a Turbine maximum continuous rating (TMCR) of 800 MW at generator terminals based on the following site conditions.

- Ambient air temperature
- Condenser cooling water inlet temperature of 33°C and 9°C temperature rise across the condenser.
- Generator power factor of 0.85.
- Fuel specification as given elsewhere.
- Design temperature for electrical equipment is 50°C.

The VVO capacity of the steam turbine shall not be less than 105% of TMCR flow at rated parameters. Boiler maximum Continuous Rating (BMCR) will be established to match the steam flow at VVO conditions, but BMCR flow shall not less than 108% of TMCR flow.

The capacity of the unit is selected so as to deliver the rated output even after ageing that will occur between overhauls, as a result of deposition of salts in turbine blades, wear and tear etc.

The plant load factor (PLF) being considered is 85%.

1.7 Power Evacuation

Power will be evacuated from the proposed thermal power station at 765 KV voltage level through 765 KV transmission lines . The power evacuation lines would be double circuit 765 KV lines which will act as Line in & Line out circuit.

1.8 Site Selection

The following factors which influence the project site selection have been found very favourable to establish and operate the project.

- a. Availability of fuel.
- b. Existing power plant
- c. Availability of adequate cooling water.
- d. Availability of adequate land for locating the power plant with approach roads.
- e. Suitability of land from topographical and geological aspects
- f. Proximity of National Highways, Ports & Transport of fuel & heavy equipment.
- g. Facility for interconnection with transmission and distribution system for evacuation of power.
- h. Environmental aspects.

Total land required for the project is approx. 900 acres which is under the possession of TANGEDCO.

1.9 Fuel

1.9.1 Source of Fuel



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Coal shall sourced from Indonesia or any other source Domestic coal requirement for the power plant will be sourced from coal mines in Orissa.

The steam generator shall be designed for the following conditions :

- **Best Coal** – 100% Imported Coal
- **Design Coal** – 70% Imported & 30% Domestic Coal
- **Worst Coal** – 50% Imported & 50% Domestic Coal

The analysis of fuel is given below :

1.9.2

Coal Analysis:

Coal Quality Parameters

SL.NO	DESCRIPTION	DOMESTIC COAL	IMPORTED COAL
1.	HIGHER HEATING VALUE -As Fired basis given Kcal/kg	2800 (GCV as received basis)	6250 (GCV Air dried basis) 5642 (as received basis)
2.	TOTAL MOISTURE %	During rainy season 20% (inherent + surface)	16.5%
3.	HGI* Abrasion expected YGP Shale and sand stone content Feed coal size	45 to 55 Average 52 50 to 70 mg/kg 20% max. upto 50 mm.	51

* for SG design the belnded coal is the weighted average of the parent coal. For mill design HGI 45 shall be considered,

DOMESTIC COAL

Sr. No.	Particulars	Units	Parameters
A.	Proximate Analysis		
1.	Moisture	%	16.00
2.	Volatile Matter	%	19.00
3.	Ash	%	45.00
4.	Fixed carbon	%	20.00
	Total	%	100
B.	ULTIMATE ANALYSIS, % (As received)		
1.	Carbon	%	27.70
2.	Hydrogen	%	2.60
3.	Nitrogen	%	0.52
4.	Oxygen	%	7.26
5.	Sulphur	%	0.50
6.	Ash	%	45.00
7.	Moisture	%	16.00



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Sr. No.	Particulars	Units	Parameters
8.	Carbonates	%	0.38
9.	Phosphorous	%	0.04
10.	Others	%	-
	Total	%	100.00
C.	Ash fusion temperature	deg C	
1.	Initial deformation, IT	deg C	1100
2.	Spherical, ST	deg C	1200
3.	Hemispherical, HT	deg C	1300
4.	Fluid, FT	deg C	-
D.	Ash Analysis, %		
1.	SiO ₂	%	59.54
2.	Al ₂ O ₃	%	29.00
3.	Fe ₂ O ₃	%	6.42
4.	CaO	%	1.50
5.	Na ₂ O	%	0.08
6.	K ₂ O	%	-
7.	TiO ₂	%	1.60
8.	SO ₃	%	0.25
9.	P ₂ O ₅	%	0.51
10.	MgO	%	0.50
11.	Others	%	0.60
12.	Total		100.00
E	Resistivity of fly ash	Ohm - cm	1.73x 10 ¹²

IMPORTED COAL

Sr. No.	Particulars	Units	Parameters
A.	Proximate Analysis (As received)		
1.	Moisture	%	16.50
2.	Volatile Matter	%	36.45
3.	Ash	%	6.62
4.	Fixed carbon	%	40.43
5.	Total	%	100.00
B.	ULTIMATE ANALYSIS, % (As received)		
1.	Carbon	%	60.12
2.	Hydrogen	%	4.38
3.	Nitrogen	%	1.48
4.	Oxygen	%	10.37
5.	Sulphur	%	0.53
6.	Ash	%	6.62
7.	Moisture	%	16.5
8.	Carbonates	%	-
9.	Phosphorous	%	-
10.	Others	%	-
	Total	%	100.00
C.	Ash fusion temperature	deg C	
1.	Initial deformation, IT	deg C	1230
2.	Spherical, ST	deg C	1270



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Sr. No.	Particulars	Units	Parameters
3.	Hemispherical, HT	deg C	1320
4.	Fluid, FT	deg C	-
D.	Ash Analysis, %		
1.	Sio2	%	36.00
2.	Al 2 O3	%	13.90
3.	Fe2O3	%	14.80
4.	CaO	%	12.70
5.	Na2O	%	0.70
6.	K2O	%	1.70
7.	TiO2	%	0.80
8.	SO3	%	10.60
9.	P2O5	%	0.20
10.	MgO	%	8.60
11.	Others	%	-
12.	Total	%	100.00

The plant should be suitable to accept imported coal sourced from any country. The limiting parameters of imported coal are furnished below :

S. No.	Particulars	Unit	Parameter
1	Total Moisture (ARB)	%	Up to 23 (Max)
2	Ash (ADB)	%	Up to 20 (Max)
3	Gross Calorific Value (ADB)	Kcal / Kg	5800 - 6500
4	Sulphur (ADB)	%	Up to 1 (Max)
5	Fixed Carbon (ADB)	%	30-50
6	Volatile Matter (ADB)	%	25-45
7	HGI		45-60
8	IDT (Under Reducing Atmosphere)	Deg C	1100-1250
9	Size	Mm	< 50

Note: ADB stands for “As dried Basis” and ARB for “As Received Basis”

1.9.3

Specification of LDO

Specific gravity @ 15° C	0.8348
Gross calorific value, Kcal/kg	10400
Pour point “°C” max.	12
Flash point “°C” min.	66
Sulphur % “T” max.	0.5
K. Viscosity in Centistokes @ 50° C max.	7.5
Ash by wt. %	0.01
Water & sediment Vol. Max. %	0.25



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1.9.4 Specification of HFO

Flash point “°C” min.	66
K. Viscosity in Centistokes @ 50° C max.	370
Ash by wt. %	0.1
Water content by volume % max	1
Sediment by weight % max	0.25
Total Sulphur by weight % max	4.5
Gross calorific value, Kcal/kg	10800

1.9.5 Fuel Linkage

Coal is proposed to be imported from Indonesia or any other country and blended with domestic coal.

1.9.6 Fuel Transportation

The coal shall be received at Tuticorin port and transported by rail from there.

1.10 Source Of Water**1.10.1 Source**

The raw water intake shall be from Bay of Bengal.

1.10.2 Chemical analysis of Sea Water:

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



13.	Total hardness (as CaCO ₃)	8,155
14.	Permanent hardness (as CaCO ₃)	6,200
15.	Temporary hardness (as CaCO ₃)	1,955
16.	Calcium hardness (as CaCO ₃)	1,255
17.	Magnesium hardness (as CaCO ₃)	6,900
18.	P _H	8.2

1.10.3 Requirement

The requirement of water for the plant will be for meeting the requirement of make up for the re-circulating cooling water system, dust suppression system in coal handling plants, ash disposal system and the RO/ D.M. water plant which will be supplying the power cycle make up requirements, etc. In addition the water requirements will be for drinking and service purposes. Water requirement is estimated as approx. 18000 m³/hr.

1.11 Source of Equipment

The proposed plant will be supplied, erected and commissioned on EPC basis with BTG & BOP as separate packages..

1.12 Power Evacuation Plan

Power will be evacuated from the proposed thermal power station at 765 KV voltage level and fed to Tamil Nadu Transmission Corporation Limited (TANTRANSCO). The Karaikudi substation is about 40 KM north west of the plant.

1.13 Average Yearly Generation

The average yearly generation is calculated considering the following.

- The expected plant load factor is 85 %. With this PLF the average yearly generation will be around 11914 Million units.

1.14 INFORMATION FOR ENVIRONMENTAL APPRAISAL

1.0 GENERAL INFORMATION ABOUT THE PROJECT

- 1.1 Name / Title of the Project : 2 x 800 MW Supercritical Coal Based Uppur Thermal Power Project
- 1.2 Name of Owner : Tamilnadu Generation and Distribution Corporation (TANGEDCO)



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- 1.3 Location of the Project : Uppur, Valamavoor and Thiruppalaikudi Villages, Ramanathapuram District, Tamil Nadu
- 1.4 Capacity of the project under consideration : 2x 800MW
- 1.4.1 Govt. land / Private land / others : Land being acquired
- 1.45.2 Topographical feature, demographic profile & physiography : Refer Volume VI
- 1.5.3 Nature of soil : Clayey soil
- 1.5.4 Distance from the nearest town / city / major human settlements : Madurai – 140 KM
- 1.5.5 Population to be displaced : Nil
- 1.5.6 Distance from water source : Approx. 1 km
- 1.5.7 Area of forest land, if involved : Nil
- 1.5.8 Distance of forest from the site : N.A
- 1.6 Is this an extension? : No
If so indicate capacity of existing plant
- 1.7 What is the ultimate capacity envisaged : 2 x 800 MW
- 2.0 GENERAL ENVIRONMENTAL INFORMATION**
- 2.1 Area of the land proposed to be acquired : Refer Plot Plan Land already acquired
- i. Area required for plant : 900 Acres
- ii. Ash disposal : 100 % dry fly ash disposal and 100% wet bottom ash disposal is envisaged to existing ash pond.



- iii. Plant facilities : The area is adequate for locating all the required systems for 2x800 MW.
- 2.2 Area proposed to be built-up or developed : Power station will be built-up in the proposed site as indicated in the plot plan.
- 2.3 Specify site characteristics River basin/ estuarine / coastal / others : Site is adjacent to Bay of Bengal
- 2.4 Is the site situated in the forest area? Give following details : No
- 2.4.1 Area : N.A
- 2.4.2 Type of forests : N.A
- 2.5 Is site situated near to the forests? Give the distance from the site. : N.A.
- 2.6 Give a description of the flora within 25 km of your plant site under the following heads :
- a. Crops :
b. Forest :
c. Grass land :
d. Endangered species :
e. Others (Specify) :
- 2.6.2 Give details of the following features, if they exist, within a radius of 25 km of the proposed site? :
- i. Fisheries :
ii. Sanctuary / natural park biosphere reserve :
iii. Lakes / ponds / reservoir :
iv. Stream / river :
v. Estuary / sea : Bay of Bengal is 1 km from site
vi. Hills / mountains :
vii. Historic / cultural / tourist / archaeological scenic :
- Refer details in the specification elsewhere.



sites / defence
installations

2.7 Human settlement :

2.7.1 Total number of persons :
proposed to be employed

i. During construction : 2500

1200(0.75person/MW) TANGEDCO

ii. During operation : direct employees



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SECTION - I

SPECIFIC TECHNICAL REQUIREMENTS

SECTION I-A: SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)

SECTION I-B: SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)

SECTION I-C: SPECIFIC TECHNICAL REQUIREMENTS (C&I)

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SECTION - IA

SPECIFIC TECHNICAL REQUIREMENTS - MECHANICAL

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1. SCOPE:

Design (i.e. preparation and submission of drawing /documents including “As Built” drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection/ testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles (as applicable), fill of lubricants & consumables (excluding chemicals), mandatory spares along with spares for erection, start-up and commissioning as required, forwarding, proper packing, shipment and delivery at site for 2 x 800 MW UPPUR STPP (Stage-I, Unit 1 & 2) BTG Package Chemical Dosing System, complete with all accessories for the total scope as specified hereinafter for the following systems:-

- HYDRAZINE DOSING SYSTEM - 2 Nos. Skids.
- AMMONIA DOSING SYSTEM - 2 Nos. Skids.
- NaOH DOSING SYSTEM - 2 Nos. Skids.

2. DESIGN BASIS:

Customer specification.

The following drawings/ data sheets are enclosed for the reference:

- P&ID for Hydrazine dosing system.
- P&ID for Ammonia dosing system.
- P&ID for NaOH dosing system.
- DATA SHEET – A for all above systems.

3. SCOPE OF SERVICE

The bidder's scope also includes following services for scope under this specification:

- Design and engineering.
- Fabrication of the skid mounted chemical dosing system.
- Inspection and testing of the skid as per the approved quality assurance plan.
- Supply of the skid mounted chemical dosing system up to the power plant site along with all accessories as defined in the technical specification.
- Painting as per approved painting requirement to be finalized during detailed engineering. However the same shall be prepared in line with the painting requirement enclosed in ANNEXURE IV of technical specification.

4. DESIGN PHILOSOPHY

Chemical dosing systems are designed to dose required quantity of chemicals to maintain the quality of boiler feed water. Chemicals are dosed both in low pressure side of feed water cycle as well as in ECW system.

5. LOW PRESSURE CHEMICAL DOSING

The LP dosing consists of Hydrazine dosing system, ammonia dosing system for boiler feed water and NaOH dosing skids for ECW system. The details of each dosing system are given below:

4.1 HYDRAZINE DOSING SYSTEM: (TOTAL NO. OF SKIDS= 2 NOS.)

(Refer Drawing no. PE-DG-425-154-A001)

One number of Hydrazine Dosing System consists of the following:

- One number Hydrazine Measuring Tank.
- One number Hydrazine Mixing cum storage tank.
- Two (2 X 100%) Hydrazine Dosing Pumps.
- One number Hand Pump with flexible hose.
- Associated Piping, valves, fitting as indicated in the P&ID of hydrazine dosing system and data

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sheet-A enclosed and as required to make the system complete.

- f) Control & instrumentation as per P&ID of Hydrazine Dosing System, Data sheet-A, Section IIA, IC and IIC.

4.2 AMMONIA DOSING SYSTEM: (TOTAL NO. OF SKIDS= 2 NOS.)

(Refer Drawing no. PE-DG-425-154-A002)

One number of Ammonia Dosing System consists of the following:

- a) One number Ammonia Measuring Tank.
- b) One number Ammonia Mixing cum storage tank.
- c) Two (2 X 100%) Ammonia Dosing Pumps.
- d) One Hand Pump with flexible hose.
- e) Associated Piping, valves, fitting as indicated in the P&ID of Ammonia Dosing System and data sheet-A enclosed and as required to make the system complete.
- f) Control & instrumentation as per P&ID of Ammonia Dosing System, Data Sheet-A, Section IIA, IC and IIC.

4.3 NAOH DOSING SYSTEM FOR ECW SYSTEM: (TOTAL NO. OF SKID = 2 NOS)

(Refer Drawing. No. PE-DG-425-154-A003)

One number of NaOH Dosing System consists of the following:

- a) One number NaOH Mixing cum storage tank.
- b) Two (2 X 100%) NaOH Dosing Pumps.
- c) Associated Piping, valves, fitting as indicated in the P&ID of NaOH dosing system and data sheet-A enclosed and as required to make the system complete.
- d) Control & instrumentation as per P&ID of NaOH Dosing System, Data Sheet-A, Section IIA, IC and IIC.

6. CIVIL SCOPE

Nil.

7. TERMINAL POINTS (also refer P&I Diagrams enclosed)

- a) All piping beyond battery limit of skid as indicated in P&ID's enclosed with the technical specification is excluded from bidder's scope.
- b) Electrical scope shall be as per Std. Electrical Scope Matrix attached in Section IB of the technical specification.
- c) All drains shall be brought at one point on the skid by the bidder via a drain header and further connection to the nearest plant drain shall be done by BHEL/ Customer.
- d) Counter flanges for all the piping terminal points (as per P&IDs) and for the terminal point of drain header shall be in bidder's scope.

8. QP AND SUB VENDOR APPROVAL

- 8.1 The quality assurance plan is enclosed elsewhere in technical specification. However requirement of detailed QP, inspection checklist, certificate of conformance etc. for each equipment and sub-vendor shall be finalized during detailed engineering stage; decision of BHEL/ customer shall be binding on vendor in this regard. Any changes/ additional tests insisted upon by Owner during approval of QAP's shall be accepted by bidder without any commercial and delivery implication to BHEL/ Customer. Bidder shall submit the quality plans in BHEL format during detailed engineering stage. Bidder to note further that during detailed engineering all the QAP's/ check lists etc. shall be submitted to Customer/ BHEL for approval. All inspection & testing etc. shall be carried out accordingly.
- 8.2 The sub vendor list (Annexure- II) enclosed is indicative only and is subject to approval/ acceptance by customer. Bidder to propose his sub vendor list with back up documents (experience list, end

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user performance certificate as applicable) etc. The same shall subject to BHEL and Customer approval during detailed engineering stage without any commercial & delivery implication to BHEL/ Customer.

9. DOCUMENTS TO BE SUBMITTED BY BIDDER ALONG WITH THE BID

BIDDER SHOULD SUBMIT THE SIGNED AND STAMPED COPY OF THE FOLLOWING DOCUMENTS:

- Deviation, if any in the enclosed Schedule of deviation with cost of withdrawal only with mention of specification clause for which deviation is being asked. (Stamped & Signed).
- Declaration and Compliance certificate (stamped & signed).
- Un-priced Schedule duly filled in (stamped & signed).
- List of Recommended spares, if any (stamped & signed).

Bidder to note that if bidder has taken any deviation from the technical specification requirements, the same shall be clearly mentioned in the bid in the BHEL prescribed format of Schedule of Deviations attached as Section - III of this technical specification.

In case of no deviation, Bidder to furnish signed and stamped copy of "Schedule of Deviations with cost of withdrawal" stating "**No Deviation**". No other technical document is required along with bidder's offer. Any other document submitted by bidder shall not be evaluated by BHEL and shall be considered as withdrawn. Bidder to note that any un-declared deviation mentioned in bidder offer other than specified in the scheduled of Deviations shall be considered as null and void.

10. DRAWING/ DOCUMENTS REQUIREMENT

For the drawings/ documents submission schedule, please refer ANNEXURE-III.

For the drawings/ documents submission procedure, please refer ANNEXURE-VII. The bidder has to submit the revised drawing/ document along with the compliance sheet indicating enumerate reply to all BHEL and customer comments or observations. Without compliance sheet the submission of the drawings/ documents will not be considered and the delay on this account will be solely on bidder's side only. Bidder to comply with the observations of the BHEL and CUSTOMER without price & delivery implication.

11. SPARES

- All the spares for the equipment under the contract provided by the vendor will strictly conform to the specifications and documents and will be identical to the corresponding main equipment/ components supplied under the contract.
- The quality plan and the inspection requirement finalized for the main equipment will also be applicable to the corresponding spares.

12. MANDATORY SPARES

- The list of mandatory spares considered essential by the BHEL & Customer is indicated in Annexure- V.
- All mandatory spares shall be delivered at site at least two months before scheduled date of initial operation of the first unit. However, spares shall not be dispatched before dispatch of corresponding main equipment.
- Wherever quantity has been specified as percentage (%), it shall mean percentage (%) of the total population of the item in the station (project), **unless specified otherwise** and the fraction will be rounded off to the next higher whole number.
- Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until & unless specified otherwise.
- The spares shall be treated and packed for a long storage under the climatic condition prevailing at site.

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- f) Each spare part shall be clearly marked and labelled on the outside of the packing with its description. When more than one spare part is packed in a single case, a general description of the content shall be shown on the outside of such case and a detailed list enclosed. All cases, containers, and other packages must be suitably marked and numbered for the purpose of identification.
- g) The Bidder shall note that if there is any change/ variation in equipment/ system during detail engineering which causes any change/ variation in the essential spares quantity, the same shall be supplied without any commercial implications. The price indicated for the mandatory spares shall be considered for the purpose of evaluation.

13. START-UP AND COMMISSIONING SPARES

Start-up and Commissioning spares are those which would be required during equipment or system testing, start up and commissioning. All spares used until the plant is finally handed over by the bidder to the Customer come under this category. All start-up and commissioning spares as required shall be provided by the bidder without any additional cost to the BHEL and Customer. The list of minimum start-up and commissioning spares are attached in Annexure-VI. However bidder to provide additional spares as per their system requirement without any commercial and delivery implication to BHEL/ customer during detailed engineering List of spares shall be furnished by BIDDER along with the offer.

Bidder shall be responsible for the ready and timely availability for all the start-up and commissioning spares as required during various stages of testing, cleaning and commissioning up to handing over of each unit of the total plant.

An adequate stock of start-up spares shall be available at the site such that the start-up and commissioning of the equipment/systems, Performance guarantee test and handing over the equipment/ systems to the Customer will be carried out without hindrance and delay. All start-up spares which remain unused after the taking over of the plant shall remain the property of the Customer.

14. SPECIAL TOOLS AND TACKLES

- a) One set of all special tools shall be furnished and shipped with each piece of equipment for dismantling, maintenance, adjustment, and calibration of the equipment. The tools shall be shipped in separate heavily constructed wooden boxes provided with hinged covers and padlock hasps.
- b) The Contractor shall supply under this contract all maintenance tools for each piece of equipment/ system and it shall be boxed separately and the boxes shall be appropriately marked for shipment and identification of contents.
- c) A weather-proof itemized list of the contents shall also be attached to the outside of each container.
- d) The maintenance tools shall include all special handling rigs, bars, slings, cable and all specialized equipment for control system maintenance such as extender boards, scopes, and all software and hardware. Further, Bidder shall also include a full set of regular maintenance tools and tackles required. Bidder shall also include all maintenance tools and tackles in their scope. Total price of all the maintenance tools and tackles shall be included in the quoted lump sum price.

15. PACKING

To prevent damage to any equipment/ item of the skid during transit, wooden/ angle iron/ steel frame supports to be provided wherever required. Special attention shall be provided while packing and loading for overhead equipment.

THE ACTUATOR OF THE PUMP SHALL BE PACKED IN AIR TIGHT PACKING ALONG WITH THE PUMP IN INSTALLED CONDITION FOR PREVENTING DAMAGE OF ACTUATOR.

Bidder shall submit the packing details during detailed engineering for approval. Any changes required in packing details shall be complied by the bidder without any price and delivery implication.

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16. PAINTING

Bidder to note that painting shall be as per approved painting schedule to be finalized during detailed engineering. However the same shall be prepared in line with the schedule enclosed in Section IA/ Annexure-IV.

17. DESIGN REQUIREMENTS

Bidder to note that design requirement of the chemical dosing skids shall be as below: -

- In addition to the requirements of Section-I & II the following shall also be complied under scope of this specification: The P&ID is enclosed herein in this section for bidder's compliance.
- The material of construction specified in Data Sheet-A are minimum requirements and material of construction for other components not specified shall be similarly selected by the bidder for intended duty which shall be subjects to Customer/ BHEL approval during detailed engineering.
- All instrument-wetted parts will be suitable for requested application.
- All high points on any, tanks, pumps, piping or instrumentation will be vented and provided with valve. All low points on any, tanks, pumps, piping or instruments will be drained and provided with valve.
- 5 mm (min.) thick IS 2062 Checker plate shall be provided covering the skid frame and for elevated platform for the preparation/ measuring tank, wherever applicable. The tanks supports, pumps and pipe supports and LCP/ LCP supports shall be welded to the checker plate.
- Stuffing box shall be provided for mounting the agitator to avoid air ingress.
- Vent/ overflow pipe from tank shall at least reach the bottom half of the breather/ water seal/ CO₂ absorber.
- SS pad shall be provided for welding MS structural supports to SS tanks.
- Step ladder and chemical charging platform shall be provided for easy access to top of tank.
- All the terminal points shall be easily accessible and towards one side of skid.
- All valves shall be easily accessible for the operator.
- All tanks/ pumps shall have name plate clearly indicating the equipment name.
- Pipe fittings of the system shall be done using elbows and tees. Pipe bending is not acceptable.
- All equipment shall have SS name plate.
- All LCP shall be mounted in their respective dosing skids only.
- Energy efficient level IE3 LT Motors shall be provided by the bidder.
- All the terminal points where flange joints are involved, bidder shall terminate it along with matching counter flange, nuts, bolts, gaskets etc.
- KKS codes for all drives and instruments for the project have to be followed.
- All the instruments/ equipment/ electrical items shall be provided & designed with maximum star rating as available in line with energy conservation policies notified by BEE, GOI at the time of supply.

18. ELECTRICAL LOAD DATA

Bidder has to comply with following electrical load data for Chemical Dosing System:-

S. No.	Load title	Max. Cont. Demand (kW)	Working	Standby	Voltage	Feeder
1.	Hydrazine Motorised Barrel Pump	< 1	1	0	415 V	Unidirectional
2.	Hydrazine Dosing Pump	0.75	1	1	415 V	Unidirectional
3.	Hydrazine Mixing Tank Stirrer	0.75	1	0	415 V	Unidirectional
4.	Hydrazine Dosing System LCP	2.0	1	0	415 V	Supply
5.	Ammonia Motorised Barrel Pump	< 1	1	0	415 V	Unidirectional
6.	Ammonia Dosing Pump	0.75	1	1	415 V	Unidirectional
7.	Ammonia Mixing Tank Stirrer	0.75	1	0	415 V	Unidirectional
8.	Ammonia Dosing System LCP	2.0	1	0	415 V	Supply
9.	NaOH Dosing Pump	0.37	1	1	415 V	Unidirectional
10.	NaOH Tank Stirrer	0.37	1	0	415 V	Unidirectional
11.	NaOH Dosing System LCP	1.0	1	0	415 V	Supply

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19. MISCELLANEOUS REQUIREMENTS

- a) Initial charge of all lubricants & grease.
- b) All special tools necessary for proper maintenance or adjustment of the equipment packaged in permanent box.
- c) Finish paints for touch-up painting of equipment after erection at site in sealed container.
- d) All the first fill and one Year's topping requirements or 10 % of first fill quantity, whichever is more of consumable such as greases, oil, lubricants, servo fluids/ control fluids, gases and etc. which will be required to put the equipment covered under the scope of specifications, into successful commissioning / initial operation and to establish completion of facilities shall be furnished by the bidder. Suitable standard lubricants as available in India are desired. Efforts should be made to limit the variety of lubricants to minimum.
- e) Document approval by Customer/ BHEL under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval.
- f) Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to Customer and BHEL for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.
- g) In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion. However, in case changes are necessitated due to any constraints at Customer/BHEL end, delay in review/ approval of drawing beyond one month will be to Customer/BHEL account.
- h) Final Electrical Load list will be submitted by the successful bidder as per agreed drawing/ doc submission schedule. Thereafter any change in the electrical load list shall be entertained only subject to its feasibility, and BHEL reserves the right to debit the vendor cost of any changes necessitated in the BHEL's switch gear /MCC on account of changed loads.
- i) Wherever CIVIL works is excluded from the bidder's scope, successful bidder shall furnish civil assignment / scope drawings. The corresponding CIVIL drawing prepared by BHEL / CIVIL agency, based on civil assignment drawing of bidder will be furnished to the successful bidder for concurrence. In case any modification is required in the civil work already carried out based on final civil inputs given by vendor, BHEL reserves the right to debit cost of such rework to vendor".
- j) Bidder to submit BBU during detailed engineering after approval of Basic documents. BBU shall be equal to BOQ for the package and there shall be no price and delivery implication is applicable to BHEL / CUSTOMER for the same. None of the items supplied for the project as non-billable. Incomplete BBU shall not be reviewed by BHEL.
- k) Training of plant Owner's personnel, O&M operators' personnel on plant operation and maintenance.
- l) Relevant requirements as per GTR, GCC, ECC & SCC. Any statutory requirement / clearance required for the packages from government / local body shall be in bidder's scope.
- m) In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.
- n) Vendor to attend regular engineering meeting with BHEL and Customer fortnightly in BHEL or Customer office as decided during detail engineering. Vendor will depute his entire concerned engineering representatives along with the project manager for discussion and approval. Meeting can be held at site also.
- o) Latest version of all codes and standards to be followed.
- p) For detailed dispatch instructions, Bidder to refer special condition of contract (SCC) of the project.

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ANNEXURES

- ANNEXURE I: QUALITY PLAN
- ANNEXURE II: SUB VENDORS LIST
- ANNEXURE III: DRAWING DOCUMENTS DISTRIBUTION PROCEDURE
- ANNEXURE IV: PAINTING SPECIFICATION
- ANNEXURE V: MANDATORY SPARES LIST
- ANNEXURE VI: LIST OF ERECTION & COMMISSIONING SPARES
- ANNEXURE VII: DRAWING/ DOCUMENTS SUBMISSION SCHEDULE
- ANNEXURE VIII: FORMAT FOR OPERATION AND MAINTENANCE MANUAL

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	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	SUB SECTION - I A
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ANNEXURE I: QUALITY PLAN

ANNEXURE-I

		MANUFACTURER'S NAME & ADDRESS :		QUALITY PLAN				PROJECT		2 X 800 MW UPPUR STPP STAGE-I		
				ITEM: CHEMICAL DOSING SYSTEM SUB - SYSTEM : CHEMICAL DOSING SYSTEM		QP.NO : REV. : 0 DATE : PAGE : 1 OF 4		PACKAGE CONTRACT NO. MAIN SUPPLIER		CHEMICAL DOSING SYSTEM BHEL/PEM, NOIDA		
S.NO.	COMPONENTS/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/ METHOD CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY**			REMARKS
1	2	3	4	5	6	7	8	9	M	B	R	11
1.0	WELDER'S QUALIFICATION											
1.1	WELDING PROCEDURE SPECIFICATION (WPS)	CORRECTNESS	MA	SCRUTINY	100%	ASME IX	ASME IX	QW 482	P	V	V	
1.2	WELDER PERFORMANCE & PROCEDURE QUALIFICATION RECORD	WELD SOUNDNESS & WELDING PERFORMANCE	MA	PHYSICAL TEST	ASME IX	ASME IX	ASME IX	QW 483 & QW 484	P	V	V	
2.0	TANKS											
2.1	RAW MATERIAL :											
2.1.1	PLATE	CHEMICAL & PHY. PROPERTIES	MA	CHEM & PHY TEST	1/PLATE/HT BATCH	ASTM A 240 GR.TP 304	ASTM A 240 GR.TP 304	MFG.TC/LAB REPORT	P	V	V	IDENTIFICATION BY BHEL
		IGC TEST	MI	IGC TEST	1/PLATE/HT BATCH	ASTM A 262 PR.'E'	ASTM A 262 PR.'E'					
2.1.2	PIPE FOR NOZZLE	CHEMICAL & PHY. PROPERTIES	MA	CHEM & PHY TEST	1/HT BATCH/SIZE	ASTM A 312 GR.TP 304	ASTM A 312 GR.TP 304	MFG.TC/LAB REPORT	P	V	V	
		MICRO STRUCTURE	MI	GRAIN STRUCTURE	1/HT BATCH/SIZE	FOR HEAT TREATMENT	FOR HEAT TREATMENT	MFG.TC/LAB REPORT	P	V	V	
		IGC TEST	MI	IGC TEST	1/HT BATCH/SIZE	ASTM A 262 PR.'E'	ASTM A 262 PR.'E'	MFG.TC/LAB REPORT	P	V	V	
		HYDRO TEST	NA	LEAKAGE	100%	NO LEAKAGE	NO LEAKAGE	MFG. TC/IR	P	V/W	V	REFER NOTE 4
2.1.3	FLANGES FOR TANKS	CHEMICAL & PHY PROPERTIES	MA	CHEM & PHY TEST	1/HT BATCH	ASTM A 182 GR. F 304	ASTM A 182 GR. F 304	MFG.TC/LAB REPORT	P	V	V	
2.2	IN PROCESS											
2.2.1	DISHED ENDS	DIMENSIONS	MA	MEASUREMENT WITH TEMPLATE	100%	APPD.DWG.(BY BHEL)	APPD.DWG.(BY BHEL)	MFG.TC./LAB REPORT	P	V	V	
		SURFACE DEFECTS ON WELDMENTS		DP TEST	100%	ASTM E 165	NO SURFACE DEFECTS	MFG.TC	P	V	V	
2.3	FINAL ASSEMBLY FOR TANKS:	DIMENSIONS &	MA	MEASUREMENT	100%	APPD.DWG.(BY BHEL)	APPD.DWG.(BY BHEL)	MFG.TC/INSP REPORT	P	W	W	TO BE OFFERED ALONG WITH
		ORIENTATION	MA	VISUAL		APPD.DWG.(BY BHEL)	APPD.DWG.(BY BHEL)	MFG.TC/INSP REPORT	P	W	W	FINAL SKID ASSEMBLY
2.3.1		LEAKAGE	MA	WATER FILL FOR 2 HR	100%	N.A.	NO LEAKAGE	MFG.TC/INSP. REPORT	P	W	W	INSPECTION.
3.0	STIRRER :											
3.1	RAW MATERIAL FOR SHAFT	CHEM.& PHY. PROPERTIES	MA	CHEM & PHY TEST	1/BAR	ASTM A 479 GR.TP 304	ASTM A 479 GR.TP 304	MFG.TC/LAB REPORT	P	V	V	
		IGC TEST	MA	IGC TEST	1/HT BATCH	ASTM A 262 PR.'E'	ASTM A 262 PR.'E'	MFG.TC/LAB REPORT				
3.2	IMPELLER	CHEMICAL PROP.	MA	CHEMICAL TEST	1/PLATE	ASTM A 240 GR.TP 316	ASTM A 240 GR.TP 316	MFG.TC/LAB REPORT	P	V	V	
3.3	COMPLETE STIRRER UNIT WITH MOTOR	PERFORMANCE IN WATER FILLED TANK										
		- VIBRATION	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	
		- WOBBLING	MA	VISUAL	100%	NO WOBBLING	NO WOBBLING	MFG.TC	P	V	V	
		- POWER CONSUMPTION/ CURRENT DRAWN	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	
4.0	MOTORS:	ROUTINE TEST	MA	MFG. TC	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	
		TYPE TEST	MA	MFG. TC	1/ SIMILAR FRAME SIZE	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	
		DEGREE OF PROTECTION	MA	MFG. TC	1/ SIMILAR FRAME SIZE	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	
				** LEGEND : M : MANUFACUTRER/SUB-CONTRACTOR/SUB-VENDOR B : BHEL/ NOMINATED INSPECTION AGENCY "P" PERFORM, "W" WITNESS, AND "V" VERIFICATION								
MANUFACTURER/ SUB CONTRACTOR		MAIN SUPPLIER--BHEL		R: CUSTOMER								
SIGNATURE										SIGNATURE OF APPROVAL BY CUSTOMER		

THIS IS A PART OF TECHNICAL SPECIFICATION PE-TS-425-154-A001

ANNEXURE-I

		MANUFACTURER'S NAME & ADDRESS :		QUALITY PLAN ITEM: CHEMICAL DOSING SYSTEM SUB - SYSTEM : CHEMICAL DOSING SYSTEM				PROJECT : 2 X 800 MW UPPER STPP STAGE-I		REMARKS			
								PACKAGE CONTRACT NO. : CHEMICAL DOSING SYSTEM					
				QP.NO : REV. : 0 DATE :		PAGE : 2 OF 4		MAIN SUPPLIER : BHEL/PEM, NOIDA					
S.NO.	COMPONENTS/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/ METHOD CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY**				
1	2	3	4	5	6	7	8	9	M	B	R		
5.0	METERING PUMP:												
5.1	RAW MATERIAL :												
5.1.1	WETTED PARTS	CHEM & PHY. PROPERTIES	MA	CHEM. & PHY. TEST	1/BAR	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC/LAB REPORT	P	V	V		
		SURFACE TEST	MI	UT ON BAR>25 MM DIA	100%	ASTM A 388	REF. NOTE # 1	MFG.TC/LAB REPORT	P	V	V		
				DP ON M/C SURFACE	100%	ASME - E - 165	NO SURFACE DEFECTS	MFG.TC/LAB REPORT	P	V	V		
5.2	FINAL INSPECTION												
5.2.1	PUMP WITH MOTOR	LINEARITY	MA	PERFORMANCE	100%	API 675	API 675	INSPECTION REPORT	P	W	V		
		STEADY STATE ACCURACY	MA	SHOP TEST	100%	API 675	API 675	INSPECTION REPORT	P	W	V		
		REPEATABILITY	MA	SHOP TEST	100%	API 675	API 675	INSPECTION REPORT	P	W	V		
		POWER DRAWN @ 100% STROKE	MA	MEASURED AT WORK	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	INSPECTION REPORT	P	W	V		
		LEAKAGE	MA	HYDRO TEST	100%	@1.5X DESIGN PRESSURE	NO LEAKAGE	INSPECTION REPORT	P	W	V		
		DIMENSIONS	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	V		
		NOISE	MA	MEASUREMENT	100%	--	< 85 dbA AT 1 M RADIUS	INSPECTION REPORT	P	W	V		
		VIBRATION	MA	MEASUREMENT	100%	--	≤45 MICRONS (PEAK TO PEAK)	INSPECTION REPORT	P	W	V		
7.0	PRESSURE RELIEF VALVE	SET & RESET PRESSURE.	MA	PERFORMANCE	100%	BHEL APPD.DATA SHEET & API RP-520	BHEL APPD.DATA SHEET & API RP-520	MFG. TC	P	V	V		
		DIMENSIONS	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	MFG. TC	P	V	V		
		LEAKAGE DURING PERFORMANCE TEST	MA	VISUAL	100%	NO LEAKAGE	NO LEAKAGE	MFG. TC	P	V	V		
8	VALVES (GATE, GLOBE & NRV)												
8.1	RAW MATERIAL :												
8.1.1	BODY, BONNET COVER	CHEM. & PHY PROPERTIES	MA	CHEM. & PHY TEST	1/HT BATCH	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG. TC/LAB REPORT	P	V	V		
		HEAT TREATMENT	MA	HEAT TREATMENT	1/HT BATCH	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG. TC/LAB REPORT	P	V	V		
8.1.2	TRIM MATERIAL	CHEM. & PHY PROPERTIES	MA	CHEM. & PHY TEST	1/BAR/SIZE	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG. TC/LAB REPORT	P	V	V		
8.2	ASSEMBLY												
		LEAKAGE (BODY & SEAT)		HYDRO TEST	100%	BHEL APPD.DATA SHEET	NO LEAKAGE	MFG TC	P	V	V		
		LEAKAGE (SEAT)		PNEUMATIC TEST	100%	BHEL APPD.DATA SHEET	NO LEAKAGE	MFG TC	P	V	V		
		DIMENSIONS		MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	MFG TC	P	V	V		
		** LEGEND : M : MANUFACTURER/SUB-CONTRACTOR/SUB-VENDOR B : BHEL/NOMINATED INSPECTION AGENCY "P" PERFORM, "W" WITNESS, AND "V" VERIFICATION											
MANUFACTURER/ SUB CONTRACTOR		MAIN SUPPLIER--BHEL		R: CUSTOMER									
SIGNATURE						SIGNATURE OF APPROVAL BY CUSTOMER							
THIS IS A PART OF TECHNICAL SPECIFICATION PE-TS-425-154-A001													

ANNEXURE-I

		MANUFACTURER'S NAME & ADDRESS :		QUALITY PLAN				PROJECT 2 X 800 MW UPPUR STPP STAGE-I				
				ITEM: CHEMICAL DOSING SYSTEM		QP.NO : 0		PACKAGE CHEMICAL DOSING SYSTEM				
				SUB - SYSTEM :		REV. :		CONTRACT NO.				
				CHEMICAL DOSING SYSTEM		DATE :		MAIN SUPPLIER BHEL/PEM, NOIDA				
				PAGE : 3 OF 4								
S.NO	COMPONENTS/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/ METHOD CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY**			
1	2	3	4	5	6	7	8	9	M	B	R	11
9.0	FITTING/FLANGES FOR PIPING:											
9.1	RAW MATERIAL	CHEM.& PHY PRPERTIES	MA	CHEM. & PHY TEST	1/HT BATCH	ASTM A 182 GR.TP 304	ASTM A 182 GR.TP 304	MFG.TC/LAB REPORT	P	V	V	
		HEAT TREATMENT	MA	HEAT TREATMENT	100%	ASTM A 182 GR.TP 304	ASTM A 182 GR.TP 304	MFG.TC/LAB REPORT	P	V	V	
		IGC TEST	MI	IGC TEST	1/HT BATCH	ASTM A 262 PR. 'E'	ASTM A 262 PR. 'E'	MFG.TC/LAB REPORT	P	V	V	
9.2	FINAL INSPECTION	DIMENSIONS	NA	MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG/ ANSI B 16.11/16.5	BHEL APPD.DATA SHEET/DWG/ ANSI B 16.11/16.5	MFG.TC	P	V	V	
10.0	STRAINERS :											
10.1	RAW MATERIAL FOR BODY	PHY. & CHEM. PROPERTIES	MA	PHY. & CHEM.TEST	1/BAR/SIZE	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TCLAB REPORT	P	V	V	
10.2	SCREEN	CHEMICAL	MA	CHEMICAL	1/SIZE	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC/LAB REPORT	P	V	V	
		MESH SIZE	MA	MEASUREMENT	1/SIZE	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC/LAB REPORT	P	V	V	
10.3	FINAL INSPECTION	DIMENSIONS	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	
		LEAKAGE		HYDRO TEST	1	BHEL APPD.DATA SHEET	NO LEAKAGE	MFG.TC	P	V	V	
11.0	PIPE (SEAMLESS)											
11.1	MATERIAL	CHEMICAL	MA	CHEMICAL	1/HT BATCH/SIZE	ASTM A 312 GR.TP 304	ASTM A 312 GR.TP 304	MFG.TC/LAB REPORT	P	V	V	
		MECHANICAL TEST	MA	MECHANICAL TEST	1/HT BATCH/SIZE	ASTM A 312 GR.TP 304	ASTM A 312 GR.TP 304	MFG.TC/LAB REPORT	P	V	V	
		MICRO STRUCTURE	MI	GRAINS STRUCTURE	1/HT BATCH/SIZE	FOR HEAT TREATMENT	FOR HEAT TREATMENT	MFG.TC/LAB REPORT	P	V	V	
		IGC TEST	MI	IGC TEST	1/HT BATCH/SIZE	ASTM A 262 PR 'E'	ASTM A 262 PR 'E'	MFG.TC/LAB REPORT	P	V	V	
		HYDRO TEST	MA	LEAKAGE	100%	NO LEAKAGE	NO LEAKAGE	MFG.TC/IR	P	V/W	V	
12.0	LEVEL GAUGE :											
12.1	RAW MATERIAL	CHEM.PROPERTIES	MA	CHEM.TEST	1/HT BATCH	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC/LAB REPORT	P	V	V	
12.2	FINAL INSPECTION	DIMENSION	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	
		LEAKAGE	MA	HYDRO TEST	100%	BHEL APPD.DATA SHEET	NO LEAKAGE	MFG.TC	P	V	V	
13.0	PRESSURE & DP GAUGE											
13.1	MAT. FOR WETTED PARTS & BOURN	CHEM.PROPERTIES	MA	CHEM.TEST	1/HT BATCH	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC/LAB REPORT	P	V	V	
13.2	FINAL INSPECTION	DIMENSIONS	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	MFG.TC/LAB REPORT				
13.3	PERFORMANCE	ACCURACY & OVERLOAD PROTECTION	MA	CALIBRATION	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG. TC	P	V	V	
14.0	SWITCHES(LEVEL, PRESURE & DP) & TRANSMITTERS (LEVEL, PRESSURE & DP):											
14.1	MAT. FOR WETTED PARTS	CHEM.PROPERTIES	MA	CHEM.TEST	1/HT BATCH	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC/LAB REPORT	P	V	V	
14.2	PERFORMANCE	FUNCTIONAL	MA	CALIBRATION & VISUAL	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	
		IR-HV-IR		ELECTRICAL	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	
		DIMENSIONS		MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	MFG.TC	P	V	V	
		DEGREE OF PROTECTION	MI	VERIFICATION OF TYPE TEST CERT	TYPE TEST	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC/LAB REPORT	P	V	V	
				** LEGEND : M : MANUFACUTRER/SUB-CONTRACTOR/SUB-VENDOR B : BHEL/NOMINATED INSPECTION AGENCY "P" PERFORM, "W" WITNESS, AND "V" VERIFICATION								
MANUFACTURER/ SUB CONTRACTOR		MAIN SUPPLIER--BHEL		R: CUSTOMER								
SIGNATURE								SIGNATURE OF APPROVAL BY CUSTOMER				
THIS IS A PART OF TECHNICAL SPECIFICATION PE-TS-425-154-A001												

ANNEXURE-I

		MANUFACTURER'S NAME & ADDRESS :		QUALITY PLAN				PROJECT				
				ITEM: CHEMICAL DOSING SYSTEM REV. : 0 DATE : Q.P.NO : PAGE : 4 OF 4				PACKAGE CONTRACT NO. CHEMICAL DOSING SYSTEM MAIN SUPPLIER BHEL/PEM, NOIDA				
S.NO.	COMPONENTS/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/ METHOD CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY**			REMARKS
1	2	3	4	5	6	7	8	9	M	B	R	11
15.0	CONTROL PANEL :	DIMENSIONS	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	CONTOL PANEL TEST TO BE OFFERED ALONG WITH FINAL SKID ASSEMBLY.
		CONTINUITY, IR-HV-IR	MA	ELECTRICAL	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
		VERIFICATION OF MAKE	MA		100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
		RATING OF COMPONENTS	MA		100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
		PAINT SHADES, THICKNESS	MA		100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
		ADHESION	MA		100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
		DEGREE OF PROTECTION	MI	VERIFICATION OF TYPE TEST CERTIFICATE	TYPE TEST	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	MFG.TC/LAB REPORT	P	V	W	
16.0	COMPLETE SKID ASSEMBLY:	DIMENSIONS & ORIENTATION	CR	MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
		LEAKAGE, CHECK ON WELDMENTS		VISUAL & HYDRO TEST	100%	DISCH.PIPING - 1.5 x DISCH PR. OF PUMP	NO LEAKAGE	INSPECTION REPORT	P	W	W	
		FUNCTIONAL TEST FOR INTERLOCKS	MA	VISUAL	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
	PMI Test for SS	GRADE CONFIRMATION	MA	CHEM.TEST	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
		PAINTING	MA	VISUAL & MEASUREMENT	100%	BHEL APPD PAINTING SCHEME	APPD DWG/PAINTING	INSPECTION REPORT	P	W	W	
NOTE-1) WHEN BACK WALL ECHO IS SET TO 100% OF FSH IN SOUND AREA, DEFECT ECHO SHALL NOT EXCEED 20% OF FSH. MAX BACH WALL ECHO IS 20% OF FSH. TOTAL NO OF DEFECTS SHALL BE MAX. 5 NO IN ONE METER LENGTH. MIN DISTANCE BETWEEN TWO DEFECTS SHALL BE 3 TIMES THE DIA OF BAR.												
NOTE-2) CHEMICAL DOSING SKID VENDOR SHALL BE SELECTED FROM CUSTOMER APPROVED SOURCES. ALL THE BOUGHT OUT ITEMS OF THE CHEMICAL DOSING VENDOR SHALL BE PROCURED FROM BHEL APPROVED SOURCES.												
NOTE- 3) ALL VENDOR DRAWINGS/DATASHEETS SHALL BE APPROVED BY BHEL. ONLY MANUFACTURING QP(PREPARED IN LINE WITH THIS STANDARD QP) OF THE VENDOR SHALL BE FORWARDED FOR CUSTOMER APPROVAL. ALL THE BHEL APPROVED DOCUMENTS SHALL BE FURNISHED TO CUSTOMER FOR INFORMATION/RECORDS ALONG WITH O&M MANUAL. COPY OF THE SAME SHALL ALSO BE FURNISHED TO INSPECTION AGENCY DURING INSPECTION.												
NOTE 4) FOR PIPES PURCHASED DIRECTLY FROM MANUFACTURER'S OR AUTHORIZED DEALERS, APART FROM TC REVIEW, CHECK WILL BE AS PER CLAUSE 2.1.2 AND 10.0; HOWEVER FOR HYDRAULIC TEST, MANUFACTURER TC SHALL BE REVIEWED . IN CASE ON IMPORTED PIPES PURCHASED FROM OPEN MARKET, TEST SHALL BE PERFORMED AS PER CLAUSE 2.1.2 AND 10.0 (INCLUDING HYDRAULIC TEST).												
NOTE 5) FOR RAW MATERIAL (BARS/PIPES/CASTINGS/FORGINGS) WHERE HEAT TREATMENT ARE CARRIED OUT BY MATERIAL PRODUCERS ON BULK QUANTITIES, THEIR TEST CERTIFICATE SHALL BE REVIEWED (EXCEPT TIME TEMPERATURE CHART)												
NOTE 6) NDT REQUIREMENT ON WELDING (TANK, PIPE, BREATHER/WATER SEAL/CO2 ABSORBER) SHALL BE AS -- A) ON BUTT WELD-- 25% DP & 25% RT FOR PUMP SUCTION SIDE & 100% DP & 100% RT FOR PUMP DISCHARGE SIDE. B) ON FILLET WELD--100% DP TEST												
		** LEGEND :										
MANUFACTURER/ SUB CONTRACTOR		MAIN SUPPLIER--BHEL		M : MANUFACUTRER/SUB-CONTRACTOR/SUB-VENDOR B : BHEL/NOMINATED INSPECTION AGENCY R: CUSTOMER								
SIGNATURE				"P" PERFORM, "W" WITNESS, AND "V" VERIFICATION				SIGNATURE OF APPROVAL BY CUSTOMER				
THIS IS A PART OF TECHNICAL SPECIFICATION PE-TS-425-154-A001												

	TITLE: 2 X 800 MW UPPUR STPP (STAGE-I, UNIT 1 & 2) BTG PACKAGE	SPECIFICATION NO. PE-TS-425-154-A001
		SECTION I
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	SUB SECTION - I A
		REV.NO. 0 DATE : 15.11.2017

ANNEXURE II: SUB VENDORS LIST

	TITLE:	SPECIFICATION NO. PE-TS-425-154-A001
	2 X 800 MW UPPUR STPP (STAGE-I, UNIT 1 & 2) BTG PACKAGE	SECTION I
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SUB VENDOR LIST - MECHANICAL

	TITLE:	SPECIFICATION NO. PE-TS-425-154-A001
	2 X 800 MW UPPUR STPP (STAGE-I, UNIT 1 & 2) BTG PACKAGE	SECTION I
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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
1.	TANKS/DISSOLVING BASKETS/WATER SEAL/CO2 ABSORBER/BREATHING	SELF MAKE OF MAIN VENDOR		
2.	METERING PUMPS	VK PUMPS	NASIK	
		MILTON ROY INDIA	CHENNAI	
		SWELLORE	AHMEDABAD	
		POSITIVE METERING PUMPS	NASIK	
		METACHEM	MUMBAI	
3.	AGITATOR	REMI PEOCESS PLANT & M/C	MUMBAI	
		FIBRE & FIBRE	MUMBAI / SILVASA	
		CEECONS	CHENNAI	
		STANDARD ENGINEERS	MUMBAI	
4.	BALL VALVE (MANUAL /PNEUMATIC/ ELECTRIC) CLASS 150	A.V. VALVES LTD	AGRA	
		AKAY INDUSTRIES PVT.LTD.	DHARWAD	
		BELGAUM AQUA VALVES PVT. LTD.	BELGAUN	
		ASIAN INDUSTRIAL VALVES & INSTRUMENTS.	CHENNAI	
		ATAM VALVES PVT. LTD.	JALANDHAR	
		DEMBLA VALVES LTD.	THANE	
		M/S GM ENGINEERING	RAJKOT	
		HAWA VALVES (INDIA) PVT. LTD.	NAVI MUMBAI	
		INTERVALVE (INDIA) LTD.	PUNE	
		LEADER VALVES LTD.	JALANDHAR	
		MICROFINISH VALVES PVT LTD.	HUBLI	
		NILON VALVES PRIVATE LIMITED	AHMEDABAD	
		SURYA VALVES AND INSTRUMENTS MFG CO.	CHENNAI	
		UNIFLOW	CHENNAI	
		VALTECH INDUSTRIES	MUMBAI	
		VAAS AUTOMATION PVT. LTD.	NEW DELHI	
		WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD.	NEW DELHI	
5.	DIAPHRAGM VALVE (MANUAL / PNEUMATIC) CLASS 150	WEIR BDK	HUBLI	
		CRANE FLOW PROCESS	SATARA	
		PROCON	MUMBAI	
		MAJESTIC VALVES (LABLINE)	-	
		HAWA ENGINEERS	AHMEDABAD	
6.	DUAL PLATE CHECK	ADVANCE VALVES PVT. LTD.	NOIDA	

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	VALVES	FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD	1. DUAL PLATE CHECK VALVE CI - CLASS 150 & UP TO 600NB, 2. DUAL PLATE CHECK VALVE CCS - CLASS 150 & UP TO 500NB
		R AND D MULTIPLES (METAL CAST) PVT LTD	MUMBAI	
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	CI, CCS & STAINLESS STEEL SPRING ASSISTED DUAL PLATE CHECK VALVES UPTO 700 NB AND 150 CLASS RATING.
7.	Y-TYPE STRAINER / STRAINER (WATER SERVICE)	OTOKLIN GLOBAL BUSINESS LIMITED	MUMBAI	
		GRAND PRIX	NEW DELHI	
		JAYPEE	NEW DELHI	
		GREAVES COTTON	MUMBAI	
		MULTITEX FILTRATION ENGINEERS LIMITED,	NEW DELHI / NOIDA	
		FILTRATION ENGINEERS (I) PVT. LTD	MUMBAI	
		FLUIDNYE	-	
		SUNGOV ENGINEERING PVT. LTD.	DELHI	
		GRAND PRIX	FARIDABAD	
		JAYPEE INDUSTRIES PVT. LTD.	DELHI	
		BHATIA ENGINEERING CO.	DELHI	
8.	SS PIPES / TUBES	APEX TUBES	BEHROR (ALWAR)	
		RATNAMANI	CHATTRAL	
		REMI	TARAPUR	
		PRAKASH STEELAGE	-	
9.	SAFETY SHOWER	UNICARE	-	
		MOHAN INDUSTRIES	-	
		SUPER SAFETY SERVICES	-	
10.	STROKE CONTROLLER	V K PUMPS	NASIK	
		METACHEM	MUMBAI	
		SWELORE	AHMEDABAD	
		MILTON ROY INDIA	CHENNAI	
11.	SAFETY VALVES/RELIEF VALVES	METACHEM	MUMBAI	
		KEYSTONE	BARODA	
		V K PUMPS	NASIK	
		MILTON ROY	CHENNAI	
12.	STEEL GATE/GLOBE/NR	A.V. VALVES LTD	AGRA	



TITLE:
**2 X 800 MW UPPUR STPP (STAGE-I, UNIT 1
& 2) BTG PACKAGE**

**TECHNICAL SPECIFICATION FOR
CHEMICAL DOSING SYSTEM**

SPECIFICATION NO. PE-TS-425-154-A001

SECTION I

SUB SECTION - I A

REV.NO. 0

DATE : 15.11.2017

VALVES	ATAM VALVES PVT. LTD.	JALANDHAR	(1) CARBON STEEL GATE VALVES & NON RETURN VALVES: 15 NB TO 50 NB (#800) & 65 NB TO 300 NB (#150) (2) CARBON STEEL GLOBE VALVES: 15 NB TO 50 NB (#800) & 65 NB TO 200 NB (#150)
	FLUIDLINE VALVES COMPANY PVT.LTD.	KAUSHAMBI	
	M/S GM ENGINEERING	RAJKOT	
	INTERVALVE (INDIA) LTD.	PUNE	A) STEEL GATE VALVES: UPTO 50NB, #800 AND 65NB TO 150NB, #150 B) STEEL GLOBE VALVES: UPTO 50NB, #800 AND 65NB TO 100NB, #150 C)SUPPLIER NOT REGISTERED FOR NR VALVES
	LEADER VALVES LTD.	JALANDHAR	
	NITON VALVE INDUSTRIES PVT LTD	MUMBAI	
	NSSL LIMITED.	NAGPUR	
	STEEL STRONG VALVES (I) PVT. LTD.	NAVI MUMBAI	LIMITED TO RANGES & CLASSES AS AVAILABE IN VD FILE.
	VENUS PUMPS AND ENGG. WORKS	KOLKATA	CC/CSS-GATE-BBT- UPTO600NB CL UPTO300,GATE-PSBT UPTO250NB CL 1500,GLV-BBT- UPTO300NB CL UPTO600,SCNRV- BBT-UPTO600NB CL UPTO150,SCNRV- BBT-UPTO300NB CL 300,SCNRV-PSBT- UPTO150NB CL UPTO900
	VALTECH INDUSTRIES	MUMBAI	CAST CARBON & ALLOY STEEL - VALVE/RATING/SIZE- GV/150/900, GV/300/400, GV/600/300, GV/GLV/NRV/900/250, GLV/300/300, GLV/150/350, SCNRV/150/700, SCNRV/300/350, SCNRV/600/250.

	TITLE:	SPECIFICATION NO. PE-TS-425-154-A001
	2 X 800 MW UPPUR STPP (STAGE-I, UNIT 1 & 2) BTG PACKAGE	SECTION I
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		V.K. VALVES PVT. LTD.,	JALANDHAR	
		WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD.	NEW DELHI	
13.	FITTINGS (CS/SS)	M.S. FITTINGS	KOLKATA	
		METAL LLOYDS	MUMBAI	
		TRUE FORGE	FARIDABAD	
		TUBE PRODUCTS	BARODA	
		NL HAZRA	KOLKATA	
		GUJRAT INFRA PIPES	BARODA	
		EDWARDS	USA	
		PIPEFIT ENGINEERS	BARODA	
		SIDDARTH & GAUTAM	FARIDABAD	
		EBY	MUMBAI	
14.	FLANGES (SS/CS)	PRADEEP METALS LTD	MUMBAI	
		TUBE PRODUCT INCORPORATION	BARODA	
		MS FITTINGS	KOLKATA	
		HAWA ENGINEERING	-	
		ALIANCE PIPE & PLANGES	KOLKATA	
		JAI AMBE	MUMBAI	
15.	PAINT			
		BERGER PAINTS INDIA LTD		
		GOODLASS NEROLAC		
		JENSON & NICHOLSON (I) LTD		
		CDC CARBOLINE (I) LTD.		
		SHALIMAR PAINTS LTD.		
		ADDISON PAINTS LTD		
		GRAND POLYCOAT		
		BOMBAY PAINTS		
		HEMPLE PAINTS (SINGAPORE)		
16.	MOTORISED ACTUATOR	JOTUN PAINTS		
		ROTARK	-	
		AUMA	-	
		LIMITORK	-	

NOTE:

1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL.

BIDDER TO PROPOSE SUB VENDOR WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED.

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2. DEALERS ARE NOT ACCEPTABLE FOR ANY ITEM OF THE PACKAGE. BIDDER SHALL PROCURE ALL ITEMS INCLUDING PLATES, STRUCTURAL, FLANGES; COUNTER FLANGES ETC. FROM APPROVED SUB VENDOR ONLY.
3. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER.

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SUB VENDOR LIST ELECTRICAL

SUB-VENDOR LIST FOR ELECTRICAL ITEMS		
SL NO.	VENDOR NAME	ADDRESS
SUB-VENDOR LIST FOR LT MOTORS		
1	ABB	14, MATHURA ROAD, FARIDABAD, HARYANA-121003
2	BHARAT BIJLEE LTD.	BHARAT BIJLEE LIMITED, 1ST FLOOR, 7-B, RAJINDRA PARK, PUSA ROAD, NEW DELHI - 110 060.
3	CROMPTON GREAVES	3RD FLOOR, EXPRESS BUILDING,9-10, BAHADUR SHAH ZAFAR MARG, NEAR ITO CROSSING,NEW DELHI-110002, INDIA
4	GE-POWER	KAMAK TOWER, 3RD FLOOR, PLOT NO. 12-A, TVK INDUSTRIAL ESTATE, EKKADUTHANGAL, GUINDY, CHENNAI-600032
5	KIRLOSKAR ELECTRIC CO LTD.	P.O. BOX 5555 , MALLESWARAM WEST ,BANGALORE 560055
6	LAXMI HYDRAULICS PVT. LTD	129/130, INDUSTRIAL ESTATE PATIL NAGAR, HOTGI ROAD SOLAPUR- 413003, MAHARASHTRA
7	MARATHON	MARATHON ELECTRIC INDIA PRIVATE LTD.SECTOR - 11, MODEL TOWN, FARIDABAD - 121006
8	NGEF	POCKET NO.10, FLAT NO. 37 & 38, EXPANDABLE DDA FLATS, NASIRPUR DWARKA, PHASE-I NEW DELHI-110 045
9	RAJINDRA ELECT INDUSTRIES	14 SHAH IND.ESTATE VEERA DESAI RD,ANDHERI(W) MUMBAI- 400053
10	SIEMENS	RC-IN I S NR DEL AREA, JIL BUILDING, TOWER-B, PLOT NO. 78, SECTOR 18, GURGAON-122015, INDIA
SUB-VENDOR LIST FOR GLANDS		
1	ALLIED TRADERS & EXPORTERS	C-124 A, SECTOR-2, NOIDA -201 301, UTTAR PRADESH, INDIA
2	ARUP ENGG & FOUNDARY WORKS	391/119,PRINCE ANWAR SHAH ROAD, CALCUTTA-700068
3	BALIGA LIGHTING EQPT.PVT.LTD.	63A,CP RAMASWAMY ROAD, ALWARPET,P.B.No 6910, CHENNAI-600018
4	COMMET BRASS PRODUCTS	NUTAN CHEMICAL COMPOUND, WALBHAT ROAD, GOREGAON, MUMBAI-400063
5	DOWELLS	M/S. DOWELLS ELECTRICALS 47/47A, SATGURU INDUSTRIAL ESTATE. OFF AAREY ROAD, GOREGOAN (EAST). MUMBAI 400 063.
6	ELECTROMAC INDUSTRIES	27/28AF NEW EMPIRE IND.ESTT., R.KRISHNA MANDIR RD.JB NGR ,ANDHERI(E),MUMBAI-400059
7	INCAB	HARE STREET,KOLKATA,WEST BENGAL-700001
SUB-VENDOR LIST FOR LUGS		
1	DOWELLS	M/S. DOWELLS ELECTRICALS 47/47A, SATGURU INDUSTRIAL ESTATE. OFF AAREY ROAD, GOREGOAN (EAST). MUMBAI 400 063.
2	UNIVERSAL MACHINES LTD.	4,B.B.D.BAG (EAST) 90,STEPHEN HOUSE,5TH FLR CALCUTTA- 700001
SUB-VENDOR LIST FOR JUNCTION BOXES		
1	JASPER ENGNIREES PVT. LTD.	A-23, SECTOR - 8, NOIDA-201301
2	Electro Controls & Devices	M/S ELECTRO CONTROLS & DEVICES, F-41, SITE-C, SURAJPUR INDUSTRIAL AREA GREATER NOIDA, UTTAR PRADESH :201308
3	M/s Shrenik & Co.	39A/3, PANCHRATNA INDUSTRIAL ESTATE, SARKHEJ-BAVLA ROAD, CHANGODAR, AHMEDABAD – 382 213

4	M/s PHOENIX MECANO LTD.,	388 BHARE, TALUKA MULSHI, POST GHOTAWADE, PIRANGOOT, INDUSTRIAL AREA, PUNE-412115
5	Adroit Control Engineers Pvt.Ltd.	M/S ADROIT CONTROL ENGINEERS PVT.LTD. PLOT-3, KRISHNA INDL. AREA, SECTOR-25 FARIDABAD – 121004
6	M/s PHOENIX MECANO LTD.,	388 BHARE, TALUKA MULSHI, POST GHOTAWADE, PIRANGOOT, INDUSTRIAL AREA, PUNE-412115
7	MIKA ENGINEERS	BRANCH OFFICE : 'D'-101, DHEERAJ HERITAGE RESIDENCY II, SHASTRI NAGAR, SANTACRUZ (W), MUMBAI 400 054.
8	M/s PHOENIX MECANO LTD.,	388 BHARE, TALUKA MULSHI, POST GHOTAWADE, PIRANGOOT, INDUSTRIAL AREA, PUNE-412115
9	BAJAJ ELECTRICALS	BAJAJ ELECTRICALS LTD. ENGINEERING & PROJECTS BU (NORTH) 3rd FLOOR, GULMOHARHOUSE, COMMUNITY CENTRE 161/B-4, GAUTAM NAGAR, YUSUF SARAI NEW DELHI – 110049
10	AJMERA INDUSTRIES & ENGG. WORKS	AJMERA INDL. AND ENGG. WORKS. AJMERA HOUSE, A-61 / KHAIRANE MIDC. , TTC INDL. AREA, NAVI MUMBAI – 400705.
11	S.B. ELECTRICAL ENGINEERING CORPORATION	03, SARDAR GRIHA BUILDING, LOHAR CHAWAL, MUMBAI- 400002

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SUB VENDOR LIST C&I

LIST OF C&I VENDORS

SI No	Package Name	Supplier Name	Supplier Communication Address
1	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	BOSE PANDA INSTRUMENTS PVT.LTD.	Mr. Partha Bose 44, Saheed Hemanta Kumar Bose, Sarani, Kolkata Phone- +91 33 2548 7220 Pincode : 700074 Email : parthabosebpi@gmail.com; bosepanda@vsnl.net
2	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in
3	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com
4	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
5	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com
6	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	FORBES MARSHALL (HYD) LTD.	MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T- 4/2, IDA, NACHARAM, HYDERABAD Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com
7	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net
8	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,

LIST OF C&I VENDORS

SI No	Package Name	Supplier Name	Supplier Communication Address
9	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
10	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Nesstech Instruments Private Limited	26/2, G Type, Global Industrial Park Near Nahuli Railway Crossing, Valvada Vapi Phone- 9920576002 Pincode : 396105 Email : sales@nesstech.co.in
11	LEVEL GAUGE	BLISS ANAND PVT. LTD.	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com
12	LEVEL GAUGE	TOSHNIWAL BROTHERS PVT.LTD.	WORKS:TOSHNIWAL IND.PVT.LTD, INDUSTRIAL ESTATE MAKHUPURA, AJMER Phone- 441171 Pincode : 305002 Email : toshniwalprocess@gmail.com
13	LEVEL GAUGE	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in
14	TRANSMITTERS	ABB LIMITED	MR. RAJIV GOVIL 14, MATHURA ROAD, FARIDABAD Phone- 09971085678 Pincode : 121003 Email : vipin.swami@in.abb.com
15	TRANSMITTERS	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com
16	TRANSMITTERS	V. AUTOMAT & INSTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com

LIST OF C&I VENDORS

SI No	Package Name	Supplier Name	Supplier Communication Address
17	TRANSMITTERS	Moore Industries International Inc.	Leonard.W. Moore/ Matt Moren 16650 Schoenborn St. North Hills Phone- +1 818 830 5548 Pincode : 91343 Email : mmoren@miinet.com
18	TRANSMITTERS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com
19	TRANSMITTERS	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhupura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,
20	TRANSMITTERS	Endress + Hauser (India) Pvt. Ltd.,	Mr. Prakash Vaghela 215-216, DLF Tower 'A', Jasola District Centre, New Delhi, Phone- 9717593001, Pincode : 110025, Email : prakash.vaghela@in.endress.com,
21	TRANSMITTERS	YOKOGAWA INDIA LIMITED,	PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, BANGALORE, Phone- 080-41586000, Pincode : Email : uday.shankar@in.yokogawa.com,
22	TRANSMITTERS	SBEM PVT. LTD.	MR.N.K. BEDARKAR/MR. VISHWANATH KARANDIK 39, ELECTRONIC CO.OP. ESTATE, PUNE SATARA ROAD PUNE, Phone- 912041030100 Pincode : 411009 Email : newdelhi@sbem.co.in
23	TRANSMITTERS	SIEMENS LIMITED	Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai Phone- 0124 383 7377 Pincode : 400018 Email : ankit.varshney@siemens.com
24	TRANSMITTERS	EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	Mr. Amit Paithankar/Vikram Raj Singh 206-210,BALARAMA BUILDING 2ND FLR. BANDRA EAST MUMBAI Phone- 9619121500 Pincode : 400051 Email : vikramraj.singh@emerson.com

LIST OF C&I VENDORS

SI No	Package Name	Supplier Name	Supplier Communication Address
25	TRANSMITTERS	SMART INSTRUMENTS LTD, BRAZIL	Agents: Digital Electronic Ltd. 74/11 'C' Cross Road MIDC Andheri (East) MUMBAI Phone- 28208477 Pincode : 400093 Email : corp@delbby.rpgms.ems.vsnl.net.in
26	TRANSMITTERS	NIVO CONTROLS PVT. LTD.	Mr. Praveen Toshniwal 104-115, Electronic Complex, Indore Phone- 0731-4081305 Pincode : 452010 Email : sales@nivocontrols.com
27	TRANSMITTERS	Honeywell Automation India Limited	Mr. Ritwij Kulkarni 917, INTERNATIONAL TRADE TOWER, NEHRU PLACE, NEW DELHI Phone- 9890200584 Pincode : 110019 Email : rajesh.chaudhary@honeywell.com
28	JUNCTION BOX	Shrenik & Company,	Mr. Mitesh Shah/Mr. Pulin Shah 39 A/3 ,Panchratna Industrial Estate, Sarkhej-Bavla Road Ahmedabad Phone- 9825024921 Pincode : 382213 Email : sales@pustron.com, pulin@sumin.com
29	JUNCTION BOX	SUCHITRA INDUSTRIES	NO-2,OPP-27 AECS LAYOUT 2ND STG REJAMAHALVILAS EXTN 2ND STG BANGALORE Phone- Pincode : Email : suchitra.industriesblr@gmail.com
30	JUNCTION BOX	FLEXPRO ELECTRICALS PVT. LTD.	Mr. Dineshbhai Zaveri C-1/ 27&37, GIDC, Kabilpore, Navsari Phone- 02637-265140,265003 Pincode : 396424 Email : flexpro@flexproltd.com
31	JUNCTION BOX	K.S.INSTRUMENTS PVT.LTD.	S Raghavan No. 72, 3rd Main, 1st Stage Industrial Suburb, Yeshwanthpur Bangalore Phone- 9880385770 Pincode : 560022 Email : sales1@ksinstruments.net
32	JUNCTION BOX	AJMERA INDUSTRIAL & ENGINEERING WORKS	JIGNESH MAHENDRA AJMERA DENA BANK BLDG.,SHREE NAGESH INDL. ESTATE,STATION ROAD, MUMBAI Phone- 022 67973578 Pincode : 400 088 Email : ajmera@ajmera.net, imajmera@yahoo.com

LIST OF C&I VENDORS

SI No	Package Name	Supplier Name	Supplier Communication Address
33	INSTRUMENTS TUBE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91- 9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
34	INSTRUMENTS TUBE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
35	INSTRUMENTS TUBE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W- 167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
36	INSTRUMENTS TUBE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
37	INSTRUMENTS PIPE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91- 9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
38	INSTRUMENTS PIPE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
39	INSTRUMENTS PIPE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
40	INSTRUMENTS PIPE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W- 167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com

LIST OF C&I VENDORS

SI No	Package Name	Supplier Name	Supplier Communication Address
41	INSTRUMENT FITTINGS	Arya Crafts & Engineering Pvt. Ltd.	Mr.Sanjay Brahman/Mr.Shyam Vazirani 102, Vora Industrial Estate No.4 Navghar, Vasai Road (E) Dist.Thane, Mumbai Phone- +91-250-2392246 Pincode : 401210 Email : arya@aryacrafts.com
42	INSTRUMENT FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
43	INSTRUMENT FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
44	INSTRUMENT FITTINGS	Comfit & Valve Pvt. Ltd.	Mr. Jeetu Jain/Mr. Vinay Sosa Survey No. 23/1, Part 2, Ahmedabad-Mehsana Highway Laxmipura, Nandasan Phone- 02764-267036/37 Pincode : 382705 Email : marketing@com-fit.com
45	INSTRUMENT FITTINGS	Perfect Instrumentation Control (India) Pvt. Ltd.	MD Hussain Shaikh/Shahanawaz Khan Gala No. 168, Loheki Chwal,216/ 218, Maulana Azad Rd. Nagpada Junction Mumbai Phone- 91-9324383121 Pincode : 400008 Email : shahanawaz_khan@perfectinstrumentation.com
46	INSTRUMENT FITTINGS	HP VALVES & FITTINGS INDIA PVT. LTD.	S. Harichandran/P.S. Pandi B-11, Mugappair Industrial Estate, CHENNAI Phone- 044 26252537 Pincode : 600037 Email : sales@hpvalvesindia.com
47	INSTRUMENT FITTINGS	FLUIDFIT ENGINEERS PVT. LTD.	Mr. Abbas Bhola Potia Building No. 2, Office No. 3,292, Bellasis Road,Mumbai Central (East) Mumbai Phone- 9920044113 Pincode : 400008 Email : ab@fluidfitengg.com
48	INSTRUMENT FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com

LIST OF C&I VENDORS

SI No	Package Name	Supplier Name	Supplier Communication Address
49	INSTRUMENT FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
50	INSTRUMENT FITTINGS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com

NOTE:

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

	TITLE:	SPECIFICATION NO. PE-TS-425-154-A001
	2 X 800 MW UPPUR STPP (STAGE-I, UNIT 1 & 2) BTG PACKAGE	SECTION I
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	SUB SECTION - I A
		REV.NO. 0 DATE : 15.11.2017

ANNEXURE III:

DRAWING DOCUMENTS DISTRIBUTION PROCEDURE

	TITLE:	SPECIFICATION NO. PE-TS-425-154-A001
	2 X 800 MW UPPUR STPP (STAGE-I, UNIT 1 & 2) BTG PACKAGE	SECTION I
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	SUB SECTION - I A
		REV.NO. 0 DATE : 15.11.2017

DRAWING DOCUMENTS DISTRIBUTION SCHEDULE

Documents	PEM-Engineering
Documents for approval	8
Documents for information	8
Schedules, diagrams, lists, tables, calculation, specifications and other documents	8
Final as-built drawings	
CD-ROMs of final as-built drawings	10
Final as-built drawings (hard copy)	14
Final O&M manuals	18
CD-ROMs of Final O&M Manuals	10
Detailed project time schedules	5

Note:

- Bidder shall submit soft copy/hard copy/CD ROMs of all the finally approved drawings and O&M Manuals as required by Customer/Customer consultant/BHEL-site/BHEL-PEM. The exact number of hard copies/CD ROMs of these documents to be submitted shall be notified to the bidder at the time of detailed engineering and bidder shall submit the same without any commercial/delivery implications to BHEL/Customer.
- All the drawing documents along with the O&M manual (of all the revisions) are necessarily to be submitted in soft copies in addition to hard copies.
- Bidder to submit soft copies of all the drawing and document along with quality plans for BHEL review and approval.
- The date of submission of drawing documents shall be considered as the date of submission of hard and soft copies whichever is later.
- All the drawings shall be prepared on computer auto cad and other documents (like datasheet etc.) on MS office software. Bidder not complying these requirements shall not be considered. For the execution of the contract regular meeting (generally once in 15 days or as per project requirement) is required.
- Bidder has to come for meeting with the concerned dealing persons as per BHEL or customer requirement in a short notice.
- Bidder to submit instrument schedule, cable schedule and valve schedule (as applicable) in MS-Excel format during detailed engineering.
- Bidder to also furnish the auto cad copy/ MS-word (as applicable) of the following documents after award of contract. However any other auto cad copy/ MS-Excel/ MS-word of any other document as per the insistence of BHEL/ customer will also be submitted by the bidder without any delivery/ commercial implication to BHEL/ Customer.
 - P&IDs.
 - GA & Foundation Drawing
 - Local Control Panel/ Junction Box Wiring Diagram

	TITLE: 2 X 800 MW UPPUR STPP (STAGE-I, UNIT 1 & 2) BTG PACKAGE	SPECIFICATION NO. PE-TS-425-154-A001
		SECTION I
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	SUB SECTION - I A
		REV.NO. 0 DATE : 15.11.2017

ANNEXURE IV: PAINTING SPECIFICATION

CHAPTER - 6

PAINTING

1.0 SCOPE

This section defines the technical requirements for surface preparation, selection and application of paints on equipment, vessels, machinery, piping, ducts etc. However, manufacturers shall follow their standard procedures for painting their equipment. The bidder shall submit a detailed painting procedure for approval of owner/ owner's representative after the award of contract.

The following surface and material shall require painting:

- a. All un-insulated carbon steel and alloy steel equipment like columns, vessels, storage tanks, pumps, heat exchangers etc.
- b. All un-insulated carbon steel and low alloy piping, fitting and valves (including painting of identification marks).
- c. All pipe structural steel supports, walkways, platforms, handrails, ladders etc.

The following surfaces and materials shall not require painting :

- a. Non-ferrous materials
- b. Austenitic stainless steel
- c. Plastic and / or plastic coated materials
- d. Insulated surface of equipment and pipes except color coating wherever required.
- e. Painted equipment like blowers, pumps, valves etc. with finishing coats in good condition and with matching color code.

2.0 CODES AND STANDARDS

Painting of equipment shall be carried out as per the specifications indicated below and shall conform to the relevant IS specification for the material and workmanship.

The following Indian Standards may be referred to for carrying out the painting job :

IS:5	:	Colours for ready mixed paints and enamels
IS:1303	:	Glossary of terms relating to paints
IS:2379	:	Colour code for identification of pipelines
IS:1477	:	Code of practice for painting of ferrous metals in buildings (Parts I & II)
IS:2524	:	Code of practice for painting of non-ferrous metals in buildings (Parts I & II)
IS:2395	:	Code of practice for painting of concrete, masonry and plaster surfaces (Parts I & II)



IS:2338	:	Code of practice for finishing of wood and wood based materials (Parts I & II)
IS:158	:	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting.
IS:2074	:	Ready mixed paint, air drying, red Oxide Zinc Chrome, priming
IS:104	:	Ready mixed paint, brushing, Zinc Chrome, priming
IS:2932	:	Enamel Synthetic exterior (a) Undercoating (b) finishing
IS:4682	:	Code of practice for lining of vessels & equipment
SIS 559000	:	Swedish standard for blasting
ISO 8504-2	:	Preparation of steel substrates before application of paints and related products. Surface preparation methods Part 2 Abrasive blast cleaning
ISO 8501-1	:	Preparation of steel substrates before application of paints and related products. Visual assessment of surface cleanliness. Part 1 : Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings.
SIS 05 5800	:	Surface preparation by acid pickling
SSPC SP08	:	Surface preparation by acid pickling
IS 2629	:	Recommended practice for hot dip galvanizing of iron and steel
ASTM A780	:	Standard practice for repair of damaged galvanized coatings
SSPC	:	Steel structures painting council
NACE	:	National association of Corrosion Engineers
DIN	:	Deutsehes Institute for Normung
BS	:	British Standard
ASTM	:	American Society for Testing material
AWWA	:	American Water works association

3.0 SURFACE PREPARATION

The surface shall be prepared in a manner suitable for coatings. Chemical derusters or rust converters shall not be applied. Acid cleaning is subject to approval of Purchaser/ Purchaser's representative.

3.1 BLASTING

The surface of the part/ component shall be blasted before the coating material is applied.

Compressed air supply for blast cleaning shall be free of water and oil. Air compressors shall not be allowed to deliver air above 1100C. Blasting activity shall be performed at temperatures 30C above dew point and substrata temperature between 50C & 500C and relative humidity not exceeding 85% shall be maintained during painting. Necessary safety precautions for equipment and operator shall be adhered to and shall comply with applicable laws, regulations, ordinances etc., of the local authority, state or the nation pertains to the work.



Abrasive used for blast cleaning carbon steel and alloy steel shall be as per ISO 8504-2 and SSPC painting manual. Suggested abrasives are chilled iron grit, shot steel, malleable iron grit and shots of non metallic abrasive (aluminum oxide, copper slag, garnet etc.).

The grade of blasting shall be performed in line with the approved painting scheme.

The nature, quality and grain size of abrasives and the parameter of their use are to be chosen to obtain the required surface profile depth and cleanliness.

Surfaces prepared for coating shall be coated the same day and before any visible rusting occurs (the time elapsed between blast cleaning and commencement of painting shall under no circumstances exceed 4 hours, but in any case must commence before signs of degradation occur).

The grades of surface finish

	ISO 8501-1	SIS 055900	SSPC	NACE
White metal	Sa3	Sa3	SP5	1
Near White metal	Sa 2½	Sa 2½	SP10	2
Commercial Blast	Sa2	Sa2	SP6	3
Brush off blast	Sa1	Sa1	SP7	4

Unless otherwise specified in the documents, the surface shall satisfy the following requirements after blasting

(a) Blasting according to SIS 055900, Grade Sa 2½

Primer paint shall be Zinc Silicate of approved brand. Dry film thickness of each primer coat shall be 15-25 µm.

3.2 Manual Rust Removal

Manual rust removal shall be allowed for welded zones and for touching up installed components.

3.3 Cleaning

Removal of impurity

	Impurity	Removal
a)	Dust, Loose deposits	Vacuum cleaning, brushing
b)	Adhesive deposits	Power brushing
c)	Oils, greasy impurities	Wet Blasting, Use of Detergent Additives by agreement
d)	Salt deposits	Rinsing
e)	Markings (eg felt up pen)	Organic solvents to manufacturer's specifications eg Trichloro trifluoro ethane and solvents containing acetone (renew solvent and rag frequently)

3.4 Acid Pickling

Prior to galvanizing the surface preparation shall be done by acid pickling as per SSPC-SP-08.



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4.0 PROCESSING**4.1 General Application Conditions**

The primer shall be applied to properly prepared surfaces only. The specifications of the coating material manufacturers shall be observed. The minimum temperature shall be + 5°C and the relative humidity shall not exceed 80%. The temperature of the work piece shall be at least 3°C above dew point.

4.2 Application Procedure

The primer shall be applied by means of brush or by spary. The top coats shall be applied by means of brush, roller or spray.

At points where coating application is interrupted, the individual layers shall be adequately stepped to ensure proper layer sequence when coating operations are resumed.

4.3 Touching Up

Before each layer is applied, previous coating shall be touched up where necessary by way of rust removal and cleaning according coating manufacturers specification. The final top shall be reapplies completely.

4.4 Uncoated Surfaces

Moving parts of machines (e.g stems, shafts, sliding and locating bearings), nameplates, instruments and sealing surface shall not be coated. Welds shall be left free of coating upto a distance of 30 mm on each side of the weld edge until erection and weld examinations, if any, have been completed.

4.5 Bond Strength

The pill off stress determined using the pull off test method for adhesion shall not be less than 1.5 N/mm², according to ISO 4624.

5.0 SURFACE CONDITIONS OF COATING SURFACES

The coating surface shall have a uniform film thickness, shade and gloss and shall be free from inclusions, sags and wrinkles.

6.0 COATING SYSTEMS**6.1 General Requirements for Coating Systems**

Coating materials according to SSPC, BS 5493 or DIN 55 928 shall be used. Intermediate coats are to be pigmented with micaceous iron oxide. The materials shall be matched with each other so that they are compatible. Coatings deviating this



specification shall be subject to approval. Standards of surface preparation and painting shall give a time to first maintenance of 10 years.

The colour and gloss of top coats shall be in accordance with sub clause suggested colour codes for painting (Sub Clause 6.8)

6.2 Standard Coating System (External Coatings)

(a) Steel Surfaces

- (i) All steel structures shall receive two primer coats and two sandwich coat of MIO Epoxy paint and one finish coat of painting. First coat of primer shall be given in shop after fabrication before dispatch to erection site after surface preparation as described below. The second coat of primer shall be applied after erection and final alignment of the erected structures. Two intermediate coats and one finished coat shall also be applied after erection.
- (ii) Steel surface which is to be painted shall be cleaned of dust and grease and the heavier layers of rust shall be removed by chipping prior to actual surface preparation. The surface shall be abrasive blasted as explained in clause 3.1 to Sa 2½ finish as per SIS05-5900. Primer paint shall be Zinc Silicate of approved brand. Dry film thickness of each primer shall be 60 microns.
- (iii) Two intermediate MIO Epoxy paint, and one top polyurethane coating of approved brand shall be applied. Dry film thickness of each intermediate coat shall be 90 microns and top polyurethane coating shall be 30 microns. The under coat and finish coat shall be of different tint to distinguish the same from finish paint. The total dry film thickness shall be 330 microns. All paints shall be of approved brand and shade as per owner's requirement.
- (iv) Joints to be site welded shall have weldable primer applied within 100 mm of welding zone. Similarly where friction grip fasteners are to be used removable anti corrosive coating shall be provided. On completion of the joint the surfaces shall receive the paint as specified.
- (v) Surfaces inaccessible after assembly shall receive two coats of primer prior to assembly. Surfaces inaccessible after erection including top surfaces of floor beams, supporting gratings or chequered plate shall receive one additional coat of finish paint over the above number of coats specified before erection. Portion of steel member embedded/ to be encased in concrete shall not be painted.

(b) Gratings and Step Threads

- (i) Surface Preparation

Gratings and step threads shall be cleared by acid pickling as per SSPC-SP-08

- (ii) Hot Dip galvanizing

The hot dip galvanizing shall be done as per IS 2629. The average mass of coating shall be 610 gm/m².



(iii) Post Treatment

Immediately after galvanizing post treatment such as chromating shall be applied to retard white rust attack.

(iv) Touch up mechanical damages

The repair of damages coatings shall be done as per the recommended practice ASTM A780.

6.3 Painting of Indoor components such as valves, pumps, motors, electrical parts, tanks etc.

At Works

Surface Preparation

Blasting according to SIS 055900 grade Sa 2½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 25 µm may be used.

Prime Coat

Two (2) layers of Zinc phosphate epoxy, total dry film thickness 75µm.

At Site

Thorough cleaning to remove oil, grease, dirt and any other contaminants. Derusting of all mechanical damages according to SIS 055900 Grade ST3. Touch up with dry film thickness 50 µm.

Finish Coat

Application of two (2) finishing coats of chlorinated rubber paint in approved shades at 30-40 microns DFT each coat in approved shades.

Remarks

Equipment coated with a standard application system can be accepted if the quality of this application system is corresponding with the quality of the above mentioned system.

6.4 Painting of Outdoor equipment (external surfaces) such as piping, valves, pumps, motors, electrical parts, tanks etc.

Weather exposure, weather resistance, temperature upto 120°C as per clause 6.1 & 6.3. However

Surface Preparation



Blasting according to SIS 055900 grade Sa 2½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Two (2) layers of Zinc phosphate epoxy, total dry film thickness 75µm.

Intermediate Coat

One (1) layer 2 pack high build epoxy polyamide MIO, DFT 100µm.

Finish Coat

Application of two (2) finishing coats of chlorinated rubber paint in approved shades at 50 microns DFT each coat in approved shades.

6.5 Special Coating

(a) Parts exposed to temperatures above 120°C, upto 200°C, not insulated

(i) At Works

Surface Preparation

Blasting according to SIS 055900 grade Sa 2½ and ISO 8501-1:1958. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Inorganic ethyl Zinc silicate, total dry film thickness 75µm.

(ii) At Site

Pretreatment

Dersuting of all mechanical damages, according to ISO 8501-1:1989, grade St 3 touch up with 1 pack inorganic ethyl zinc silicate, dry film thickness 50µm.

Intermediate Coat

1 pack silicon acrylic dry film thickness 35 µm.

Final Coat

1 pack silicon acrylic, dry film thickness as 35µm.
Total system dry film thickness 145µm.
Final coat according to colour code.



(b) Parts exposed to temperatures above 200⁰C, upto 400⁰C, not insulated**(i) At Works****Surface Preparation**

Blasting according to ISO 8501-1:1958 grade Sa-2½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Inorganic ethyl Zinc silicate, total dry film thickness 75µm.

(ii) At Site**Pretreatment**

Derusting of all mechanical damages, according to standard Sa 2½ to ISO 8501-1:1988. Touch up with coating system according to manufacturer's recommendations.

(c) Insulated parts continuously exposed to condensing water or parts exposed to temperatures

For parts that are provided with insulation on site.

(i) Insulated parts exposed to condensing water

At Works

Surface Preparation

Blasting according to Sa 2½ to ISO 8501-1:1988. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm shall be used.

Prime Coat

Inorganic ethyl Zinc silicate, total dry film thickness 75µm

(ii) Insulated parts exposed to temperatures

Parts exposed to temperatures upto < 400⁰C

Surface Preparation

Blasting according to Sa 2½ to ISO 8501-1:1988. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm shall be used.



Parts exposed to temperature above 400⁰C at works (Steam pipes, pressure tubes and parts for the HRSG, such as heating surfaces, heaters and superheaters, reheaters etc)

Temporary Primer

Varnish

(d) Intermittent exposure due to condensing water/ chemicals (Indoors)

(i) At Works

Surface Preparation

Blasting according to Sa 2½ and ISO 8501-1:1988. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Two layers of Zinc phosphate primer, total dry film thickness 75µm.

(ii) At Site

Pretreatment

Dersuting of all mechanical damages, according to standard Sa3 to ISO 8501-1:1988, touch up with 2 pack high build epoxy with volume solid content of more than 85%, 75µm.

Intermediate Coat

2 pack high build epoxy, dry film thickness 80 µm.

Finish Coat

2 pack silicon acrylic, dry film thickness of 50µm.

Total system dry film thickness 205µm.

When exposed o weathering, weather resistance finish coat shall be applied.

(e) Water Exposure

(i) At Site/ Works

Pretreatment

Removal of all welding pearls.



Blasting according to Sa 3 to ISO 8501-1:1988

Coat

4 coats 2 pack coal tar epoxy, dry film thickness 125 μm each.

Total system dry film thickness 500 μm

Touch up after erection as required.

6.6 Painting of Pipes

6.6.1 Buried Piping

Internal surfaces

- (i) Surface cleaning by sand blasting.
- (ii) Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.
- (iii) Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.

The total dry film thickness of 150 microns.

Note : All steel pipes carrying sea water shall be internally coated with corrocoat/ polyurea coating having thickness 1500 DFT.

Tests to be carried out after application : Bond/ Adhesion test, Holiday test

External surfaces

- (i) Surface cleaning by Sand Blasting.
- (ii) Coal tar primer compatible with coal tar enamel grade. The number of coats shall be two with a DFT of 35 microns each.
- (iii) Coal tar enamel shall be applied. A single spiral inner wrap of glass fibre tissues shall be applied overlapping at least 25 mm ensuring impregnation of glass fibre tissues in the first coat. The second coat of enamel and second outer wrap of glass fibre felt, Type – I to IS: 7193-1974 will be applied in the same way confirming to Table – 10 of IS – 10221 – 1982.

The total thickness of the coating will not be less than 4.0 mm

- (iv) Alternatively Wrapping with coal tar based anticorrosion tape conforming to IS 15337: 2003 is also acceptable in lieu of s.no. (iii) above. Wrapping thickness shall be 4.0 mm.



Tests to be carried out after application : Bond/ Adhesion test, Holiday test

6.6.2 Overground Piping

Internal surfaces

- (i) Surface cleaning by sand blasting.
- (ii) Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.
- (iii) Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.

The total dry film thickness of 150 microns.

Note : All steel pipes carrying sea water shall be internally coated with corrocoat/ polyurea coating having thickness 1500 DFT.

External surfaces

- (i) Surface cleaning by Sand Blasting.
- (ii) Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.
- (iii) Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.

6.7 Internal Coatings

6.7.1 Tanks (Internal surfaces) as specified in relevant sections of specification

Industrial deionised, demineralised and potable water upto 60°C pH range 4.5-9.5

Blasting according to Sa 2½ and ISO 8501-1:1988.

Prime Coat

Two layers of Zinc phosphate epoxy primer, total dry film thickness >75µm.

Pretreatment

Dersuting of all mechanical damages, according to standard Sa3 to ISO 8501-1:1988, touch up with 2 pack high build epoxy with volume solid content of more than 85%, 75µm.

Intermediate Coat

2 pack high build epoxy, dry film thickness 80 µm.



Finish Coat

2 pack silicon acrylic, dry film thickness of 150µm per coat.

In case of service or potable water tanks, the coating material selected shall not taint the water. The paint system shall conform to regulations issued by Food & drug administration/ National Public Health service/ AWWA/ OSHA and comply with applicable laws, regulations, ordinances etc. of the local authority, state or the nation pertains to work.

QA/ QC Procedure including pinhole inspection, shall be submitted for approval by Owner/ Owner's representative.

6.6.2 Rubber Lining of Pipes, Valves and Tanks for DM Water**Pretreatment**

Blasting according to Sa 2½ and ISO 8501-1:1988

Rubber Lining

Hard rubber 5 mm for DM water applications as IS – 4682

6.7 Painting for Electrical items

6.7.1 All the steel work shall be thoroughly cleaned of rust, scale, oil, grease, dirt and swarf by pickling, emulsion cleaning etc. The sheet steel shall be phosphate/ oven dried and then painted with two coats of zinc rich primer paint. After application of the primer, two coats of finishing epoxy paint shall be applied. The colour of the finishing coats inside shall be glossy white and exterior of the treated sheet steel shall be shade 631 of IS-5/ RAL 7032 for all switchboard/ MCC/ Distribution boards, control panels etc.

6.7.2 All electrical equipment shall be given tropical and fungicidal treatment and outdoor equipment shall be provided with rain hood to prevent entry of rain water into the equipment.

6.7.3 Painting of I & C equipment : Epoxy coating required for all I & C equipment.

6.8 SUGGESTED COLOUR CODES FOR PAINTING

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
1.	Structures, platforms, galleries, ladders and handrails	Dark Admiralty Grey	632	-	-
2.	Boiler casing, ducting	Nut Brown	413	-	-



SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
3.	Crane				
3.1	Crane structure	Golden Yellow	356	Black	-
3.2	Trolley & hook	Crimson	540	-	-
4.	Fans, pumps, motors, compressors	Light Grey	631	-	-
5.	Tanks (without insulation and cladding)				
5.1	Outdoor	Aluminium	-	-	-
5.2	Indoor	Light grey	631	-	-
6.	Vessels & all other proprietary equipment (without insulation & cladding)	Light grey	631	-	-
7.	Switchgear	Light grey (Powder coated)		-	-
8.	Control & relay panels	Light grey (Powder coated)	631/70 78 of IS 1650	-	-
9.	Turbines	Light Grey	631	-	-
10.	Generators & Exciter	Light Grey	631	-	-
11.	Transformers	Aluminum	-	-	-
12.	Machinery guards	Signal red	537	-	-
13.	Piping (without insulation and cladding)				
13.1	Water System				
a	Boiler feed	Sea Green	217	-	-



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SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
b	Condensate	Sea Green	217	Light Brown	410
c	DM Water	Sea Green	217	Light Orange	557
d	Soft Water	Sea Green	217	French Blue	166
e	Bearing Cooling Water	Sea Green	217	French Blue	166
f	Potable & filtered Water	Sea Green	217	French Blue	166
g	Service and clarified water	Sea Green	217	French Blue	166
h	Cooling water	Sea Green	217	French Blue	166
l	Sea Water	Sea Green	217	White	-
14.	Ash Transmitting Vessels and pipe lines	Aluminium	-	-	
15.	Air System				
15.1	Station air	Sky blue	101	-	-
15.2	Control air	Sky blue	101	White	-
16.	Oil system				
16.1	Fuel oil	Light brown	410	French	166
16.2	Light oil (HSD)	Light Brown	410	Brilliant green	221
16.3	Lubricating oil	Light brown	410	Light grey	631
16.4	Transformer oil	Light brown	410	Light orange	557
17.	Gas System				
17.1	Carbon dioxide	Canary yellow	309	Light grey	631
17.2	Hydrogen	Canary yellow	309	Signal red	537
18.	Fire services	Fire red	536	-	-
19.	Effluent pipes	Black	-	-	-
20.	Vacuum pipes	Sky blue	101	Black	-

Notes :

1. This colour code basically refers to IS:2379 for piping with necessary modifications



2. Where band colour is specified, same shall be provided at 30 meter intervals on long uninterrupted lines and also adjacent to valves and junctions.

Bidder shall furnish his painting specification to suit corrosive atmosphere of coastal area along with the bid. The specification shall in general be in line with the above requirements.



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ANNEXURE V: MANDATORY SPARES LIST

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MANDATORY SPARES FOR CHEMICAL DOSING SYSTEM (<u>ON PER UNIT BASIS</u>)			
S. No.	ITEM	QUANTITY	UNIT
C&I Mandatory Spares (FOR EACH UNIT)			
1.	MEASURING & FIELD INSTRUMENTS		
1.1.	Indicators, Recorders, Electrical Metering and Skid Mounted Instruments		
a.	For skid mounted instruments.	10% of total number of instruments, valves, C&I equipment, C&I item etc. for each Type and model or a minimum of one number for each model and type, whichever is more.	Nos.
b.	Indicators, recorders and meters offered from each model for the project. These instruments shall be supplied with three sets of blank scales.	10 % of Installed of each type/ Model or a minimum of one Number for each model and type, whichever is more.	Nos.
1.2.	Temperature, Transmitters and Electronic Transmitters (For Pressure, DP, Temp, Flow, Level), Process Transmitters, Level & Flow Transmitter for each type, Rotameters, Sight Flow indicators, Temperature, Pressure, Flow & Level Switch, safety & Protection switches, Gauges, Process meters, Junction Boxes, Position Transmitters/ switches, Analysers, Transducers, or any other instrument etc.	I. 10% of total number of each item offered for each model and type for the project or a minimum of one number, whichever is more. II. 10% of Electronic card/ PCB assembly and power supply card/ module for each type, model & rating of Transmitter, analysers & Flow meters.	Nos.
1.3.	Level gauge	I. 10% or 2 nos. whichever is more of each type of illuminators with holder and reflector. II. 20% or 5 nos. whichever is more of each type of bulb. III. 10% or 2 nos. whichever is more of each type of bicolour rollers. IV. 10% or 2 nos. whichever is more of each type of glass along with pair of gaskets cushion & wet gaskets). V. 10% or 2 nos. whichever is more of each type of gaskets for gauge cocks/ valve bonnet/ packing. VI. 10% or 2 nos. whichever is more of each type scale.	
2.	Relay Based Control Panels		

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a.	LEDs for indicating lights.	100% of quantity installed.	Nos.
b.	Control circuit fuses.	300% of installed of each type, current rating.	Nos.
c.	Relays modules & contactors.	20% spare of quantity Installed of each type & rating.	Nos.
d.	Cooling Fans of each type, model and rating.	20% or 2 nos. of each type and rating, (whichever is more).	Nos.
e.	MCB/MCCB of each rating.	10% of each current rating required.	Nos.
f.	Push buttons, ILPBs.	Ten (10) percent or 2 nos. (Whichever is more) of each type.	Nos.
g.	Electric meter.	Ten (10) percent or 2 nos. (whichever is more) of each type.	Nos.
h.	Power supply modules.	Ten (10) percent or 2 nos. (whichever is more) of each type.	Nos.
3.	Alarm Annunciation System		
a.	Logic modules, group card modules, power supply modules, Hooters and any other electronic module.	20% spares of each type installed.	Nos.
b.	Un-engraved window boxes complete with LED etc.	5% spares of each size installed.	Nos.
c.	LEDs for annunciation facia windows and LEDs box assemblies offered for the project.	20% of quantity installed.	Nos.
d.	Annunciator hooter.	One (1) No. of each type.	Nos.
e.	MCB, and Power sockets used in LIE/ LIR.	Ten (10) percent of each type.	Nos.
f.	Fuses used in LIE/ LIR.	Fifty (50) percent of each type.	Nos.
4.	Erection hardware		
a.	Instrument valves, manifold, fittings, impulse pipe, impulse tubes, drains pipes.	Ten (10) percent of each type, rating, model number & Size installed.	Nos.
b.	Manifold.	Ten (10) percent of each type & Size installed.	Nos.
c.	Fittings.	Ten (10) percent of each type & Size installed.	Nos.
5.	Mandatory spares not covered above Sensor/ instrument, analysers/ special instruments/ Electronic card, instrumentation/ mechanical fittings etc.	10% or 1 no. (whichever is more) of each type.	Nos.

- 100 % spare LED lamps shall be provided with each panel, these are in additional to mandatory spares.
- 50 % spare fuses shall be provided with each panel, these are in additional to mandatory spares.

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The vendor warrants:

1. That all spares supplied will be new and in accordance with the contract document and will be free from defects in design, material and workmanship and shall further guarantee as under:
2. In case of any failure in the original component/ equipment due to faulty designs, materials and workmanship, the corresponding spare parts if any, supplied will be replaced without any extra cost to the BHEL and customer unless a joint examination and analysis by BHEL and/ or customer of such spare parts prove that the defect found in the original part that failed can safely be assured not to be present in spare parts.
3. The long term availability of spares to the BHEL and the customer for the full life of the equipment covered under the contract and that before going out of production of spare parts of the equipment covered under the contract, vendor and his sub-vendors shall give the BHEL and the customer at least 24 (Twenty Four) months advance notice so that the latter may order his bulk requirements of spares, if he so desires. The same provision will also be applicable to the sub-vendors. Further, in case of discontinuance of manufacture of any spares by the vendors or his sub-vendors the vendors and his sub-vendors, will provide the BHEL and the customer, 2 (two) years in advance, with full manufacturing drawings, material specifications and technical information required by the BHEL and the customer for the purpose of manufacture of such items and also the right to manufacture such spares for their own requirements.
4. Further in case of discontinuance of supply of spares by the vendors or his sub-vendors, the vendor will provide the BHEL and the customer with full information for replacement of such spares with other equivalent makes, if so required by the BHEL and the customer.
5. Notwithstanding the above, the vendor shall be responsible for supply of spares for the lifetime of the package at reasonable prices. The prices of all future requirements of spares shall be derived from the corresponding ex-works price at which the orders for such spares have been placed by the BHEL and the customer as a part of the mandatory or long term or any other kind of spares. The base indices for calculating ex-works price shall be commissioning of last equipment under main contract.
 - i) In case of emergency requirements of spares, the vendor would make every effort to expedite the manufacture and delivery of such spares on the basis of mutually agreed time schedule.
 - ii) In case the vendor fails to supply the mandatory or long term or any other kind of spares on the terms stipulated above, the BHEL and the customer shall be entitled to purchase the same from the alternate sources at the risk and the cost of the vendor and recover from the vendor, the excess amount paid by the BHEL and the customer over the rates as per the contract. In the event of such risk purchase by the BHEL or the customer, the purchases will be as per the works and procurement policy of the BHEL and the customer prevalent at the time of such purchases and BHEL & the customer at his option may include a representative from the vendor in finalizing the purchases.
 - iii) It is expressly understood that the final settlement between the parties in terms of relevant clauses of the tender document shall not relieve the vendor of any of his obligations under the provision of long term availability of spares and such provisions shall continue to be enforced till the expiry of 30 (thirty) years period reckoned from the scheduled date of completion of trial operation of the last equipment unless otherwise discharged expressly in writing by the BHEL or the customer.

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ANNEXURE VI:

LIST OF ERECTION & COMMISSIONING SPARES



TITLE:
**2 X 800 MW UPPUR STPP (STAGE-I, UNIT 1
& 2) BTG PACKAGE**

**TECHNICAL SPECIFICATION FOR
CHEMICAL DOSING SYSTEM**

SPECIFICATION NO. PE-TS-425-154-A001

SECTION I

SUB SECTION - I A

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LIST OF COMMISSIONING SPARES

SL. NO.	ITEM DESCRIPTION	Quantity per skid (No.)	Total Nos.
1.0	HYDRAZINE DOSING SYSTEM		
1.1	Oil Seals for drive end.	4	8
1.2	Gaskets for drive end	4	8
1.3	Guide ring for plunger.	4	8
1.4	Teflon rings for valve/s.	8	16
1.5	Level gauge glass	2	4
1.6	Back up fuse	3	6
1.7	Pilot lamp	2	4
1.8	Push Button	2	4
1.9	Control fuse	2	4
1.10	Bulb for Annunciation	4	8
2.0	AMMONIA DOSING SYSTEM		
2.1	Oil Seals for drive end.	4	8
2.2	Gaskets for drive end	4	8
2.3	Guide ring for plunger.	4	8
2.4	Teflon rings for valves.	8	16
2.5	Level gauge glass	2	4
2.6	Back up fuse	3	6
2.7	Pilot lamp	2	4
2.8	Push Button	2	4
2.9	Control fuse	2	4
2.10	Bulb for Annunciation	4	8
3.0	NaOH DOSING SYSTEM		
3.1	Oil Seals for drive end.	4	8
3.2	Gaskets for drive end	4	8
3.3	Guide ring for plunger.	4	8
3.4	Teflon rings for valve/s.	8	16
3.5	Level gauge glass	2	4
3.6	Back up fuse	3	6
3.7	Pilot lamp	2	4
3.8	Push Button	2	4
3.9	Control fuse	2	4
3.10	Bulb for Annunciation	4	8

Notes: -

- Any other commissioning spare/ special tools and tackles required for the commissioning of the bidder's chemical dosing skids shall be in bidder's scope and same shall be supplied by bidder as part of his base offer and the same shall be mentioned specifically by the bidder in the un-priced schedule.
- All the commissioning spares provided shall be strictly of the same make and specification of the items it shall replace and shall be perfectly interchangeable.
- All the commissioning spares shall be separately packed and properly marked for easy identification at site.

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		SECTION I
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ANNEXURE VII

DRAWING / DOCUMENTS SUBMISSION SCHEDULE

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	2 X 800 MW UPPUR STPP (STAGE-I, UNIT 1 & 2) BTG PACKAGE	SECTION I
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DRAWING/ DOCUMENTS SUBMISSION SCHEDULE

After award of LOI, following minimum drawing/ documents shall be submitted by the bidder for BHEL and Customer approval. However any additional drawing/document if found necessary for completion of the engineering, the same shall be submitted by bidder without any commercial & delivery implication to BHEL.

For the Drawings/ Documents Distribution procedure, please refer Annexure-III. The submission of soft copy or hard copy of the drawing/document whichever is later will be considered as final date of submission of the drawing/ documents. The bidder has to submit the revised drawing/document along with the compliance sheet indicating enumerate reply to all BHEL and customer comments or observations. Without compliance sheet the submission of the drawings/ documents will not be considered and the delay on this account will be solely on bidder's side only. Bidder to comply with the observations of the BHEL and CUSTOMER without price & delivery implication.

Bidder to further note that drawings submitted shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. Engineering meeting shall be held fort nightly, for which the bidder shall depute his concerned engineer along with project manager to BHEL PEM office or at customer office. The meeting can also be held at site.

List and schedule of drawings/documents to be submitted after award of contract:-

S. No.	Drawing/ document No.	Drawing/ document Title	No. of weeks for drawing/ document submission after placing LOI/ PO
1.	PE-V0-412-154-A001	P&I DIAGRAM FOR CHEMICAL DOSING SYSTEM	2
2.	PE-V0-412-154-A002	TECHNICAL DATA SHEET-CHEMICAL DOSING SYSTEM	4
3.	PE-V0-412-154-A003	GA DRAWING & FOUNDATION DETAILS	2
4.	PE-V0-412-154-A004	LOCAL CONTROL PANEL (INCLUDING WIRING DIAGRAM, LOGIC DIAGRAM AND FIELD TERMINATION DETAILS) - CDS	4
5.	PE-V0-412-154-A005	QAP FOR CHEMICAL DOSING SYSTEM	2
6.	PE-V0-412-154-A006	O&M MANUAL FOR CHEMICAL DOSING SYSTEM	16

NOTES:-

- Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.
- In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion. However, in case changes are necessitated due to any constraints at customer end, delay in review/ approval of such revised drawing beyond one month will be to customer's account.
- Bidder to note that drawings/documents submission shall be through web based Document Management System. Bidder would be provided access to the DMS for drawings/documents approval

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and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end.

- a) Internet explorer version – Minimum Internet Explorer 7
- b) Internet speed – 2 mbps (Minimum preferred)
- c) Pop ups from our external DMS IP (124.124.36.198) should not be blocked
- d) Vendor's internal proxy setting should not block DMS application's link (<http://124.124.36.198/wrenchwebaccess/login.aspx>)
- e) DMS user manuals to be used by BHEL PEM vendors for uploading, viewing, revising, commenting and tracking documents on PEM's DMS have been uploaded on PEM internet website (www.bhelpem.com) under the Vendor session.
- f) For quick access bidder may refer the link <http://bhelpem.com/DMSManuals/DMSManuals.html>

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	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	SUB SECTION - I A
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ANNEXURE VIII:

FORMAT FOR OPERATION AND MAINTENANCE MANUAL

	TITLE:	SPECIFICATION NO. PE-TS-425-154-A001
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	CHEMICAL DOSING SYSTEM	REV.NO. 0 DATE : 15.11.2017

ANNEXURE-VIII
FORMAT FOR OPERATION AND MAINTENANCE MANUAL

Bidder to submit operation and Maintenance manual with minimum information as listed in below check list during contract stage.

Check List for Operation & Maintenance Manual

Project name :
Project number :
Package Name :
PO reference :
Document number :
Revision number :

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
1.	Cover page				
1.1	Project Name				
1.2	Customer/ consultant Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX ,email address, Emergency Contact number				
1.5	Name and sign of prepared by, checked by & approved by				
1.6	Revision history with approval Details				
2.0	Index				
2.1	Showing the sections & related page nos. All the pages should be numbered section wise				
3.0	Description of Plant/ System				
3.1	Description/ write up of operating principle of system equipment/ associated sub-systems & accessories/controls system, operating conditions, performance parameters under normal , start up and special cases				
3.2	Equipment list and basic parameter with Tag numbers				
3.3	Data sheets approved by Customer/ for information and catalogues provided by original manufacturer				
3.4	Associated other packages and Interface/ terminal points				
3.5	P&ID & Process Diagrams				
3.6	GA Layout drawings, As-built drawings, Actual photograph of items/ system (Drawings of A2 & bigger sizes are to be attached in the last)				
3.7	Single line/ wiring diagrams				
3.8	Control philosophy/ control write-ups				
4.0	Commissioning Activities (if not covered in separate document i.e. erection manual, commissioning manual)				
4.1	Pre-Commissioning Checks				
4.2	Handling of items at site				
4.3	Storage at site				

	TITLE:	SPECIFICATION NO. PE-TS-425-154-A001
	2 X 800 MW UPPUR STPP (STAGE-I, UNIT 1 & 2) BTG PACKAGE	SECTION I
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	SUB SECTION - I A
		REV.NO. 0 DATE : 15.11.2017

4.4	Unpacking & Installation procedure				
5.0	Operation Guidelines for plant personal/ user/ operator				
5.1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
5.2	Start up, normal operation and shut down procedure for equipment along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5.3	Do's & Don't of the equipment.				
5.4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5.5	Parameters to be monitored with normal values and limiting values				
5.6	Trouble shooting with causes and remedial measures				
5.7	Routine operational checks, recommended logs & records				
5.8	Changeover schedule if more than one auxiliary for the same purpose is given				
5.9	Painting requirement and schedule				
5.10	Inspection, repair, Testing and calibration procedures				
6.0	Maintenance guidelines for plant personal				
6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				
6.3	Preventive Maintenance & Overhauling schedules linked with running hours/ calendar period along with checks to be given				
6.4	Long term maintenance schedules especially for structural, foundations etc.				
6.5	Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/handling requirement of consumables/self-life.				
6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest addresses, service centres, Telephone Nos.,				

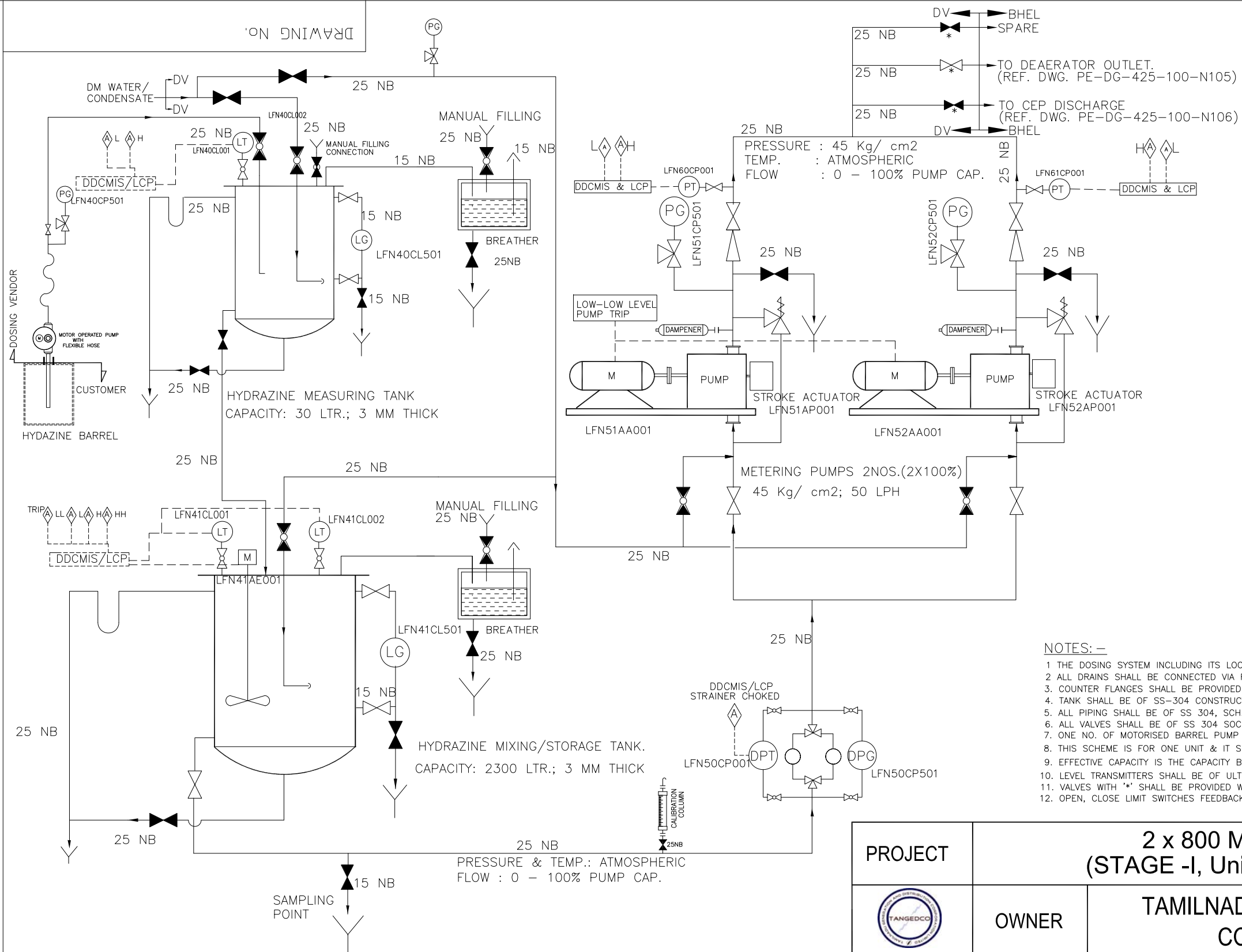
	TITLE:	SPECIFICATION NO. PE-TS-425-154-A001
	2 X 800 MW UPPUR STPP (STAGE-I, UNIT 1 & 2) BTG PACKAGE	SECTION I
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	SUB SECTION - I A
		REV.NO. 0 DATE : 15.11.2017

	Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts list				
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				
6.10	Guarantee and warranty clauses				
7.0	Statutory and other specific requirements considerations.				
8.0	List of reference documents				
9.0	Binding as per requirement				

	TITLE:	SPECIFICATION NO. PE-TS-425-154-A001
	2 X 800 MW UPPUR STPP (STAGE-I, UNIT 1 & 2) BTG PACKAGE	SECTION I
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	SUB SECTION - I A
		REV.NO. 0 DATE : 15.11.2017

P&IDs FOR CHEMICAL DOSING SYSTEM

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L E G E N D	
	GATE VALVE NORMALLY OPEN
	GATE VALVE NORMALLY CLOSED
	NON RETURN VALVE
	GLOBE VALVE NORMALLY OPEN
	PRESSURE RELIEF VALVE
	THREE WAY VALVE
	VENT TO ATMOSPHERE
	FUNNEL
	PRESSURE GAUGE
	LEVEL GAUGE
	MOTOR OPERATED (AC)
	GLOBE VALVE NORMALLY CLOSED
	LEVEL TRANSMITTER.
	DUPLEX FILTER
	DIFF PRESSURE TRANSMITTER
	DIFFERENTIAL PRESSURE GAUGE
	PRESSURE TRANSMITTER.
	LEVEL TRANSMITTER.

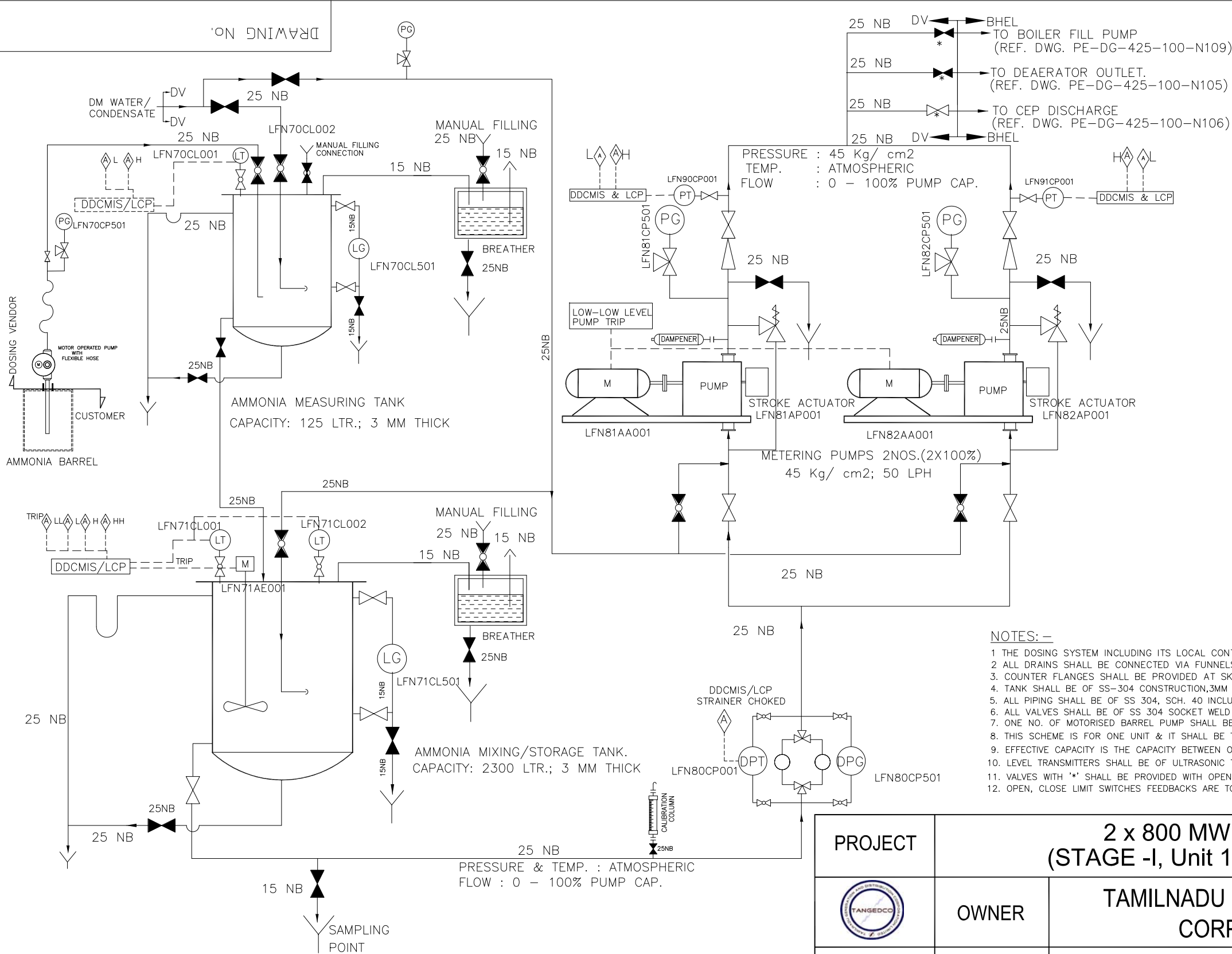
- NOTES: –
- 1. THE DOSING SYSTEM INCLUDING ITS LOCAL CONTROL PANEL SHALL BE SKID MOUNTED.
 - 2. ALL DRAINS SHALL BE CONNECTED VIA FUNNELS TO MAIN DRAIN HEADER AND TERMINATED AT ONE POINT ON SKID.
 - 3. COUNTER FLANGES SHALL BE PROVIDED AT SKID INLET & OUTLET TERMINAL POINTS.
 - 4. TANK SHALL BE OF SS-304 CONSTRUCTION, 3MM THICK.
 - 5. ALL PIPING SHALL BE OF SS 304, SCH. 40 INCLUDING DRAIN PIPES.
 - 6. ALL VALVES SHALL BE OF SS 304 SOCKET WELD ENDS.
 - 7. ONE NO. OF MOTORISED BARREL PUMP SHALL BE SUPPLIED WITH ONE SKID.
 - 8. THIS SCHEME IS FOR ONE UNIT & IT SHALL BE TYPICAL FOR OTHER UNIT.
 - 9. EFFECTIVE CAPACITY IS THE CAPACITY BETWEEN OVERFLOW LEVEL & LOW LEVEL SET POINT.
 - 10. LEVEL TRANSMITTERS SHALL BE OF ULTRASONIC TYPE & LT SHALL BE PROVIDED WITH AN ISOLATION VALVE.
 - 11. VALVES WITH '*' SHALL BE PROVIDED WITH OPEN, CLOSE LIMIT SWITCHES FOR FEEDBACK IN DDCMIS.
 - 12. OPEN, CLOSE LIMIT SWITCHES FEEDBACKS ARE TO BE CONNECTED TO DDCMIS.

PROJECT		2 x 800 MW UPPUR STPP (STAGE -I, Unit 1 & 2)- BTG Package					
		OWNER	TAMILNADU GENERATION & DISTRIBUTION CORPORATION LIMITED				
		OWNER'S CONSULTANT:-	TRACTEBEL ENGINEERING PRIVATE LIMITED				
 BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NEW DELHI		DEPT CODE		NAME	SIGN	DATE	
		A	DRN	DK		28.04.2017	
			DESN	MA/AKS		28.04.2017	
			CHD	JP		28.04.2017	
			APPD	PK		28.04.2017	
TITLE P&I DIAGRAM FOR HYDRAZINE DOSING SYSTEM		DRAWING No. PE-DG-425-154-A001					
		SHEET 01 OF 01			REV 00		

COMPUTER FILE NAME :

REV. 01	DATE 12.7.2017	ALTD DK	CHD MA/AKS/JP	APPD PK	JOB No. 425
REVISED AS PER CUSTOMER COMMENTS					STATUS CONTRACT
					DISTRIBUTION

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- NOTES: -
- 1 THE DOSING SYSTEM INCLUDING ITS LOCAL CONTROL PANEL SHALL BE SKID MOUNTED.
 - 2 ALL DRAINS SHALL BE CONNECTED VIA FUNNELS TO MAIN DRAIN HEADER AND TERMINATED AT ONE POINT ON SKID.
 3. COUNTER FLANGES SHALL BE PROVIDED AT SKID INLET & OUTLET TERMINAL POINTS.
 4. TANK SHALL BE OF SS-304 CONSTRUCTION, 3MM THICK.
 5. ALL PIPING SHALL BE OF SS 304, SCH. 40 INCLUDING DRAIN PIPES.
 6. ALL VALVES SHALL BE OF SS 304 SOCKET WELD ENDS.
 7. ONE NO. OF MOTORISED BARREL PUMP SHALL BE SUPPLIED WITH ONE SKID.
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 9. EFFECTIVE CAPACITY IS THE CAPACITY BETWEEN OVERFLOW LEVEL & LOW LEVEL SET POINT.
 10. LEVEL TRANSMITTERS SHALL BE OF ULTRASONIC TYPE & LT SHALL BE PROVIDED WITH AN ISOLATION VALVE.
 11. VALVES WITH '*' SHALL BE PROVIDED WITH OPEN, CLOSE LIMIT SWITCHES FOR FEEDBACK IN DDCMIS.
 12. OPEN, CLOSE LIMIT SWITCHES FEEDBACKS ARE TO BE CONNECTED TO DDCMIS.

PROJECT		2 x 800 MW UPPUR STPP (STAGE -I, Unit 1 & 2)- BTG Package					
		OWNER	TAMILNADU GENERATION & DISTRIBUTION CORPORATION LIMITED				
		OWNER'S CONSULTANT:-	TRACTEBEL ENGINEERING PRIVATE LIMITED				
 BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NEW DELHI		DEPT CODE		NAME	SIGN	DATE	
		A	DRN	DK		28.04.2017	
			DESN	MA/AKS		28.04.2017	
			CHD	JP		28.04.2017	
			APPD	PK		28.04.2017	
TITLE P&I DIAGRAM FOR AMMONIA DOSING SYSTEM		DRAWING No. PE-DG-425-154-A002					
		SHEET 01 OF 01			REV 00		

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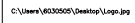
REV.	DATE	ALTD	CHD	APPD	JOB No.
01	12.7.2017	DK	MA/AKS/JP	PK	425
REVISED AS PER CUSTOMER COMMENTS					STATUS
					CONTRACT
					DISTRIBUTION

[illegible]

	METERING PUMP
	PUMP MOTOR
	GATE VALVE NORMALLY OPEN
	GATE VALVE NORMALLY CLOSED
	NON RETURN VALVE
	GLOBE VALVE NORMALLY OPEN
	PRESSURE RELIEF VALVE
	MULTI VALVE MANIFOLD
	VENT TO ATMOSPHERE
	FUNNEL
	PRESSURE GAUGE
	LEVEL GAUGE
	STIRRER MOTOR
	GLOBE VALVE NORMALLY CLOSED
	LEVEL TRANSMITTER
	DUPLEX STRAINER
	DIFFERENTIAL PRESSURE TRANSMITTER
	DIFFERENTIAL PRESSURE GAUGE
	PRESSURE TRANSMITTER
	STIRRER
	CHEMICAL SEAL DIAPHRAGM
	ALARM
	INTERLOCK
	STUFFING BOX

1. THE DOSING SYSTEM INCLUDING ITS LOCAL CONTROL PANEL SHALL BE SKID MOUNTED.
2. ALL DRAINS SHALL BE CONNECTED VIA FUNNELS TO MAIN DRAIN HEADER AND TERMINATED AT ONE POINT ON SKID.
3. COUNTER FLANGES SHALL BE PROVIDED AT SKID INLET & OUTLET TERMINAL POINTS.
4. TANK SHALL BE OF SS-304 CONSTRUCTION, 3MM THICK.
5. ALL PIPING SHALL BE OF SS 304, SCH. 40 INCLUDING DRAIN PIPES.
6. ALL VALVES SHALL BE OF SS 304 SOCKET WELD ENDS.
7. THIS SCHEME IS FOR ONE UNIT & IT SHALL BE TYPICAL FOR OTHER UNIT.
8. EFFECTIVE CAPACITY IS THE CAPACITY BETWEEN OVERFLOW LEVEL & LOW LEVEL SET POINT.
9. LEVEL TRANSMITTERS SHALL BE OF ULTRASONIC TYPE LT & THIS SHALL BE PROVIDED WITH AN ISOLATION VALVE.
10. VALVES WITH '*' SHALL BE PROVIDED WITH OPEN, CLOSE LIMIT SWITCHES FOR FEEDBACK IN DDCMS.
11. OPEN, CLOSE LIMIT SWITCHES FEEDBACKS ARE TO BE CONNECTED TO DDCMS.

REV.	DATE	ALTD	CHD	APPD	JOB No. 425
01	12.7.2017	DK	MA/AKS/JP	PK	
	REVISED AS PER CUSTOMER COMMENTS				STATUS CONTRACT
					DISTRIBUTION

PROJECT		2 x 800 MW UPPUR STPP (STAGE -I, Unit 1 & 2)- BTG Package						
		OWNER	TAMILNADU GENERATION & DISTRIBUTION CORPORATION LIMITED					
		OWNER'S CONSULTANT:-	TRACTEBEL ENGINEERING PRIVATE LIMITED					
		BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NEW DELHI		DEPT CODE		NAME	SIGN	DATE
				A	DRN	DK		28.04.2017
					DESN	MA/AKS		28.04.2017
					CHD	JP		28.04.2017
					APPD	PK		28.04.2017
TITLE		P&I DIAGRAM FOR NaOH DOSING SYSTEM			DRAWING No. PE-DG-425-154-A003			
					SHEET 01 OF 01		REV	00

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COMPUTER FILE NAME :

	TITLE: 2 X 800 MW UPPUR STPP (STAGE-I, UNIT 1 & 2) BTG PACKAGE	SPECIFICATION NO. PE-TS-425-154-A001	
		SECTION I	
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	SUB SECTION - I A	
		REV.NO. 0	DATE : 15.11.2017

DATA SHEET - A

S. NO	DESCRIPTION	HYDRAZINE DOSING	AMMONIA DOSING	NaOH DOSING
1.0 a	No. of skid(s) per unit	One (1)	One (1)	One (1)
1.0 b	Total skid(s) for station	Two (2)	Two (2)	Two (2)
2.0	Measuring tank:			
2.1	No. of tanks per Skid	One	One	NA
2.2	Capacity in litres	30	125	NA
2.3	Type	Vertical cylindrical, dished bottom tank	Vertical cylindrical, dished bottom tank	NA
2.4	Material of the tank	SS-304	SS-304	NA
2.5	Thickness	3 mm	3 mm	NA
2.6	Motorised Stirrer	NA	NA	NA
2.7	Dissolving basket	NA	NA	NA
2.8	MOC of stirrer	NA	NA	NA
2.9	Design Standard	IS 803/API 650	IS 803/API 650	NA
3.0	Mixing cum storage tank			
3.1	No. of tanks per Skid	One	One	One
3.2	Capacity in litres	2300	2300	500
3.3	Type	Vertical cylindrical, Bottom Dished end.	Vertical cylindrical, Bottom Dished end.	Vertical cylindrical, Bottom Dished end.
3.4	Material of the tank	SS-304	SS-304	SS-304
3.5	Thickness	3 mm	3 mm	6 mm
3.6	Motorised Stirrer	Propeller type with slow speed reduction gear unit		
3.7	Dissolving basket	NA	NA	Provided(50Mesh BS)
3.8	MOC -Dissolving basket	NA	NA	SS 316
3.9	MOC of stirrer	SS 316	SS 316	SS 316
3.10	Design Standard	IS 803/API 650	IS 803/API 650	IS 803/API 650
4.0	Metering pump:			
4.1	Medium to be handled	Hydrazine solution	Ammonia solution	NaOH solution
4.2	Type of pump	-----Positive displacement (Plunger type) metering pump-----		
4.3	Make of pump	As per approved sub vendor list during detailed engineering		
4.4	Nos. of pump-motor assembly	Two (2 × 100%)	Two (2 × 100%)	Two (2 × 100%)
4.5	Capacity	0-50 LPH	0-50 LPH	0-10 LPH
4.6	Discharge pressure	45 Kg/Cm ² (g)	45 Kg/Cm ² (g)	10 Kg/Cm ² (g)
4.7	All Wetted parts of pumps	SS-316	SS-316	SS-316
4.8	Applicable standard	API 675	API 675	API 675
4.9	Type of stroke control	Local manual & automatic		
4.10	Connection at suction, Position	1" ANSI B16.5 #150, bottom		
4.11	Connection at discharge, Position	1" ANSI B16.5 #300, top		
5.0	Strainers:			

	TITLE: 2 X 800 MW UPPUR STPP (STAGE-I, UNIT 1 & 2) BTG PACKAGE	SPECIFICATION NO. PE-TS-425-154-A001	
		SECTION I	
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	SUB SECTION - I A	
		REV.NO. 0	DATE : 15.11.2017

5.1	No. of strainers	One	One	One
5.2	Type	Duplex type	Duplex type	Duplex type
5.3	Material of screen	SS-304	SS-304	SS-304
5.4	Mesh Size	50 (BS)	50 (BS)	50 (BS)
6.0	Main, Drain & Overflow Piping:			
6.1	Material	ASTM A 312 GR TP 304 SCH 40	ASTM A 312 GR TP 304 SCH 40	ASTM A 312 GR TP 304 SCH 40
6.2	Diameter	25 NB	25 NB	25 NB
7.0	Sampling & Vent Pipe:			
7.1	Material	ASTM A 312 GR TP 304 SCH 40	ASTM A 312 GR TP 304 SCH 40	ASTM A 312 GR TP 304 SCH 40
7.2	Diameter	15 NB	15 NB	15 NB
8.0	Main Drain Header:			
8.1	Material	ASTM A 312 GR TP 304 SCH 40	ASTM A 312 GR TP 304 SCH 40	ASTM A 312 GR TP 304 SCH 40
8.2	Diameter	40 NB	40 NB	40 NB
9.0	Valves:			
9.1.00	Gate & Globe valves	The following parameters are applicable for all three systems.		
9.1.01	Body, Bonnet, Stem	ASTM A182 Gr. TP 304. Material for Stem shall be SS 316.		
9.1.02	Design standard	ANSI B 16.34/API 602 for gate valves, BS 5352 for globe valve		
9.1.03	Test standard	API 598		
9.1.04	Size	As per P&ID		
9.1.05	End Connections	SW ANSI B 16.11		
9.1.06	Rating	-----Class ASA 800-----		
9.1.07	Valve operation	Manual		
9.2.00	Check valves/ NRV			
9.2.01	Body, cover, disc/piston	ASTM A182 Gr. TP 304	ASTM A182 Gr. TP 304	ASTM A182 Gr. TP 304
9.2.02	Design standard	ANSI B 16.34/API 602	ANSI B 16.34/API 602	ANSI B 16.34/API 602
9.2.03	Test standard	API 598/MSS-SP-61	API 598/ MSS-SP-61	API 598/ MSS-SP-61
9.2.04	Size	25 NB	25 NB	25 NB
9.2.05	End Connections	SW ANSI B 16.11	SW ANSI B 16.11	SW ANSI B 16.11
9.2.06	Rating	-----Class ASA 800-----		
9.2.07	Valve operation	Manual	Manual	Manual
9.3.00	Pressure relief valve (PRV)			
9.3.01	Body, bonnet, disc, nozzle	ASTM A182 Gr. TP 316	ASTM A182 Gr. TP 316	ASTM A182 Gr. TP 316
9.3.02	Valve discharges to	Mixing/storage Tank	Mixing/storage Tank	Mixing/storage Tank
9.3.03	Back pressure	Constant	Constant	Constant
9.3.04	Set pressure	50 Kg/Cm ²	50 Kg/Cm ²	12 Kg/Cm ²
9.3.05	Inlet Connections	25 NB, Flanged, ANSI B16.5, 300#	25 NB, Flanged, ANSI B16.5, 300#	25 NB, Flanged, ANSI B16.5, 300#
9.3.06	Outlet Connections	25 NB, Flanged, ANSI B16.5, 150#	25 NB, Flanged, ANSI B16.5, 150#	25 NB, Flanged, ANSI B16.5, 150#

	TITLE:	SPECIFICATION NO. PE-TS-425-154-A001
	2 X 800 MW UPPUR STPP (STAGE-I, UNIT 1 & 2) BTG PACKAGE	SECTION I
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	SUB SECTION - I A
		REV.NO. 0 DATE : 15.11.2017

10.0	Fittings	Forged steel to A182 F304, Dimension to ANSI B 16.11 socket weld ends.		
11.0	Flanges (pump suction / pump discharge)	-----ANSI B 16.5 CL 150 / ANSI B 16.5 CL 300 -----		
12.0	Structural steel	IS 2062	IS 2062	IS 2062
13.0	Motorised barrel pump	One (1) no., Wetted Part MOC: SS-304. <u>Solution strength: 30%.</u>	One (1) no., Wetted Part MOC: SS-304. <u>Solution strength: 50%.</u>	NA
14.0	Step ladder with platform	IS 2062	IS 2062	IS 2062
15.0	Nut & Bolt	ASTM A-193 Gr B7 and ASTM A-194 Gr. 2H respectively.	ASTM A-193 Gr B7 and ASTM A-194 Gr. 2H respectively.	ASTM A-193 Gr B7 and ASTM A-194 Gr. 2H respectively.



TITLE:
**2 X 800 MW UPPUR STPP (STAGE-I, UNIT 1
& 2) BTG PACKAGE**

**TECHNICAL SPECIFICATION FOR
CHEMICAL DOSING SYSTEM**

SPECIFICATION NO. PE-TS-425-154-A001
SECTION I

SUB-SECTION - IB

REV.NO. 0 DATE : 15.11.2017

SECTION I-B: SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)



**ELECTRICAL EQUIPMENT SPECIFICATION
FOR
CHEMICAL DOSING SYSTEM**

**2 X 800 MW UPPUR STPP (STAGE-I, UNIT 1 & 2)
BTG PACKAGE**

SPECIFICATION NO.
VOLUME
SECTION
REV
PAGE 1 OF 1

SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER/ PURCHASER

- a) Services and equipment as per "Electrical Scope between BHEL and Vendor".
- b) Any item/ work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.
- c) Supply of mandatory spares as specified in the specifications of mechanical equipment.
- d) Electrical load requirement for Chemical Dosing System.
- e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
- f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer/ BHEL approval without any commercial and delivery implications to BHEL.
- g) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals, etc. shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.
- h) Motor shall meet minimum requirement of motor specification.
- i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
- j) Cable BOQ worked out based on routing of cable listing provided by the vendor for "both end equipment in vendor's scope" shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.
- k) Technical requirements shall be as per specifications listed in Clause 3.1, 3.2, 3.3, 3.4 & 3.5. In case of any discrepancy between Customer specification and BHEL standard specification, Customer specification shall prevail.

2.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

- 2.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of compliance certificate/No deviation certificate.
- 2.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc. is required during tender stage. Any such submission even if made, shall not be considered as part of offer

3.0 LIST OF ENCLOSURES

- 3.1 Electrical scope between BHEL & vendor (Annexure-I).
- 3.2 Technical specification – Customer specification for Motors.
- 3.3 Technical specification – Customer specification for LT Power Cable and Control Cable.
- 3.4 Technical specification – Customer specification requirement for cabling system.
- 3.5 Technical specification – Customer specification requirement for Earthing & Lighting.
- 3.6 BHEL standard specification for LT motors : PE-SS-999-506-E101
- 3.7 Motor Datasheet – A & Data Sheet- C.
- 3.8 Load data format (Annexure-II).

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

PACKAGE: CHEMICAL DOSING SYSTEM

SCOPE OF VENDOR: SUPPLY

PROJECT: 2 X 800 MW UPPUR STPP

<u>S.NO</u>	<u>DETAILS</u>	<u>SCOPE SUPPLY</u>	<u>SCOPE E&C</u>	<u>REMARKS</u>
1	415V MCC	BHEL	BHEL	240 V AC (supply feeder)/415 V, 3 phase, 4 wire AC supply shall be provided by BHEL. Based on the load data provided by the vendor at contract stage for all equipment supplied by the vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor. Starter for single phase motor (if applicable) shall be in vendor's scope. BHEL shall provide only single phase supply feeder.
2	Local control panel	Vendor	Vendor*	Refer C&I specification for details.
3	Local push buttons	Vendor	Vendor*	
4	Power cables, ordinary control cables and screened control cables	Vendor	Vendor*	Within the skid. If starters are in MCC, then outside skid, cables scope shall be as per note no. 1.
5	Junction box for control & instrumentation cable (if applicable)	Vendor	Vendor*	
6	Any special type of cable like compensating, co-axial, prefab, MICC & fibre optical	Vendor	Vendor*	Within the skid.
7	Equipment grounding	Vendor	Vendor*	Within the skid. All equipment metallic enclosures / frames, metal structure etc. shall be grounded at two points each to the nearest grounding points / risers provided by BHEL.
8	Motors with base frame and fixing hardware for motors.	Vendor	Vendor*	Makes shall be subject to customer/ BHEL approval at contract stage.

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR FOR SKID MOUNTED SYSTEM (FOR EPC PROJECTS)**PACKAGE: CHEMICAL DOSING SYSTEM****SCOPE OF VENDOR: SUPPLY****PROJECT: 2 X 800 MW UPPUR STPP**

9	Cable glands ,lugs and bimetallic strip for equipment 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 and control cables.
10	Below grade grounding	BHEL	BHEL	
11	a) Input cable schedules (C & I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
12	Electrical Equipment GA drawing & skid GA drawing	Vendor	-	For necessary interface review.

NOTES: - 1. If motor starters are provided in main MCC then BHEL will provide power & control cable including supply, laying & termination.
 2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.

*E & C by vendor during factory assembling of the skid.

[illegible]

	TITLE LV MOTORS <u>DATA SHEET-A</u>		SPECIFICATION NO.	
			VOLUME	
			SECTION	
			REV NO. 00	DATE
			SHEET 1	OF 1

1.0	Design ambient temperature	:	50 °C
2.0	Maximum acceptable kW rating of LV motor	:	Upto 200KW
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Degree of Protection	:	IP55
5.0	Cooling	:	TEFC
6.0	Details of supply system		
a)	Rated voltage (with variation)	:	415V ± 10%
b)	Rated frequency (with variation)	:	50 Hz (Variation: +3% TO –5%)
c)	Combined voltage & freq. variation	:	10% (sum of absolute values)
d)	System fault level at rated voltage	:	50 kA for 1 sec
e)	Short time rating for terminal box	:	50 kA for 0.25 sec
f)	LV System grounding	:	Solidly
7.0	Class of insulation	:	Class ‘F’, with temp rise limited to class B
8.0	Minimum voltage for starting (As percentage of rated voltage)	:	80% of rated voltage
9.0	Power cables data	:	Shall be given during detailed engg.
10.0	Earth Conductor Size & Material	:	Shall be given during detailed engg.
11.0	Space heater supply (30KW & ABOVE)	:	240 V, 1Φ , 50 Hz
12.0	Rating up to which Single phase motor	:	Acceptable below 0.20 Kw
13.0	TYPE OF STARTER PROVIDED IN MCC	:	DOL
14.0	Locked rotor current		
a)	Limit as percentage of FLC	:	As per IS 12615
b)	Permissible tolerance, if any	:	
15.0	Additional tests	:	As per QP
16.0	Flame-proof motor		
a)	Enclosure suitable (As per IS: 2148)	:	As per requirement
b)	Classification of Hazardous area (As per IS: 5572 part-I)	:	As per requirement
c)	Degree of protection	:	IP65
17.0	Makes	:	AS PER ANNEXURE-I (Sub-vendor list)
18.0	Terminal box	:	Suitable to rotate at 90 degrees
19.0	Paint shade	:	RAL 5012
20.0	Efficiency class	:	IE3

NOTE: Detailed Customer spec. for Motors is also to be referred as enclosed with the technical spec.

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TITLE:
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1 & 2) BTG PACKAGE**

**TECHNICAL SPECIFICATION FOR
CHEMICAL DOSING SYSTEM**

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SECTION I

SUB SECTION - IC

REV.NO. 00 DATE : 15.11.2017

SECTION – IC: SPECIFIC TECHNICAL REQUIREMENTS (C&I)



TITLE:
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SPECIFIC TECHNICAL REQUIREMENTS (C&I) WITH SCOPE OF SUPPLY

1. CHEMICAL DOSING SYSTEM shall be controlled from DCS through operator work stations located in control room (BHEL Scope). Also refer to the standard block diagram for further information.
2. The Contractor shall provide complete Instrumentation and Control for monitoring and operation of entire Chemical dosing system. The requirement given are to be read in conjunction with detailed Technical specification enclosed. Further in case of any discrepancy in the requirement within the same or different section, as noted by the bidder in the specification, the same will be brought to the notice of BHEL in the form of pre- bid clarification. In absence of any pre-bid clarification, the more stringent requirement as per interpretation of BHEL/customer shall prevail without any commercial implication. Local control panel required for operation is in bidder's scope.
3. The make/ model of various instruments/items/systems shall be as per the attached Vendor list. However, the make/model of various instruments/ items shall be subject to approval of owner/ purchaser during detailed engineering stage. No commercial/ time implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements, as per customer interpretation, among them are to be complied with.
4. Number of pairs to be selected for Screen Control cable (Size: 0.5 mm²)
 - F-Type: 2P/4P/8P/12P/20P
 - G-Type: 2P/4P/8P/12P
 - Core Cable: 3CX2.5sqmm² / 12CX1.5sqmm²
(also shown in Drive control philosophy).
5. Regarding the supply scope of cables, please refer the "Standard scope matrix of cables" in Electrical portion of the technical specification.
6. Bidder to provide mandatory spares as per Mandatory Spares List enclosed with the technical specification.
7. The bidders shall specifically mention any deviation they would like to take on the C&I specification. In absence of any deviation, a "No deviation" certificate is to be furnished.
8. All field instruments shall be weatherproof, drip tight, dust tight and splash proof suitable for use under outdoor ambient conditions prevalent in the subject plant. All field-mounted instruments shall be mounted in suitable locations where maximum accessibility for maintenance is achieved. The enclosures of all electronic instruments shall conform to IP-65 unless otherwise specified and an anticorrosive paint shall be applied to the field mounted enclosures/ instruments. All the field instruments shall also be provided with SS tag nameplate and double compression type Nickel-plated brass cable gland.

Gaskets, Fasteners, Counter and mating flange (SS316 material), nuts & bolts etc. shall also be included, wherever required with the field instruments. Components of instruments, control devices, accessories, piping etc. which contact with steam, condensate or boiler feed water shall be manufactured from copper free materials which do not react with media at operating parameters.

All wetted parts of instrument shall be suitable for sea water application (Duplex stainless steel or better) if applicable. Instruments, fittings, valves etc. shall be suitable for the hazardous area application.

Material described in the specification (for instrument, equipment, accessories etc. are the minimum requirements, which shall be complied by bidder. Any other better material shall also be considered to suit the process and environmental conditions at site subject to owner's approval. Material, if found not suitable shall be changed without any price/time implication.

All Field Instruments used in acid or alkaline atmosphere shall be with standard anti corrosion coating i.e. the combination of Polyurethane and epoxy resin baked coating (ANSI/ISA-71.04). The junction boxes and instruments / electronics housing used shall be made of non – corrosive material.



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Painting Process/ procedure & Painting material shall be suitable for sea water and saline conditions at site in line with national and international standards like ASTM, ISO etc.

9. The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold, junction boxes and all the other accessories required for mounting/ erection of these local instruments shall be provided by bidder, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments; sensors, etc. for external connection including spare contacts shall be wired out to suitably located junction boxes by bidder.
10. The quantity of instruments for the 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 implication.
11. Use of process actuated switches shall be avoided unless unavoidable.
12. Non-contact type level transmitters like Ultrasonic, Radar based (Type as per Owner Approval) shall be provided by bidders as specified in the specification and as approved by owner.
13. All instruments should be supplied with valid calibration and test certificates provided by OEM. All transmitters shall be HART compatible and should have provision for calibration by Universal Hand Held Calibrator (BHEL Scope).
14. Bidder to terminate all instrumentation and control elements in junction boxes. Bidder to provide input/ output list, drives list, junction box schedule and termination details, recommended control logics/ write-up etc. the list of documents to be submitted after award of contract is to be referred by bidder.
15. All the transmitters supplied by Bidder shall be rack mounted. The transmitter racks shall be in Bidder's scope of supply.
16. Bidder to perform tests of C&I items/ instruments/systems as per Quality plans/ type test requirement attached in the specification. However, if any test not specified in the quality plan but specified in specification Tests for I&C equipment included elsewhere in specification will have to perform by bidder without any cost/ time implication.
17. Instrument installation and accessories required shall be in Bidder's scope and shall be submitted after award of contract. However any instrument installation not covered in the same shall be subject to customer and BHEL approval during detailed engineering.
18. Bidder to furnish electrical load/UPS load data during detailed engineering.
19. 2 Feeders of 415 V AC power supply shall be provided by BHEL at a single point, vendor shall provide feeder with auto changeover facility with indication.
20. Bidder to include necessary power distribution board in his scope. Any power supply other than the above, if required by any instrument/equipment has to be derived by the bidder from the above supply & all necessary hardware for the same shall be in bidder scope. Bidder to submit the power requirement along with the bid.
21. Contractor shall furnish Instrument Schedule, I/O list, Drive list, Cable Schedule, Cable interconnection, JB grouping, Annunciation list, SOE list, List of Instruments/devices for HART in BHEL approved format. Also reusable database format like MS Excel, MS Access etc. of these documents shall also be provided by Contractor in BHEL approved format. Soft copy of the formats shall be provided to the successful bidder.



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22. Interface of MCC, HT SWGR, field instruments, Actuators etc. with DDCMIS based control system shall be as per Drive Control Philosophy enclosed in specification.
23. All field instruments enclosure shall be IP65 or better and local panel/ cabinet enclosure shall be IP 42 or better, unless otherwise specified.
24. Diaphragm seal shall be provided for Instruments as specified in the Instrument Specifications.
25. Double root valve shall be provided for all pressure tapings where the design pressure exceeds 40kg/cm².
26. Drawings/Documents and data to be furnished by bidder after award of the contract as mentioned in section" List of Documents/ Deliverables".
27. Diaphragm seal shall be provided with Instruments having contact with corrosive media.
28. Level transmitters shall be ultrasonic.
29. Local panel with annunciation system, push button with indicators, with mimic diagram shall be in bidder's scope.
30. Operation of stroke controller will be from CCR in addition to operation from local panel.



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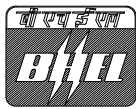
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SECTION- IIA

GENERAL TECHNICAL REQUIREMENTS (MECH.)



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1.0 SCOPE:

Design (i.e. preparation and submission of drawing /documents including "As Built" drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection/ testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles (as applicable), fill of lubricants & consumables (excluding chemicals), mandatory spares along with spares for erection, start-up and commissioning as required, forwarding, proper packing, shipment and delivery at site for 2 x 800 MW UPPUR STPP (STAGE-I, UNIT 1 & 2) Chemical Dosing System, complete with all accessories for the total scope as specified.

2.0 DESIGN BASIS:

- Design Calculation for the systems
- Customer specification

3.0 DESIGN PHILOSOPHY:

Chemical dosing systems have been designed to dose required quantity of chemicals in low-pressure side of feed water cycle to maintain the quality of boiler feed water.

4.0 LOW PRESSURE CHEMICAL DOSING:

4.1 HYDRAZINE DOSING SYSTEM (TOTAL NO. OF SKIDS = 2 NOS.)

(Refer drawing no.: PE-DG-425-154-A001)

Residual oxygen present in feed water can be detrimental to feed cycle equipment. In order to control the same, continuous dosing of dilute solution of hydrazine is done at deaerator outlet (BFP suction) only. Though provision has been kept to dose hydrazine at CEP discharge and deaerator outlet also, but dosing shall be done at one place at a time. For this purpose one (1) no. per unit skid mounted Hydrazine dosing system shall be provided. Dosing system shall mainly comprise of the following:

4.1.1 HYDRAZINE MEASURING TANK (1 No.)

A Hydrazine measuring tank for storing & measuring the concentrated Hydrazine shall be provided. The tank shall be provided with accessories like breather with vent, level gauge, level transmitter and overflow. A filling connection shall be provided to fill the concentrated solution from motorized barrel pump in the tank. Concentrated solution shall be manually transferred to Hydrazine mixing cum storage tank by gravity flow when solution is to be prepared.

4.1.2 HYDRAZINE MIXING CUM STORAGE TANK (1 No.)

A dilute solution shall be prepared in the solution mixing cum storage tank using condensate and shall be uniformly mixed by a motorized stirrer (180 - 200 rpm). The tank shall also be provided with accessories like breather with vent, motorized stirrer, level gauge, level transmitter & overflow drain with sealing arrangement. The solution shall then be dosed to the required point with the help of dosing pumps.

4.1.3 HYDRAZINE DOSING PUMPS (TOTAL 2 Nos.)

Two numbers (2 X 100%) Positive displacement plunger type metering pumps (electrically operated, auto adjusted) with relief valves shall be provided.

The stroke of the pumps shall be adjustable from zero to 100% even when the pump is in operation so as to achieve a step-less variation of capacity over the specified range of operation.

A duplex strainer (1 x 100%) (Common for both pumps) shall be provided in the suction line of the pump with Differential Pressure Transmitter (DPT) and Differential Pressure Gauge (DPG). The pump shall also be provided with a pressure gauge & pressure transmitter in the individual discharge line of dosing pumps.

4.1.4 BARREL PUMP (1 NO.)

A motorized barrel pump complete with flexible hose and couplings for transferring hydrazine from drum at finished floor level of the vicinity to measuring tank shall be provided.

4.1.5 ASSOCIATED PIPING, VALVES ETC:



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As indicated in the drawing enclosed, to make the system complete, all associated piping & valves shall be provided. All piping in the skid shall be ASTM 312 Gr. TP 304 (seamless), pipe size: 40/ 25/ 15 Nb. Valve material shall be SS-304, ASA 800 rating. All valves shall be manually operated.

Drains from tanks & pipes shall be inter-connected to a common drain header and terminated at the dosing skid itself. Level gauge drain shall not be connected to main drain header since quantity of liquid is very small and occurrence of such cases is rare. The same may be manually disposed of. As flow in drains is not continuous & of very small quantity the same shall be led to local storm water drain.

4.1.6 PARAMETERS FOR HYDRAZINE DOSING:

Major parameters of the equipment as calculated & provided in the system are mentioned in enclosed Datasheet A.

4.1.7 FLUSHING

Condensate tapped from Condensate water line shall be used for flushing the various pipes lines and pumps of the system as shown in P & I drawing.

NOTE: - The scope described above for Hydrazine Dosing System is for one unit and it shall be typical for second unit.

4.2 AMMONIA DOSING SYSTEM (TOTAL NO. OF SKIDS = 2 NOS.)

(Refer drawing number: PE-DG-425-154-A002)

Boiler feed water/Condensate water should have proper pH in order to protect the system from corrosion. In order to control the same dosing of dilute solution of Ammonia is done at CEP discharge. Though provision has been kept to dose ammonia at deaerator outlet (BFP suction) and boiler fill pump discharge also, but dosing shall be done at one place at a time only. For this purpose one (1) no. skid mounted ammonia-dosing system shall be provided. Dosing system shall mainly comprise of the following:

4.2.1 AMMONIA MEASURING TANK (1 No.)

An Ammonia measuring tank for storing & measuring the concentrated Ammonia shall be provided. The tank shall be provided with accessories like breather with vent, level gauge, level transmitter and overflow. A filling connection shall be provided to fill the concentrated solution from motorized barrel pump in the tank. Concentrated solution shall be manually transferred to Ammonia mixing cum storage tank by gravity flow when solution is to be prepared.

4.2.2 AMMONIA MIXING CUM STORAGE TANK (1 No.)

A dilute solution shall be prepared in the solution mixing cum storage tank using condensate and shall be uniformly mixed by a motorized stirrer (180-200 rpm). The tank shall also be provided with accessories like breather with vent, motorized stirrer, level gauge, level transmitter & overflow drain with sealing arrangement. The solution shall then be dosed to the required point with the help of dosing pumps.

4.2.3 AMMONIA DOSING PUMPS (TOTAL 2 Nos.)

Two numbers (2 X 100%) Positive displacement plunger type metering pumps (electrically operated, auto adjusted) with relief valves shall be provided.

The stroke of the pumps shall be adjustable from zero to 100% even when the pump is in operation so as to achieve a step-less variation of capacity over the specified range of operation.

A duplex strainer (1 x 100%) (Common for both pumps) shall be provided in the suction line of the pump with Differential Pressure Transmitter (DPT) and Differential Pressure Gauge (DPG). The pump shall also be provided with a pressure gauge & pressure transmitter in the individual discharge lines of dosing pumps.

4.2.4 BARREL PUMP (1 NO.)

A motorized barrel pump complete with flexible hose and couplings for transferring ammonia from drum at finished floor level of the vicinity to measuring tank shall be provided.



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4.2.5 ASSOCIATED PIPING, VALVES ETC:

As indicated in the drawing enclosed, to make the system complete, all associated piping & valves shall be provided. All piping in the skid shall be ASTM 312 Gr. TP 304 (seamless), pipe size: 40/25/15 Nb. Valve material shall be SS-304, ASA 800 rating. All valves shall be manually operated.

Drains from tanks & pipes shall be inter-connected to a common drain header and terminated at the dosing skid itself. Level gauge drain shall not be connected to main drain header since quantity of liquid is very small and occurrence of such cases is rare. The same may be manually disposed of. As flow in drains is not continuous & of very small quantity thus can be led to local storm water drain.

4.2.6 PARAMETERS FOR AMMONIA DOSING:

Major parameters of the equipment as calculated & provided in the system are mentioned in enclosed Datasheet A.

4.2.7 FLUSHING

Condensate tapped from Condensate water line shall be used for flushing the various pipes lines and pumps of the system as shown in P&I drawing.

NOTE: - The scope described above for Hydrazine and Ammonia Dosing System is for one unit and it shall be typical for second unit.

4.3 CONTROL PHILOSOPHY (common for hydrazine and ammonia dosing systems):-

This control write-up is applicable for the following LP dosing systems:

- i) Hydrazine dosing system
- ii) Ammonia dosing system

The operation of LP dosing system shall be as follows:-

The control of all dosing systems shall be realized in **DDCMIS** including ON/OFF command of the individual pumps and stirrers. All controls, fault indicators/alarms, interlocks, logics shall be implemented in DDCMIS. Separate local panel shall be provided for each of the above said system.

The starter of all the motors shall be clubbed with main plant MCC. Power to all pumps, agitators etc. shall be fed from MCC. DDCMIS commands shall extend to MCC.

A local panel comprising of '**START**' push button, '**STOP**' push button along with '**ON/OFF/TRIP**' indication, local/ remote indication, stroke position indicator, raise/ lower push button for stroke position and local annunciation shall be provided for local operation. The '**START**' push button and '**STOP**' push button shall be routed to **DDCMIS**.

The ON/OFF operation of all motorized stirrers and pumps shall also be provided in DDCMIS with local ON, OFF facility.

The auto stroke controllers (I/E converter) of each pump shall be mounted on the local panel of respective dosing skid. The stroke position & adjustment will be done from DDCMIS and the stroke controller (I/E converter) shall be suitable for accepting 4-20 mA DC signals. The pumps shall be provided with 24 V DC, 2- wire LVDT Type Position feedback transmitter to generate 4-20 mA DC signals to indicate stroke position in DDCMIS & Local panel.

The Local/ Remote selection switch (soft) shall be provided in DDCMIS and its indication shall be provided in LCP. LCP shall be located on the dosing skid.

1. Following interlocks shall be provided at low-low Level in the mixing cum storage tank:
 - i) Running Dosing pump shall be tripped.
 - ii) Stirrer motor of the respective tank shall be tripped.
2. Following conditions to be ensured before starting a stirrer:
 - i) Level in the tank adequate.
 - ii) MCC not disturbed.

3. Following conditions to be ensured before starting a pump:



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- i) Level in the tank adequate.
- ii) MCC not disturbed.
- iii) Duplex strainer- not choked

Standby Dosing Pump shall be started automatically in case of header pressure low.

- 4. Following shall be provided on LCP:
 - i) ON/ OFF/ Fault- Lamp Indications for all drives (pumps & agitator)
 - ii) Operation 'Local selected' / operation 'Remote selected'- Lamp Indication, common for all drives.
 - iii) Pump- Start/ Stop & Agitator-Start/ Stop –Push Buttons
 - iv) Auto stroke controller.
 - v) Stoke position indicator (may be a part of controller).
 - vi) Local LED based annunciation driven by DDCMIS.
- 5. Following fault indications with alarm annunciations shall be provided on LCP:
 - i) Low level in the mixing cum storage tank.
 - ii) Low-low level in the mixing cum storage tank
 - iii) High level in the measuring tank
 - iv) High level in the mixing cum storage tank
 - v) High-high level in mixing cum storage tank
 - vi) High pressure at pump discharge header
 - vii) Low pressure at pump discharge header
 - viii) Strainer choked
 - ix) Dosing pump-1--tripped
 - x) Dosing pump-2--tripped
 - xi) Stirrer motor—tripped
 - xii) Low Level in measuring tank

SIGNAL EXCHANGE

- 6. Following signals shall be wired from **DDCMIS to LCP**. These shall be 24V DC powered signals. (PF contacts are not used to avoid the higher voltage LCP power supply reaching DDCMIS while contact interrogation).
 - i) Operation local selected.
 - ii) Operation remote selected.
 - iii) Pump- 1/2 & stirrer (ON/OFF/FAULT).
 - iv) Process conditions (as per clause 5 above).
 - v) Pump- 1/2 stroke length demand signal (4-20 mA).
- 7. Following signals shall be wired from **LCP to DDCMIS**. Binary signals shall be P.F. contacts.
 - i) All field signals.
 - ii) START & STOP–PB commands for all drives (pumps & agitator).
 - iii) Pump- 1/2 stroke length feedback signal (4-20 mA).
 - iv) LPC healthy/ disturbed.
- 8. Signal Exchange **between DDCMIS & MCC** shall be as per applicable Drive Control Philosophy i.e.
 - i) START & STOP command from DDCMIS to MCC.
 - ii) ON, OFF & MCC Disturbed feedback from MCC to DDCMIS.
- 9. Signal Exchange **between LCP & MCC** shall be
 - i) EMERGENCY STOP-PB for all drives (pumps & agitators) shall also be wired directly to MCC.

All the field instruments i.e. level transmitter, differential pressure transmitter, pressure transmitter etc. & stroke actuator shall be terminated at local panel by the vendor, for taking further to DDCMIS

Instrument cabling from instruments to LCP and pre-wiring within LCP shall be done by BHEL's chemical dosing vendor. Any cabling to and fro between LCP and DDCMIS shall be done by BHEL.



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Local Control Panel with one no. GIU per unit shall be provided for LP Hydrazine + Ammonia Dosing System. GIU shall be provided by BHEL.

5. NaOH DOSING SYSTEM FOR ECW SYSTEM: (TOTAL NO. OF SKID = 2 NOS)

(Refer drawing number PE-DG-425-154-A003)

Sodium Hydroxide (NaOH) dosing system shall be provided to dose NaOH solution in Equipment cooling water lines manually as per requirement of desired pH (pH around 9.5) in DMCW tank judged on trial basis. The Sodium Hydroxide Dosing shall be done in the ECW cycle during the initial fill and for the compensation of cooling water for any leakage during normal run. The solution of NaOH shall be prepared manually by opening the inlet valve of DM water and adding NaOH lye in basket. The NaOH shall be dissolved by starting the motorized stirrer locally. The solution shall then be dosed to the required point by gravity. The dosing system shall consist of following:-

5.1.1 NaOH MIXING CUM STORAGE TANK:

One (1) no NaOH Mixing cum Storage Tank complete with motorized stirrer (180-200 rpm), CO₂ absorber, dissolving basket, level gauge, level transmitter, vent, overflow with water seal & drain shall be provided.

5.1.2 NaOH DOSING PUMPS (TOTAL 2 Nos.)

Two numbers (2 X 100%) Positive displacement plunger type metering pumps (electrically operated, auto adjusted) with relief valves shall be provided.

The stroke of the pumps shall be adjustable from zero to 100% even when the pump is in operation so as to achieve a step-less variation of capacity over the specified range of operation.

A duplex strainer (1 x 100%) (Common for both pumps) shall be provided in the suction line of the pump with Differential Pressure Transmitter (DPT) and Differential Pressure Gauge (DPG). The pump shall also be provided with a pressure gauge & pressure transmitter in the individual discharge lines of dosing pumps.

5.1.3 ASSOCIATED PIPING, VALVES ETC:

As indicated in the drawing enclosed, to make the system complete, all associated piping & valves shall be provided. All piping in the skid shall be ASTM 312 Gr. TP 304 (seamless) SCH. 40, Line size: 40/25/15 Nb. Valve material shall be SS-304, ASA 800 rating. All valves shall be manually operated.

Drains from tanks & pipes shall be inter-connected to a common drain header and terminated at the dosing skid itself. Level gauge drain shall not be connected to main drain header since quantity of liquid is very small and occurrence of such cases is rare. The same may be manually disposed of. As flow in drains is not continuous & of very small quantity thus shall be led to local storm water drain.

5.1.4 PARAMETERS FOR NaOH DOSING:

Major parameters of the equipments as calculated & provided in the system are mentioned in enclosed Datasheet A.

5.1.5 CONTROL & INSTRUMENTATION

The operation of NaOH Dosing System shall be as follows: -

The control of all dosing systems shall be realized in **DDCMIS** including ON/OFF command of the individual pumps and stirrers. All controls, fault indicators/alarms, interlocks, logics shall be implemented in DDCMIS. Separate local panel shall be provided for each of the above said system.

The starter of all the motors shall be clubbed with main plant MCC. Power to all pumps, agitators etc. shall be fed from MCC. DDCMIS commands shall extend to MCC.

A local panel comprising of '**START**' push button, '**STOP**' push button along with '**ON/OFF/TRIP**' indication, local/ remote indication, stroke position indicator, raise/ lower push button for stroke position and local annunciation shall be provided for local operation. The '**START**' push button and '**STOP**' push button shall be routed to **DDCMIS**.



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The ON/OFF operation of all motorized stirrers and pumps shall also be provided in DDCMIS with local ON, OFF facility.

The auto stroke controllers (I/E converter) of each pump shall be mounted on the local panel of respective dosing skid. The stroke position & adjustment will be done from DDCMIS and the stroke controller (I/E converter) shall be suitable for accepting 4-20 mA DC signals. The pumps shall be provided with 24 V DC, 2- wire LVDT Type Position feedback transmitter to generate 4-20 mA DC signals to indicate stroke position in DDCMIS & Local panel.

The Local/ Remote selection switch (soft) shall be provided in DDCMIS and its indication shall be provided in LCP. LCP shall be located on the dosing skid.

1. Following interlocks shall be provided at low-low Level in the mixing cum storage tank:
 - iii) Running Dosing pump shall be tripped.
 - iv) Stirrer motor of the respective tank shall be tripped.
2. Following conditions to be ensured before starting a stirrer:
 - iii) Level in the tank adequate.
 - iv) MCC not disturbed
3. Following conditions to be ensured before starting a pump:
 - iv) Level in the tank adequate.
 - v) MCC not disturbed.
 - vi) Duplex strainer- not choked
4. Following shall be provided on LCP:
 - i) ON/ OFF/ Fault- Lamp Indications for all drives (pumps & agitator)
 - ii) Operation 'Local selected' / operation 'Remote selected'- Lamp Indication, common for all drives.
 - iii) Pump- Start/ Stop & Agitator-Start/ Stop –Push Buttons
 - iv) Auto stroke controller
 - v) Stoke position indicator (may be a part of controller)
 - vi) Local LED based annunciation driven by DDCMIS.
5. Following fault indications with alarm annunciations shall be provided on LCP:
 - i) Low level in the mixing cum storage tank.
 - ii) Low-low level in the mixing cum storage tank
 - iii) High level in the mixing cum storage tank
 - iv) High-high level in mixing cum storage tank
 - v) High pressure at pump discharge header
 - vi) Low pressure at pump discharge header
 - vii) Strainer choked
 - viii) Dosing pump-1--tripped
 - ix) Dosing pump-2--tripped
 - x) Stirrer motor—tripped

SIGNAL EXCHANGE

6. Following signals shall be wired from **DDCMIS to LCP**. These shall be 24V DC powered signals. (PF contacts are not used to avoid the higher voltage LCP power supply reaching DDCMIS while contact interrogation).
 - i) Operation local selected.
 - ii) Operation remote selected.
 - iii) Pump- 1/2 & stirrer (ON/OFF/FAULT).
 - iv) Process conditions (as per clause 5 above).
 - v) Pump- 1/2 stroke length demand signal (4-20 mA).
7. Following signals shall be wired from **LCP to DDCMIS**. Binary signals shall be P.F. contacts.
 - i) All field signals.
 - ii) START & STOP–PB commands for all drives (pumps & agitator).
 - iii) Pump- 1/2 stroke length feedback signal (4-20 mA).



TITLE:
**2 X 800 MW UPPUR STPP (STAGE-I, UNIT
1 & 2) BTG PACKAGE**

**TECHNICAL SPECIFICATION FOR
CHEMICAL DOSING SYSTEM**

SPECIFICATION NO. PE-TS-425-154-A001

SECTION II

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iv) LCP healthy/ disturbed.

8. Signal Exchange **between DDCMIS & MCC** shall be as per applicable Drive Control Philosophy i.e.

- i) START & STOP command from DDCMIS to MCC.
- ii) ON, OFF, MCC Disturbed feedback from MCC to DDCMIS.

9. Signal Exchange **between LCP & MCC** shall be

- i) EMERGENCY STOP-PB for all drives (pumps & agitators) shall also be wired directly to MCC.

All the field instruments i.e. level transmitter, differential pressure transmitter, pressure transmitter etc. & stroke actuator shall be terminated at local panel by the vendor, for taking further to DDCMIS

Instrument cabling from instruments to LCP and pre-wiring within LCP shall be done by our chemical dosing vendor. Any cabling to and fro between LCP and DDCMIS shall be done by BHEL.

5.1.6 FLUSHING

DM Water shall be used for flushing the tank shown in attached drawing.

NOTE: - Local/ Remote switch shall also be provided at LCP for all the dosing pumps and stirrers of Hydrazine, Ammonia and NaOH Dosing System.



TITLE:
**2 X 800 MW UPPUR STPP (STAGE-I, UNIT 1
& 2) BTG PACKAGE**

**TECHNICAL SPECIFICATION FOR
CHEMICAL DOSING SYSTEM**

SPECIFICATION NO.: PE-TS-425-154-A001

SECTION II

SUB SECTION - IIB

REV.NO. 0

DATE : 15.11.2017

SECTION- IIB

GENERAL TECHNICAL REQUIREMENTS (ELECTRICAL)

SECTION – 14: AC & DC MOTORS**14.01.00 SCOPE**

This specification is intended to cover design, manufacture, assembly and testing of AC Squirrel Cage Induction Motors for use in Thermal Power Plants and is supplement to the driven equipment specifications under which these motors are being procured for the project.

14.01.01 Site Conditions

Site conditions are covered in 'Project Data', contained in specification of the driven equipment.

14.01.02 Gases, Fumes & Dust Particles

General - Sulphur dioxide and/or trioxide fumes mildly present. Climate is tropical, conducive to fungus growth.

14.01.03 Dust Particles

- i) Outdoor locations - Heavily dusty with abrasive dust and coal particles of size five (5) to hundred (100) microns present in atmosphere in large quantity.
- ii) Indoor Locations.
- iii) Coal conveyors - As for outdoor as per clause 14.01.3 (i) above.
- iv) Other locations - Lightly dusty with abrasive dust and coal particles of size five (5) to twenty (20) microns present in atmosphere.

14.01.04 Special Fumes

- i) Water treatment plant and acid cleaning room - Acid and alkali fumes present.
- ii) Fuel oil pumping areas & Hydrogen generation plant - Explosive fumes (flameproof motors required).
- iii) For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% (at 40 deg C) shall be considered. The equipment shall operate in a highly polluted environment.

14.02.00 LOCATION OF MOTOR - As required**14.03.00 CODES STANDARDS**

All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) / IEC as given below except where modified and/or supplemented by this specification.



Code	Name of standard
IS : 325	Specification for three phase induction motor.
IS : 900	Code of Practice for installation and maintenance of induction motors
IS : 996	Single phase AC motors
IS : 1231	Dimensions of three-phase foot-mounted induction motors
IS : 1271	Thermal evaluation and classification of electrical insulation.
IS : 2223	Dimensions of flange mounted ac induction motors.
IS : 2254	Dimensions of vertical shaft motors for pumps
IS : 3043	Code of practice for earthing.
IS : 3177	Crane duty motors
IS : 4029	Guide for testing three phase induction motors.
IS : 4691	Degree of protection for enclosures of rotating electrical machinery.
IS : 4722	Specification for rotating electrical machinery.
IS : 4728	Terminal marking and direction of rotation for rotating electrical machinery.
IS : 4889	Methods of determination of efficiency of rotating electrical machines.
IS : 5571	Guide for selection of electrical equipment for hazardous areas.
IS : 6362	Designation of Method of Cooling of Rotating electrical machines.
IS : 8223	Dimensions and output ratings for foot mounted rotating electrical machines with frame numbers 355 to 1000.
IS : 8789	Values of performance characteristics for three phase induction motors.
IS : 12065	Noise level of motors.
IS : 12075	Measurement and evaluation of vibration of rotating electrical machines.
IS : 12615	Induction motors - Energy efficient, three-phase, squirrel cage - Specification
IS : 12802	Temperature rise measurement of rotating electrical machines.
IS : 12824	Temperature rise measurement of rotating electrical machines



IS : 12824	Type of duty and classes of rating assigned.
IS : 14222	Requirements and method of Impulse withstand test
IEC: 60034-1	Rotating electrical machines.
ISO : 1940-1	Mechanical vibration – Determination of permissible residual unbalance
NEMA, MG-1	Motors and Generators
DIN/IEC/IS	RTD
BS 5308 part II	RTD triad Cable

Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be furnished during detail engineering.

The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

14.04.00 TYPE

14.04.01 AC Motors:

- i) Squirrel cage induction motor suitable for direct-on-line starting.
- ii) Continuous duty LT motors rated above 0.37kW upto 200 KW Output rating (at 50 deg. C ambient temperature), shall be **Efficiency class-IE3**, conforming to IS 12615, or IEC:60034-30. However this is not applicable for geared motors (motors completely integrated with driven equipment) which are specifically designed to suit the driven equipment duty.
- iii) Crane duty motors shall be squirrel cage Induction motor of S4 duty and 40% CDF.

14.04.02 DC Motors shunt wound.

14.05.00 VOLTAGE (NOMINAL)

14.05.01 LV Motors

For motors upto and including 200 KW - Four hundred fifteen (415) V.

14.05.02 MV Motors

For motors above 200 kW upto and including 2000kW. Six point six (6.) kV.



- 14.05.03 HV Motors
- i) For motors above 2000kW - eleven (11) KV
 ii) All motors are to be designed for system grounding described in "System Particulars" under site information of the Driven Equipment Specification.
- 14.06.00 FREQUENCY (NOMINAL) - fifty (50) Hertz**
- 14.07.00 NUMBER OF PHASES - Three (3)**
- 14.08.00 SPEED - As required by the driven equipment**
- 14.09.00 TYPE OF STARTING - Direct on-line**
- 14.10.00 DUTY**
- 14.10.01 Continuous motor rating shall be arrived at considering 15% margin over the duty point input or 10% over the maximum demand of the driven equipment, whichever is higher, considering highest system frequency and voltage variation. Crane motors shall be rated for S4 duty, 40% cyclic duration factor. If however, a higher margin is stipulated in the accompanying driven equipment specification, the higher stipulated margin shall prevail.
- 14.10.02 Motor rating shall be such that it is not overloaded at any operating point of driven equipment from zero to full load.
- 14.10.03 The break-away torque, pull-up torque and pull-out torque of the motors shall be properly co-ordinated with the requirements of driven equipment to ensure smooth and rapid starting and steady operation. The torque-speed characteristic of motor super imposed thereon on driven equipment torque-speed characteristics at 100%, 90%, 80% shall be furnished.
- 14.10.04 Maximum torque shall not be less than 205% of full load torque.
- 14.10.05 All HV & MV motors shall be provided with vibration pads for mounting vibration detectors.
- 14.10.06 All motors shall be designed to withstand hundred twenty (120) percent of rated speed without any mechanical damage for two (2) minutes.
- 14.10.07 Motors shall be designed to keep torsional and rotational natural frequencies of vibration of the motor and driven equipment atleast twenty five (25) percent above or below, preferably above the motor operating speed (to avoid resonance in vibration over the operating speed) range.
- 14.10.08 All LV motors rated 0.37kW and higher upto and including 200kW (LV Motors) with S1 duty shall be compulsorily be of energy efficiency level IE 3 as per IS 12615:2011.



- 14.10.09 HV & MV motors shall have full load efficiency of 95% minimum and rated full load power factor of 0.8 minimum. The required power factor shall be achieved without using external capacitor.
- 14.11.00 SUPPLY VARIATIONS** Motors shall be capable of running continuously at full load under following variations in power supply.
- 14.11.01 Voltage (percent of nominal voltage) Plus minus ($\pm$) ten (10) for LT
Plus minus ($\pm$) Six (6) for MV & HT
- 14.11.02 Frequency (percent of minimal frequency)..... Plus Three 3 & minus (-) five (5)
- 14.11.03 Combined voltage & frequency (percent) Ten (10) (sum of absolute percentage value of voltage and frequency variation)
- 14.12.00 ABNORMAL CONDITIONS CAPABILITY**
- Motor shall have following capabilities as specified design ambient temperature:-
- 14.12.01 The motors shall also be capable of running up again after voltage collapse to about 40% for approximate duration of 0.5 sec. Subsequent rise in voltage to 70% and further to 80% and 100%, the total duration not exceeding 20 sec.
- 14.12.02 Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with non-energized shaft rotating at 125% rated speed in reverse direction.
- 14.12.03 Low Voltage Running:-
- Motor shall be capable of running satisfactorily at seventy five (75) percent nominal voltage for five (5) minutes.
- 14.12.04 Momentary Low Voltage Withstanding:
- Motor, when running at full load, shall not stall when voltage drops down to seventy (70) percent nominal voltage for one (1) minute.
- 14.13.00 STARTING CAPABILITY**
- 14.13.01 Low Voltage Starting
- Motor shall be capable of starting and accelerating to full speed at full load (including loaded equipment e.g. mills and conveyors etc) at eighty (80) percent nominal voltage at motor terminals. Mill motors may be permitted to start with terminal voltage not below 90%.
- 14.13.02 Cold Motor Starting



Under specified voltage variations two (2) starts in quick succession and third start five (5) minutes thereafter, all with full load (including loaded equipment eg mills and conveyors etc) of driven equipment. No additional start shall be made till lapse of further thirty (30) minutes. (with initial temperature of the motor at ambient temperature)

14.13.03 Hot Motor Starting

Under specified voltage variations, one (1) immediate and two (2) fifteen (15) minutes interval starts all with full load (including loaded equipment e.g. mills and conveyors etc) of driven equipment. No additional start shall be made till lapse of further thirty (30) minutes. (with initial temperature of the motor at full load operating level)

14.13.04 Motor shall also be suitable for three (3) equally spread starts per hour when the motor is under normal service condition.

14.13.05 Break-away Starting Current

Breakaway starting current as percent of full load current for various motor ratings shall not exceed the values given below:-

- i) Motors upto 1000 KW 600% subject to IS Tolerance of plus 20%
- ii) Motors (above 1000 KW upto 3000 KW) 600%. Subject to 20% IS tolerance.
- iii) Motors above 3000 KW.....450%. Not subject to any positive tolerance.For energy efficient
- iv) LT motors, locked rotor current shall be as per IS: 12615.
- v) Locked rotor current of the VFD controlled AC motors shall be limited to 300% of the full load current, and is subject to IS tolerance

14.14.06 Where variable voltage and variable frequency (VVFD) operation is envisaged through VVFD drives, motors shall be specially designed for such application.

14.14.00 STARTING VOLTAGE REQUIREMENT

14.14.01 All Motors (except Mill Motors)

- i) 80% of rated voltage for Motors upto 4000 kW
- ii) 75% of rated voltage for Motors above 4000 kW

14.14.02 For Mill Motors:

- i) 85% of rated voltage for Motors above 1000 kW
- ii) 90% of rated voltage for Motors below 1000 kW

14.15.00 TORQUE REQUIREMENTS



14.15.01 Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10%. Motor full load torque.

14.15.02 Full out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty Motors.

14.16.00 STARTING TIME

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

14.16.02 For motors with starting time more than 20 secs. and up-to 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at-least 5 secs. more than starting time.

14.16.03 For motors with starting time more than 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at-least 10% of the starting time.

14.16.04 At no stage, speed switch shall be provided to achieve requirements mentioned in Clause No. 14.16.01 to 14.16.03.

14.17.00 CLASS OF INSULATION

14.17.01 LV Motors Class F.

14.17.02 HV & MV Motors Class F

14.17.03 However temperature rise shall be restricted to limits corresponding to Class 'B' insulation for both MV, HV & LT motors. The temperature under abnormal running conditions shall be limited to 5°C above class 'B' limits.

14.17.04 The value of the polarization index for motors above 200kW should not be less than 2 when determined according to IS: 78114.0

14.17.05 For the VFD operated drives, insulation shall be designed to take care of stresses due to high DV/DT. Motors shall be wound with dual coated winding wires and impregnated with VPI process. Further for such application, insulated bearings shall be provided to avoid circulating current caused by shaft induced voltages,

14.17.06 HT motors shall withstand 1.2/50 micro sec impulse Voltage wave of 4U+5 kV (U=Line voltage in kV). The coil inter-turn insulation shall be as per IEC-60034 – Part 15 followed by 1 min power frequency high voltage test of appropriate voltage on inter turn insulation.

14.18.00 TEMPERATURE RISE UNDER NORMAL CONDITIONS



- 14.18.01 Temperature rise over specified design ambient temperature when motor is running with full load at nominal supply voltage & frequency shall not exceed the values given below:

S.No.	Specified Design Ambient Temperature	Thermometer Method	Resistance Method
i)	50°C	60°C	70°C

- 14.18.02 For Water Cooled Motors, temperature rise of insulation should be limited to 80 deg. C over inlet cooling water temperature mentioned elsewhere, by resistance method.

14.19.00 BUS TRANSFER WITHSTAND CAPABILITY

Motors shall be connected to an automatic bus transfer system and hence may be subjected to one hundred and fifty (150) percent of the nominal voltage during changeover of buses due to the vector difference between the residual voltage and incoming supply voltage and the duration of this condition may be one second. Motors shall be capable of withstanding the voltage and torque stresses developed under such conditions without damage. The manufacturer/ vendor shall indicate the special precautions taken to meet the above requirements and confirm.

- 14.19.02 That motor shall be capable of withstanding heavy inrush transient current caused by such bus transfers without damage.
- 14.19.03 That the motor winding's shall be adequately braced to satisfactorily withstand mechanical stresses under these conditions.
- 14.19.04 The motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torques under these conditions.

14.20.00 TYPE OF ENCLOSURE

- 14.20.01 Outdoor Motors.....IP 55 (Additional canopy to be provided by Bidder).
- 14.20.02 Indoor Motors IP 55
- 14.20.03 IP-55 degree of protection shall be achieved without application of any compound, putty etc.

14.21.00 METHOD OF COOLING

- 14.21.01 Method of cooling shall be IC 411 (TEFC), IC 511 (TETV) or IC 611 (CACA). However, motors rated 3000kW or above can be closed air circuit water cooled (CACW).
- 14.21.02 Large capacity motors not available with above types of cooling may be accepted with IC 81 W for IC 91 W (CACW) cooling subject to the approval of the Owner.



14.22.00 TYPE OF MOUNTING As required for the driven equipment.

14.23.00 MAXIMUM MECHANICAL VIBRATIONS

Vibration shall be limited within the limits prescribed in IS: 12075 / IEC 60034-14. Motors shall withstand vibrations produced by driven equipment. HV & MV motor bearing housings shall have flat surfaces, in both X and Y directions, suitable for mounting 80mmX80mm vibration pads. Vibration pads with screwed holes along with vibration probes shall be provided at both DE and NDE.

14.24.00 NOISE LEVEL

14.24.01 Noise level for all the motors shall be limited to 85dB(A) except for BFP motor for which the maximum limit shall be 90dB(A). at 1m from operating motor measured in accordance with IS: 10265.

14.24.02 Motor body shall have two earthing points on opposite sides.

14.24.03 The spacing between gland plate & centre of terminal stud shall be as per Table-I.

TABLE – I

DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS

Motor MCR in KW	Minimum distance between centre of stud and gland plate in mm
UP to 3 KW	As per manufacturer's practice.
Above 3 KW - upto 7 KW	85
Above 7 KW - upto 13 KW	115
Above 13 KW - upto 24 KW	167
Above 24 KW - upto 37 KW	196
Above 37 KW - upto 55 KW	249
Above 55 KW - upto 90 KW	277
Above 90 KW - upto 125 KW	331
Above 125 KW-upto 200 KW	203

14.24.04 For HV & MV motors the distance between gland plate and the terminal studs shall not be less than 500 mm.



14.24.05 All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.

14.24.06 For motors rated 1000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.

14.25.00 WINDING & INSULATION

14.25.01 Type : Non-hygroscopic, oil resistant, flame resistant

14.25.02 11kV & 6.6 kV AC : Thermal class 155 (F) insulation and the motors temperature rise shall be limited to Class B. Winding material shall be of copper. The winding insulation process shall be total Vacuum Pressure Impregnated i.e resin poor method. The lightning Impulse & inter-turn insulation surge withstand level shall be as per IEC-60034 part-15

14.25.03 240VAC, 415V : Thermal Class(F)
AC & 220V
DC motors

14.26.00 DIRECTION OF ROTATION

14.26.01 As needed by driven equipment.

14.26.02 The 3 phase motor shall, however, be suitable for operation in both directions of rotation. A plate showing direction of rotation as determined by the phase sequence on the terminals marking shall be screwed at non-driving end of the body of the motor.

14.26.03 If, in the case of HV & MV motors, fan is suitable for only one direction of rotation, the fan shall be so designed that with the slight modification work, it can be made suitable for other direction of rotation also. No extra material shall be required for doing above modification work.

14.27.00 BEARINGS

14.27.01 Greased ball, roller and/or sleeve bearing shall be rated for minimum standard life of 40000 hours taking bearing and driven equipment loads into account. Loss of grease shall be scarce and it shall not creep along shaft into motor housing.

14.27.02 Bearing shall be effectively sealed against dust ingress and shall be pressure grease gun lubricated.



-
- 14.27.03 If the bearings are oil lubricated, a drain plug shall be provided for draining residual oil and oil level gauge shall be provided to show precisely oil level required under standstill and running conditions.
- 14.27.04 Unless otherwise approved, bearing lubricating system shall be such that no external forced oil or water is necessary to maintain required oil supply to keep bearing temperature within design limits.
- 14.27.05 For MV & HV motors rated 1000KW and above, the bearings shall be insulated wherever necessary to prevent damage to motor bearings from shaft current.
- 14.27.06 When pressure oiling is required for horizontal motors, bearings shall be sleeve type arranged for pressure oiling supplied from lubrication system of driven machine, with ring oiling for starting and emergency duty. Ring oiling system shall be adequate for starting and continuous operation of motor for at least half an hour, without pressure oiling system in operation. Oil sight flow gauges shall be provided to indicate oil flow through each bearing.
- 14.27.07 Lubricants shall be selected for prolonged storage and normal use of motors in tropical climate and shall contain corrosion and oxidation inhibitors. Greases shall have suitable bleeding characteristics to minimize setting. The selected lubricants shall be indigenously available.
- 14.27.08 Sleeve bearings for use with motors having flexible coupling with limited end play, shall have adequate axial end play to prevent transmission of thrust from driven equipment to motor bearings.
- 14.27.09 Bearings shall be of internationally reputed make subject to the approval of the Owner/Consulting Engineer.
- 14.27.10 Large motors shall preferably have spherically seated babitted, ring forced, feed lubricated, water-cooled bearings. If anti-friction bearings are provided, these shall be roller bearings rated for a minimum standard life of 30000 hours taking all bearing and driven equipment loads into account.
- 14.28.00 **SHAFT EXTENSION** Key slotted bare shaft extension of required length with key on driving end.
- 14.29.00 **DRAIN HOLES** Two (2) drain holes with plugs, one (1) on either end of motor at the bottom most point.
- 14.30.00 **LIFTING DEVICES** Motors shall be provided with eye-bolts, lugs or other means to facilitate safe lifting.
- 14.31.00 **DOWEL PINS**..... It shall be possible to drill holes vertically inclined through motor feet or mounting flange for installing dowel pins after assembling motor and driven equipment, before despatch (for completed driving + driven equipment assembly) or at site after erection (for separate supplies of above equipment).



- 14.32.00 **CENTERING SPIGOT**..... Flange mounted motor shall have centering spigot to match driven equipment socket.
- 14.33.00 **EASE OF MAINTENANCE**..... Motor shall be so constructed that it can be de-assembled and reassembled with ease.
- 14.34.00 **NAMEPLATES**..... Motor shall have nameplate(s) showing diagram of connections, all particulars as per IS: 325 and following additional information:-
- 14.34.01 In addition, an arrow block shall be screwed on to the body of motor on the non-driving end to indicate direction of rotation of motor.
- 14.34.02 Temperature rise under normal/abnormal conditions.
- 14.34.03 Type of bearing and recommended lubricants.
- 14.35.00 FINISH**
- 14.35.01 Motor shall have synthetic enamel paint shade as mentioned in Chapter 1.
- 14.35.02 All sharp edges and scales shall be removed from the surface, which shall then be thoroughly degreased, de-rusted and given two (2) coats of primer and two (2) coats of finish paint. It is preferred that a phosphate coat is given to motor prior to application of primer coat. Motors for water treatment plant shall have Zinc Chromate base with acid resistant Epilex 4 paint.
- 14.36.00 TERMINAL BOXES**
- 14.36.01 General
- i) Motors shall be provided with separate terminal boxes for main, space heaters, embedded temperature detectors, bearing temperature indicators and moisture detectors terminals, Neutral CT terminals. When it is not possible to provide LT motors with separate terminal box for space heater terminals, space heater terminals shall be adequately segregated from the main terminals in the single box. Terminal boxes shall be weatherproof and water-tight confirming to minimum IP-55 degree of protection with removable front cover for making connections. IP-55 degree of protection shall be achieved without application of compound. Space between and around terminals shall be adequate for easily connecting aluminium conductor cables. Terminal box arrangement shall be to the approval of the Owner /Consulting Engineer. All terminal boxes shall be suitable for proper termination cable to be finalized during detailed engineering.
- ii) The terminal boxes shall be complete with cable glands and termination accessories as required. Suitable non-magnetic material construction shall be adopted for terminal boxes where single core



cables are to be terminated. All HV & MV motors shall be provided with phase segregated terminal box.

- iii) Terminal bushings and clamps shall be non-absorbent, non-inflammable, insulated material for connecting with cable.

14.36.02 Main Terminal Box

- i) LV Motors Main terminal box shall be capable of being turned through 360 degrees in steps of 90 degrees.
- ii) MV & HV Motors shall be provided with two (2) terminal boxes for stator terminals. One (1) terminal box shall be for phase terminals while other one for forming star connection. For motors rated below 1000 KW should be interchangeable to facilitate cable routing.
- iii) Neutral terminal box for HV motors rated 1000 KW and above shall be suitable for mounting of three (3) Nos. wound/bar primary/ring type cast resin insulated current transformers for differential protection. These CTs shall be mounted in the motor neutral terminal box. Stator phase terminal box shall be phase segregated terminal box suitable for both top or bottom entry of cables (i.e. they should be capable of being turned through 180 Degrees). The terminal box shall be designed for termination of XLPE cables using heat shrinkable terminating Kit. Terminal leading shall be stud type or leading wire type.
- iv) Terminal Boxes shall be provided with cable end boxes having cable lugs and cable glands for cables.
- v) The terminal boxes shall be capable of withstanding at the terminals the system fault level (as indicated below) without rupture for a duration of atleast 0.25 seconds.
- vi) Phase to Phase/ Phase to Earth Air Clearance:-
- a) Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows:-

Motor MCR in KW	Clearance
UP to 110 KW	10mm
Above 110 KW and upto 150 KW	12.5mm
Above 150 KW	19mm

- vii) Terminal Accessories.....Each terminal end shall be furnished with bimetallic washers, spring washers, nuts and crimp type aluminium (preferably tinned) lugs suitable for cables of sizes.

14.37.00 TYPE AND SIZE OF CABLES



14.37.01 Space Heaters

- i) For LV Motors: Two point five (2.5) mm², two (2) core copper conductor PVC insulated, armoured and FRLS PVC sheathed heavy duty 650/1100 V grade cable to IS: 1554 (Part-I).
- ii) For MV & HV Motors: Six (6) mm² two core aluminium conductor XLPE insulated armoured and FRLS PVC sheathed heavy duty 650/1100V grade cable to IS: 1554 (Part-I).
- iii) For Embedded Temperature Detectors two sets of six (6) Twisted triad 0.5 mm² ATC copper conductor armoured, shielded cable, 650/1100 V Grade IS: 1554 (Part-I). For bearing temperature, RTDS, two (2) sets of four (4) twisted triad 0.5 mm², ATC copper conductor armoured shielded 650/1100 V Grade, IS: 1554 (Part-I).
- iv) Bearing Temperature Indicators - For each indicator, 0.5 mm² six (6) tarnished triad ATC copper conductor, PVC insulated, shielded armoured and FRLS PVC sheathed heavy duty 650/1100 V grade cable as per IS: 1554 Part-I. Two (2) cables one (1) for each bearing temperature indicator.
- v) For Moisture Detectors.....As for space heaters as per Clause 14.041.1 (i) above.

14.37.02 For Main Terminals:-

- i) LT Motors
 - a) Three (3) core cablesStranded aluminium conductor, XLPE insulated, colour coded, laid up, FRLS PVC type ST2 sheathed, GI wire / strip armoured, FRLS PVC type-ST2 jacketed overall, 650 / 1100V grade, heavy-duty cables as per IS: 1554 (Part-I).
 - b) Single core cablesStranded aluminium conductor, XLPE insulated, hard drawn aluminium wire/ strip armoured FRLS PVC type ST2 jacketed overall, 1100V grade, heavy duty cable as per IS: 1554 (Part-I).
- ii) HV & MV Motors

Three (3) core cables stranded aluminium conductor, XLPE insulated, screened colour coded, laid up, FRLS PVC type ST2 sheathed, GI wire/strip armoured FRLS PVC type ST2 jacketed overall, 6.6 KV / 11 KV un earthed grade, heavy duty cables as per requirement for unearthed system as per IS: 7098 (Part-II).

14.38.00 GROUNDING



14.38.01 General..... Two (2) grounding terminals one (1) on either side at the bottom suitable for connecting mild steel/GI flat/GI wire grounding conductor, size of grounding conductor shall be decided during detailed engineering.

14.38.02 LV Motors.....At each earthing point, two (2) drilled and tapped holes with hexagonal head bolts, plain washers, spring washers and tinned lugs (for motors upto 5.5 KW) for size of conductor specified shall be provided.

14.38.03 HV & MV Motors.....Non-corrodible metallic grounding pad shall be welded or brazed at each earthing point. The size of grounding pad shall be 75x65x25 mm. Grounding pad shall have 40 mm apart two (2) drilled and tapped holes with hexagonal head bolts, plain washers and spring washers for size of conductor specified. In addition, one suitable earthing terminal shall be provided inside the stator phase terminal box for earthing metallic shield of XLPE cables.

14.39.00 EMBEDDED TEMPERATURE DETECTORS

HV & MV motor shall be provided with four (4) Nos. simplex or two (2) Nos. duplex platinum resistance temperature detectors (RTDs) in each phase embedded in stator winding at locations where high temperatures are expected. In addition one (1) duplex type RTD shall be provided in each bearing. The RTDs shall be 3 wire duplex platinum resistance type having a value of 100 ohms at 0 Deg.C

14.40.00 BEARINGS TEMPERATURE INDICATORS

HV & MV motors shall be provided with dial type two (2) bearing temperature indicators and shall have two (2) sets of contacts, each set having 2 NO + 2 NC contacts rated for 5A at 240V AC and 0.5A at 220V DC. One set shall be set to operate at lower value to give alarm and other set at a higher value to trip the motor.

14.41.00 SPACE HEATERS

14.41.01 Valve / Damper actuator motors; and Motors 30 KW and above shall be provided with one (1) or two (2) space heaters suitable for 240V, 50 Hertz single phase AC supply and of adequate capacity to maintain motor internal temperature above dew point to prevent moisture condensation or deterioration of insulation during shut down. Heaters shall be mounted inside the motor in accessible locations so that their removal and replacement is simple.

14.41.02 The terminals of space heaters shall be brought out to a separate totally enclosed dust proof and weatherproof terminal box.

14.41.03 The space heater shall be wired to maintain the motor internal temperature above dew point when the motor is in idle condition.

14.42.00 HOT AIR TEMPERATURE DETECTOR



If the motor is of CACA or CACW enclosure, dial type temperature indicator shall be provided (one each for hot and cold air temperature monitoring for CACA and CACW and one each for inlet and outlet water temperature monitoring for CACW). In addition one (1) duplex type RTD shall be provided in each enclosure for alarm and if trip is required for cooling air temperature, temperature switch shall be provided.

14.43.00 WATER FLOW INDICATOR

If the motor is of CACW enclosure a provision shall be made for visual indication of water flow and flow switch shall also be provided with alarm contacts. Thermometers shall be provided in water inlet and outlet circuits. In addition one (1) duplex type RTD shall be provided in each water inlet and outlet circuit

14.44.00 MOISTURE DETECTORS

Motors with type of cooling 1C 81W or 1C 91 W shall be provided with moisture detectors for raising alarm in the event of water tube failure.

14.45.00 BED PLATE

Whenever motor is supplied with driven equipment the Supplier shall ensure that bed plate suits both motor and driven equipment and is adequately braced to keep vibration and misalignment within allowable limits to the approval of driven equipment and motor manufacturers.

14.46.00 OTHER ACCESSORIES

Motor shall be supplied with all accessories and parts other than those, specified above which are necessary and/or useful for efficient operation.

14.47.00 TESTS

14.47.01 HV & MV Motors

i) Routine Tests

All equipment shall be completely assembled, wired, adjusted and all acceptance and routine tests as per the specification and relevant standards shall be carried out. These tests shall be carried out in presence of the Owner's representative, for which a minimum 7 days notice shall be given by the Bidder. Charges for these shall be deemed to be included in the equipment price.

ii) Type Tests

- a) For each type & rating of HV & MV motors the Bidder shall submit for Owner's approval the reports of all the type tests as per relevant standards. These reports should be for the tests conducted on the equipment similar to those proposed to be



supplied under this contract and the test(s) should have been conducted at an independent laboratory. Period - With in 5 Years from the zero date.

- b) In case the Bidder is not able to submit report of the type test(s) conducted,, or in case the type test report(s) are not found to be meeting the specification requirements, the Bidder shall conduct all such tests under this contract free of cost to the Owner and submit the reports for approval, for which a minimum 7 days notice shall be given by the Bidder. Charges for these shall be deemed to be included in the equipment price

iii) List of minimum type tests to be conducted

The following Minimum type tests shall be conducted on each type and rating of HV & MV motor:-

- a) No load saturation and loss curves upto approximately 115% of rated voltage.
- b) Measurement of noise at no load.
- c) Momentary excess torque test.
- d) Full load test
- e) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp., coolant flow and its temp. shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose. In case due to test bed limitations at the manufacturing works, mixed frequency method as per latest IEC 60034 is also acceptable.
- f) Lightning Impulse withstand test on the sample coil shall be as per IEC-60034, part-15
- g) Surge-withstand test on interturn insulation shall be as per clause no. 5.1.2 of IEC60034, part-15
- h) Degree of protection test for the enclosure followed by IR, HV and no load run test.
- i) Terminal box-fault level withstand test for each type of terminal box.
- j) All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

14.47.02 LT Motors

- i) Routine Test



All equipment shall be completely assembled, wired, adjusted and routine tested as per relevant IS/IEC Standards at manufacturer's works in the presence of Consultant /Owner or his representative.

ii) List of minimum tests for which reports have to be submitted

The following minimum type test reports shall be submitted for each type and rating of LT motor of above 30 KW only

- a) Measurement of resistance of windings of stator and wound rotor.
- b) No load test at rated voltage to determine input current power and speed.
- c) Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors)
- d) Full load test to determine efficiency power factor and slip.
- e) Temperature rise test.
- f) Momentary excess torque test.
- g) High voltage test.
- h) Test for vibration severity of motor.
- i) Test for noise levels of motor(Shall be limited as per clause No. 14.24.00 of this section)
- j) Test for degree of protection and
- k) Over speed test.
- l) Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1

iii) All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

14.48.00 INFORMATION WITH PROPOSAL

14.48.01 AC Motor Data Sheet.

14.48.02 Dimension Drawing/Foundation load details of motor and driven equipment.

14.48.03 Manufacturer's catalogue showing constructional details.

14.49.00 INFORMATION ON AWARD OF CONTRACT

14.49.01 Motor Data Sheet

Certified binding dimension drawing of motor complete with all accessories and fittings specifically showing terminal boxes, terminal spacing and sizes, earthing connections and sizes thereof, mounting details, lifting lugs, final foundation loads and dimensions with tolerances of centering spigot (where needed), shaft extension and key.

14.49.02 Following characteristics curves:-



- i) Torque-speed curves for motor at eighty (80), hundred (100) and hundred ten (110) percent rated voltage as well as torque-speed curve for driven equipment except for mill motor. For mill motor torque speed curve for motor at ninety (90) hundred (100) and hundred ten (110) percent rated voltage as well as torque-speed curve for driven equipment
- ii) Current-speed curves at eight (80), hundred (100) and hundred ten (110) percent rated voltage except for mill motor. For mill motor current speed curve for motor at ninety (90) hundred (100) and hundred ten (110) percent rated voltage
- iii) Current-time curves at eighty (80), hundred (100) and hundred ten (110) percent rated voltage except for mill motor. For mill motor current time curve for motor at ninety (90) hundred (100) and hundred ten (110) percent rated voltage.
- iv) Thermal withstand curves for hot and cold at eighty (80), hundred (100) and hundred ten (110) percent rated voltage except for mill motor. For mill motor thermal withstand curve for motor at ninety (90) hundred (100) and hundred ten (110) percent rated voltage.
- v) Efficiency, power factor, current and speed versus power output curves.
- vi) Speed-time curves at eight (80), hundred (100) and hundred ten (110) percent rated voltage except for mill motor. For mill motor speed time curve for motor at ninety (90) hundred (100) and hundred ten (110) percent rated voltage.
- vii) Negative phase sequence current withstand characteristics.

14.50.00 DC MOTOR

- 14.50.01 D.C. Motor provided for emergency service shall be shunt / compound would type. The starting current shall be as per manufacturer's standard.
- 14.50.02 Motor shall be sized for operation with fixed resistance starter for maximum reliability.
- 14.50.03 Starter panel complete with all accessories shall be included in the scope of supply.

14.51.00 DRAWINGS, DATA & MANUALS

- 14.51.01 Minimum Drawings, data & manuals for the motors to be submitted
 - i) Dimensional General Arrangement drawing
 - ii) Foundation Plan & Loading
 - iii) Cable end box details
 - iv) Space requirement for rotor removal
 - v) Thermal withstand curves hot & cold



- vi) Starting and speed torque characteristics at 80% & 100% voltage except for mill motor. For mill motor Starting and speed torque characteristics at 90% & 100% voltage.
- vii) Complete motor data
- viii) Erection & Maintenance Manual
- ix) Test reports
- x) QAP



DATASHEET

	Auxiliary power supply	
1.1	HV supply	
	11kV, 3 Φ , 3W, 50 Hz non effectively earthed Earthed through resistance, limiting earth fault current to 400 Amps	Motors rated above 2000 kW
	Fault level	50 kA for 1 second
	HV Motors	shall be controlled through vacuum circuit breaker
	The cooling tubes of Motor	Shall be of Stainless Steel
1.2	MV supply	
	6.6kV, 3 Φ , 3W, 50 Hz non effectively earthed. Earthed through resistance, limiting earth fault current to 400 Amps	Motors above 200kW upto and including 2000kW
	Fault level	40 kA for 1 second
	MV Motors	shall be controlled through vacuum circuit breaker
	The cooling tubes of Motor	Shall be of Stainless Steel
1.3	LV supply	
	415V, 3 Φ , 3W, 50 Hz effectively earthed	Motors below and including 200kW
	Fault level	50kA for 1 second
	110V, 1 Φ , 2W, 50 Hz effectively earthed	Lighting, space heating, AC control and protective devices
	LT motors rated up to 90 kW	shall be controlled through MPCB/ MCCB and contactor.
	LT motors rated more than 90 kW	Shall be controlled through air circuit breaker
1.4	DC supply	
	220V, 2W, unearthed	DC alarm, control and protective devices.
	Fault level	25 kA for 1 second
2	Range of variation	As indicated in the specification
2.1	AC supply	



	voltage	-----
	Frequency	-----
	Combined voltage & frequency	-----
2.2	DC supply	198 to 240 V
Note: During starting of largest motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.		



SECTION – 18: LV POWER CABLES**18.01.00 SCOPE OF SUPPLY**

- i) The LV Power cables shall be supplied, installed and commissioned in accordance with the following specification.
- ii) Other cables including special cables if any which are necessary as per proven engineering practice for satisfactory & trouble free operation of the entire cable system of the power plant shall also be within the scope of supply. These shall include all such cables for electrical integral with mechanical equipment systems and subsystems.

18.02.00 CODES & STANDARDS

- i) All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on zero date. In case of conflict between this specification and those (IS: codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes:

IS:1554 (Part-I)	PVC insulated (heavy duty) electric cables for working voltage up to and including 1100 V.
IS: 2982	Copper conductor in insulated cables and cords.
IS : 3961	Recommended current ratings for cables
IS : 3975	Low carbon galvanized steel wires, formed wires and tapes for armouring of cables.
IS : 4905	Methods for random sampling.
IS : 5831	PVC insulation and sheath of electrical cables.
IS:7098 (Part - I)	Cross linked polyethylene insulated PVC sheathed cables for working voltages up to and including 1100V.
IS : 8130	Conductors for insulated electrical cables and flexible cords.
IS : 10418	Drums for electric cables.
IS : 10810	Methods of tests for cables.
IEC: 60	High voltage test techniques
IEC: 230	Impulse tests on cables and their accessories
IEC: 287	Calculation of the continuous current rating of the cables (100% load factor).
IEC: 288	Nominal cross sectional area and composition of conductor of insulated cables.
IEC-331	Fire resisting characteristics of electric cables
IEC: 502	Extruded solid dielectric insulated power cables for rated voltages from 1kV up to 30kV.
IEC: 540	The methods for insulations and sheath of electric cables and cords(elastomeric and thermoplastic compounds)
IEC-754 (Part-I)	Test on gases evolved during combustion of electric cables.
IEC -60332	Tests on Electric cables under fire conditions. Part-3 : Tests on bunched wires or cables (category -B)



IEEE-383	Standard for type test of Class IE Electric Cables.
ASTM-D -2843	Standard test method for density of smoke from the burning or decomposition of plastics.
ASTM-D-2863	Standard method for measuring the minimum oxygen concentration to support candle like combustion of plastics.
NES-715-1	Temperature index
SS-4241475 classF3	Swedish Chimney test
	SVENSK Standard SS-4241475 Class F3

- ii) BICC Hand Book For cables in fire regarding temperature index- chapter-6
- iii) Indian Electricity Rule.
- iv) Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted subject to approval of the Owner. In such case, copies of the English version of the standards adopted shall have to be submitted along with the bid.
- v) The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Codes of Practice. In addition, other rules and regulations applicable to the work shall be followed.

18.03.00 DESIGN CRITERIA

- i) The cables shall be used for connection of power circuits of the system. Actual cable sizes shall be selected based on approved sizing calculations. Number of different sizes selected shall be kept to a minimum for optimization.
- ii) Cables shall be generally laid on ladder type cable trays. For interplant connection cables shall be routed along overhead cable bridge.
- iii) For continuous operation at specified rating, maximum conductor temperature shall be limited to the permissible value as per relevant standard and/or this specification.
- iv) The insulation and sheath materials shall be resistant to oil, acid and alkali and shall be tough enough to withstand mechanical stresses during handling.
- v) The inner and outer sheath shall have flame retardant low smoke (FRLS) characteristics or fire survival characteristics as the case may be, and shall meet the requirements of additional tests specified for the purpose.
- vi) Core identification for multicore cable shall be provided by colour coding.



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- vii) Cables shall be so designed and manufactured that no damage occurs during handling, transit, storage, installation under any operative conditions which they may be subjected to.
 - viii) Maximum continuous operating temperature shall be 90 deg C under normal operation and 250 deg C under short circuit condition. The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS: 5831.
 - ix) Power cables shall be chosen taking into account the factors mentioned in Section-I.

18.04.00 SPECIFIC REQUIREMENTS / CONSTRUCTIONAL REQUIREMENTS**18.04.01 1.1KV Aluminium Conductor Power Cables**

- i) 1100 volt, 90 Deg. C rating, heavy duty power cables with stranded aluminium conductor, extruded XLPE insulation, extruded PVC,FR-LS inner sheath, aluminium round wire armour for single core cables and galvanized steel strip /wire armour for three (3) core cables, and extruded PVC, FR-LS overall sheath. Cables shall be manufactured in conformity to IS-7098 part 1 - 1988, amended up to date and bearing ISI mark.
- iii) Conductor

The cable conductor shall be made from standard Aluminum of grade H2 and Class 2 to form compact conductor having a resistance within the limits specified. All the cables of size 25mm² and above shall have sector shaped conductors.
- iv) Insulation

The insulation shall be XLPE type. It shall be designed and manufactured for the specified system voltage. The manufacturing process shall ensure that insulation shall be free from voids. The insulation shall withstand mechanical and thermal stresses under steady state and transient operating conditions. The insulation of the cables shall be of high standard quality.
- v) Inner Sheath
 - a) The laid up insulated cores of twin and multicore power cables shall be provided with an inner sheath of extruded FRLS PVC, compound conforming to Type ST2 of IS:5831. Single core power cables need not be provided with any inner sheath.



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- vi) Armour
 - a) For single core armoured cables, armouring shall be of aluminium wires/formed wires of H4 grade.
 - b) For multicore armoured cables, armouring shall be of galvanised steel strip /wire.
 - vii) Overall Sheath
 - a) Outer sheath shall be of extruded FRLS PVC compound conforming to type ST2 as per IS: 5831 & black in colour. In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall be applied with anti rodent and termite additives.

18.04.02 1.1KV Grade Copper Conductor Fire Survival Power Cables

- i) 1100 volt grade, 90 Deg. C rating, Power cables with stranded Copper conductor, heat resistance elastomeric insulation generally conforming to Type IE-2 of IS: 6380-1984, extruded Halogen free or very low Halogen elastomeric inner sheath, generally conforming to Type SE-3 of IS-6380-1984, round wire/strip armour and extruded outer sheath of elastomeric material generally conforming to Type SE-3 of IS: 6380-1984. The cables shall be generally manufactured in conformity to IS-9968 Part-1/1988. The cables can withstand 750 Deg. C temperature for three (3) hours.
- ii) Conductor
 - a) Conductor shall be of stranded construction, consisting of high conductivity annealed plain copper wires conforming to Class-II of IS 8130.
 - b) A suitable heat barrier tape, preferably glass mica tape shall be provided over the conductor.
- iii) Insulation
 - a) Cores of the cable shall be identified by colouring of insulation. Following colour scheme shall be adopted.

1 core -	Red, Black, Yellow or Blue
2 core -	Red & Black
3 core -	Red, Yellow & Blue
4 core -	Red, Yellow, Blue & Black
- iv) Laying up of cores (For multi core cables only)
 - a) The core shall be suitably identified in accordance with IS: 9968 (Part-I).



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- b) The suitable fire retardant material fillers shall be used for filling in the interstices.
 - c) Two layers of plain glass fiber binder tape shall be applied over the laid up cores.
 - v) Inner Sheath
 - a) An inner sheath of extruded special low smoke and very low halogen content (acid gas generation shall be less than 2% by weight) elastomeric (HOFR) compound of black colour conforming to Type SE-3 of IS-6380/1984, amended up to date, shall be provided over the laid up cores. This shall be provided even for single core cables after providing two layers of plain glass fiber tape over the insulation.
 - vi) Armour
 - a) For Single core cables to be used in A.C system, the armouring over inner sheath shall consist of single layer of round copper wire.
 - b) For multi-core cables to be used in A.C. system and single/two core cables in D.C. System, the armouring over inner sheath shall consist of single layer of round galvanized steel wire.
 - vii) Outer Sheath
 - a) The extruded outer sheath shall be of special low smoke and very low Halogen content (Acid gas generation shall be less than 2% by weight) elastomeric HOFR compound comprising of synthetic rubber and shall generally conform to the type SE-3 of IS: 6380 latest revision.
 - b) Minimum value of 'Tensile Strength' and 'Percentage elongation at rupture' shall be 8 Newton/Sq. mm and 250% respectively.
 - c) The colour of outer sheath shall be black or any other colour agreed mutually between Owner and Supplier.

18.04.03 Flexible Trailing Cables

1100 V Grade flexible trailing cable shall be tinned copper of Class – 5 of IS – 8130, heat resistant electrometric compound based on EPR insulation, inner sheath of heat resistant electrometric compound PCP sheath, nylon cord reinforcement and heat resistant, oil resistant and flame retardant heavy duty electrometric compound FRLS CSP outer sheath.



18.05.00 GENERAL REQUIREMENTS**18.05.01 Drum Length & tolerance**

- i) Cable shall be supplied in wooden drums. The standard single length of each drum shall be minimum 500 metres for large size of cable minimum 1000 metre for smaller size of cables.
- ii) 1.1KV Copper Fire Survival Power cables shall be supplied in wooden drums. Each drum shall be minimum 500 metres single length of cable.
- iii) Allowable tolerance on individual drum length is (+) 5%.

18.05.02 Non-standard length

Contractor shall be required to obtain Owner's approval before packing the non standard length of cables on drums. Non-standard lengths shall not be less than half of the standard packing length in any case.

18.05.03 Cable identification

Cable identification shall be provided by embossing on every meter on the outer sheath the following:

- a) TANGEDCO
- b) Manufacturer's name or trademark
- c) Voltage grade
- d) Year of manufacture
- e) Type of insulation and sheath, e.g. XLPE /PVC FRLS, IE2/SE3 F.S. as applicable.
- f) No. of core and size of cables.
- g) Sequential length marking at an interval of 1m through out the length of the cable.
- h) ISI mark with C/ML Number
- i) Type of improved fire performance, e.g. FR/FR-LSH/FS.

18.05.04 Packing

- i) Cables shall be supplied in non-returnable drums. The drums shall be of heavy construction as per relevant IS. All wooden parts shall be manufactured from seasoned wood. All ferrous parts used shall be treated with suitable rust preventive finish or coating to avoid rusting during transit or storage. Wooden drums shall be treated by immersing in copper nitrate solution
- ii) Cable shall be wound and packed on drums in such a manner that it shall be properly sealed and firmly secured to the drum. The ends of each length shall be sealed before shipment. Heat shrinkable cable seals shall be used for this purpose
- iii) A label shall be securely attached to each end of the reel indicating the length, type, voltage grade, conductor size and number of core of the cable. A tag containing the same information shall be attached to the leading end of the cable inside. An arrow and necessary instructions



shall be marked on the drum indicating the direction in which it should be rolled. Drum numbers are to be indicated on cable drums.

- iv) The cable drums should carry the following details in printed form (non returnable):-
- a) TANGEDCO & Manufacturer's name or trade make
 - b) Type of cable & voltage grade
 - c) Year of manufacture
 - d) Type of insulation / sheath e.g. XLPE /PVC FRLS, IE2/SE3 F.S. as applicable.
 - e) No. of core and size of cables
 - f) Cable code
 - g) Length of cable on drum
 - h) Direction of rotation, by arrow
 - i) Approx. gross mass.
 - j) ISI mark
 - i) IS / IEC number

18.06.00 TESTING PROCEDURE

18.06.01 Tests During Manufacture:-

During the manufacture of cables, manufacturer's standard tests shall be performed and record / test report shall be made available to Owner's representative during inspection / testing.

18.06.02 Type Tests:-

- i) Cables shall be type tested quality. For each type and rating of cables reports on all type tests as per relevant standards, and carried out with in last five years from the zero date shall be submitted.
- ii) These reports shall be for the tests conducted on the similar type of cables proposed to be supplied under this contract. These tests should have been conducted with in last 5 years from the zero date at an independent laboratory. If type test certificate are not available or in the case of type test report(s) are not found to be meeting the specification requirements, the same shall be conducted in the presence of the Owner free of cost.

18.07.00 SPECIAL TESTS ON PVC 'FR-LS' MATERIAL

- i) All the sizes of XLPE power cables of the 'FRLS' PVC sheathed type shall pass following special test requirements. Inner sheath wherever applicable shall also be of the 'FR-LS' type 'PVC' to meet these special tests:-
 - a) Oxygen/Temperature Index test on sheath material:-
 - b) This test shall be carried out as per American National Std. A STM-D-2863/77.
 - c) The minimum oxygen index shall be 29 at room temperature.



- d) For determination of the temp.index, the oxygen index test shall be carried out at different temperature upto 250°C. However, the test shall be carried out by extra-polation method beyond temperature at which the material of sheath may start deformation. The minimum temperature index (i.e. the temperature at which the oxygen index is minimum 21) shall be 250°C generally as per BICC Hand Book Chapter-6.
- ii) Acid gas emission test on sheath material:-
This test shall be carried out as per IEC Std. 754-1. The maximum acid gas emission shall be less than 20 by weight.
- iii) Smoke density test on sheath material:-
This test shall be carried out as per American National Standard ASTM-D-2843/1977 and also as per UITP method (3M cube test on finished cable sample). The ASTM test method is compulsory. For passing this test, the requirement of light transmission shall be minimum 40% after the test.
- iv) Flammability test on finished cable sample:-
This test shall be carried out as per the following method:
- v) Swedish Std.SS:424-14-75 Class-F3. This test known as Swedish Chimney test is compulsory.
- vi) IEEE std. 383-1974 – This test known as the vertical tray flame propagation test shall be conducted if insisted by Owner.
- vii) IEC Std: 332-1. – The cable should meet the requirement of all the above standards.

18.08.00 ROUTINE TESTS

The following tests shall be carried out as Routine tests on each and every drum length of cable, as per IS 7098 (Part 2) / 1985:-

- a) High Voltage Test
b) Conductor Resistance Test
c) Partial discharge test (for screened cables) – on full drum length.

18.09.00 ACCEPTANCE TEST

- i) The following test shall be carried out as Acceptance Test in the presence of TANGEDCO Inspecting Engineer on samples taken from the delivery lot. One drum out of every 10 number of drums or less shall be selected at random sampling basis in each lot for the Acceptance Tests which shall be carried out at manufacturer's/supplier's cost:-
- a) High Voltage Test
b) Conductor Resistance Test



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- c) Tensile / wrapping test.
 - d) Partial discharge test (In screened cables).
 - e) Insulation Resistance/Volume resistivity test
 - f) Measurement of thickness of insulation and sheath and other dimensions
 - g) Tensile strength & elongation at break for insulation & sheath.
 - h) Hot set test on XLPE insulation
 - i) Flammability test as per Swedish standard SS:424-15-75 Class-F-3 (Swedish Chimney test)
 - j) Acid gas generation test as per IEC-754-1.
 - k) Smoke density test as per ASTM-D-2843/1977
 - l) Oxygen index test as per ASTM-D 2863/1977
 - m) Temp. index test as per ASTM-2863/77
 - n) Test for Rodent and termite repulsion property

18.10.00 TEST WITNESS

Tests shall be performed in presence of Owner's representative. The Contractor shall give atleast fifteen (15) days advance notice of the date on which the tests are to be carried out.

18.11.00 TEST CERTIFICATES

- i) Certified reports of all the tests carried out at the works shall be furnished for approval of the Owner's representative.
- ii) Test reports shall be completed with all details and shall also contain IS/IEC specified limit values, wherever applicable, to facilitate review.
- iii) The cables shall be dispatched from works only after receipt of Owner's written approval of the test reports.

18.12.00 DRAWINGS, DATA AND MANUALS TO BE FURNISHED FOR APPROVAL

Bidder shall submit the following minimum drawings and documents for approval during detail engineering stage.

- Design basis report
- Cable sizing calculation
- General arrangement drawings
- Technical data sheet
- Test reports
- Catalogues
- Sub-vendor list
- Manufacturing quality plan
- Field quality plan



DATA SHEET

1100 V grade, power cable conforming to following requirement and in line with IS-1554, IS-5831, IS-8130 & IS-3975.			
S.NO.	DESCRIPTION	:	SPECIFICATION
1	Conductor	:	Stranded and compacted plain aluminium of grade H2 and class 2/stranded, high conductivity annealed plain copper, generally conforming to IS:8130
2	Insulation	:	Extruded Cross linked Polyethylene (XLPE).
3	Inner Sheath	:	Extruded FRLS PVC compound conforming to type ST2 of IS: 5831 for multicore cable. Single core power cables need not be provided with any inner sheath.
4	Armour	:	Galvanised single round/ strip steel wire armour for twin and multicore cables. Non-magnetic hard drawn aluminum single round wire conforming to H4 grade for single core cables.
	Overall Sheath	:	Extruded FRLS PVC compound conforming to type ST2 of IS: 5831.



SECTION – 19: CONTROL CABLES**19.01.00 SCOPE OF SUPPLY**

The cables shall be supplied, installed and commissioned in accordance with the following specification.

19.02.00 CODES & STANDARDS

- i) All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on zero date. In case of conflict between this specification and those (IS: codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes:

IS:1554 (Part-I)	PVC insulated (heavy duty) electric cables for working voltage up to and including 1100 V.
IS: 2982	Copper conductor in insulated cables and cords.
IS : 3961	Recommended current ratings for cables
IS : 3975	Low carbon galvanized steel wires, formed wires and tapes for armouring of cables.
IS : 4905	Methods for random sampling.
IS : 5831	PVC insulation and sheath of electrical cables.
IS:7098 (Part - I)	Cross linked polyethylene insulated PVC sheathed cables for working voltages up to and including 1100V.
IS : 8130	Conductors for insulated electrical cables and flexible cords.
IS : 10418	Drums for electric cables.
IS : 10810	Methods of tests for cables.
IEC: 60	High voltage test techniques
IEC: 230	Impulse tests on cables and their accessories
IEC: 287	Calculation of the continuous current rating of the cables(100% load factor).
IEC: 288	Nominal cross sectional area and composition of conductor of insulated cables.
IEC-331	Fire resisting characteristics of electric cables
IEC: 502	Extruded solid dielectric insulated power cables for rated voltages from 1kV upto 30kV.
IEC: 540	The methods for insulations and sheath of electric cables and cords(elastomeric and thermoplastic compounds)
IEC-754 (Part-I)	Test on gases evolved during combustion of electric cables.
IEC -60332	Tests on Electric cables under fire conditions. Part-3 : Tests on bunched wires or cables (category -B)
IEEE-383	Standard for type test of Class IE Electric Cables.
ASTM-D -2843	Standard test method for density of smoke from the burning or decomposition of plastics.
ASTM-D-2863	Standard method for measuring the minimum oxygen concentration to support candle like



	combustion of plastics.
NES-715-1	Temperature index
SS-4241475 classF3	Swedish Chimney test
	SVENSK Standard SS-4241475 Class F3

- ii) BICC Hand Book For cables in fire regarding temperature index- chapter-6
- iii) Indian Electricity Rule.
- iv) Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted subject to approval of the Owner. In such case, copies of the English version of the standards adopted shall have to be submitted along with the bid.
- v) The electrical installation shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Codes of Practice. In addition, other rules and regulations applicable to the work shall be followed.

19.03.00 DESIGN CRITERIA

- 19.03.01 The cables shall be used for connecting control circuits.
- 19.03.02 Cables shall be generally laid on overhead cable trays/cable trays in cable trenches. For interplant connection cables routed along overhead cable bridge.
- 19.03.03 Perforated type cable trays to be used for control cables. Only in cable risers ladder type cable trays can be used for control cables.
- 19.03.04 For continuous operation at specified rating, maximum conductor temperature shall be limited to the permissible value as per relevant standard and/or this specification.
- 19.03.05 The insulation and sheath materials shall be resistant to oil acid and alkali and shall be tough enough to withstand mechanical stresses during handling.
- 19.03.06 The inner and outer sheath shall have flame retardant low smoke (FRLSH) characteristics or fire survival characteristics as the case may be, and shall meet the requirements of additional tests specified for the purpose.
- 19.03.07 Conductor of control cables shall have plain annealed copper. The minimum size of control cable shall be of 1.5 sq.mm. For CT circuit minimum size shall be 4.0sq.mm copper. Control cables shall have 20% spare cores. For PT circuit minimum size shall be 2.5 sqmm
- 19.03.08 Voltage transformer leads shall be checked for voltage drop which shall be limited to within 1% for all cases other than tariff metering. For tariff metering the voltage drop shall be limited to 0.2%. In case the voltage drop with 2.5 sq.mm copper conductor exceeds this value, higher conductor sizes shall be used.



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- 19.03.09 The cables shall be designed and manufactured in accordance with the best engineering practice and shall be such as has been proven to be suited for the intended purpose.
- 19.03.10 For fire survival control cable, the armouring over inner sheath shall consist of single layer of wire/round galvanized steel wire as per IS 975 amended upto date.
- 19.04.00 SPECIFIC REQUIREMENTS / CONSTRUCTIONAL REQUIREMENTS**
- 19.04.01 1100 V Copper Conductor PVC FRLS Control Cables
- 1100 Volt grade, control cables with stranded copper conductors, PVC Insulation Type A, extruded FRLS PVC, of type ST1 Inner sheath, round wire/strip armour as specified elsewhere in the specification and extruded FRLSPVC, of type ST1 overall sheath. The cables shall be suitable for use in 1100V non-effectively earthed system. Control cable shall generally conform to IS 1554 latest and have ISI marked with C/ML Number. Armour shall be GS.
- 19.04.02 Conductor
- Conductor shall be stranded, non-compacted & circular, high conductivity annealed, plain (untinned) copper conductor. Conductor shall be generally conforming to Class-II of IS 8130.
- 19.04.03 Insulation
- The conductors shall be insulated with PVC compound conforming generally to type-A of IS:5831/1984 amended up to date ,except for the special properties / parameters, necessary at normal operation.
- 19.04.04 Inner Sheath
- The laid up insulated cores of twin and multicore control cables shall be provided with an inner sheath of extruded FRLSPVC, compound conforming to Type ST1 of IS:5831/1984 amended up to date.
- 19.04.05 Armouring
- For cables up to and inclusive 7 cores, galvanized round steel wire armour shall be provided. However, for control cables above 7 cores, galvanized steel strip armour shall be provided.
- The armouring wire/strip shall generally conforming to IS: 3975 amended up to date.
- 19.04.06 Overall Sheath
- A tough overall sheath of extruded FRLSPVC,Compound conforming to type ST1 of IS: 5831/1984 shall be provided over armour. The colour of outer



sheath shall be black or any other natural colour (with prior approval of the Owner).

19.04.07 1100 V Copper Conductor Fire Survival Control Cables

Fire survival cable shall be of copper conductor and comply with IEC-60331 (withstanding 750 degree C temperature for 3 hours). Also the halogen acid contents in outer sheath shall not be more than 2% when tested as per IEC-60754 and the smoke density in percent light absorption shall not exceed 20% when tested as per ASTM-D-2843. 1.1 kV earthed grade fire survival cables shall constitute the following:

- Circular/shaped stranded and compacted annealed copper conductor
- Elastomeric materials (XLPE, EPR, SR, or LSOH) insulated
- Glass mica tapped
- Extruded FRLS compound or LSOH material as inner sheath
- Galvanised steel formed wire/strip
- Extruded FRLS compound or LSOH material as inner sheath

19.04.08 Laying Up Of Cores (For Multi Core Cables Only)

- i) The core shall be suitably identified in accordance with IS: 9968 (Part-I).
- ii) The suitable fire retardant material fillers shall be used for filling in the interstices.
- iii) Two layers of plain glass fiber binder tape shall be applied over the laid up cores.

19.04.09 Inner Sheath

An inner sheath of extruded special low smoke and very low halogen content (acid gas generation shall be less than 2% by weight) elastomeric (HOFR) compound of black colour or any other natural colour with prior approval from Owner conforming to Type SE-3 of IS-6380/1984, amended up to date, shall be provided over the laid up cores.

19.04.10 Armour

The armouring over inner sheath shall consist of single layer of wire/round galvanized steel wire as per IS 3975 amended up to date.

19.04.11 Outer Sheath

The outer sheath shall be of special low smoke and very low Halogen content (Acid gas generation shall be less than 2% by weight) elastomeric HOFR compound comprising of synthetic rubber and shall generally conform to the type SE-3 of IS: 6380 latest revision.

The colour of outer sheath shall be black or any other natural colour agreed mutually between Owner.



19.05.00 GENERAL REQUIREMENTS**19.05.01 Drum Length & Tolerance**

- i) The cable shall be supplied in wooden drums. Each drum shall be minimum 1000 meters single length of cable. For above cable drums, allowable tolerance on individual drum length is +/- 5%.
- ii) 1.1KV Copper Fire Survival control cables shall be supplied in wooden drums. Each drum shall be minimum 500 metres single length of cable. Allowable tolerance on individual drum length is +5%.

19.05.02 Non-standard length

Bidder shall be required to obtain Owner's approval before packing the non standard length of cables on drums. Non-standard lengths shall not be less than half of the standard packing length in any case.

19.05.03 Cable identification

- i) Cable identification shall be provided by embossing on every meter on the outer sheath the following:
 - a) TANGEDCO
 - b) Manufacturer's name or trademark
 - c) Voltage grade
 - d) Year of manufacture
 - e) Type of insulation and sheath, e.g. PVC/ FRLS, IE2/SE3/FS as applicable.
 - f) No. of core and size of cables.
 - g) Sequential length marking at an interval of 1m through out the length of the cable.
 - h) ISI marked with C/ML Number
- ii) Type of improved fire performance eg. FR/FR-LSH-FS

19.05.04 Packing

- i) Cables shall be supplied in non-returnable drums. The drums shall be of heavy construction as per relevant IS. All wooden parts shall be manufactured from seasoned wood. All ferrous parts used shall be treated with suitable rust preventive finish or coating to avoid rusting during transit or storage.
- ii) Cable shall be wound and packed on drums in such a manner that it shall be properly sealed and firmly secured to the drum. The ends of each length shall be sealed before shipment.
- iii) A label shall be securely attached to each end of the reel indicating the length, type, voltage grade, conductor size and number of core of the cable. A tag containing the same information shall be attached to the leading end of the cable inside. An arrow and necessary instructions



shall be marked on the drum indicating the direction in which it should be rolled. Drum numbers shall be indicated on cable drums.

- iv) The cable drums should carry the following details in printed form (non returnable):-
- a) TANGEDCO & Manufacturer's name or trade make
 - b) Type of cable & voltage grade
 - c) Year of manufacture
 - d) Type of insulation / sheath e.g. PVC/ FRLS, IE2/SE3/FS. as applicable.
 - e) No. of core and size of cables.
 - f) Cable code.
 - g) Single length of cable on drum
 - h) Direction of rotation, by arrow
 - i) Approx. gross mass.
 - j) ISI mark.

19.06.00 TESTING PROCEDURE

19.06.01 1100 V Copper Conductor PVC FRLS Control Cables

- i) Type Tests:-

Cables shall be type tested quality. For each type and rating of cables reports on all type tests as per relevant standards, and carried out with in last five years from the zero date shall be submitted.

- a) These reports shall be for the tests conducted on the similar type of cables proposed to be supplied under this contract. These tests should have been conducted at an independent laboratory. If type test certificate are not available or in the case of type test report(s) are not found to be meeting the specification requirements, the same shall be conducted in the presence of the Owner without cost implication.

- ii) Special Tests On PVC 'FRLS' Material

All the sizes of 1.1 KV Grade PVC insulated, PVC Control cables of the FRLSH sheathed type shall pass these special test requirements. Inner sheath wherever applicable shall also be of the 'FRLSH' type 'PVC' to meet these special tests.

- iii) Oxygen/Temperature Index Test On Sheath Material

- a) This test shall be carried out as per American National Std. ASTM-D-2863/77. The minimum oxygen index shall be 29 at room temperature.
- b) For determination of the temp index, the oxygen index test shall be carried out at different temperature upto 250°C. However, the test shall be carried out by extrapolation method beyond temperature at which the material of sheath may start deformation. The minimum temp. index (i.e. the temperature



at which the oxygen index is minimum 21) shall be 250°C generally as per BICC Hand Book Chapter-6.

iv) Acid Gas Emission Test On Sheath Material

This test shall be carried out as per IEC Std. 754-1. The maximum acid gas emission shall be less than 20% by weight.

v) Smoke Density Test On Sheath Material

a) This test shall be carried out as per American National Standard ASTM-D-2843/1977 and also as per UITP method (3M cube test on finished cable sample). The ASTM test method is compulsory. For passing this test, the requirement of light transmission shall be minimum 40% after the test (Corresponding to 60 % smoke density).

vi) Flammability Test On Finished Cable Sample

a) This test shall be carried out as per the following method:-

- i) Swedish Std.SS:424-14-75 Class-F3. (This test known as Swedish Chimney test is compulsory).
- ii) IEEE std. 383-1974 – This test known as the vertical tray flame propagation test shall be conducted if insisted by Owner.
- iii) IEC Std: 332-1. – The cable should meet the requirement of all the above standards.

vii) Routine Tests

a) The following tests shall be carried out as Routine tests on each and every drum length of cable, as per IS: 1554 / IS: 8130/1984.

- 1) High Voltage Test.
- 2) Conductor Resistance Test.

viii) Acceptance Test

a) The following test shall be carried out as Acceptance Test in the presence of Owner's Inspecting Engineer on samples taken from the delivery lot. One drum out of every 10 number of drums or less shall be selected at random sampling basis for the Acceptance Tests.

- i) Tensile / wrapping test.
- ii) High Voltage Test.
- iii) Conductor Resistance Test
- iv) Insulation Resistance/Volume resistivity test.
- v) Measurement of thickness of insulation and sheath and other dimensions.



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- vi) Tensile strength & elongation at break for insulation & sheath.
 - vii) Flammability test as per Swedish standard SS: 424-15-75 Class-F-3 (Swedish Chimney test).
 - viii) Acid gas generation test as per IEC-754-1.
 - ix) Smoke density test as per ASTM-D-2843/1977.
 - x) Oxygen index test as per ASTM-D 2863/1977.
 - xi) Temp. index test as per ASTM-2863/77
 - xii) Test for Rodent and termites repulsion property

19.06.02 1100 V Copper Conductor Fire Survival Control Cables

i) Type Tests

Cables shall be type tested quality. For each type and rating of cables reports on all type tests as per relevant standards, and carried out with in last five years from the zero date shall be submitted.

These reports shall be for the tests conducted on the similar type of cables proposed to be supplied under this contract. These tests should have been conducted at an independent laboratory. If type test certificate are not available the same shall be conducted in the presence of the Owner.

ii) Routine Tests

- a) The following test shall be carried out as Routine Tests on each and every delivery length of cable:-

- | | | | |
|----|---------------------------|---|---------------|
| 1) | High Voltage Test | - | IS: 9968 (I) |
| 2) | Conductor Resistance test | - | IS: 8130/1984 |

iii) Acceptance Tests

- a) Following tests shall be carried out as acceptance tests in the presence of Owner's Inspecting Engineer on samples taken from the delivery lot. One drum out of every 10 drums or less shall be selected on random sampling basis:-

- | | | | |
|----|---|---|--------------|
| 1) | Annealing Test | - | IS 9968 (I) |
| 2) | High Voltage test
(Water immersion Test) | - | IS 9968 (I) |
| 3) | Conductor resistance test | - | IS8130/1984 |
| 4) | Insulation Resistance Test | - | IS6380/1984 |
| 5) | Measurements of thickness of
Insulation and sheath and other
Dimensions | - | IS: 9968(I) |
| 6) | Tensile strength & elongation at | - | IS 6380/1984 |



	Break for sheath	
7)	Tensile strength and elongation at - -As per GTP break of sheath	IS 6380/1984
8)	Oxygen index test on inner & outer - 2863/77	ASTM-D-
	Sheath material at room temperature	Min.29 degC
9)	Temp. index test on inner & outer material sheath	- ASTM-D- 2863/77 Min 350 degC IEC-331
10)	Acid gas emission test on inner & sheath material	Acid gas shall be outer less than 2% generation IEC-754-1
11)	Smoke density test on inner & outer material	Max smoke sheath density shall not exceed 20% in percentage light Absorption. ASTM-D-2863/77
12)	Flammability test on finished cable Sample as per following method	
	a) Fire Survival Test	IEC -331
	b) Swedish Chimney Test	SS-424-14-75 Class-F3)

19.07.00 DRAWINGS, DATA AND MANUALS TO BE FURNISHED FOR APPROVAL

Bidder shall submit the following minimum drawings and documents for approval during detail engineering stage.

- Design basis report
- Cable sizing calculation
- General arrangement drawings
- Technical data sheet
- Test reports
- Catalogues
- Sub-vendor list
- Manufacturing quality plan
- Field quality plan



DATA SHEET

1100 V grade, PVC Control cable conforming to following requirement and in line with IS-1554, IS-8130, IS-5831 & IS-3975.			
S.NO.	DESCRIPTION	:	SPECIFICATION
1	Conductor	:	Conductor shall be Stranded, non-compacted & circular, high conductivity annealed plain copper, generally conforming to IS:8130.. Conductor shall be generally conforming to Class-II of IS 8130.
2	Insulation	:	The conductors shall be insulated with PVC compound conforming generally to type-A of IS:5831/1984 amended up to date
3	Inner sheath	:	Extruded FRLS PVC compound conforming to type ST1 of IS: 5831 for multicore cables. Single core cables shall have no inner sheath
4	Armour	:	For cables up to and inclusive 7 cores, galvanized round steel wire armour shall be provided. However, for control cables above 7 cores, galvanized steel wire/strip armour shall be provided.
5	Overall sheath	:	Extruded FRLS PVC compound conforming to type ST1 of IS:5831



SECTION-20: CABLING SYSTEM**20.01.00 SCOPE OF WORK**

20.01.01 The scope of work covers supply, erection, testing and commissioning of complete electrical system including cabling, fire stop mortar seal, fire retardant cable coating system etc. the scope shall broadly cover, but not be limited to:

- i) TG Building & Transformer Yard
- ii) Boiler Area, ESP
- iii) All auxiliary buildings (including electrical rooms of respective buildings) and structures as per details in the general electrical specification/ plot plan & related drawings.
- iv) Service Building
- v) CPU Regeneration Building
- vi) Fuel Oil Pressurisation Pump House
- vii) DG House
- viii) Pipe cum cable rack (within the battery limits).
- ix) Air Washer Units
- x) All electrical equipment as described in different sections.
- xi) As built drawing for all above systems on completion of project.

20.01.02 The scope of work shall also include all civil and structural works necessary for successful installation, commissioning & commercial operation of all electrical equipment to be erected under this specification.

20.02.00 SCOPE OF SUPPLY

20.02.01 The equipments and materials within the scope of supply shall include but not limited to:-

- i) Power & control cabling works (including that of special cables):
- ii) Galvanized steel pre-fabricated cable trays, coupler plates, nuts, bolts & washers, reducers, covers, wall brackets, hanger clamps, straight run, elbows, bends, cable trays supporting structures etc.
- iii) Supply and installation (including laying & termination) of control cables, special cables, instrumentation cables for all equipments and systems.
- iv) Supply and installation (including laying & termination) of all power cables (HV, MV and LV) for all equipments and systems.
- v) Cable routing has to be planned such that it shall not cross the steam lines, oil lines.
- vi) Fire Sealing Arrangement: All cable entries into the panel (HV & MV & LV SWGR panels) should be provided with fire sealing arrangements.
- vii) Cable/cable tray openings in walls and floors or through pipe sleeves from one area to another or from one elevation to another within the unit shall be sealed by a fire proof sealing system (FPSS). The FPSS



shall effectively prevent the spread of fire from the flaming to non-flaming side of a fire.

- viii) Galvanized steel rigid/ flexible conduits and accessories, ferrules, lugs, glands, terminal blocks, galvanized sheet steel junction boxes, cable fixing clamps, nuts & bolts etc as required.
- ix) All necessary erection materials, consumables and sundry items including arc welding rods to complete the installation for satisfactory and trouble free operation.
- x) Any item of works or erection materials which have not been specifically mentioned but are necessary to complete the work involved shall be deemed to be included in the scope of this specification and shall be furnished by the Bidder without any extra charge to the Owner.
- xi) Thickness of galvanizing on steel sections shall be not less than 610 gm/sq.m on all steel sections.

20.03.00 CODES AND STANDARDS

20.03.01 All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on zero date. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards/ codes as applicable.

IS:513	Cold rolled low carbon steel sheets and strips.
IS:802	Code of practice for the use of Structural Steel in Overhead Transmission Line Towers.
IS:1079	Hot Rolled carbon steel sheet & strips
IS:1239	Mild steel tubes, tubular and other wrought steel fittings
IS:1255	Code of practice for installation and maintenance of power cables up to and including 33 KV rating
IS:1367 Part-13	Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners).
IS:2147	Degree of protection provided by enclosures for low voltage switchgear and control gear
IS:2309	Code of practice for the protection of building and allied structures against lighting.
IS:2629	Recommended practice for hot dip galvanising of iron & steel.
IS:2633	Method for testing uniformity of coating on zinc coated articles.
IS:6745	Method for determination of mass of zinc-coating on zinc coated iron & steel articles.
IS:8308	Compression type tubular in-line connectors for aluminium conductors of insulated class.
IS:8309	Compression type tubular terminal ends for aluminium conductors of insulated cables.
IS:9537	Conduits for electrical installation.



IS:9595	Metal – arc welding of carbon and carbon manganese steels - recommendations.
IS:13573	Joints and terminations for polymeric cables for working voltages from 3.3kv up to and including 33kv performance requirements and type tests.
BS:476	Fire tests on building materials and structures
BS:6121	Specification for mechanical Cable glands for elastomers and plastic insulated cables.
	Indian Electricity Act.
	Indian Electricity Rules.
DIN 46267 (Part-II)	Non tension proof compression joints for Aluminium conductors.
DIN 46329	Cable lugs for compression connections, ring type ,for Aluminium conductors
VDE 0278	Tests on cable terminations and straight through joints

20.03.02 Equipment complying with other internationally accepted standards such as IEC, BS, DIN, USA, VDE etc. shall also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards along with copies of all official amendments and revisions in force as on zero date and shall clearly bring out the salient features for comparison.

20.04.00 DESIGN AND CONSTRUCTIONAL FEATURES

20.04.01 Inter Plant Cabling

Interplant cabling for main routes shall be laid along overhead trestles/ pipe racks. However, from tap-offs, same can be through shallow trenches. In case of Duct banks, pull-pits shall be filled with sand and provided with a PCC covering.

20.04.02 Cable entry

Cable entry from outdoor underground/cable routes to the buildings, if any, shall be above the finished floor level of the building.

20.04.03 Trenches

- i) PCC flooring of built up trenches shall be sloped for effective drainage with sump pits and sump pumps.
- ii) No subzero level cable vault/trenches shall be provided below control building/switchgear rooms in main plant areas.
- iii) All field switches for equipments corresponding to a stream located within a radius of 4-5 m shall be wired out to a field junction box and from field junction box to control panel/Input – Output cabinet by screened instrumentation cables.
- iv) Cable trenches shall be provided in Transformer Yard and Switchgear/MCC rooms. In other areas local cable trenches with length not exceeding 5 metres are allowed just near the equipment.



- v) Two separate cable routes one on each side shall be provided for each boiler unit. Cables for one set of auxiliaries such as ID,FD & PA fans & half of the coal mills shall be routed in one route & for through other set of auxiliaries through other route.
- vi) Bidder shall provide two independent routes for cables between Switchyard Control Room & Main Plant Control Room. Bidder shall provide the cable trays along with its supporting structure arrangement on the trestle.
- 20.04.04 Cable Vault:
- i) Cable vault of not less than 3.5 metres clear height shall be provided.
- ii) Clear access passage of at least 750 mm wide & 2.0 Mts clear height shall be provided at entrances & along cable ways. Wherever the passage is through cable routes clear height shall not be less than 1.5 Mts.
- iii) Cable vaults shall be provided with adequate drainage facility for drainage of fire water.
- iv) Each cable vault should have two fire proof doors.
- v) Exit signs shall be provided near doors for personnel escape in case of emergency.

20.05.00 EQUIPMENT DESCRIPTION**20.05.01 Cable trays, Fittings & Accessories**

- i) Cable trays shall be ladder/perforated type as specified complete with matching fittings (like brackets, elbows, bends, reducers, tees, crosses, etc.), accessories (like side coupler plates, etc.) and hardware (like bolts, nuts, washers, G.I. strap, hook etc.) as required. Cable tray shall be ladder type for HV, MV & LV power cables and perforated type for control & instrumentation cables. However in vertical risers ladder cable trays shall be used for control & instrumentation cables also.
- ii) These shall be prefabricated hot dip galvanized sheet steel trays free from flaws such as laminations, rolling marks, pitting etc. These (including hardware) shall be hot dip galvanized as per relevant IS.
- iii) Cable trays shall have standard width of 600 mm, however trays with 450mm, 300mm & 150mm may be used in places considering the requirement and space constraint. The trays shall have standard lengths of 2.5 metre. Minimum thickness of mild steel sheets used for fabrication of cable trays and fittings shall be 2 mm. The thickness of side coupler plates shall be minimum 3 mm.
- iv) Cable troughs shall be required for branching out few cables from main cable route. These shall be U-shaped, fabricated of mild steel sheets of minimum thickness 2 mm and shall be hot dip galvanized as per relevant IS. Troughs shall be standard width of 50 mm & 75 mm with depth of 25 mm.



- v) Prefabricated hot dip galvanized sheet steel cable trays shall be used for maximum support span of 1500 mm. Cable trays shall be suitable for a cable weight of 100 kg/meter running length of tray. Minimum thickness of sheet steel/galvanizing shall be 2mm/75 microns respectively. The amount of zinc deposit shall not be less than 610 gm per square meter.

In areas, where acid/alkaline ingration is likely (such as Battery Room, etc.) to occur, Fibre Reinforced Plastic trays with fire retardant corrosion resistance properties shall be used.

20.05.02 Support System for Cable Trays

- i) Cable tray supports shall be fabricated from standard steel structures of different structures of different sizes. The sizes selected shall be adequate for the weight of cables/trays encountered.
- ii) The steel members shall be cleaned thoroughly for rust and painted as follows:-
- For indoor One shop coat of red oxide zinc chromate primer and two site coats of aluminium alkali paint.
 - For outdoor & corrosive areas like battery room – Hot dip galvanised.

20.05.03 Pipes, Fittings & Accessories

- i) Pipes offered shall be complete with fittings and accessories (like tees, elbows, bends, check nuts, bushings, reducers, enlargers, coupling caps, nipples etc.) The size of the pipe shall be selected on the basis of maximum 40% fill criteria
- ii) GI Pipes shall be of medium duty as per IS: 1239.
- iii) Duct banks shall be High Density PE pipes encased in PCC (10% spare of each size, subject to minimum one) with suitable water-proof manholes.

20.05.04 Junction Boxes

- i) Junction box with IP 55 degree of protection shall comprise of a case with hinged door constructed from FRP material. The junction box shall be provided with canopy. The boxes shall include brackets, bolts, nuts, screws, glands, lugs, M8 earthing stud etc.
- ii) Terminal blocks shall be of 650 Volt grade, rated for 10 A and in one piece moulding. It shall be complete with insulating barriers, clip-on-type terminal numbering on wiring diagrams. Terminal block shall be suitable for terminating 2Cx2.5mm² cable on both sides and arranged to facilitate easy termination. Cable entry shall be from bottom.
- iii) The boxes shall have provision for wall, column, pole or structure mounting and shall be provided with cable / conduit entry knockouts and terminals.



- iv) Junction boxes shall be of two types viz one suitable for control wiring and the other with terminals for power cable terminations. Junction boxes for power cable terminations shall have minimum nine (9) Nos. of terminals. Size of terminals shall be suitable to accommodate cables of sizes as required.
- v) The junction boxes shall have the following indelible markings:-
 - a) Circuit Nos. on top by white-stenciled paint at site.
 - b) Circuit Nos. with ferrules (inside) as per approved drawing.
 - c) Danger sign in case of 415 V circuit.
 - d) Junction boxes shall be provided with two Nos. (2) earthing terminals complete with nuts and washers suitable for connection to 8 SWG G.I. wire.

20.05.05 Terminals

- i) Multi-way terminal blocks of approved type, complete with screws, nuts; washers and marking strips shall be furnished for connection of incoming/outgoing wires.
- ii) Each control cable terminal shall be suitable for connection of N nos. 2.5 sq.mm. stranded copper conductors without any damage to the conductor or looseness of conductors.

20.05.06 Terminations & Straight through Joints

- i) Termination and jointing kits for 11/6.6 kV grade XLPE insulated cables shall be of proven design. Termination kits and jointing kits shall be pre-moulded type, taped type or heat shrinkable type. 11/6.6 kV grade joints and terminations shall be type tested as per IS: 13573. Critical components used in cable accessories shall be of tested and proven quality as per relevant product specification/ESI specification. The kit shall be complete with the aluminium solder less crimping type cable lugs & ferrule as per DIN standard.
- ii) Straight through joint and termination shall be capable of withstanding the fault level for 11 kV and 6.6 kV systems.
- iii) 1.1 KV grade straight through joints shall be of proven design.

20.05.07 Cable glands

- i) Cable glands shall conform to BS: 6121 and be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating Rubber components shall be of neoprene and of tested quality. Necessary cable dimensions shall be furnished to the successful Bidder.



- ii) Cable glands shall be double compression type. Glands for classified hazardous areas shall be double compression type flameproof and weather proof duly certified by CMRS and approved by CCE. Cable glands shall match with the sizes of different HV/MV/LV/Control cables.

20.05.08 Cable lugs/ferrules

- i) The cables lugs shall be conforming to IS: 8309.
- ii) Machine ferruling shall be adopted.
- iii) Cable lugs for power cables shall be Aluminium solder less crimping type suitable for aluminium compacted conductor cables.
- iv) The cable lugs for control/instrumentation/ telephone cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipments.
- v) Cable lugs shall be suitable for termination of different cross-sections of control/ instrumentation /telephone cables and shall be of following types.
- vi) Copper tubular terminal end for solder less crimping to copper conductors.
- vii) Cable lugs for control cable termination shall be insulated type. These lugs shall be flat type/ring type/U type to suit the terminals provided in the pan.
- viii) Pin type lugs shall not used.
- ix) Aluminium tubular terminal ends for solder less crimping of two Aluminium conductor.
- x) Solder less crimping of terminals shall be done by using corrosion inhibiting compound. The cable lugs shall suit the type of terminals provided on the equipment. Lugs for control/instrumentation cables shall be PVC insulated/sleeved type.

20.05.09 Cable Clamps & Straps

- i) The cable clamps required to clamp multicore cables on vertical run shall be made up of Aluminium strip of 25x3 mm size. For clamping the multicore cables, self-locking, de-interlocking type nylon clamps/straps shall be used. The clamps/straps shall have sufficient strength and shall not get affected by direct exposure to sun rays and outdoor environment.
- ii) Trefoil clamps for single core cables shall be pressure die cast aluminum or fibre glass or nylon and shall include necessary fixing accessories like G.I. nuts, bolts, washers, etc. Trefoil clamps shall have adequate mechanical strength to withstand the forces generated by the system short circuit current of 105 KA peak.



20.05.10 Galvanizing

- i) Galvanizing of steel components and accessories shall conform to IS: 2629 & IS: 2633. Additionally galvanizing shall be uniform, clean smooth, continuous and free from acid spots.
- ii) The amount of zinc deposit over threaded portion of bolts, nuts, screws and washers shall be as per IS: 1367. The removal of extra zinc on threaded portion of components shall be carefully done to ensure that the threads shall have the required zinc coating on them as specified.

20.05.11 Welding

The welding shall be carried out in accordance with IS: 9595. All welding procedures and welders qualification shall also be followed strictly in line with IS: 9595.

20.06.00 CONSUMABLES AND HARDWARE

20.06.01 The Bidder shall furnish all erection materials, hardware and consumables required to complete the installation.

20.06.02 The materials shall include but not limited to the following:-

- i) Consumables: Welding rods & gas, oil and grease, cleaning fluids, paints, electrical tape, soldering materials etc.
- ii) Hardware: Bolts, nuts, washers, screws, brackets, supports, clamps, hangers, saddles, cleats, sills, shims etc.
- iii) Supply of cement, sand, stone etc. required for the execution of the contract shall be the responsibility of the Bidder.

20.07.00 METHODS AND WORKMANSHIP

20.07.01 All work shall be installed in a first class, neat workmanlike manner by mechanics/electricians skilled in the trade involved.

20.07.02 The erection work shall be supervised by competent supervisors holding relevant supervisory license from the government.

20.07.03 All details on installation shall be electrically and mechanically correct.

20.07.04 The installation shall be carried out in such a manner as to preserve access to other equipment installed.

20.08.00 INSTALLATION

20.08.01 Cable Tray and Support System Installation

- i) Cables shall run in cable trays mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other



building structures. All cable trays shall be in vertical configuration in boiler areas.

- ii) Horizontally running cable trays shall be clamped by bolting to cantilever arms and vertically running cable trays shall be bolted to main support channel by suitable bracket/clamps on both top and bottom side rails at an interval of 1500 mm. For vertical cable risers/shafts cable trays shall be supported at an interval of 1000mm. Fixing of cable trays to cantilever arms or main support channel by welding shall not be accepted. Cable tray installation shall generally be carried out as per relevant Standard. The cantilever arms shall be positioned on the main support channel with a minimum vertical spacing of 300 mm unless otherwise indicated in the relevant approved tray layout drawings.
- iii) All cable way sections shall have identification, designations as per approved cable way layout as and painted/stenciled at each end of cable way and where there is a branch connection to another cable way. Minimum height of letter shall be not less than 75 mm. For long lengths of trays, the identification shall be painted at every 10 meter. Risers shall additionally be painted/ stenciled with identification numbers at every floor.
- iv) In certain cases it may be necessary to site fabricate portions of trays, supports and other non standard bends where the normal prefabricated trays, supports and accessories may not be suitable. In such cases the Bidder shall fabricate at site suitable sections of trays, supports and accessories to make the installation complete for the specific purpose after obtaining Owner's prior approval, which shall be neat in appearance and shall match with the prefabricated sections in the dimensions. They shall be applied with one coat of red lead primer, one coat of oil primer followed by two finishing coats of aluminium paint.

20.09.00 CONDUITS/PIPES/DUCTS INSTALLATION

- 20.09.01 The Bidder shall be fully responsible for properly embedding conduit pipe sleeves wherever necessary for cabling work. All openings in the floor/roof/wall / cable tunnel/cable trenches made for conduit installation shall be sealed and made water proof by the Bidder.
- 20.09.02 GI pull wire of adequate size shall be laid in all conduits before installation. Metallic conduit runs at termination shall have two lock nuts wherever required for junction boxes etc.
- 20.09.03 Conduit runs/sleeves shall be provided with PVC bushings having round edge at each end. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed with Glass wool/Cement Mortar/Putty to prevent entrance of moisture and foreign material.
- 20.09.04 Cable routing between lined cable trench and equipment/motors shall be taken through GI pipe sleeves of adequate size. Pipe sleeves shall be laid at an angle of maximum 150 to the trench wall. In case of larger dia cables i.e. 50mm and above, adequately sized pipe with larger bend radius shall be



provided for ease of drawing of cable or for replacement. In places where it is not possible, a smaller trench may be provided if approved by Site Engineer.

- 20.09.05 Exposed conduit/pipe shall be adequately supported by racks, clamps, straps or by other approved means. Conduits /pipe support shall be installed square and true to line and grade with an average spacing between the supports as given below, unless specified otherwise

Conduit /pipe size (dia).	Spacing
Up to 40 mm	1 M
50 mm	2.0 M
65-85 mm	2.5 M
100 mm	3.0 M

- 20.09.06 In areas like WTP, chemical handling, battery room etc. exterior surface of the conduits shall be further coated with chromate or polymer for better resistance to corrosion.

- 20.09.07 All G.I. pipes shall be laid as per approved layout drawings and site requirements. Before fabrication of various profiles of pipe by hydraulically operated bending machine (which is to be arranged by the Bidder), all the burrs from the pipes shall be removed. The bends formed shall be smooth. GI Pipes with bends shall be buried in oil/concrete in such way that that the bends shall be totally concealed. For GI pipes shall be undertaken well before paving is completed and necessary co-ordination with paving agency shall be the responsibility of Electrical Bidder. The open ends of pipes shall be suitably plugged with G.I. plugs after they are laid in final position. G.I. plugs shall be supplied by the Bidder at no extra cost.

20.10.00 JUNCTION BOXES INSTALLATION

- 20.10.01 Junction boxes shall be mounted at a height of 1200mm above floor level or as specified in the approved drawings or as decided by Owner and shall be adequately supported/mounted on masonry wall by means of anchor fasteners/ expandable bolts or shall be mounted on an angle, plate or other structural supports fixed to floor, wall, ceiling or equipment foundations.

20.11.00 CABLE LAYING AND INSTALLATION

- 20.11.01 Cable network shall include power, control, lighting, communication and fire alarm system cables, which shall be laid in trenches, cables trays/conduits as detailed in the approved drawings and cable schedules. Erection of cable trays and aligning and leveling as required shall be the responsibility of the Bidder.

- 20.11.02 Cable installation shall be carried out as per IS: 1255 and other applicable standards. Cable drums shall be unloaded, handled and stored in an approved manner on hard and well drained surface so that they may not sink. In no case shall be drum be stored flat i.e. with flange horizontal. Rolling of drums shall be avoided as far as possible. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum. In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cables. For unreeling the cable, the drum shall be mounted on suitable jacks or on cable wheels and shall be



rolled slowly so that cable comes out over the drum and not from below. All possible care shall be taken during unreeling and laying to avoid damage due to twist, kink or sharp bends. Cable ends shall be provided with sealed plastic caps to prevent damage and ingress of moisture.

- 20.11.03 Laying of cables directly buried in ground is not acceptable.
- 20.11.04 All tray levels shall be checked after erection and marked in as built drawings. Cable routing given on the layout drawings shall be checked in the field to avoid interference with structures, heat sources, drains, piping, air-conditioning duct etc. and minor adjustments shall be done to suit the field conditions wherever deemed necessary. All tray runs shall be installed parallel to the trench/building walls and floors except otherwise noted in the approved drawings. The Bidder shall have to secure rack/tray supports by welding to those inserts, suitable embedded steel inserts shall be provided. Outdoor trays shall be installed by welding on the steel/concrete structure with inserts by the Bidder. As far as practicable, cable trays shall be supported from one side only in order to facilitate installation and maintenance of cables from the other side.
- 20.11.05 While laying cable, ground rollers shall be used at every 2 metre interval to avoid cable touching ground. The cables shall be pushed over the rollers by a gang of people positioned in between the rollers. Cables shall not be pulled from the end without having intermediate pushing arrangements. Pulling tension shall not exceed the values recommended by cable manufacturer. Selection of cable drums for each run shall be so planned so as to avoid using straight through joints. Care should be taken while laying the cables so as to avoid damage to cables.
- 20.11.06 All temporary ends of cables must be protected against dirt and moisture to prevent damage to the insulation. For this purpose, ends of all cables shall be tapped with an approved PVC or rubber insulating tape. Use of friction type or other fabric type tape is not permitted.
- 20.11.07 Cables installed above grade shall be run in trays, exposed on walls, ceilings or structures and shall be run parallel or at right angles to beams, walls columns. Cables shall be so routed that they shall not be subjected to heat from adjacent hot piping or vessels.
- 20.12.00 LAYING OF CABLES IN CABLE TRAYS**
- 20.12.01 Cables shall be laid on cable trays strictly in line with cable schedule furnished. Where specific cable layouts are not shown on approved drawings, Bidder shall route these as directed by the Owner.
- 20.12.02 Power and control cables shall be laid on separate tiers. The laying of different voltage grade cables shall be on different tiers according to the voltage grade of the cables. In horizontal tray stacks, H.V. cables shall be laid on topmost tier and cables of subsequent lower voltage grades on lower tiers of trays.

Trefoil Cable Clamps

- Clamps required for single core cables carrying alternating current shall be suitable for holding three cables together in delta formation. Clamps shall be of FRP material.



- Clamps shall be of suitable sizes to firmly hold the cables of various outer diameters including tolerance in OD.
- Clamps should have been type tested for Short Circuit Withstand Test.
- For Trefoil clamps run spacing shall be 2000 mm and axial spacing shall be double the diameter of larger adjacent trefoils cable or 150 mm whichever is less. Supports shall also be provided at each bend

Omega Cable clamps

- Omega clamps shall be of galvanized mild steel and shall be used to fasten the individual multi-core cables.
- Clamps shall be of simple construction, made of 2 mm thick, 25 mm wide strip of omega shape and suitable for clamping on the rungs / perforated sheet of tray with the help of two bolts.
- Clamps shall be of different sizes for different outer diameters of cables. Omega cable clamps shall be used for individual cables above 35 mm outer diameter.
- Steel clamps shall be hot dip galvanized. Weight of zinc not less than 610 grams. per sq. metre
- For cables of above 35 mm OD, cables shall be individually clamped at 5000 mm interval for Horizontal runs and shall be individually clamped at 1000 mm interval for Vertical runs. Supports shall also be provided at each bend.
- For cables of up to 35 mm OD, cables shall be collectively clamped at 5000 mm interval for Horizontal runs and shall be collectively clamped at 1000 mm interval for Vertical runs. Supports shall also be provided at each bend.
- For cables supported along structures/ceiling, clamp spacing shall be 750 mm. Supports shall also be provided at each bend.

Strip Cable Clamps

- Strip clamps shall be of galvanized mild steel and shall be used to fasten the group of multi-core cables up to 35 mm diameter only on a full or part of the tray width.
- Clamps shall be of simple construction, made of 3 mm thick Steel, 25 mm wide strip to cover the entire width up to 300 mm wide tray and part of the tray for more than 300 mm wide trays. Strip shall have two right angle bends at each end for fixing on to the rung/ perforated sheet of tray with the help of two bolts.
- Clamps shall be of different sizes for different sizes of tray width. However, the maximum size of clamp shall be 300 mm and for cable trays of greater width, two clamps shall be used.
- Clamps shall be hot dip galvanized. Weight of zinc not less than 610 grams. per sq. metre

Self-locking Clamps

- Clamps shall be of FRP material. Clamps shall have self-locking feature when the cord is looped. Clamps shall be provided with manual lock release.
- Clamp cord shall not move in the backward position once it has been locked, unless the lock release is applied.
- Type test certificates to ascertain the strength of clamps shall be submitted for Owner's approval.
- Not more than four (4) cables shall be clamped together, wherever collective clamping is permitted.



- Clamp length shall be selected such that not more than 80% of lockable length is utilised for clamping.
- Nylon self-locking tie strips for collective clamping (up to 35 mm OD max. group of 4 cables) shall be 4 mm having Tensile strength 30 kg.
- Nylon self-locking tie strips for individual multicore clamping (above 35 mm OD up to 55 mm OD) shall be 4 mm having Tensile strength 20 kg.
- Nylon self-locking tie strips for individual multicore clamping (above 55 mm OD) shall be 7 mm having Tensile strength 60 kg.

All multicore cables shall be laid in touching formation. LT power cables above 95 sq.mm size shall be laid in single layer touching formation in trays while cables upto & including 95 sq.mm shall be laid in maximum of 2 layers. Control and Instrumentation cables can be laid upto a maximum of three layers in each tray.

- 20.12.03 All communication cables (telephone, P.A. System) RTD Cables shall run on instrument trays/ducts/trenches. Wherever these are not available, cables shall be taken in a separate trench/trays with a minimum clearance of 600mm away from electrical trench/trays as per the direction of Site Engineer and Communication cables shall cross power cables at right angles.
- 20.12.04 Power and control cables shall be secured fixed to trays/support with arrangement described above.
- 20.12.05 Bending radii for cables shall be as per manufacturer's recommendations and IS: 1255.
- 20.12.06 Individual cables or small groups which run along structures/walls etc shall be clamped by means of 16 SWG GI saddles on 25x6mm saddle bars. The cost of saddle and saddle bars shall be deemed to have been included in the installation of cables. Alternatively small group of cables can be taken through 100mm slotted channel/ISMC 100. They shall be rightly supported on structural steel and masonry, individual or in groups as required, if drilling of steel must be drilled where the minimum weakening of the structure shall result.
- 20.12.07 **Multi core power cables, control and instrumentation cables shall be tied and secured with nylon self locking cable ties at an interval of 5 metres when laid in horizontal trays and at an interval of 2 metres when laid in vertical trays or in cable risers (raceway).**
- 20.12.08 Where cables cross roads/rail tracks, the cables shall be laid in Hume pipe/PVC pipe. At road crossing and other places where cables enter pipe sleeves adequate bed of sand shall be given so that the cables do not slack and get damaged by pipe ends. The hume pipes shall be laid at a depth of minimum 1000mm such that cables are not damaged.
- 20.12.09 Power and Control Cables, as far as possible, shall be laid in complete, uncut lengths from one termination to the other. Straight through joints in power cable shall be allowed only in nearest of rare situation only after approval of Owner.
- 20.12.10 Joints for less than 250 Meters run of cable shall not be permitted.



- 20.12.11 In each cable run some extra length shall be kept at suitable point to enable one LV/two HV straight through joints to made, should the cable develop fault at a later stage. Straight through joint and termination shall be capable of withstanding the fault level of 50 kA for 11/11 kV cables and 40 kA for 6.6/6.6 kV Cables. Control cable termination inside equipment enclosure shall have sufficient lengths so that shifting of termination in terminal blocks can be done without requiring any splicing.
- 20.12.12 Wherever few cables are branching out from main trunk route troughs shall be used.
- 20.12.13 Cables shall be neatly arranged in the trenches/trays in such a manner so that criss-crossing is avoided and final take off to the motor/switchgear is facilitated. Arrangement of cables within the trenches/trays shall be the responsibility of the Bidder.
- 20.12.14 The Bidder shall ascertain the exact requirement of cable for a particular feeder by measuring at site and avoiding interference with structure, foundation, pipelines or any other works. Before the start of cable laying, cable drum schedule shall be prepared by electrical Bidder and get that approved by site engineer to minimize/avoid straight through joints. The actual number of straight through joints required shall be worked out by the Bidder. During the erection period the Bidder shall furnish a monthly report on cable position in an approved proforma so as to keep the Owner apprised of the position.
- 20.12.15 The installation work shall be carried out in a neat workman like manner & areas of work shall be cleaned of all scraps, water, etc. after the completion of work in each area every day. Bidder shall replace RCC/Steel trench covers after the Installation work in that particular area is completed or when further work is not likely to be taken up for some time.
- 20.12.16 Electrical cable trays exposed to hazardous process fluid shall be covered with detachable G.I. covers. The covers shall be suitable to resist wind forces.
- 20.12.17 Separation
- i) Sufficient spacing not less than 300mm shall be provided between different tiers of trays and maintained to permit adequate access for installation and maintenance of cables.
 - ii) At least 300mm clearance shall be provided between:
 - HV power & LV power cables,
 - LV power & LV control/instrumentation cables,
- 20.12.18 Segregation
- i) Segregation means physical isolation to prevent fire jumping.
 - ii) Cables from two different services viz. supply from Station Board and Unit Board shall be segregated.
 - iii) Interplant cables of station auxiliaries and unit critical drives shall be segregated in such a way that not more than half of the drives are lost in case of single incident of fire. Power and control cables for AC drives



and corresponding emergency AC or DC drives shall be laid in segregated routes. Cable routes for one set of auxiliaries of same unit shall be segregated from the other set.

20.13.00 CABLE FIRE SEALING

- 20.13.01 Cable/cable tray openings in walls and floors or through pipe sleeves from one area to another or from one elevation to another within the unit shall be seated by a fire proof sealing system (FPSS) of minimum 2 Hrs rating. The FPSS shall effectively prevent the spread of fire from the flaming to non-flaming side of a fire.
- 20.13.02 Wherever the cables/cable trays pass through walls/floors, fire proof cable penetration seals rated for two hour shall be provided. This shall be by suitable block system using individual blocks with suitable framework or by silicon RTV foaming system. In case foaming system is offered, damming board, if used, shall not be considered for fire rating criteria. Any of the system offered shall be of proven type as per BS: 476 (Part-20) or equivalent standard.
- 20.13.03 In order to prevent fire propagation through cable penetrations, after laying, dressing & clamping of cables, all the openings shall be properly sealed by using Fire Stop Mortar Seal and Fire Retardant Cable coating compound. Also the cable runs both before and after the fire scale shall be suitably sprayed with anti-fire propagation liquid.

20.14.00 Cable laying in trenches

- 20.14.01 RCC cable trenches with removable covers shall be provided by the Bidder for areas as mentioned in Cl 1.35.00 of Chapter - 1.
- 20.14.02 For cable trays are laid in trench in more than two tiers a space of minimum 600 mm shall be available for maintenance. In case two or more tiers of cable trays are running parallel along both sides of trench walls there shall be space of minimum 600 mm between them.
- 20.14.03 Cables shall be handled carefully during installation to prevent mechanical injury to the cables. Ends of cable leaving trenches shall be coiled and provided with a protective pipe or cover tilt such times the final termination to the equipment is completed.
- 20.14.04 Prior to laying of cables inside both indoor and outdoor trenches, the Bidder shall properly clean inside of those trenches.
- 20.14.05 When cables are laid in multiple tiers, spacing between individual tiers shall be as approved by Site Engineer. Space between individual tiers shall be filled and compacted with soil and sand.
- 20.14.06 As each row of cables is laid in place and before covering with sand every cable shall be given on insulation test in the presence of Site Engineer. Any cable, which proves defective, shall be replaced before the next groups of cables are laid.
- 20.14.07 All wall openings/pipe sleeves shall be effectively sealed after installation of cables to avoid seepage of water inside building/lined trench.



- 20.14.08 Where cables rise from trenches to motor, control station, lighting panels etc., they shall be taken in G.I. Pipes for mechanical protection up to a minimum of 150mm above grade.
- 20.14.09 Cable ends shall be carefully pulled through the conduit, to prevent damage to these cables. Where required, approved cable lubricant shall be used for this purpose. Where cable enters conduit the cable should be bent in large radius. Radius shall not be less than the recommended bending radius of the cables specified by the manufacturer.
- 20.14.10 Following guide of the pipe fill shall be used for sizing the pipe size:-
- i) 1 cable in pipe - 53% full
 - ii) 2 cables in pipe - 51% full
 - iii) 3 or more cables - 40% full
- 20.14.11 After the cables are installed and all testing is complete, conduit ends above grade shall be plugged with a suitable weatherproof plastic compound/'PUTTI' for sealing purpose. Alternatively G.I. Lids or PVC bushes shall be employed for sealing purposes. The cost for the same shall be deemed to have been included in the installation of G.I. pipe and no separate payment shall be allowed.
- 20.14.12 Where cables pass through foundation walls or other underground structures, the necessary ducts or openings shall be provided in advance for the same. However, should it become necessary to cut holes in existing foundations or structures, the electrical Bidder shall determine their location and obtain approval of the Site Engineer before cutting is done.
- 20.15.00 CABLE IDENTIFICATION**
- 20.15.01 Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry & exit, and at every 20 meters in cable tray/trench runs. Cable tags shall also be provided inside the switchgear, motor control centers, control and relay panels etc. where a number of cables enter together through a gland plate. Cable tag shall be of rectangular shape for power cables and control cables.
- Cables shall be provided with cable number tags for identification.
 - Cable tags shall be of aluminium.
 - Cable numbers shall be engraved type
 - Tags shall be of durable quality of size 60 mm x 12 mm with a tie hole at each end.
 - Samples of tags shall be approved by the Owner before delivery.
 - Tags shall be provided with non-corrosive wire of sufficient strength for tagging.
- 20.15.02 If laying of underground cable is specifically agreed by Owner as a special case then the underground cables shall be provided with identity tags of Stain less steel securely fastened every 30 M of its underground length with at least one tag at each end before the cable enters the ground. In unpaved areas cable trenches shall be identified by means of markers. These posts shall be placed at location of changes in the direction of cables and at intervals of not



more than 30 M for straight run and at cable joint locations with additional inscription 'Cable Joint'. For buried cables the marker shall project 150mm above ground.

- 20.15.03 Drum number of each cable from which it is taken shall be recorded against the cable number in the cable schedule.

20.16.00 CABLE TERMINATIONS & CONNECTIONS

- 20.16.01 The termination and connection of cables shall be done strictly in accordance with cable termination kit manufacturer's instructions, drawings and/or as directed by Site Engineer. Cable jointer shall be qualified to carryout satisfactory cable jointing/termination. Bidder shall furnish for review documentary evidence/experience reports of the jointers to be deployed at site.
- 20.16.02 Work shall include all clamps, fittings etc. and clamping, fitting, fixing, plumbing, soldering, drilling, cutting, taping, preparation of cable end, crimping of lug, insulated sleeving over control cable lugs, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job to the satisfaction of the Site Engineer.
- 20.16.03 Responsibility of proper termination shall lie on the Bidder. Guarantee for termination shall also have to be given by the Bidder.
- 20.16.04 The equipment shall be generally provided with undrilled gland plates for cables/conduit entry. The Bidder shall be responsible for punching of gland plates, painting and touching up. Holes shall not be made by gas cutting. The holes shall be true in shape. All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively sealed by 2mm thick aluminium sheets.
- 20.16.05 Bidder shall drill holes for fixing glands wherever necessary at no extra cost. Gland plate shall be of non-magnetic material/aluminium sheet in case of single core cables. If the cable end box or terminal chamber provided on the equipment is found unsuitable and requires major modifications the same shall be carried out by the Bidder at the discretion of the Engineer-in-Charge.
- 20.16.06 Control cable cores entering control panel/switchgear /MCC/miscellaneous panels shall be neatly bunched, clamped and tied with self locking type nylon cable ties with de interlocking facility to keep them in position.
- 20.16.07 The panels where a larger number of cables are to be terminated and cable identification may be difficult, each core ferrule shall include the complete cable number. The ferrules shall be indelible interlocking type and shall fit tightly on cores. Spare cores shall have similarly ferrules with a suffix letter 'S' along with cable numbers and coiled up after end sealing.
- 20.16.08 All cable terminations shall be appropriately tightened to ensure secure and reliable connections.
- 20.16.09 It is the responsibility of the Bidder to terminate the cables at motor terminals in correct phase sequence to ensure the proper direction of rotation.



- 20.16.10 All cables upto 1.1KV grade shall be terminated at the equipments by means of compression type cable glands. They shall have a screwed nipple with conduit electrical threads and check nut.
- 20.16.11 All cable entries shall be through bottom only and top entry terminations are made only after getting approval of Site Engineer.
- 20.16.12 Power cables, wherever colour coding is not available, shall be identified with red, yellow and blue PVC tapes. Where copper to aluminium connections is made, necessary bimetallic washers shall be used. For trip circuit identification additional red ferrules shall be used only in the particular cores of control cables at the termination points in the Switchgear/Control panels and Control Switches.
- 20.16.13 In case of control cables all cores shall be identified at both ends by their terminal numbers by means of PVC ferrules. Wire numbers shall be as per schematic/ wiring/ inter-connection diagram. Bidders shall have the samples of PVC markers approved before starting the work. All unused spare cores of control cables shall be neatly bunched and ferruled with cable tag at both ends. Control cables shall be neatly bunched and served with PVC perforated tape to keep it in position at the terminal block.
- 20.16.14 Where threaded cable gland is screwed into threaded opening of different size, suitable brass threaded reducing bushing shall be used provided.
- 20.16.15 The cable shall be taken through glands inside the panels or any other electrical equipment such as motors. The individual cores shall then be dressed and taken along the cable ways (if provided) or shall be fixed to the panels with polyethylene straps. Only control cables of single strand and lighting cables may be directly terminated on to the terminals.
- 20.16.16 In case of termination of cables at the bottom of a panel over a cable trench having no access from the bottom, close fit hole should be drilled in the bottom plate for all the cables in one line, and then bottom plate should be split in two parts along the centre line of holes. After installation of bottom plate and cables it should be sealed with cold setting compound. Cables shall be clamped over the open armouring to connect it to earth bus.
- 20.16.17 Cable leads shall be terminated at the equipment terminals by means of crimped type solder less connectors.
- 20.16.18 Crimping shall be done by hand crimping/hydraulically-operated tool and conducting jelly shall be applied on the conductor.
- 20.16.19 Insulation of the leads should be removed immediately before the crimping. Conductor surface shall be cleaned and shall not be left open.
- 20.16.20 Termination and connection shall be carried out in such a manner as to avoid strain on the terminals.
- 20.16.21 All cable entry points shall be properly sealed and made dust and vermin proof. Unusual opening, if any, shall be effectively closed. Sealing work shall



be carried out with approved sealing compound having fire withstand capability for at least three hours.

20.17.00 Cable accessories for H.V. Systems

20.17.01 The H.V. cables terminations/joints shall be done by skilled and experienced jointers duly approved by the Site Engineer.

20.17.02 The termination and straight through joint kits for use on high voltage system shall be suitable for the type of cables offered by the Bidder or the type of cables issued by Owner for installation. The materials required for termination and straight through joints shall be supplied in kit form. The kit shall include all insulating and sealing materials apart from conductor fittings and consumable items. An installation instruction shall be included in each kit.

20.17.03 The termination kits shall be suitable for termination of the cables to an indoor switchgear or to a weatherproof cable box of an outdoor mounted transformer/motor. The termination kits shall preferably be as of the following types.

4.1.1 i) Termination kits shall be 'Push on type' or 'heat shrinkable type'.

For outdoor installations, weather shields/sealing ends and any other accessories required shall also form part of the kit.

20.17.04 The straight through jointing kits shall be suitable for underground buried installation with uncontrolled backfill and possibility of flooding by water.

However, termination kits for HV cables shall be of Heat Shrinkable type of makes with specific approval of Owner.

For outdoor installations, weather shields/sealing ends and any other accessories required shall also form part of the kit.

20.18.00 CLEANING UP OF WORK SITE

20.18.01 The Bidder shall, from time to time, remove all rubbish resulting from execution of his work. No materials shall be stored or placed on passage or drive ways.

20.18.02 Upon completion of work, the Bidder shall remove all rubbish, tools, scaffoldings, temporary structures and surplus materials etc. to leave the premises clean and fit for use.

20.19.00 QUALITY ASSURANCE PROGRAMME

20.19.01 Bidder shall furnish detailed Quality Assurance Programme and Quality Plans for all materials and accessories to be supplied and installed under the scope of the specification as per General Technical Conditions of technical specification. The Quality Plans shall include all tests/ checks as per relevant National/International Standards and the requirements of this specification including tests listed in this section.



20.20.00 TESTS**20.20.01 Routine / Acceptance Tests**

Following routine/acceptance tests shall be carried out on all the equipments, devices & materials supplied:

20.20.02 Galvanizing Tests

- i) The quality of galvanizing shall be inspected visually and shall be smooth, continuous, and free from flux stains.
- ii) Uniformity of coating – The coating of any article shall withstand four 1 minute dips in standard copper sulphate solution without the formation of an adherent red spot of metallic copper upon the basic metal.
- iii) The quality of cadmium/zinc plating on items with screw threads shall be inspected visually and shall be free from visible defects such as unplanted areas, blisters and modules.
- iv) In addition, the plating thickness shall be determined microscopically/chemically or electronically.

20.21.00 WELDING

20.21.01 The quality of welding shall be visually inspected, particular attention being paid to the following points:-

- i) The welded joints shall be continuous along its length on both sides and of uniform width and thickness. It should be free from blow holes.
- ii) The weld metal shall be properly fused with the parent metal without undercutting.
- iii) The outside surface of the weld shall be clean. All slag shall have been removed. All welding shall be regularly checked for cracking using magnetic particle inspection or their equivalent technique.
- iv) Physical and dimensional checks for all items.
- v) All conduits/pipes, etc. shall be routine/acceptance tested as per relevant standards.
- vi) All acceptance and routine tests on cable glands as for BS: 6121. Additionally Proof torque test shall be carried out as acceptance on each body group of cable glands.
- vii) Deflection test cable trays.
- viii) All acceptance and routine tests on Junction boxes.
- ix) Following tests shall also be carried out on each type of equipments, devices and materials/items supplied:-
 - a) Physical and Dimensional checks



- b) Check/measurement of thickness for Nickel chrome plating for cable glands and tinning for cable lugs.
- c) Check chemical composition of brass parts for cable glands.
- d) Hardness check on gaskets.
- e) Test for uniformity of galvanization.

20.22.00 CABLE TRAYS / SUPPORTS AND ACCESSORIES

- 20.22.01 Check for proper galvanizing/painting and identification number of the cable trays/supports and accessories.
- 20.22.02 Check for continuity of cable trays over the entire route.
- 20.22.03 Check that all sharp corners, burrs, and waste materials have been removed from the trays supports.
- 20.22.04 Check for earth continuity and earth connection of cable trays.
- 20.22.05 Bidder shall submit the following minimum drawings and documents for approval during detail engineering stage.
 - General arrangement drawings
 - Technical data sheet
 - Test reports
 - Installation details for junction boxes
 - Sub-vendor list
 - Manufacturing quality plan
 - Field quality plan



SECTION – 24: EARTHING & LIGHTNING PROTECTION

24.01.00 GENERAL

This specification is intended to cover the design, engineering, manufacture, assembly, testing at manufacturer's works, supply in properly packed condition for transport to site and delivery Grounding and Lightning system complete with all accessories for efficient and trouble-free operation of 2 x 800 MW Supercritical Coal Based Uppur Thermal Power Project in Ramnathapuram District, Tamil Nadu for TANGEDCO.

24.02.00 CODES AND STANDARDS

All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) / IEC as given below except where modified and/or supplemented by this specification. All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments. All work shall be carried out as per the following standards/ codes as applicable.

CODE	NAME OF STANDARD
IS:513	Cold rolled low carbon steel sheets and strips.
IS:802	Code of practice for the use of Structural Steel in Overhead Transmission Line Towers.
IS:1079	Hot Rolled carbon steel sheet & strips
IS:1239	Mild steel tubes, tubulars and other wrought steel fittings
IS:1255	Code of practice for installation and maintenance of power cables up to and including 33 KV rating
IS:1367 Part-13	Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners).
IS:2147	Degree of protection provided by enclosures for low voltage switchgear and control gear
IS:2309	Code of Practice for the protection of building and allied structures against lightning.
IS:2629	Recommended practice for hot dip galvanising of iron & steel
IS:2633	Method for testing uniformity of coating on zinc coated articles.
IS:3043	Code of practice for Earthing
IS:3063	Fasteners single coil rectangular section spring washers.
IS:6745	Methods for determination of mass of zinc coating on zinc coated iron & steel articles.
IS:8308	Compression type tubular in- line connectors for aluminium conductors of insulated cables



IS:8309	Compression type tubular terminal ends for aluminium conductors of insulated cables.
IS:9537	Conduits for electrical installation.
IS:9595	Metal – arc welding of carbon and carbon manganese steels – recommendations.
IS:13573	Joints and terminations for polymeric cables for working voltages from 6.6kv upto and including 33kv performance requirements and type tests.
BS:476	Fire tests on building materials and structures
IEEE:80	IEEE guide for safety in AC substation grounding
IEEE:142	Grounding of Industrial & commercial power systems
DIN 46267 (Part-II)	Non tension proof compression joints for Aluminium conductors.
DIN 46329	Cable lugs for compression connections, ring type, for Aluminum conductors
VDE 0278	Tests on cable terminations and straight through joints
BS:6121	Specification for mechanical Cable glands for elastomers and plastic insulated cables.
	Indian Electricity Act.
	Indian Electricity Rules.
	National Electrical Code, 1985.

Equipment complying with other internationally accepted standards such as IEC, BS, DIN, VDE etc. shall also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidders shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards alongwith copies of all official amendments.

24.03.00 GROUNDING & LIGHTNING PROTECTION

24.03.01 General

The main objectives of grounding system are to:

- a) Provide safety to personnel from contact of dangerous potential caused by ground fault.
- b) Ensure sufficient grounding current for effective relaying.
- c) Stabilize circuit potential with respect to ground.
- d) Contractor shall carry out earth resistivity test of power project site within battery limit and shall establish homogeneous soil resistivity for earthing design. Number of earth resistivity test locations shall be not less than 15. The test locations shall be subject to Owner's approval.

24.03.02 Grounding system

- i) In order to meet the above objectives, ground grid mesh shall be provided for the entire area within battery limit.
- ii) Fault current for the earthing system shall be designed for 50 KA for duration of 1 sec.



- iii) All electrical equipment, non-current carrying metal parts, structures, building steel, lightning protection system, transformer neutrals shall be connected to this station ground grid.
- iv) Treated earth pits including riser shall be provided for Transformer neutral earthing.
- v) Connection between the equipment earth lead and the grid conductor shall be welded. For rust protection, the welds shall be treated with zinc chromate primer and coated with zinc rich paint.
- vi) Entire erection of grounding work shall be carried out in such a way as to be capable of withstanding the intended services of carrying full short circuit level currents to ground mat without any damage/deformation.
- vii) The major aspects to be considered for grounding system design are given below:

24.03.03 Ground Grid Conductor

- i) Ground grid conductor of mild steel rod shall be used.
- ii) The minimum conductor section is determined on the basis of ground fault current. This section is then increased by an allowance to account for the soil corrosion loss of 0.3 mm (on diameter of conductor) per year over the design life of 40 years.

24.03.04 Underground Grid

- i) The ground grid mesh is designed to keep the touch and step voltages within safe limits as per recommendation of IEEE 80.
- ii) The ground grid conductors shall be buried in earth at a depth of 600 mm. However suitable precaution to be taken wherever under ground drains / Trenches are passing through it. The length of ground conductors below earth shall be sufficient to ensure a ground resistance less than one (1) ohm for each area/building.
- iii) The ground grid conductor shall be so laid as to provide short and direct connection to building steel and major electrical equipment.
- iv) Ground rods shall be provided at the points where system neutrals/lightning protections are connected to the ground grid.
- v) All ground grid conductor connections shall be welded type.
- vi) Earth mat of each area/building (ie Main Plant Building, Transformer Yard, Service Building, DG Building and CPU Regeneration building etc) shall be interconnected with the earth mat conductor of the neighbouring area at atleast two (2) points for further reducing the ground grid resistance.
- vii) A minimum earth coverage of 300 mm shall be provided between the ground grid conductor and the bottom of trenches, tunnels, underground pipes,



foundations, railway tracks etc. The ground grid conductor shall be re-routed in case it fouls with equipment foundations.

- viii) In some cases, it may happen that the construction work of cable trench, foundation and laying of underground pipes are being taken up after the grounding mat has been laid. It may be required to cut a portion of grounding conductor to avoid fouling with cable trench, equipment foundations, underground pipes etc. In this case, the ground conductor shall be properly rerouted and rejoined/reconnected with the main grounding mat during the construction/laying of above underground objects and good electrical continuity of grounding conductor shall be ensured.
- ix) Grounding conductors crossing the road may have to be laid at greater depth to suit the site conditions.
- x) Grounding conductor around the building shall be buried in earth at a minimum distance of 1200 mm from the outer boundary of the building.
- xi) The Bidder shall carryout the interconnection among various peripheral earthing grids/mats, steel structures, lightning protection system as well as grounding of all electrical equipment, etc.

24.03.05 Ground Electrode

Ground electrodes shall be 40 mm dia. and 3 metre long M.S. rod. These are to be fabricated and driven into the ground by the side of mat conductors. All connections to the conductors shall be done by arc welding process.

24.03.06 Above Ground Connections

- i) Galvanised steel flats shall be used for all connections above earth.
- ii) Inside building, ground conductors shall be run for each floor supported on building steel and/or cable trays. These ground conductors in turn shall be connected to the station ground grid through riser (at least two) coming up along building columns/cable shafts.
- iii) Two separate and distinct ground connections shall be provided for each electrical equipment in compliance with I.E. Rules.
- iv) All connections above ground shall be welded type except connection to equipment/structures which shall be bolted type.

24.03.07 Column Grounding

All steel columns and structures shall be connected to the earth mat through 40 mm dia M.S. rods. All welded joints shall be painted to protect from rusting.

24.03.08 Risers

Risers are required for connecting the equipment and structures with the ground mat. Risers are to be provided from underground mat to above ground levels where the ends shall be left free for connecting to the equipment. Each riser



shall be 1 No. 40 mm dia. M.S. rod and shall project above grade level/concrete floor level by minimum 300 mm. They are to be clamped or supported along the outer edge of the concrete foundation. Connection to the ground mat shall be done by arc welding.

24.03.09 Equipment Ground Lead

- i) Equipment ground connections shall be sized to carry the ground fault current. Considerations shall also be given to mechanical ruggedness of the connections and to limit the number of sizes.
- ii) The minimum ground conductor sizes for various equipment and structures are given in below.

DESCRIPTION	SIZE	MATERIAL
a) Main Grounding Grid Conductor	40 mm dia Rod	Mild Steel
b) Riser/Pigtail From GroundingGrid/Mat	40 mm dia Rod	Mild Steel
c) Electrode	40 mm dia,3000 mm long Rod	Mild Steel
Conductor used for connection of various equipment/structures as listed below		
i) TGs, GTs, UATs and IPBD	75 x 10 mm	GI Flat
ii) Transformer body	75x10 mm	GI flat
iii) 11 kV & 6.6 kV Switchgears, Motors	75 x 10 mm	GI Flat
iv) 415V Switchgear, MCCs, Battery Charger, distribution Boards	75 x 10 mm	GI Flat
v) Sub-mat	75 x 10 mm	GI Flat
vi) 415 Motors		
1) Above 100 KW upto200 KW	75x10 mm	GI Flat
2) Above 55 KW upto 100 KW	40x6 mm	GI Flat
3) Above 22 KW upto 55 KW	40x6 mm	GI Flat
4) Above 5.5 KW upto 22 KW	25 x 6 mm	GI Flat
5) Upto 5.5 KW	4 SWG	GI Wire
vii) Cable Trays	40 x 6 mm	GI Flat



viii) Control Panel & Control Desks etc.	40 x 6 mm	GI Flat
ix) Steel Column	75 x 10 mm	GI Flat
x) Fence and Gate	40 x 6 mm	GI Flat
xi) Push Button Stations	8 SWG	GI Wire
xii) Lighting panel, Junction Boxes	4 SWG	GI Wire
xiii) System neutrals (for service transformers)	1Cx400 sqmm	XLPE cable
xiv) Lighting Fixtures & Receptacles	14 SWG	GI Wire
xv) Welding Outlets	8 SWG	GI Wire
xvi) Rails	40 x 6 mm	GI Flat

- iii) 75 x 10 mm galvanized steel flats(minimum size) shall be run as main earthing conductors above ground along building columns, walls, steel structure, etc. for equipment and other structures earthing. These earthing conductors shall be interconnected between them and to the main ground grid through risers/pigtail. The connection between earthing conductor and riser shall be made above ground. Earthing conductors along their run on column, wall etc. shall be supported by suitable welding/clamping at intervals set exceeding 750 mm.
- iv) Earthing conductors can be embedded in concrete floor of the building wherever necessary without having direct contact with the reinforcement rods. At the crossing of building walls, floors etc. the earthing conductor shall be passed through galvanised conduit sleeves. Both ends of the sleeve shall be sealed to prevent the passage of water through the sleeves.
- v) All indoor and outdoor electrical equipment and associated non-current carrying metal works, supporting structures, building/ boiler columns, fence, system neutrals, lightning masts/arresters shall be connected to the plant ground system.
- vi) Miscellaneous devices such as junction boxes, pull boxes, pushbutton stations, lockout switches, cable end boxes, lighting fixtures, receptacles, switches etc. shall be effectively grounded whether specifically shown or not.
- vii) Metallic conduits and pipes shall not be used as earth continuity conductor. These shall be grounded at both ends.
- viii) A continuous 40 x 6 mm (minimum size) G.S. flat earthing conductor shall run along the cable trays and supporting structure of all cable



routes. This earthing conductor shall be attached to each section of cable tray/trays through 40 x 6 mm G.S. flats. The earthing conductor shall be securely connected to the earth mat at both ends.

- ix) Fence within the ground grid shall be bonded to the plant ground system at regular interval not exceeding ten (10) metres. Fence gate shall be separately grounded with flexible connection to permit movement.
- x) The street lighting poles, junction boxes mounted on the poles, flood light supporting structures etc. shall be connected to ground grid at minimum two points.
- xi) The steel columns, metallic stairs, hand-rail etc. of the building where electrical equipment are located shall be connected to the nearby ground mat by earthing conductor. Electrical continuity shall be ensured by bonding the different sections of handrails and metallic stairs.
- xii) The railway tracks within plant area shall be bonded across fish plates and the rail tracks shall be connected to grounding grid at different locations. The rail tracks leaving the plant boundary shall be made electrically discontinuous from the rail tracks inside the plant area by providing suitable arrangements at fish plate joints.
- xiii) The overhead crane rails shall be grounded at both ends. In addition all joints shall be bonded to provide electrical continuity.
- xiv) The metallic sheaths, screens and armour of cables shall be earthed at both switchgear/MCC/DB and equipment ends.
- xv) The flexible earthing connection of jumpering wire shall be provided where flexible conduits are connected to rigid conduits to ensure continuity.

24.03.10 Jointing and Connection

- i) All ground conductor connections below ground level shall be done by electric arc welding with low hydrogen content electrode. The contact surfaces shall be thoroughly cleaned to provide good electrical continuity.
- ii) The bending of the large diameter ground conductor where necessary shall be done by gas heating.
- iii) The projected portion of riser/pigtail above ground shall be coated with two coats of bitumen paints (anti-corrosive paints) with a minimum thickness of 1 mm after connection.
- iv) The connections between the riser/pigtail and earthing conductors (galvanized steel flats) and between the earthing conductors above ground level shall be made by electric arc welding.
- v) The portion of galvanized steel flats, which undergoes welding at site, shall be coated with two (2) coats of cold galvanizing anti-corrosive paint



after welding.

- vi) The earthing connections to equipment grounding pads/terminals and some removable structures shall be bolted type with GI bolts and nuts. The contact surfaces shall be thoroughly cleaned (to free from scale, paint, enamel, grease, rust) before connection to ensure good electrical contact.
- vii) Equipment/structures ground connections shall be coated with weather resistant paints/cold galvanizing paints after proper checking / testing.
- viii) Whether specifically shown or not, all conduits, trays, cable armour and cable end box, electrical equipment such as motors, switchboards, panels, cabinets, junction boxes, lockout switches, fittings, fixtures, etc. shall be effectively grounded.

24.04.00 Earthing of cabling system

- Armour of the HT cables and LT single core cables shall be earthed only at one end of cable.
- Armour of other cables shall be earthed at both ends of cable.
- Screen of HT power cables shall be earthed at one end only.
- Screen of C&I screened control cables shall be earthed at one end.
- Screen of electronic earthing system cables shall be earthed as per the requirements.

After completion of grounding system installation, the measurement of ground resistance shall be performed by the Contractor. Continuity of earth conductors and efficiency of all bonds and joints shall be checked. The method of measurement shall be as per relevant standards / codes. The ground resistance of system shall be not more than 0.5 ohm. Earth resistance at earth terminations shall be measured in presence of Owner's representatives

24.05.00 General:

- i) Electronic earthing shall be provided as per relevant International standard for all control systems (such as DDCMIS, PLC, SAS, EDMS etc.) For electronic equipment chemical earthing pit shall be provided. The earth pit shall be tested and proven type and shall be guaranteed for service life of 40 years. The chemical earth pit shall comprise pipe electrode, crystalline conductive mixture, bentonite etc. constructed in a pit of not less than 4000 mm depth. The pit shall be effective in all weather conditions and offer medium resistance. For electronic earthing system, earthing conductor shall be of copper
- ii) Neutral of Service transformers shall be earthed through minimum of 400 sqmm single core cable through two numbers treated earth pit and in turn shall be connected to station earth grid.
- iii) LV Neutral Points of the following transformers shall be connected to Neutral Grounding Resistors (NGRs). NGR shall be connected to earth through two numbers treated earth pit.
 - Unit transformer



-
- Station Transformer
 - Unit auxiliary transformer
 - Station auxiliary transformer
 - Other auxiliary transformers
- iv) Steel to copper connections shall be brazed type and shall be treated to prevent moisture ingress.
- v) Metallic sheaths and armour of all multi-core power cables shall be earthed at both equipment and switchgear end. Sheath and armour of single core power cables shall be earthed at switchgear end only.
- vi) Earthing conductors along their run on cable trench, ladder, walls etc. shall be supported by suitable welding / cleating at intervals of 1000 mm. Wherever it passes through walls, floors etc., pipe sleeves shall be provided for the passage of the conductor and both ends of the sleeve shall be sealed to prevent the passage of water through the sleeves.
- vii) Railway tracks within the plant area shall be bonded across fish plates and connected to earthing grid at several locations.
- viii) Electronic panels and equipment shall be grounded utilising an insulated copper ground wire terminated at separate earth electrode.

24.06.00 Lightning Protection System

- i) The main purposes of lightning protection system are to:
- a) Provide protection to structures from lightning strokes.
 - b) Provide a low resistance-conducting path to lightning discharge.
- ii) Lightning protection shall be provided as per IS: 2309 for the structures, equipments and buildings within the battery limit.

24.06.01 System Design

- i) Air termination network with down conductors and earthing electrodes shall be provided on the basis of IS Code of Practice.
- ii) Horizontal air termination shall be so laid out that no part of the roof shall be more than 9 meters from the nearest conductor.
- iii) Shielding angle for one vertical air termination shall be 45 degrees. For more than one rod, shielding angle between the rods shall be taken as 60 Degrees.
- iv) Down conductors shall run along the outer surfaces of the building and shall have a test joint about 1500 mm above ground.
- v) An earth electrode shall be provided at the connection point of the down conductor with the station ground.
- v) Galvanised steel rods and flats shall be generally used for air termination and



connections. All connections shall be welded type.

- vi) The lightning protection system in the transformer yard shall cover the following equipment in the protection zone.
 - Generator transformers
 - Station transformers
 - Standby transformers
 - Auxiliary transformers
- vii) All areas of the power station shall be provided with lightning protection. The lightning protection system for buildings shall consist of air termination network, down conductors, test link and earth electrodes.
- viii) Air termination network consisting of vertical or horizontal conductors or combination of both shall be provided for the building. Down conductors shall follow the most direct path possible between the air terminal network and the earth termination network. Each down conductor shall be provided with a test link for testing. An earth electrode shall be connected to each down conductor.
- ix) For Lightning protection, material Thickness of galvanising shall be atleast 610 gm/sq.m for all galvanised steel conductors.
- x) The lightning protection system shall not come in direct contact with other equipment/systems such as cables, conduits, electrical equipment, underground metallic ducts etc. All metallic structures within vicinity shall be bonded to the lightning protection system.
- xi) All welded/brazed joints shall be coated with anti- corrosive paint for rust protection.
- xii) Lightning conductor when used above ground level and shall be connected through test link with earth electrode/earthing system. Down conductors shall be as short and straight as practicable and shall follow a direct path to earth. Down conductor shall not be connected to other earthing conductors above ground level.
- xiii) Each down conductor shall be provided with a test link at 1500 mm above ground level for testing but it shall be in accessible to interference. No connections other than the one direct to an earth electrode shall be made below a test point. All joints in the down conductors shall be of welded type.
- xiv) Down conductors shall be cleated on outer side of building wall/ welded to outside building columns at 750 mm interval.
- xv) Lightning conductor on roof shall be cleated on surface of roof using insulated clamps/saddles for conductor fixing at an interval of 1000 mm for horizontal run and 750 mm for vertical run.
- xvi) Conductors of the lightning protection system shall not be connected with the conductors of the safety earthing system above ground level.



- xvii) Installation of lightning conductors on the roofs of buildings shall include construction of support, laying, anchoring, fastening and cleating of horizontal conductors, grouting of vertical rods wherever necessary, laying, fastening / cleating / welding of the down comers on the walls / columns of the building and connection to the test links to be provided above ground level.

24.06.02 Air Terminations

- i) The vertical air terminal rods shall be installed at the roof of buildings for MCC/Switchgear rooms, ESP Control rooms etc to protect these objects from lightning strokes.
- ii) The projected length of the Air termination rod shall be as required to protect the object (on which the rod is fixed) from lightning stroke.
- iii) The air terminal rod shall be properly fixed on the top of the building/structure to withstand very high wind pressure. In case the air terminal rod is embedded at the top of roof of building, the portion embedded inside the concrete shall not touch the reinforcement bars and shall be duly insulated from them.
- iv) All the vertical air terminal rods shall be electrically connected together by means of horizontal conductors of size 50 x 6 mm galvanized steel flats. Horizontal air termination (i.e. G.S. Flat conductor) shall be so laid that no part of the rod shall be more than nine (9) metres from the nearest roof conductor.

24.06.03 Shielding Masts

- i) The shielding mast for lightning protection shall be installed at the top of steel columns cap plates of the associated building.
- ii) The shielding mast shall be made of galvanized steel rod and the height of the same shall be decided considering the zones to be protected.
- iii) Each shielding mast shall be connected to grounding grid by a down conductor 50 x 6 mm minimum. Galvanised steel flat run along the building column. In addition all building columns joints shall be electrically bonded.

24.06.04 Down Conductors

- i) Galvanized steel down conductors of suitable size shall be connected with air terminal rod/horizontal conductor at the top of roof/structure and other end connected to the nearest 40 mm dia. mild steel rod riser from ground electrode.
- ii) Each down conductor shall have an independent earth termination. In no case conductors of the lightning protection system shall be connected with the conductor of grounding system above ground level.
- iii) The connection between each down conductor and rod electrode (by means of 40 mm mild steel rod riser) shall be made via test link located



at approximately 1500 mm above ground level.

- iv) The down conductor shall be laid straight and sharp bends shall be avoided as far as practicable. These shall be cleared on outside of the building wall and column/structure at about 750 mm intervals unless stated otherwise in the drawing.
- v) At all supports for down conductor along the column/wall of the buildings etc. the portion embedded inside the building concrete should not touch the reinforcement bars.
- vi) All exposed metallic parts of the buildings shall be bonded to the down conductors. Such parts shall include ladders, balconies, conduits etc.
- vii) The down conductors shall be protected at the ground level against mechanical injury by means of non-metallic pipes, viz. PVC pipes filled with bituminous compound.

24.06.05 Electrodes (for Lightning Protection)

- i) The electrodes shall be 40 mm diameter 3000 mm long mild steel rod. These shall be driven into the ground.
- ii) All the electrodes shall be interconnected by means of one (1) 40 mm dia mild steel rod which shall be laid under ground at a minimum depth of 1000 mm below finished grade level unless stated otherwise. This ground mats/electrode in turn shall be connected to main grounding grid.

24.06.06 Riser (for Lightning Protection)

All risers connected to grounding mat shall be 40 mm mild steel rods and shall be projected 300 mm above grade level unless stated otherwise.

24.06.07 Jointing & Connection

- i) All ground conductor connections below ground level shall be done by electric arc welding with low hydrogen content electrode.
- ii) The projected portion of riser above ground shall be coated with two (2) coats of bitumen paints (anti-corrosive paints) with a minimum thickness of 1 mm after connection.
- iii) The joints in the lightning conductors shall be kept to a minimum and there shall be no joint in the underground portions of conductors.
- iv) All the joints shall be done by arc welding process overlapping of the conductors at straight joints shall not be less than 150 mm. The contact surfaces shall be cleaned properly before jointing.
- v) The portion of galvanized steel flats, which undergoes welding at site, shall be coated with two (2) coats of cold galvanizing anti-corrosive paint after welding.



- vi) The bolted joint of the test link shall be covered with thick coating of bitumen paint after successful testing.
- vii) The air terminal rods and shielding mast shall be coated with weather resistant anti-corrosive paint (zinc chromate followed by two coats of aluminium paint).
- viii) The steel to copper connection shall be brazed type.
- ix) The lightning protection of inflammable liquid storage tanks wherever required, shall be provided with horizontal conductors strung between tall poles covering the entire zones or with air terminal rods mounted on top of poles/structure. These horizontal conductors/vertical air terminal rods shall be connected to rod electrodes, which in turn shall be connected to station ground mat.
- x) The sizes and materials of earthing conductors to be used in lightning protection system are listed below:-

DESCRIPTION	SIZE	MATERIAL
1) Horizontal air termination and down conductors for buildings, boilers and other tall structures.	25 x 6 mm	GI Flat
2) Vertical air termination rods for other buildings / tanks etc.	20 mm dia 1000 mm long	MS rod

Note: The above sizes are indicative only. Actual size shall be arrived at as per design by the Bidder.

24.07.00 DRAWINGS & DOCUMENTS

Bidder shall submit the following minimum drawings and documents for approval during detail engineering stage:

- Soil resistivity report
- Design basis report for earthing and lightning protection system
- Earthing design calculation
- Typical installation drawings for earthing and lightning protection
- Electronic earthing layout and details
- Earthing layout for Transformer Yard
- Earthing layout for Power house building, Boiler and ESP
- Earthing layout for all auxiliary plant buildings
- Earthing layout for all non-plant buildings
- Lightning protection design calculation
- Lightning protection layout for Power house building, Boiler and ESP
- Lightning protection layout for transformer yard
- Lightning protection layout for all auxiliary plant buildings
- Lightning protection layout for all non-plant buildings
- Field quality plan



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GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

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

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1.0

INTENT OF SPECIFIATION

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

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

2.0

CODES AND STANDARDS

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

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

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

3.0

DESIGN REQUIREMENTS

3.1

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

3.2

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

3.3

Starting Requirements

3.3.1

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

3.3.2

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

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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.		

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

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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.		

	TITLE MOTOR DATA SHEET - C	SPECIFICATION NO.
		VOLUME II B
		SECTION D
		REV NO. 00 DATE 29/08/2005
		SHEET 1 OF 2

S. No.	Description	Data to be filled by successful bidder
A.	General	
1	Manufacturer & country of origin	
2	Motor type	
3	Type of starting	
4	Name of the equipment driven by motor & Quantity	
5	Maximum Power requirement of driven equipment	
6	Rated speed of Driven Equipment	
7	Design ambient temperature	
B.	Design and Performance Data	
1	Frame size & type designation	
2	Type of duty	
3	Rated Voltage	
4	Permissible variation for	
5	a Voltage	
6	b Frequency	
7	c) Combined voltage & frequency	
8	Rated output at design ambient temp (by resistance method)	
9	Synchronous speed & Rated slip	
10	Minimum permissible starting voltage	
11	Starting time in sec with mechanism coupled	
12	a) At rated voltage	
13	b) At min starting voltage	
14	Locked rotor current as percentage of FLC (including IS tolerance)	
15	Torque	
	a) Starting	
	b) Maximum	
16	Permissible temp rise at rated output over ambient temp & method	
17	Noise level at 1.0 m (dB)	
18	Amplitude of vibration	
19	Efficiency & P.F. at rated voltage & frequency	
	a) At 100% load	
	c) At 75% load	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

	TITLE MOTOR DATA SHEET - C	SPECIFICATION NO.
		VOLUME II B
		SECTION D
		REV NO. 00 DATE 29/08/2005
		SHEET 2 OF 2

S. No.	Description	Data to be filled by successful bidder
	c) At starting	
C.	Constructional Features	
1	Method of connection of motor driven equipment	
2	Applicable Standard	
3	DOP of Enclosure	
4	Method of cooling	
5	Class of insulation	
6	Main terminal box	
	a) Type	
	b) Power Cable details (Conductor, size, armour/ unarmour)	
	c) Cable Gland & lugs details (Size, type & material)	
	d) Permissible Fault level (kArms & duration in sec)	
7	Space heater details (Voltage & watts)	
8	Flame proof motor details (if applicable)	
	a) Enclosure	
	b) suitability for hazardous area	
	i Zone	O / I / II
	ii Group	IIA / IIB / IIC
9	No. of Stator winding	
10	Winding connection	
11	Kind of rotor winding	
12	Kind of bearings	
13	Direction of rotation when viewed from NDE	
14	Paint Shade & type	
15	Net weight of motor	
16	Outline mounting drawing No (To be enclosed as annexure)	
D.	Characteristic curves/ drawings (To be enclosed for motors of rating $\geq 55\text{KW}$)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			



TITLE:
**2 X 800 MW UPPUR STPP (STAGE-I, UNIT 1
& 2) BTG PACKAGE**

**TECHNICAL SPECIFICATION FOR
CHEMICAL DOSING SYSTEM**

SPECIFICATION NO. PE-TS-425-154-A001
SECTION II

SUB SECTION - IIC

REV.NO. 0 DATE : 15.11.2017

SECTION- IIC

GENERAL TECHNICAL REQUIREMENTS (C&I)

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

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

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

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

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

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

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

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

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



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

- 3.02.00 Following minimum requirement of field instruments shall be fulfilled by Bidder (In addition, Redundancy criteria for field instruments shall be as specified else where in specification): -
- i. Level switches / pressure switches / flow switches/any other process switches etc. for OLCS / Alarms / Interlocks / Protection. Pressure switches at inlet, outlet of individual pumps and discharge header of pumps for protection and auto start / stop & alarms.
 - ii. Level switches (Type as per Owner Approval) for sump/tank/vessel/containers/heaters/hoppers/silo level very high/high/normal/low/very low interlocks.
 - iii. Level Transmitters (Type as per Owner approval) for open sump/tank/bunker/vessel/heaters/containers/silo etc. in addition to level switches.
 - iv. Stand pipes on both side of tank for all level instruments (LT, LS & LG).
 - v. Flow elements (Type as per Owner Approval) with flow transmitter & Flow meter for flow measurement of process medium like Steam, Water, Air, Flue Gas, Fuel oil, Lube oil, open channel liquid, solid fuel, ash flow, ash slurry, DM water, PT plant, ETP Plant, Raw water, Instrument and Service air etc. as decided by owner with in terminal points and scope.
 - vi. Pressure gauges, temp. Gauges and Temp. Element at inlet and outlet of each heat exchanger and cooler.
 - vii. DPG, DPT & DPS across the filters/strainers.
 - viii. Tapping points/test points shall be provided.
 - ix. All primary Instruments, hardwares & JB's etc used for measurement for HFO, LDO & Turbine Lube Oil system shall be flame proof (IEC-79.1, Part I). All primary Instruments, hardwares & JB's etc used for measurement for Hydrogen Gas & Oxygen Gas shall be intrinsically safe and explosion proof as per NEC article 500, class 1, Division 1 area I.
 - x. All Thermocouples & RTDs (Type as per Owner Approval) shall be Duplex. Thermocouples shall be provided for Mill outlet temperature and for Services with Temperature ≥ 200 deg C.
 - xi. All Field Instruments used in acid or alkaline atmosphere shall be with standard Anti corrosion coating i.e. the combination of Polyurethane and epoxy resin baked coating (ANSI/ISA-71.04).
 - xii. All primary instruments installed at "Minus level or Floor" shall be with protection class of IP 68.



- xiii. Transmitters (all type) for monitoring & controls purpose.
- xiv All field mounted push button, selector switch etc. shall be as per IEC or NEMA 4X protection.
- xv All limit switch shall be conform to IEC-60947-5-1 and shall have minimum 2SPDT/DPDT contacts.

- xviii. Temp. Transmitters are envisaged with RTD & Thermocouples for monitoring services/application only. However any RTD & Thermocouples are used for control, interlock & protection application, Metal Temperature, and bearing & winding temperature, same shall be directly wired to DDCMIS/DCS/PLC using instrumentation & Extension cables respectively.
- xix. As for the water flow/ steam flow measurements, **necessary flow elements/ transmitters are chosen in the process line and supplied such that their algebraic summation shall be mass balanced for calculating the system efficiency.**
- xx. Non Contact Type, electronic 2-wire position transmitters shall be provided for all inching type motorised valve and dampers.
- xxi. For Turbine oil tank, LDO/HFO tank, DM water tanks, CS tank, Chemical dosing tanks, Acid and alkali applications, lube oil tanks, and any other tank/sump etc., only non contact type level transmitters like Acoustic, Ultrasonic, Radar based (Type as per Owner Approval) shall be provided by bidders as specified in the specification and as approved by owner.

- xxiii. For Turbine oil, HFO/LDO applications & H2 Gas application, zener protection on power supplies shall be included.



- xxiv. Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application. For HFO, LFO Applications, SS capillary with thin wafer element with ANSI RF flanged ends are to be provided. For hazardous area, explosions proof enclosure as described in NEC article 500 shall be provided.
- xxv. Gauges (all type) for local monitoring in field.
- xxvi. Each switching element including the limit and torque switches of valve actuators shall be provided with minimum two contacts i.e. 2SPDT OR DPDT.
- xxvii. All instruments should be supplied with valid calibration and test certificates provided by OEM.
- xxviii. Canopy/Enclosure shall be provided for field instruments like transmitters, switches & flow meters, etc and any other equipment to protect from direct sun light, lightning & rain.

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

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

Smart Transmitters of the electronic type shall be furnished.

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

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

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

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



- Measurement element	:	Teflon seal
		For Hydrogen gas pressure/differential pressure transmitters, the suitable material and coating shall be chosen as per the suggestion of transmitter manufacturer.
- Valves	:	Carbon steel for non-corrosive Applications SS316 for corrosive applications.
Output signal	:	4 to 20 m Amp. DC (Two wires) HART Compatible
Local Indicator	:	LCD indicator (5 digit) with scale of Engg. unit
Overall Accuracy	:	$\pm 0.04\%$ or better of Span $\pm 0.2\%$ or better of span for remote seal type transmitter.
Turn down ratio	:	100:1 in general 30:1 or better of Span for very high pressure & very low pressure services.
Stability	:	$\pm 0.15\%$ of URL for 10 years.
Response time	:	150 msec.
Power supply	:	24V DC nominal
Drive capability	:	600 Ohms nominal
Enclosure Class	:	IP-65 /(Explosion proof for NEC Class-1, Division 1 area)/Flame proof (IEC – 79.1, Part I).
Span and Zero	:	Locally adjustable, non-interacting
Zero suppression / elevation	:	At least 100% of Span

Connection

- Process		Quarter (1/4) inch NPT with/without oval flanges
- Electrical	:	Suitable for Plug in type connection (Both side of transmitter), unused entry with blind plug.
IBR Requirement	:	For high pressure & high temperature service, Process tapping and root valves shall be as per IBR rules and regulations.

Accessories

:



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

Requirments for flanged remote seal diaphragm:

Maximum pressure rating : To meet 200 percent of process pressure

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

Single Capillary connection for pressure transmitters.

Capillary length : 6.0 m

Fill fluid : Suitable oil

Process connection size : 1 inch

Flange size and Accessories : As per process requirement.

Flange pressure rating : Required Class (ANSI)

Process liquid : Sea water, Ash water, chemical, hydrogen gas, sealoil etc.,

Process fluid temperature : 25°C to 60°C

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

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

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



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

- Over range protection : One Fifty (150) percent of full scale
Enclosure Class : IP-65 or better (Explosion/Flame proof for NEC Class-1/2, Division 1 area)/Flame Proof (IEC – 79.1, Part I) as applicable.

IBR Requirement : For high pressure service, Process tapping and root valves are as per IBR rules and regulations.

Accessories

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

3.03.03 PRESSURE & DIFFERENTIAL PRESSURE GAUGES (PG & DPG)

Applicable standard : IS:3602-1966, IS/3624, ASME B 40.1
Type/Construction

-760 mm to 1.0Kg/cm2 : Bellows/Diaphragm
-Above1.0Kg/cm2 : Bourdon Tube
- Suction side of pumps : Compound gauge

Materials

- Bourdon tube : 316 SS
- Bellows : 316 SS
- Movement : 316 SS
- Case : SS 316/ Die-cast aluminum with stoved enamel black finish. Epoxy coating shall be provided for corrosive atmosphere.
- Protective Diaphragm : Teflon

Dial size : 150mm with toughened shatter proof glass.
300 mm with toughened shatter proof glass for frame mounted gauges.

Scale Details : Graduations in black lines on white dial, on white dial, 270 Deg. pointer deflection scale provided with



glass cover. Smallest scale division shall be one (1) percent of full scale value or smaller. Pointer stop for all gauges.

Accuracy	:	$\pm$ One (1) percent or better
Connection - Instrument Process	:	1/2 inch NPT Male Bottom
Mounting	:	Local / Frame mounted.
	:	1/2 inch NPT Male (Back entry) mounted on local gauge board.
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)
IBR Requirement	:	For high pressure service, Process tapping and root valves are as per IBR rules and regulations.

Accessories

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

Other particulars

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

Other Requirments

:	Movement mechanism shall be glycerin filled for oil services & vibration prone area.
:	For Fuel oil & corrosive liquid lines diaphragm type sensors required. Armored capillary of 10 M for Fuel oil & Corrosive liquid service.
:	Contact type pressure gauges are not acceptable for interlock & protection.
:	For condensate storage tank and DM water storage tanks, the pressure



IBR Certification : For high pressure service, Steam Temp., Fuel oil temp. measurement as per IBR rules and regulations

3.03.10 TEST THERMOWELLS (TW)

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

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

3.03.11 DIRECT MOUNTED LEVEL TRANSMITTERS (LT)

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

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

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



Resolution	:	$\pm 0.1\%$ of span
Temperature Compensation	:	Integral, To be provided with Transducer.
Operating temp.	:	Transmitter-50 deg C and Sensor – 80 deg C
MOC Sensor	:	Body- PVDF and Face – Polyurethane
Humidity	:	1% to 95% non condensing.
Enclosure	:	IP-67 Epoxy painted die cast Aluminum or SS316L housing.
Cable Connection	:	3/4" ET
Mounting	:	2" – 4" NPT or flanged
Accessories	:	Cable gland, prefab cable, mounting accessories like EPDM seal, SS316 flanged etc.
		Additional separate local display unit with large Alphanumeric back light LCD/LED & to be provided for the applications, which will be decided during detailed engineering.

Separate Sensor unit & electronic unit with LCD display to be provided for the applications, which will be decided during detailed engineering by owner.

All weather canopy for protection from direct Sunlight, lightening and direct rain.

Note:-

- 1) Bidder can also provide Radar type transmitter in place of ultrasonic transmitters subject to approval by Owner during detailed Engineering.
- 2) The frequency used for Ultrasonic /sonic measurements shall be suitable for envisaged applications and this shall be supported by the standard product catalogue of the instrument manufacture.

3.03.13 CAPACITANCE TYPE LEVEL TRANSMITTER

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

Type	:	Capacitance type
Probe	:	a) Rod or suspended electrode. b) Rope type probes may be used only where required probe length is greater than 3 meters
Probe Mounting	:	Stainless steel 1-1/2 ANSI RF Flange / 3/4" NPT (M)
Material of construction	:	316 SS
Insulation	:	PTFE Part/Full as per service.
Transmitter	:	The transmitter shall receive output of the preamplifier and convert it into 4-20 mA DC output signal.
Accuracy	:	$\pm 1\%$ of Full scale
Repeatability	:	$\pm 0.5\%$ of Full scale



Load	:	Min 600 Ohms
Enclosure	:	Powder/Epoxy coated Die cast aluminum. with neoprene gasket conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
Ambient temperature	:	0-60 °C.
Mounting	:	Wall / Surface
Supply voltage	:	UPS 240V AC, 50Hz / 24V DC
Response time	:	100 m sec or better
Cable connection	:	¾" ET
Accessories	:	Counter flange, Cable gland, prefab cable if any
Preferable features	:	Alarm output contacts with adjustable set point facility

3.03.14 GUIDED WAVE RADAR/RADAR LEVEL TRANSMITTER

Type	:	Guided wave Radar (Contact type)/Radar (Non contact type) as finalized by owner.
Application	:	For HP Heaters, Deaerators, Turbine Lube oil tank, lube oil tanks, HFO & LDO tank level, Condenser Hotwell, LP heaters, CBD tank level, Stator water expansion level, and other Low pressure, Vacuum vessels.

Also Bulb type with Teflon coating & drop antenna shall be used acid /chemical tank applications.

For oil tank applications, four wire transmitter shall be supplied with zener barrier protection for power supply connected to level transmitters.

Environment Class	:	Highly abrasive with Gases and Fumes
Orientation	:	Vertical
Probe Type	:	Flexible Single lead with chuck
Probe Material	:	SS 316L
Connection Size & Type	:	2" Flanged ANSI 300 lb SS316L material
Connection material	:	SS 316L
Accuracy	:	+/- 5 mm
Resolution	:	± 1 mm
Type (Transmitter)	:	SMART, 2 Wire
Operating Principle	:	Time Domain Reflectometry
Output	:	4-20 mA, DC with HART protocol and 600 Ω output load.
Electrical Connection	:	½" NPT
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)
Electrical Power	:	11-42 V DC
Housing material	:	Die Cast Aluminum
Vent & Drain Plug material	:	SS
Side Flange Material	:	SS
Local Display	:	Provided (LCD Digital)



Units of Measurement : Length M

Electromagnetic compatibility: EN-61326

3.03.15 3 D TYPE ACOUSTIC WAVE LEVEL TRANSMITTER

Type	:	Acoustic Wave Level Transmitter (3 D type)
Application	:	One set of 3 D type Acoustic wave type level transmitter for each ESP Hopper (First field) measuring Level, Volume & Mass. 2 Nos. to be provided for Coal bunker level measurement for coal feeder in addition to 1 no. strain gauge type level measurement. Median from three values shall be chosen from triple redundancy.
Temperature compensation	:	Required for high temp applications
Operating Principle	:	Non - Intrusive acoustic wave transmission & Reflection
Frequency Range	:	3 – 10 KHz
Measurment Range	:	Empty to full
Accuracy	:	+/- 0.25 % for even surface & $\pm$ 0.5% for uneven surface.
Resolution	:	1 mm
Output	:	4-20mA DC with HART to corresponding control system.
Display Unit:		
Type	:	Head mounted LCD Display with Engg. Units
Location	:	Suitable location at bunker / Silo operating floor area
Protection Class	:	IP 65 or better// flame proof (IEC-79.1, Part I) As applicable).
Material Of construction:		
Housing	:	Polypropylene/Aluminum/SS
Flange	:	Polypropylene/Aluminum/SS
Sizes:		
Flange Size	:	2" ANSI 300 # RF SS minimum.
Electrical connection size	:	1/2" NPT (F)
Accessories	:	i. Double compression type Nickel Plated Cable glands. ii. Suitable Mating Flange, necessary gaskets, Canopy/Enclosure.



Tests	:	Tested at two hundred (200) percent of the maximum process pressure
Other details	:	For larger lengths, additional gauge glasses shall be provided with minimum of 50 mm overlap.

3.03.22 FLOAT & BOARD TYPE LEVEL GAUGE

Type of Instrument	:	Mechanical Type (Float Operated)
Service/ Application	:	As per service requirement
Measuring Range	:	as per requirement
Material Specification	:	
a) Float Material	:	SS316 having 2 nos. Guide wires
b) Float Wire Pulley	:	Shall comprise of 2 nos. Cast Aluminum Pulley housing Assembly with SS 304 pulley and pulley shaft. Steel ball bearings shall be provided in pulley housing for easier float movement. Float wire material shall be SS316L. Between 2 pulleys, 1" SS short pipe.
c) Guide wire Assembly	:	SS chamber with SS316 spring and adjuster having 1" Class 150 ANSI RF SS flange. Guide wire rope shall be SS316L.
d) Counter Weight	:	MS counter – weight with Aluminum Pointer and Brass assembly Pull Chain.
e) Scale	:	SS 316/Aluminum material in mm with 1 % accuracy.
Nozzle Details	:	For float wire pulley assembly, one tapping and for guide wire assembly two tapping at the top of the tank; Size 1" NB (Top Mounting Type)
Process Connection	:	Flanged as per ANSI B 16.5 to suit 1" NB nozzle (Nozzle length - 150 mm for float wire, 100 mm for guide wire)
Accessories (to be supplied with the instrument)	:	
a) Counter flange	:	All mating Flanges, Nozzle
b) Mounting Accessories	:	All mounting accessories
c) Tag Plate	:	To be provided (material SS316)

3.03.23 MASS FLOW METER**Sensor**

Measuring Principle	:	Coriolis Mass flow.
Primary Element	:	Flow Tube of 316SS or better
Heating Arrangement	:	Integral with Flow meter.
Temperature Control For Heating	:	To be provided.
Process Connection	:	ANSI RF Flanged and rating as per process requirement.



~~3.03.40~~ **DEW POINT METER**

Type	:	2 Wire Loop Powered Dew point Transmitter
Overall Range	:	-60°C to +20°C Dew point
Accuracy	:	± 2°C Dew point
Material	:	SS316 (wetted parts)
Features	:	AUTOMATIC CALIBRATION • Can be Configured for Linear 4-20mA signal in °C & °F Dew point, ppm(v), ppb(v), g/m3 • Temperature Compensation • Failure Diagnostics • Long Term Stability • Fast Response • IP 66 / NEMA4X Protection • Supplied with Calibration Certificate Traceable to National & International Humidity Standards • Sensor protection with sintered filter • Local LCD Display for Dew Point

3.03.41 **Junction Boxes**

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



M6 Ni plated Brass earthing stud shall be provided (external 2 nos. internal 1 no.)
Gasket (Normal)- Neoprene/Polyurethane thickness 6.0 mm. Silicon for High Temperature area.
Colour : In General same as provided for control panels, and for special services, To be decided during detailed engineering & subject to owner's approval.

3.03.42 Cable Glands

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

3.03.43 Interposing Relays (IPR)

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

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

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

3.03.44 RECORDERS (CHARTLESS)

Type : Micro-processor based, Digital TFT display type
No. of Channels : Six (6) points and Forty Eight (48) point).
The parameters shall be decided during detailed Engineering. Quantities of recorders for BTG packages shall be decided during detailed Engineering.
(Simultaneous parameter display preferred)



Software to be supplied along With instrument :

Software required for data archives from chartless recorder through Ethernet, remote viewing in PC through Ethernet, file transfer through Ethernet to PC.

External Storage media : Compact USB flash drive & Compact flash memory card with high capacity to be provided.

Math Function : General Arithmetic function, Summation for each channel and group of channels, Statistical operations like Average Maximum, Minimum etc.,

Ethernet Cable with Connectors : 50 metres for each recorder

For virtual memory of chartless recorder :

Provision of Modbus Protocol and its communication interface card in Chartless recorders for reading/writing of measurements/data from third party system/ electronic modules through digital communication.

The recorder shall carry 48 or More channels of virtual measurements through data communication from third party system/ electronic modules

Color laser Multi function printer : 1 No. A3 size color laser Multi Function printer for Print, Scan & Copy for complete set.

1 No. lap top computer with necessary CR application software to integrate with CR.

3.03.45 PANEL MOUNTED DIGITAL INDICATOR

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



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

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

3.03.67 SYNCHRONIZING RELAYS

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

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

Type	:	Momentary/Miniaturised Suitable for mosaic grid 24x48 Mm with 2 PB and 3 coloured LED.
Contact Configuration	:	2 NO + 2 NC
Contact Material	:	Hard Silver Alloy
Contact Rating	:	500V / 10 A
Insulation Voltage terminals and earth	:	2 KV for 1 minute between
Lamp Rating :-		
a) Voltage	:	240 V AC
b) Watt	:	2 Watt (approx.)
Colour		
Red	-	ON/Start/Open ILPB
Green	-	OFF/Stop/Close ILPB
Red	-	energized, running, Start, valve open LED/Lamp
Green	-	de-energized, stopped, valve closed LED/Lamp
Light yellow	-	abnormal, discrepancy LED/Lamp
Red	-	OFF/Stop/Close PB
Green	-	ON/Start/Open PB
Red	-	Emergency trip push buttons with red flap / hinged



Transperent arylc cover.

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

Colors

DESK RELEASE

Desk Lamp test

Desk Acknowledge

- Yellow

- Blue

- Green

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

3.03.71 PUSH BUTTON FOR ANNUNCIATION

Contacts

- Number & Type

: As per requirement

- Breaking capacity

: 1 Amp, 220V DC

10 Amp, 600V AC

Different colours for Accept/Acknowledgr -

Green, reset - Grey, Lamp test - Blue,

System Test - Yellow

& Audio Acknowledge - Black.

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

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

3.03.73	Hydrogen Gas System Instruments/Analysers	
3.03.73.01	Hydrogen Gas Hygrometer	
A	Performance	
1	Measuring Range	-80 deg C to 20 deg C
2	Response Time for 63% Step Change	<5 sec.
3	Output Resolution	0.01 mA
4	Storage Temp: Max	70°C
5	Operating Ambient Relative Humidity	<95%
6	Sensitivity	< 5 seconds for 63% step change in moisture content
B	Construction	
7	Measuring Principal	Thin Film Alum Oxide
8	Enclosure Protection class	Intrinsically safe and explosion proof as per NEC article 500, class 1, Division 1 area I.
9	Display	3-1/2" Digit LCD
10	Mounting	In Explosion Proof Box



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on required basis and finalized by owner any where in power plant. Details shall be finalised and approved by Owner during detailed engineering.

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

6.03.00 **TERMINATION/Marshalling CABINETS & Interposing Relay Panel**

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

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

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

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

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

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

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

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

6.04.00 **CONSTRUCTIONAL FEATURES OF PANELS,**

- i. All panels, cubicles, consoles, SOV panels, Fire alarm panels and enclosures furnished as per this specification shall be of free standing type and shall be constructed of specified gauge of steel plates. The minimum sheet thickness of panels shall be as follows unless otherwise specified herein.

Side and top – not less than 1.6 mm.

Door & mounting plate – 2.0 mm.



Base metal plate - 2.5 mm.
Gland plate – 3 mm

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

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

- iii. All panels shall be mounted on vibration dampers, which are secured to C-channels mounted on the floor. The channels shall be field welded to steel plates set into the concrete flooring. The steel plates shall be located such as to approximate the outline of panel bases. The exact mounting details shall be as approved by the owner during detailed engineering stage. All panels shall be provided with adequate ventilation and packaging density of components shall be restricted so as to limit the temperature rise above ambient to 10°C under the worst conditions. All panels shall have auto on/off switch for internal lighting. All the power supply circuit for control panels shall be provided with auto changeover circuitry.
- iv. In each panel /cabinet, a 24 VDC Voltmeter digital type shall be provided to check the Field Interrogation voltage.
- v. Exhaust Fans with louvers & filters shall be provided on door's (front & Rear) upper side to remove hot air in all consoles, control desk and panels.
- vi. Fire/Smoke detectors shall be provided inside the Control room mounted system/control cabinets.
- vii. UPS, 24 V DC & non UPS's Feeder failure/ healthy indication shall be provided in each cabinet & remote indication shall be hooked up to DDCMIS/ PLC/annunciation & suitably grouped.



- viii. All the panels shall be equipped with Anti vibration pad of min. 15 mm size thickness. Cable gland plate thickness shall be 3 mm. C Channel height shall be minimum 100 mm.
- ix. Doors shall be provided with neoprene/polyurethane gasket only. The front and rear doors shall be of full height.
- x. All the cable entries shall be at the bottom of electronic cubicles/control panels.
- xi. Protection class of panels shall be as specified at Vol. V, chapter 2.
- xii. Control panels shall be provided with proper arrangement and hardware to terminate the inert gas required for fire protection.

6.04.01 Operator Control Desk

- 6.04.01.1
 - i. In CCR, Operator work station consoles/desk shall be of granite top of curved nature with powder coated frame. OWS consoles shall be provided with the facility for locating the CPU, document etc with all required utilities.
 - ii. Unit In charge desk/consoles shall be of granite top of curved nature with powder coated frame. OWS consoles shall be provided with the facility for locating the CPU, document etc with all required utilities.
 - iii. Station In charge desk/consoles shall be of granite top of curved nature with powder coated frame. OWS consoles shall be provided with the facility for locating the CPU, document etc with all required utilities.
 - iv. All other features as specified for other OWS shall also be applicable for above control desks.
- 6.04.01.2 Engineer work station and all other consoles/desk shall be ergonomically designed industrial grade type with swivel chairs for use at the various Programming stations and all other plant locations. All the equipment like Programmers stations, PC's, various peripherals & similar devices shall be complete with desks and they shall be of industrial grade stands and other mounting accessories and the same shall be completely erected & commissioned by the bidder. Details for other operating and engineering stations shall be as below:
 - i. Operator Control desk shall be free standing table top type with doors at the back and shall be constructed of 3 mm thick CRCA steel plates. It shall have concealed cable & wire way management system. The top surface of control desk shall be 30mm thick with the top 12mm of acrylic solid surface and the remaining 18mm of laminated medium density fibre board. Control desk shall consist of vertical, horizontal and base supports with their coverings for work surface, keyboard trays, Mouse pads, Monitor shelf and concealed cable and wire way management, perforated trays with covers in both horizontal & vertical directions.
 - ii. To achieve durable & water resistant finish, a sheet of "plastic PVC membrane" on the surface of control desks shall be provided. Final paint finish with proper



smoothing is to be ensured. Final finish of CD should be in line with relevant International standards. For more durability, the membrane sheet of the Control desk should extend 200 mm more into the underside of the desk. The cabling / wiring between OWS & CPU's, power supply cables etc. shall be aesthetically routed and concealed from view.

- iii. All the control desk shall be equipped with Anti vibration pad of min. 15 mm size. Cable gland plate thickness shall be 3 mm. Base support frame height shall be min. 100 mm. Redundant fans shall be provided for ventilation.
- iv. Doors shall be provided with neoprene/polyurethane gasket only.
- v. Each OWS consoles shall be provided with the facility for locating the CPU, document etc with all required utilities.

6.04.02 SURFACE PREPARATION AND PAINTING

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

Suitable filler shall be applied to all pits, blemishes and voids in the surfaces. The filler shall be sand blasted so that surfaces are level and flat, corners are smooth and even. Exposed raw metal edges shall be ground burr free. The entire panel surface shall be sand blasted to remove rust and scale and all other residue due to the fabrication operation. Oil grease and salts etc. shall be removed from the panels by the process like DI water by pressure spray method, one or more RoHS approved solvent cleaning methods. Alternatively 7/9 tank process shall be followed.

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

As an alternative, single coat of anodic dip coat primer along with single textured powder coating with epoxy polyester meeting the thickness requirement is also acceptable.

The final finished thickness of paint film on steel shall not be less than 65-75 micron for sheet thickness of 2 mm and 50 microns for sheet thickness of 1.6 mm.

The Bidder shall furnish sufficient touch-up paint for one complete finish coat on all exterior factory applied painted surface of each item of equipment.

The finish colours for exterior and interior surfaces shall conform to the following shades:

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

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



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

6.04.03 INSTRUMENTS MOUNTING

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

6.05.00 PANEL WIRING

Interconnecting wiring shall be provided between all electrical devices mounted in the panels, and between the devices and terminal blocks if the devices are to be connected to equipment outside the panels by cabling and through pre-fabricated plug in cables. All alarm contacts located within a panel shall be wired to terminal blocks. Thermocouple and other special circuits shall be field wires direct to instrument terminal blocks without the use of panel wiring.

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

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

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

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

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

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

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



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

Wires shall not be tapped or spliced between terminal points.

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

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

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

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

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

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

6.05.01

Following **cable**/Wire size shall be utilized for internal wiring & UPS power cables (In addition, voltage drop calculation shall also be considered by bidder, while finalising the cable/wire size) :

- a. Current (4-20 mA) : 0.75 sq.mm
- Low voltage signals :
(AI/AO & DI signals)



- b. DO signals, Ammeter/ : 1.5 sq.mm
voltmeter circuit, control
switches, indicator, recorder
- c. Internal Illumination : 2.5 sq.mm
- d. Size of AC Power supply cables/wires shall be as below: -
 - i. 1 to 16 Amp. - 2.5 sq. mm
 - ii. 17 to 20 Amp. - 4 sq. mm
 - iii. 21 to 32 Amp. - 6 sq. mm
 - iv. 33 to 40 Amp. - 10 sq. mm.
 - v. 41 to 60 Amp. - 16 sq. mm
 - vi. Power earth - 4 sq. mm

6.06.00 PANEL ILLUMINATION

Panels shall be provided with LED based illuminating lamps with door switch and six (6) point 6/16A, 240V AC universal type power sockets with switch for maintenance purposes. These switches shall be with quick make and break mechanism. 100 % spare LED lamps shall be provided with each panel, these are in additional to mandatory spares.

6.07.00 FUSE BLOCKS

Where fuse blocks rated 30 amp. 250 Volts 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.

6.08.00 FUSES & MCB

All fuses shall be fast acting semiconductor types for AC supply and compatible to the UPS fuses. For all DC Powered devices, similarly the fuses shall be fast acting compatible to DCDB fuse provisions. All the AC power supplies shall be provided with the protection of Fast acting semi conductor fuses & 2 P thermomagnetic type MCB. Make of Fuses shall be GE or Siemens. For all the DC power supply circuits, electronic type DC MCB shall be used only. Make of DC MCB shall be Siemens, Phoenix contacts, Murr, Weidmuller, or Lutze.

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

6.09.00 MOULDED CASE CIRCUIT BREAKERS

Moulded case circuit breakers used in equipment covered under these specifications shall have not less than 5000 amp. Interrupting capacity at 220 Volts DC 10,000 Amp. Symmetrical interrupting capacity at 240 Volts AC. MCCB shall be provided at each main feeder line like ACDB & DCDB main feeders, PLC main feeder, control panels, UPS circuits etc.



6.10.00 GROUNDING/EARTHING SYSTEM

All panels, desks and cabinets shall be provided with a continuous bare copper ground bus of minimum 6 mm x 25/50 mm cross section. The ground bus shall be bolted to the panel structure on bottom on both sides and effectively ground the entire structure. The bolts shall face inside of the panels.

The System ground shall be isolated from the panel ground with suitable isolators. Each Ground bus shall have provision at each end for connection of ground leaks (6 mm x 50 mm copper Flats, length as applicable) by suitable bolting. All system cabinets shall be brought to a common system ground by the bidder. Electronic earthing resistance shall be < 0.5 ohms.

Shield on instrumentation cables shall be grounded on panel side. When shielding termination is required in cabinets furnished under this specification, suitable terminals shall be furnished on copper flat forming system ground.

Each circuit requiring grounding shall be individually and directly connected to the panel ground bus by ring tongue type compression lugs. For electronic system cabinets the system ground bus shall be insulated from the cabinet enclosure and shall be separately connected to the system ground. All system cabinets shall be brought to a common system ground by the bidder.

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

6.11.00 Panel Cooling Fans (for ventilation of the DDCMIS/ PLC / DCS & other cabinets)

Filter Fan for electrical cabinets and enclosures to be used with 120 V or 230 V AC versions having very low acoustic noise and lower power consumption. The fans must have UL approval and should have air flow volume as per the cabinet requirement. Wherever required, the EMC filter fans may be used. Fans should have a life of 50,000 Hours at 40 Deg C. Fan Housing, cover should be of V0 material as per UL94. Filter mat should be compliant to EU3 according to DIN 24185 standard and have a filtering degree of 80 to 90 %. The Ambient temperature range °C should be -10 to +70 Deg C and Protection class should be IP 54. Filter Material shall be Synthetic fibre with progressive construction, temperature resistant to +100°C, self extinguishing, Class F1 as per DIN 53438 standard.

6.12.00 Panel Thermostat (for temperature control of the DDCMIS/PLC/DCS panel – to be connected to switch On/Off Fan/Heater)

The panel thermostat shall be DIN Rail Mounted with an inbuilt snap action thermostatic bimetal sensor and shall be connected in series with the load without any additional supply voltage. The panel thermostat shall be available in setting temperature range of -20 deg C to 40 deg C or 0 to 60 deg C with separate modules for NO or NC contact. The electrical life at rated load AC1 shall be 1 Lakh switching cycles and shall work at an ambient temperature of -45 to +80 deg C. With AgNi contact material for switching, the



contact current carrying capacity shall be 10 Amp at a rated voltage of 250 V AC with a dielectric strength between open contacts of 500 V AC and shall have UL approval.

6.13.00 TERMINAL BLOCKS

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

6.13.01 All outputs going to MCC/SWGR terminal blocks, shall be rated 600 volts minimum and shall have strap screw less terminals suitable for connection of wires with ring tongue type lugs. Standard terminal blocks shall be screw less spring loaded cage clamps type.

The terminal blocks for DDCMIS/DCS/PLC input/output connections from/to SWGR/MCC, Actuators with Integral Starter (for Coupling relays and check back signals of 11 kV and 3.3 kV auxiliaries, LT drives/valves & dampers/solenoids, CT&VT, etc.) shall be provided with built in test and disconnect facilities complete with plug, slide clamp, test socket etc. The exact type of terminal blocks to be provided by the bidder and the technical details of the same including width etc. shall be subject to owner's approval.

Terminal blocks shall be approximately sized for larger wire size of higher voltage insulated incoming conductors as necessary. All the TBs used shall be high quality non-flammable insulating material of melamine suitable for working temperature of 105 deg C and 6.6 polyimide to withstand corrosion and the metallic portion shall be coated against rust /corrosion. All metal parts should be non –ferrous in nature.

6.13.02 Terminal blocks shall be provided with complete with all required accessories including assembly rail, locking pin and section, end brackets, partions, small partions, test plug bolts and test plug transparent covers, support brackets, distance sleeves, white marking strips and re permitted by the safety codes and standards shall be without covers.

6.13.03 Fuses shall not be mounted on terminal blocks. Neither step type terminal blocks nor angle mounting of terminal blocks will be acceptable. The terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal blocks and between terminal blocks and junction box walls.

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

6.13.05 For ensuring proper connections, Bidder shall provide suitable accessories, along with insulation sleeves. The exact connecting accessory shall be finalised as per application during detail engineering stage subject to owner's approval without any cost repercussions.

6.14.00 NAME PLATES AND LABELS

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



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

Markings/Labels

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

6.15.00 Local Instrument Racks & Enclosure

Transmitters and switches located in the field shall be grouped together and shall be installed in the enclosure (closed transmitter racks) in case of outdoor area such as Boiler area etc. And in open type Rack in case of covered area. Racks shall be factory prefabricated & painted and complete with internal tubing, manifold valve, isolation valves, integral junction boxes with outside access door, illumination etc. Racks used for furnace, flue gas and air application shall be provided with intermittent & continuous air purging.

6.15.01 Closed Type Instruments/Transmitter Racks

- (a) Required number of Instruments/transmitter racks shall be furnished to house transmitters, switches and converters by grouping them suitably, area- wise / function-wise.
- (b) The Transmitter enclosure shall be constructed of 3 mm thick steel plate. The enclosures shall preferably be of modular construction and with two end plate assembly bolted to the frame.
- (c) The enclosure shall approximately be 1200 milimeters wide, 1000 milimeters deep and 2200 milimeters high to allow easy access to the internals. Racks shall be reinforced as required to ensure true surfaces and to provide adequate support for instruments and equipment mounted therein. Double interlocking doors with three point locking arrangement shall be provided and shall be arranged for maximum possible access to the interior. Center posts or any member which would reduce access shall not be provided.
- (d) Doors shall have concealed quick removal type pinned hinges and locking handles. Doors locks shall accept the same key all over the plant. Neoprene material Gaskets shall be used between all mating sections to achieve dust proof enclosure rating for the modules and a IP-65 waterproof and dust tight rating on the terminal boxes. All Enclosures shall have access doors on front side.
- (e) Bulkheads, especially designed to provide isolation from process line vibration



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

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

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

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

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

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

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

The sequence of annunciation shall be as follows:

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

Return to Normal:



a.	Before acknowledge	Flashing	ON
b.	After acknowledge	Steady	OFF
Reset:			
a.	Alarm condition	No change	No change
b.	Return to normal	OFF	OFF



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1.0 SCOPE

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

2.0 CODES AND STANDARDS

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

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

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

3.0 TECHNICAL REQUIREMENTS

3.1 Panel Construction

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

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

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

3.1.4 The salient features of construction shall be:

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

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

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

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

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

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

3.1.10 All operable and indicating devices shall be mounted on the front of the panel while aux. Relays / timers MCBs etc. required for realization of control logics shall be mounted on a mounting plate inside the panel. Auxiliary relays and timers etc. shall be grouped according to the control function.
No operable or indicating devices shall be mounted below 750 mm and above 1800 mm (w.r.t. finished ground level). The devices shall be located in such a way so as to ensure easy access for operation / maintenance.

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

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

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

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

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

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

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

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

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

~~3.2 Hazardous Area Panel Requirement~~

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

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

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

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

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

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

3.3 Control & Monitoring devices

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

3.3.2 Alarm Annunciator System

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

3.3.3 Relays

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

3.3.4 Timers

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

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

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

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

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

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

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

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

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

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

4.0 TESTING AND INSPECTION

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

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



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

4.3.1 Routine Tests

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

4.3.2 Type Tests

1. Enclosure Class Test

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5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

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

5.2. Mandatory Spares

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

5.3. Recommended Spares

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

6.0 DRAWINGS AND DOCUMENTS

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

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

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

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

7.0 MARKING AND PACKING

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

8.0 APPLICABLE DATA SHEET FORMS

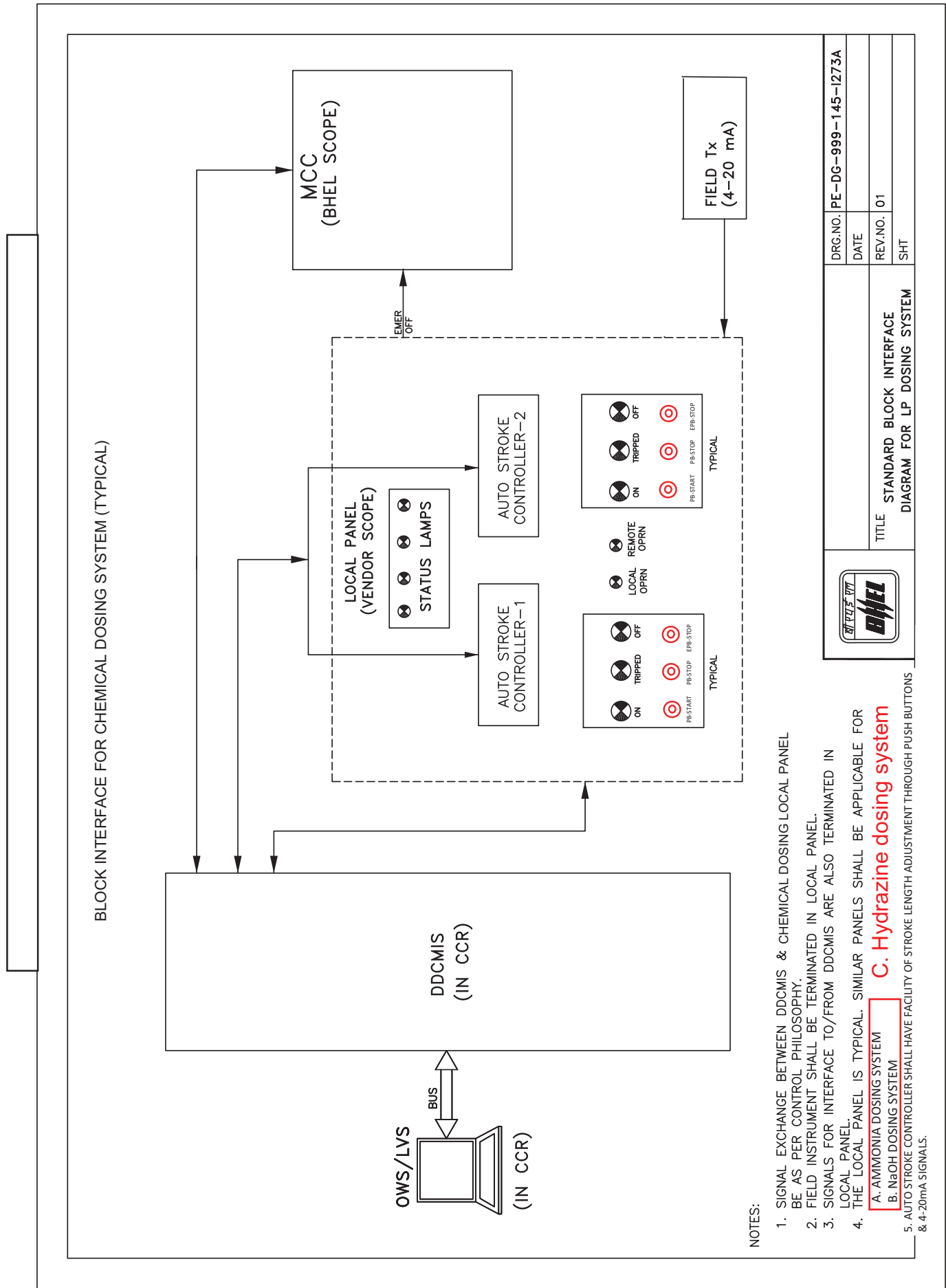
This document shall be read with one or more of the following data sheet forms :

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

	DATA SHEET FOR LOCAL PANELS		SPECIFICATION NO.:	
			VOLUME	
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TAG No. Qty.....			Data Sheet No.: PES-145A-DS1-0	
Data Sheet A & B				
DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
GENERAL	MANUFACTURER			
	CONSTRUCTION		☒ FOLDED (Steel) ☐ WELDED (As per requirement)	
	ENCLOSURE SHEET THICKNESS	FRONT	2.5 mm	
		OTHER	2.5 mm (Gland Plates- 3.0 mm)	
DOOR		2.5 mm		
TECHNICAL	INPUT POWER SUPPLY		☐ 240V 50 Hz AC ☐ 220V DC ☒ 415V 3 PHASE, 4WIRE	
	NO. OF FEEDERS		☐ ONE ☒ TWO	
	CONTROL SUPPLY		☐ 110V AC ☐ 220V AC ☐ 220V DC ☒ During detailed engg. (As per requirement)	
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)		AS REQUIRED	
	PAINT TYPE		☐ EPOXY ENAMEL ☒ EPOXY POWDER COATED	
	PANEL COLOUR (EXTERNAL)		☒ Exterior- RAL 7032/7035, to be finalized during detailed engineering.	
	FINISH		☒ MATT ☐ GLOSSY ☐ SEMI GLOSSY	
	PANEL COLOUR (INTERNAL)		☒ BRILLIANT WHITE ☐ CREAM ☐ OFF WHITE	
	FINISH		☐ MATT ☐ GLOSSY ☒ SEMI GLOSSY	
	CLASS OF PROTECTION		☒ IP-55 ☐ IP-65	
	CONTROL HARDWARE		☒ RELAY BASED	
	FOUNDATION ARRANGEMENT		☒ FOUNDATION BOLTS ☐ ANCHOR FASTENERS	
	WEIGHT OF PANEL (Kg.)			
	PANEL TYPE		☐ PRESSURISED ☒ UNPRESSURISED As per Requirement	
	CABLE GLAND		☐ SINGLE COMPRESSION ☒ DOUBLE COMPRESSION	
	AMMETER (TYPE OF INPUT)		☒ 1 Amp CT ☐ 4-20 mA	
NAME SIGNATURE DATE	PREPARED BY		CHECKED BY	
		APPROVED BY		COMPANY SEAL NAME SIGNATURE DATE

	DATA SHEET FOR LOCAL PANELS			SPECIFICATION NO.:	
				VOLUME	
				SECTION	
				REV. NO.	DATE:
				SHEET 1	OF 1
TAG No. Qty.....			Data Sheet No.: PES-145A-DS1-0		
Data Sheet C					
DATA SHEET-C FOR LOCAL PANEL (TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)					
GENERAL	MANUFACTURER				
	CONSTRUCTION				
	ENCLOSURE SHEET THICKNESS	FRONT			
		OTHER			
	DOOR				
TECHNICAL	INPUT POWER SUPPLY				
	NO. OF FEEDERS				
	CONTROL SUPPLY				
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)				
	PAINT TYPE				
	PANEL COLOUR (EXTERNAL)				
	FINISH				
	PANEL COLOUR (INTERNAL)				
	FINISH				
	CLASS OF PROTECTION				
	CONTROL HARDWARE				
	FOUNDATION ARRANGEMENT				
	WEIGHT OF PANEL (Kg.)				
	PANEL TYPE				
	CABLE GLAND				
	AAMETER (TYPE OF INPUT)				
	NAME SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL NAME SIGNATURE DATE

	UPPUR 2x800MW STPP (UNIT-1&2)	
	TECHNICAL SPECIFICATION (C&I) FOR LP CHEMICAL DOSING SYSTEM	
SIGNAL EXCHANGE BETWEEN DRIVES & DCS (DCP)		
Page 224 of 246		

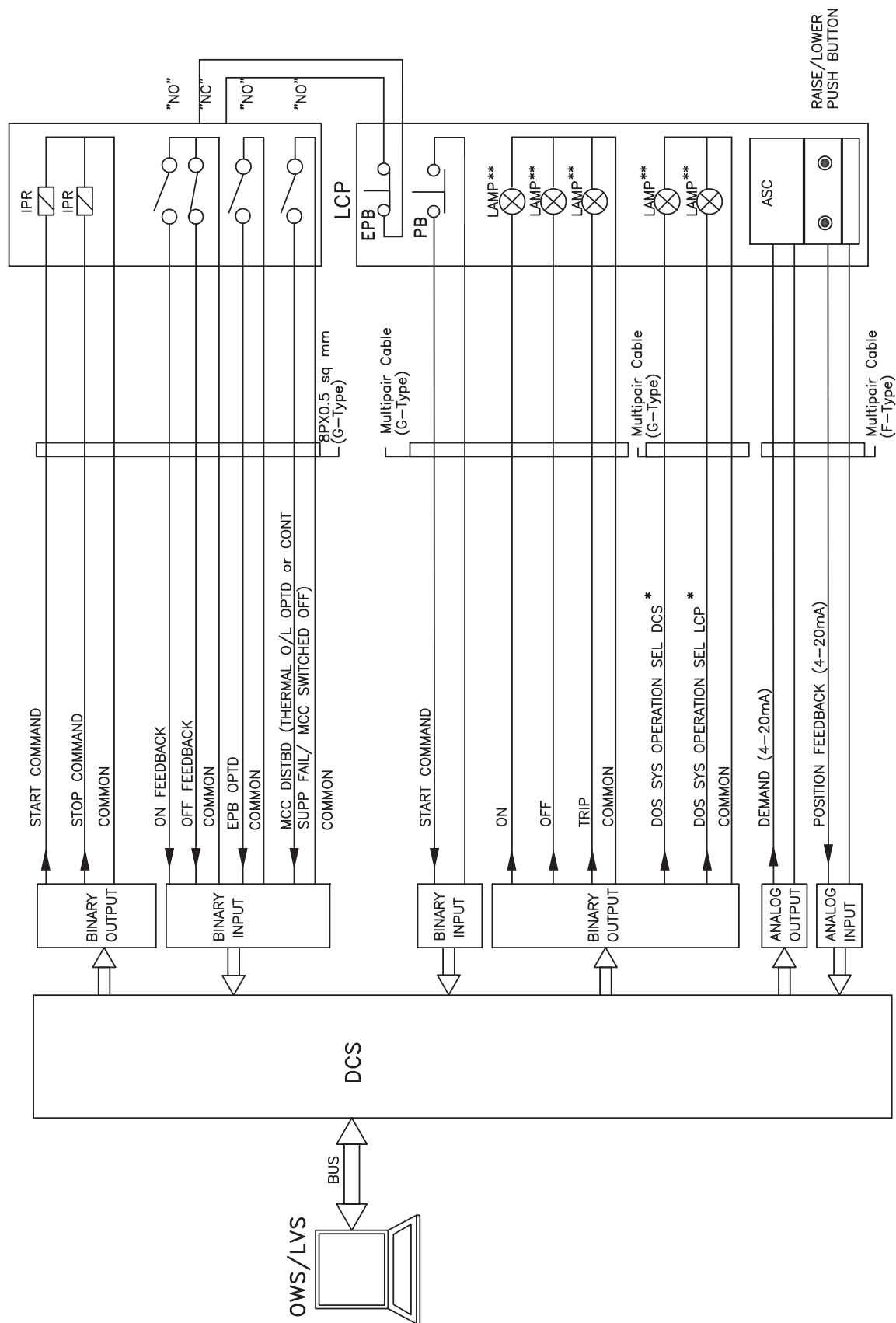


NOTES:

1. SIGNAL EXCHANGE BETWEEN DDCMIS & CHEMICAL DOSING LOCAL PANEL BE AS PER CONTROL PHILOSOPHY.
2. FIELD INSTRUMENT SHALL BE TERMINATED IN LOCAL PANEL.
3. SIGNALS FOR INTERFACE TO/FROM DDCMIS ARE ALSO TERMINATED IN LOCAL PANEL.
4. THE LOCAL PANEL IS TYPICAL. SIMILAR PANELS SHALL BE APPLICABLE FOR
 - A. AMMONIA DOSING SYSTEM
 - B. NaOH DOSING SYSTEM
 - C. Hydrazine dosing system
5. AUTO STROKE CONTROLLER SHALL HAVE FACILITY OF STROKE LENGTH ADJUSTMENT THROUGH PUSH BUTTONS & 4-20mA SIGNALS.

	DRG.NO.	PE-DG-999-145-1273A
	DATE	
TITLE		STANDARD BLOCK INTERFACE
		DIAGRAM FOR LP DOSING SYSTEM
		REV.NO. 01
		SHT

MCC



NOTE:- INTERPOSING RELAYS (IPRs) TO BE SUPPLIED ALONG WITH MCC.

LAMP INDICATION FOR CONTROL SUPPLY ON SHALL ALSO BE PROVIDED BY BIDDER.

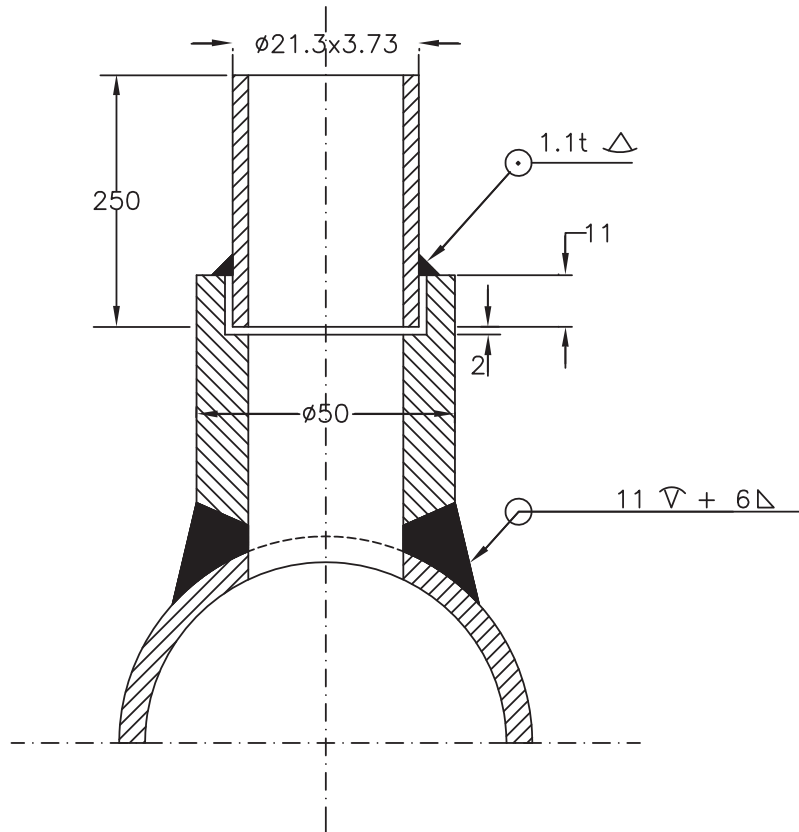
**** COMMON SIGNAL FOR ONE COMPLETE SKID.**

***** ALL LAMPS ARE 24V DC DRIVEN.**

THIS DRIVE INTERFACE IS INDICATIVE ONLY.

	UPPUR 2x800MW STPP (UNIT-1&2)	
	TECHNICAL SPECIFICATION (C&I) FOR LP CHEMICAL DOSING SYSTEM	

INSTRUMENT STUB DETAILS



NOTE :

1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B16.11.
2. THE LENGTH OF NIPPLE SHALL BE 250 MM.
3. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED
4. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY (1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES
5. STUB LENGTH SHALL BE 64mm UPTO 200Nb, 45mm ABOVE 200Nb PIPE SIZE.
6. FOR PU COATED PIPE REFER SHEET No. 9



TITLE :
INSTRUMENT STUB DETAILS
FOR PRESSURE MEASUREMENT
 (SYSTEM PRESS <60Kg/Cm² & SYSTEM TEMP
 <425 DegC, CLASS 3000#)

DRG. NO.
PE-DG-425-145-I101
 REV. 00

SH. 04 OF 10 SHS.

	UPPUR 2x800MW STPP (UNIT-1&2)	
	TECHNICAL SPECIFICATION (C&I) FOR LP CHEMICAL DOSING SYSTEM	

TYPE TEST REQUIREMENT

Note-1: Test to be witnessed by Owner.

NOTES:

1. The intent of the FAT is to demonstrate and ensure that the I&C system meets all the functional requirements as intended in the specification / contract. A completed integrated test of the system shall be carried out at vendor's works in the presence of Owner or Owner's representative, on completion of integration / manufacturing of the system. The shipment of I&C equipment to site will be effected only after the FAT has been accepted by Owner.
2. FAT procedure shall be prepared by vendor and to be submitted for Owners approval well in advance prior to the commencement of FAT.

13.02.04.21 Calibration of Instruments

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

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

i TESTS TO BE PERFORMED FOR FIELD INSTRUMENTS

1.	Pressure Gauges
	Calibration Hydro test (1.5 times max. pr.)
2.	Pressure switches
	Calibration test / Hydro test / Contact rating test / Accuracy test / Repeatability
3.	Differential Pressure Gauges
	Calibration test / Hydro test / Leak test / Over range test / Accuracy test / Repeatability test.
4.	Differential Pressure Switches
	Calibration test / Hydro test / Contact rating test / Leak test / Accuracy test / Repeatability test.
5.	Thermometers
	Calibration / Material test / Accuracy test / Bore concentricity : $\pm 5\%$ of wall thickness / Hydrostatic test for TW (1.5 times max. pr.)
6.	Temperature switch
	Calibration / Material test / Accuracy test / Bore concentricity : 1.5% of wall thickness / Hydrostatic test for TW (1.5 times max. pr.) / Contact rating test.
7.	Resistance temperature detector assembly.



	Calibration / Material test / Bore concentricity test / Insulation test ($\leq 500 \text{ M}\Omega$ at 500V DC) as per ISA, Hydro test for TW. Bore concentricity: $\pm 5\%$ of wall thickness, Accuracy test.
8.	Thermocouple assembly
	Calibration / Material test, Insulation test ($> 500 \text{ M}\Omega$ at 500 V, DC) as per ISA, Hydro static test (1.5 times max. pr.), Bore concentricity : $\pm 5\%$ of wall thickness.
9.	Thermowells
	Material test / Bore concentricity : $\pm 5\%$ of wall thickness / Hydrostatic test for TW (1.5 times max. pr.)
10.	Level Guages
	Hydrostatic test / Material test / Seat leakage test / Ball check test.
11.	Level switches (Magnetic)
	Material test / Contact rating test / Hydro test / Calibration test.
12.	Flow Switch
	Material test / Hydro static test (1.5 times max. pr.) / function test.
13.	Flow glasses
	Material test / Hydrostatic test (1.5 times max. pr.) / function test.
14.	Variable area flow meters
	Calibration test / Material test / Hydrostatic test (1.5 times max. pr.)
15.	Flow element
	100% Radiography test / Hydro test / Calibration test, IBR Certificate.
	Calibration test for flow element shall be witnessed by Owner.
16.	Control valves/Pneumatic block valve/Pressure regulating valve – Refer chapter 11.
17.	Position transmitters
	Calibration / hysteresis and Accuracy test
18.	Electro Pneumatic Convertors
	Calibration test / Accuracy test
19.	Solenoid valves
	Hydrotest / Seat leakage test / CV test / Coil insulation test
20.	Air filter regulators
	Calibration test / Accuracy test
21.	Junction Boxes
	Test for degree of protection / Material test
22.	Tests for terminal blocks
	Test for moulding for flame resistant, Non-hygroscopic and Decarbonised / Insulation test between terminals / Insulation between terminal block and frame.
23.	Thermocouple extension cable & Instrumentation Cables and Fiber Optical Cables



	a) IBR certificate form III C b) Hydrostatic test : ANSI B 16.34 c) Seat leakage test : As per ANSI B 16-104 d) CV test: As per ISA procedure e) Magnetic particle test ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 DegC) f) Liquid penetration test: ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 DegC) g) Radiography test: ANSI B 16.34 special class h) Calibration and Hysteresis test i) Actuator leakage test
36.	Pressure Regulating Valve (Pneumatic & Hydraculic type)
	a) IBR certificate form III C b) Hydrostatic test : ANSI B 16.34 c) Seat leakage test : As per ANSI B 16-104 d) CV test: As per ISA procedure e) Magnetic particle test ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 DegC) f) Liquid penetration test: ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 DegC) g) Radiography test: ANSI B 16.34 special class h) Calibration and Hysteresis test i) Actuator leakage test
38	Wiring Termination & Accessories
	Routine test: Conductor resistance test/High voltage test/Impulse dielectric test/insulation test/Humidity test/Temperature rise test on power circuits/short time current test on power circuits.
	Type test:Annealing test/Test for insulation and sheath/ Flame retardance test - a) Oxygen index, b) Flammability / Test for acid gas generation/test for water absorption/wet dielectric test
39	Marshalling/System cabinets
	Verification of degree of protection/Electrical tests as detailed under wiring Termination& accessories/Type test and routine test as per relevant Indian standards.
40.	Transmitter/Switch Enclosures & Racks :
	Hydro test, air leak test for piping / tubing and fittings. IBR certification as required for tubing / piping and fittings.
	Notes:



	1. Test Certificates in addition to inspection at manufacturers works shall be furnished for all the instruments for Owner's review.
	2. Above Test to be witnessed shall be finalized by Owner.
	3. In addition to above test, test as per approved QAP shall also be witnessed by owner.

13.02.05 TYPE TESTING

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

- A. Out of these test listed , the bidder /subvendor/manufacturer is required to conduct certain type test specifically for this contract (and witnessed by employer or his authorized representative). Even if the same have been conducted earlier as clearly indicated subsequently such tests.
- B. For the rest, submission of type test , results, and certificates shall be acceptable provided following points
 - i. The same has been carried within last five years from the date of bid opening.
 - ii. The same have been carried out by the bidder/ subvendor on exactly the same model/rating of equipment. (For control valves this shall be same size, type & design).
 - iii. There has been no change in the components from the offered equipments and tested equipments.
 - iv. The test has been carried out as per the latest standards along with amendemends as on the date of bid opening.
 - v. The test should have been either carried out at any Govt. approved laboratory and test witnessed by a client of Government Department / Government
- C. In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the bidder/sub-vendor within the quoted price and no extra cost will be payable by the owner on this account.

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



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

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

13.02.05.4 TYPE TEST REQUIREMENTS FOR C&I SYSTEMS

S.No.	Item	Test requirement	Standard	Test to be specifically conducted	Owner's Approval required on Test Certificate
1	Electrical metering instruments	As per standards	IS 1248	No	Yes



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2	Thermocouple	Degree of Protection Test	IS - 13947	No	No.
3	Junction Box	Degree of Protection Test	IS - 13947	Yes	Yes
4	RTD	As per standards	IEC-60751	No	No
5	Electronic Transmitter	As per standards	BS 6447/IEC 60770	No	Yes
6	E/P convertor	As per standards	Manufacturing standard	No	Yes

12	Local gauges	Degree of protection test	IS 13947	No	No
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equipment/Systems (minimum five nos – details shall be furnished during detailed engineering). This will include the following:-

Interfacing requirements including cables / co-axial cables / gate ways/all type of hardwares/interposing relays/ softwares for exchange of signals for information & controls are in bidder scope.

1.07.00 SYSTEM PARTICULARS

System particulars are as follows:

Tropicalisation:

1. All equipment supplied against this specification shall be given tropical & fungicidal treatment in view of the severe climatic conditions prevailing at site as described under project data.
2. Tropical protection shall conform to IS:3202 entitled "Climate Proofing of Electrical Equipment" or BI:CP-1014:1963 entitled "Protection of Electrical Power Equipment Against Climatic condition".

Gases and fumes Sulphur dioxide and/or trioxide fumes mildly present. Climate is tropical conducive to fungus growth.

Dust particles Heavily dusty with abrasive dust and coal particles of size 5 to 100 microns present in the atmosphere in large quantity.

1.08.00 CODES AND STANDARDS

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

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

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



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

1.08.02 Reference Codes and Standards

The design, manufacture, inspection, testing, site calibration and installation of all equipment and systems covered under this specification shall conform to the latest editions of codes and standards mentioned below and all other applicable ANSI, ASME, IEEE, NEC, NEMA, ISA, DIN, VDE, NFPA, IEC, EIA, TIA, ASTM, ISO and Indian Standards and their equivalents. Bidder to note that in no case, OEM/manufacturers own standards shall be accepted.

~~1.08.02.01 Temperature Measurement~~

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

~~1.08.02.02 Pressure Measurement~~

- ~~1. Performance Test Code for pressure measurement - ASME PTC 19.2 (2010)~~
- ~~2. Bourdon tube pressure and vacuum gauges - IS 3624, IS 3602, ASME B 40.1~~
- ~~3. Electronic transmitters - BS 6447.~~
- ~~4. Process operated switch devices - BS 6134.~~

1.08.02.03 Electronic measuring Instruments & Control hardware

1. Automatic null balancing electrical measuring instruments - ANSI C 39.4 (Rev. 1973), IS 9319
2. Safety requirements for electrical and electronic measuring and controlling instrumentation - ANSI C 39.5 - 1974.
3. Compatibility of analog signals for electronic industrial process instruments - ISA-S 50.1:ANSI MC 12.1 - 1975.
4. Dynamic response testing of process control instrumentation - ANSI MC 4.1 (1975): ISA-S26 (1968).
5. Surge withstand capability (SWC) tests - ANSI C 37.90A (1974)/C37.90.1 – 2012, IEEE Std. 472 (1974). IEC – 255.4.
6. Printed circuit boards - IPC TM-650, IEC 326 C
7. General requirements and tests for printed wiring boards - IS 7405 (Part-I) - 1973
8. Edge socket connectors - IEC 130-11.



9. Requirements and methods of testing of wire wrap terminations DIN 41611 Part-2.
10. Dimensions of attachment plugs & receptacles ANSI C73-1973.
11. Direct acting Electrical Indicating Instruments: IS-1248-1968.
12. IEC 61326 Electrical equipment for measurement, control and laboratory use – EMC requirements.

1.08.02.04 Instrument Switches and Contacts

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

1.08.02.05 DDCMIS, DCS, PLC & other Control System

1. Application of Safety Instrumented System – ANSI/ISA 84.01/IEC 61511 2004 & IEC 61508.
2. Functional Safety - Safety Instrumented System for Process Sector – IEC – 61151 & IEC 61508.
3. IEEE Application Guide for Distributed Digital Control Monitoring for Power Plant – IEEE 1046
4. Fossil Fuel Power Plant Steam Turbine Bypass System – ANSI/ISA – 77.13.01
5. Human System Interface Design Review Guide lines – NUREG – 700
6. Annunciation Sequence and Specification – ANSI/ISA 18.1
7. "IEEE 1050, IEEE guide for Instrumentation & control system grounding in generating station",
8. ANSI/ISA-77.44.01-2007 - Fossil Fuel Power Plant - Steam Temperature Controls
9. ANSI/ISA-RP77.60.05-2001 (R2007) - Fossil Fuel Power Plant Human-Machine Interface: Task Analysis
10. ANSI/ISA-77.42.01-1999 (R2006) - Fossil Fuel Power Plant Feedwater Control System – Drum-Type
11. ANSI/ISA-77.20-1993 (R2005) - Fossil Fuel Power Plant Simulators - Functional Requirements
12. ANSI/ISA-77.41.01-2005 - Fossil Fuel Power Plant Boiler Combustion Controls
13. ANSI/ISA-RP77.60.02-2000 (R2005) - Fossil Fuel Power Plant Human-Machine Interface: Alarms
14. ANSI/ISA-77.70-1994 (R2005) - Fossil Fuel Power Plant Instrument Piping Installation
15. ANSI/ISA-TR77.60.04-1996 (R2004) - Fossil Fuel Power Plant Human-Machine Interface-Electronic Screen Displays
16. ANSI/ISA-77.43.01-1994 (R2002) - Fossil Fuel Power Plant Unit/Plant Demand Development-Drum Type
17. ANSI/ISA-77.13.01-1999 - Fossil Fuel Power Plant Steam Turbine Bypass System.
18. ISA-99/IEC 62433-2-1- Industrial Communication Networks – Network and System Security – Establishing an industrial automation and control system security program.
19. "IEEE 1100-2005, IEEE recommended practice for Powering and Grounding Electronic Equipment".
20. IEC 61508 Functional Safety of Electrical/Electronic/Programmable Electronic Safety –Related Systems



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1.08.02.08 Control Valves

1. Control Valve sizing - Incompressible fluids - ISA S39.2 - 1972.
2. Control valve sizing - Compressible fluids - ISA S39.3 - 1973, ISA S39.4 - 1974.
3. Face to face dimensions of control valves - ANSI B16.10
4. ISA Hand book of control valves - ISBN B1047-087664-234-2.
5. Valves - flanged, threaded and welding end : ANSI B 16.34(2009)
6. Casting : ASTM A 216 / A 351 (2008)
7. Welded end connection : As per ASME boiler and pressure vessel code / ANSI.B 16.34(2009), B16.25 (2009), B 16.11(2009).
8. Defect removal: ANSI B 16.34 2009.
9. Cleaning : ASTM A 380 2006.
10. CV test : As per ISA procedure S 75.02 (2008).
11. Control Valve seat leakage : ANSI B16.104/FCI 70.2

1.08.02.09 Enclosures

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

1.08.02.10 Apparatus, enclosures and installation practices in hazardous areas

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

1.08.02.11 Sampling System

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

1.08.02.12 Annunciators

1. Specifications and guides for the use of general purpose annunciators - ISA RP 18.1-1979.
2. Surge withstand capability tests - ANSI C.37.90a - 1974 and IEEE std. 472-1974.
3. Alarm Management System - ISA 18.2 - 2009 or latest edition.

1.08.02.13 Interlocks, Protections

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1. Relays and relay system associated with electric power apparatus - IEEE std.3.13.
2. Surge withstand capability tests - ANSI C.37.90a - 1974 and IEEE Std. 472 - 1974.
3. General requirements & tests for switching devices for control and auxiliary circuits including contactor relays - IS-6875 (Part-I) 1973.
4. Turbine water damage prevention - ASME - TDP-1980.
5. Boiler safety interlocks - NFPA Section 85B, 85D, 85E, 85F, 85G, VDE 0116, Section 8.7, VDE 0160, NFPA 8502/ 8503, & EN50156-1:2004.
6. Turbine safety interlocks - IEC 61508 and IEC 61511 or VDE 0116, Section 8.7, VDE 0160.

1.08.02.14 Process Connection and Piping:

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

1.08.02.15 Instrument Tubing

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

1.08.02.16 Cables

1. Thermocouple extension wires/cables - ANSI C 96.1 - 1982.
2. Colour coding of single or multi-pair cables - VDE 0815
3. Guide for design and installation of cable systems in power generating stations (insulation, jacket materials) - IEEE Std. 422 - 1977.
4. Requirements of vertical tray flame test - IEEE 383 - 1974.
5. Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B-33 - 81.
6. Oxygen index and temperature index test - ASTM D-2863.
7. Smoke generation test - ASTM D-2843 and ASTM E-662.



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8. Acid gas generation test - IEC-754-1.
9. Swedish chimney test - SEN - 4241475 (F3)
10. Instrumentation cables and internal wiring IS-1554 (Part-I, 1976) and IS-5831(1984).
11. Standard for Control, Thermocouple Extension and Instrumentation cable - NEMA WC57-2004 (IECE S-73-532, Rev. 2, 2004)□
12. PVC insulated (heavy duty) Electric cables for working voltages upto and including 1100V - IS:1554 (Part-I)
13. Conductors for insulated electric cables and flexible cords. - IS:8130
14. PVC insulation and sheath of electric cables - IS:5831
15. Mild steel wires, strips and tapes top armoring cables - IS:3975
16. Water Immersion Test - VDE 0815
17. Drums for electric cables - IS : 1048.
18. Sectional Specification for Instrumentation and Control Cables - BS EN 50288 - 7:2005.
19. IEC 60228 Conductors of Insulated Cables
20. IEC 60332 Test on Electrical Cables under Fire Conditions
21. IEC 60811 Common test methods for insulating and sheathing materials of electric cables and optical cables.
22. IEC 61537 Cable management – Cable tray systems and cable ladder systems
23. IEC 61280 Field testing method for measuring single mode fibre optic cable

1.08.02.17 Cable Trays, Conduits

1. IEEE Guide for the design and installation of cable systems in power generating station (cable trays, support systems, conduits) - IEEE Std. 422 - 2012, NFPA-70-1984.
2. Metal Cable Tray Systems - NEMA VE-1 - 2009.
3. Galvanising of Carbon steel cable trays - ASTM A-386-78.
4. Code of Practice for Installation and maintenance of Power cables – IS : 1255.
5. IEEE 1185: IEEE Recommended Practice for Cable Installation in Generating Stations and Industrial Facility.
6. NEMA VE 2 (2013) – Cable Tray Installation Guidelines.

1.08.02.18 Flow measurement

1. ASME Performance Test Code PTC-19.5 (2004), ISA RP3.2
2. BS 1042
3. ISO 5167
4. Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi – ASME MFC – 3M.

1.08.02.19 Surge Protection System

1. Surge withstand capability tests - ANSI C37.90a-1974. IEEE Std. 472 – 1974



2 x 800 MW Supercritical Coal Based Uppur
Thermal Power Project
Spec. No. SE/E/T&H(P)/OT NO.01/2015-16
Vol. V





TITLE:
**2 X 800 MW UPPUR STPP (STAGE-I, UNIT 1
& 2) BTG PACKAGE**

**TECHNICAL SPECIFICATION FOR
CHEMICAL DOSING SYSTEM**

SPECIFICATION NO. PE-TS-425-154-A001

SECTION III

SUB SECTION -

REV.NO. 00 DATE : 15.11.2017

SECTION III

	TITLE:	SPECIFICATION NO. PE-TS-425-154-A001
	2 X 800 MW UPPUR STPP (STAGE-I, UNIT 1 & 2) BTG PACKAGE	SECTION III
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	SUB SECTION -
		REV.NO. 00 DATE : 15.11.2017

SCHEDULE OF PRE-BID CLARIFICATION

All clarification from the Technical Specification shall be filled in by the BIDDER clause by clause in this format only.

VOLUME	SECTION	CLAUSE NO.	PAGE NO.	SPECIFICATION REQUIREMENT	CLARIFICATION	REASONS FOR CLARIFICATION

Note: Bidder to furnish all the pre bid in the above indicated pre bid clarification format only. General Pre bid clarification will not be considered.

THIS IS A PART OF TECHNICAL SPECIFICATION PE-TS-425-154-A001 R0

		SCHEDULE OF DEVIATIONS WITH COST OF WITHDRAWAL							
		PROJECT:- 2 X 800 MW UPPUR STPP (STAGE-I, UNIT 1 & 2) BTG PACKAGE							
		PACKAGE:- CHEMICAL DOSING SYSTEM							
TENDER ENQUIRY REFERENCE:-									
NAME OF VENDOR:-									
SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF WITHDRAWAL OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF WITHDRAWAL OF DEVIATION IS APPLICABLE	NATURE OF COST OF WITHDRAWAL OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
TECHNICAL DEVIATIONS									
COMMERCIAL DEVIATIONS									
PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE									
NAME				DESIGNATIONS		SIGN & DATE			
NOTES:									
1. For self manufactured items of bidder, cost of withdrawal of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.									
2. For directly dispatchable items, cost of withdrawal of deviation will be applicable on the basic price including taxes, duties & freight.									
3. All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.									
4. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.									
5. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawal of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.									
6. Bidder shall furnish price copy of above format along with price bid.									
7. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.									
8. Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.									
9. For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawal of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawal of deviation shall be taken as NIL.									
10. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.									
11. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.									
12. Cost of withdrawal is to be given seperately for each deviation. In no event bidder should club cost of withdrawal of more than one deviation else cost of withdrawal of such deviations which have been clubbed together shall be considered as NIL.									
13. In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.									
14. In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.									

	TITLE:	SPECIFICATION NO. PE-TS-425-154-A001
	2 X 800 MW UPPUR STPP (STAGE-I, UNIT 1 & 2) BTG PACKAGE	SECTION III
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	SUB SECTION -
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COMPLIANCE CUM CONFIRMATION SCHEDULE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate and furnishing 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/ deviations with regard to same.
- b.) QP/ test procedures shall be submitted in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL/Customer approval in the event of order & 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. The charges for 3rd party inspection (Lloyds, TUV or equivalent) for imported components shall be included in the base price of the equipment by the bidder.
- c.) All drawings/data – sheets etc. to be submitted during contract shall be subject to BHEL/Customer review/ approval. GA drawings, as submitted with offer at tender stage are for reference purpose only and shall be subject to approval during contract stage.
- d.) There are no other deviations with respect to specification other than those furnished in the 'Schedule of Deviations'.
- e.) The offered materials shall be either equivalent or superior to those specified. Also for components where material is not specified it shall be suitable for intended duty, materials shall be subject to approval in the event of order.
- f.) The commissioning spares (if any) are supplied on 'As Required Basis' & prices for same included in the base price (If bidders reply to this is "No commissioning spares are required" and if some spares are actually required during commissioning same shall be supplied by bidder without any cost to BHEL).
- g.) All sub vendors shall be subject to BHEL/CUSTOMER approval.
- h.) Any special tools & tackles, if required, shall be in bidder's scope.
- i.) Demonstration parameters shall stand valid till the satisfactory completion of demonstration test and its acceptance by BHEL/Customer.

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DECLARATIONS

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.

Bidders Company Name

Authorized representative's
Signature

Name

Bidder's Name The bidder hereby agrees to fully comply with the requirements and intent of this specification for the price indicated